

# Cutting Edge and Cutting Corners: Evolving Technology, Expanding Usership, and Responsive Solutions in a Museum Database

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## ABSTRACT

In the mid-1980s, the Anthropology Division of the American Museum of Natural History (AMNH) began the creation of digital resources as a means of collections access. Much of the database work was a secondary component of projects funded by outside grants and driven by new accountability mandates. The ongoing upgrading process was sporadic in its progress, but it still accomplished the primary goals of improved housing for collections and an exhaustive database. This paper discusses how the historical complications of the data, the scale of the database, its irregular schedule of funding, and deadline-driven projects resulted in inconsistency in data and difficulty in use. Although the examples provided will be specific to the AMNH Anthropology database, the circumstances and issues are common to many databases and the approaches presented broadly applicable. The discussion includes the practices used to mitigate the negative impact of these problems and the way the Division is positioning itself for the future, even as the database continues to provide unprecedented public and institutional access to and utility for the AMNH Anthropology collections.

**Keywords:** museums collections, database, thesaurus, web database, online collections

A mediados de la década de 1980, la División de Antropología del Museo Americano de Historia Natural comenzó la creación de recursos digitales como medio de acceso a las colecciones. Gran parte del trabajo de base de datos era un componente secundario de los proyectos financiados por subvenciones externas e impulsado por nuevos mandatos de responsabilidad. El proceso de actualización en curso fue esporádico en su progreso, pero aún así logró los objetivos principales de mejoras al almacenamiento de colecciones y una exhaustiva base de datos. Este trabajo analiza cómo las complicaciones históricas de los datos, la escala de la base de datos, su calendario irregular de financiamiento y los proyectos impulsados por plazos resultaron en una inconsistencia en los datos y en la dificultad de uso. Aunque los ejemplos proporcionados serán específicos a la base de datos de antropología del AMNH, las circunstancias y los problemas son comunes para muchas bases de datos y los enfoques presentados son aplicables de manera general. La discusión incluye las prácticas utilizadas para mitigar el impacto negativo de estos problemas y cómo la División se está posicionando para el futuro, aun cuando la base de datos continúa brindando acceso y utilidad sin precedentes para las colecciones de Antropología de AMNH.

**Palabras clave:** colecciones de museos, base de datos, thesaurus, base de datos web, colecciones en línea

Databases are an inevitable component of managing large collections of objects as the only efficient way of storing, organizing, and extracting vast amounts of information. Creation of a database carries with it many decisions that affect how data are input and retrieved, what information can be included in the future, and what types of searches may be performed. The selection of a database structure or an off-the-shelf package can be fraught with issues of uncertainty and, potentially, remorse. What system to use, what fields of information, and even what limits to field characters can all reduce the effectiveness of the database.

Beyond the initial choices to be made are ongoing reconsiderations of the data and the science behind them. Changing the ways that objects are documented and described produces new content and information formats. The simple ability to perform data analysis will necessitate the modification of records. Developing technology affects the information within the database as well as the means of its retrieval, presentation, and interpretation.

The American Museum of Natural History Anthropology Division's experience with long-term database development was largely driven by goals and deadlines that were not always focused on

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creating optimally usable, consistent data. The primary goals centered on preserving and rehousing objects. The view of the database was similarly “collection focused.” Data fields were expanded and new types added as they became necessary. It was only after the project was well under way that the Anthropology Department began to look at the databases as entities beyond collections-finding aids.

This paper discusses how outdated and inconsistent original information combined with the breadth of the Anthropology Division’s collections overwhelmed the available database systems. Ongoing technological innovations had unanticipated effects. Database development was further affected by unavoidably irregularly spaced funding projects and deadlines. The results were unpredictable data retrieval and reduced database usability. These conditions necessitated the identification of multiple user audiences and the development of customized responses to these specialized needs through discrete interfaces and representations of the data.

## COLLECTIONS GRANTS: ENSURING PRESERVATION AND ACCESS

Starting in the mid-1980s, the Anthropology Division of the American Museum of Natural History (AMNH) received a series of grants, including special support from the National Endowment for the Humanities, the New York State Council on the Arts, and The Andrew W. Mellon Foundation. These grants were aimed at ensuring “preservation and access” to museum collections. The preservation aspect related to the housing of the physical objects, whereas access related to the digitization projects that would make the collections available to scholars, educators, and the general public. Grants provided funding for capital improvements as well as new equipment and extra staff. Substantial progress was made in two- to four-year grant periods.

The need to improve storage conditions for the Anthropology collections was the initial motivating factor for obtaining grant funding. Objects were housed under largely late-nineteenth-century conditions in difficult-to-maintain, overcrowded storerooms with no environmental controls. The greatest threat were pests, principally moths and dermestids, which were impossible to control without appropriate facilities. Substantial progress has been made in storage cabinetry in terms of improved finishing materials, an appreciation of the benefits of secure closure, and the recognition of the liabilities of unstable housing materials. The basic form, however, is largely unchanged from the steel cabinets that had been the bulwark of collections storage since the mid-twentieth century. Even a development as novel and consequential as compact storage is easily recognizable as a series of shelving units on fixed rails with an enclosing cabinet. With new cabinets, drawers, and compact storage, AMNH-Anthropology was able to increase storage space, improve order, and further the long-term stability of the collections. Additionally, objects were cleaned, organized, and placed in the new cabinetry surrounded by archivally stable housing.

Grants also funded the technology that allowed inventory entries to be completed in the text databases and allowed the attachment of high-quality digital images to complete the digital

records. The result was more than 267,000 objects databased and rehoused in 16 storage spaces and exhibit halls, better positioning the museum collection for long-term survival. The divisional websites host 300 visits per day on average. This progress was, however, driven by an intermittent pattern of grant activity, which had a side effect of irregularity in the database.

## CHALLENGES AND SOLUTIONS TO PROVIDING ACCESS

Although storage technology was largely unchanged during the span of the collections rehousing projects, the same could not be said regarding the digital technology organizing them. During the period covered by the collections grants, the rapid infiltration of computer and digital technology into everyday life greatly affected society, including museums (Anderson 1999; Ellin 1969; McDaniel 1986; Misunas 2007). This technology improved organization and access by means of databases within the institution. The eventual availability of relational databases at the PC level made data-rich, large-scale databases practical to individual users (Mainfort and Kwas 1986). AMNH-Anthropology initiated local use of dBase IV in 1984. The initial datasets became the foundation for some portions of the current relational database.

Aside from the development of more user-friendly databases, easy publication and sharing of data on the Web—accompanied by the descriptive ability of increasingly affordable digital imaging—fundamentally changed how we interact with information. When AMNH-Anthropology began digital image capture in 1991, digital camera technology was still developing. Improvement came rapidly with easier image capture, increased resolution, and better file handling and manipulation. The software for viewing and distributing images was also maturing. Despite these hindrances, the immediate availability of digital images, with no delays in processing, was instantly popular and gratifying. The Division launched the first iteration of the online database in 1997, with data and imaging for more than 65,000 North American and Asian objects. Digital photography has become indispensable in museum collections management for the ease of image creation, relatively low cost, and facility of distribution and reuse.

Despite these accomplishments, there continue to be challenges that complicate our efforts to digitize our collection and its associated data and to make it accessible. This section provides examples of those challenges as well as the practices used to mitigate the negative impact of these problems.

### Problematic Source Data

Most of AMNH-Anthropology accessions predate the mid-twentieth century. In fact, many of the most significant accessions date to the late nineteenth or early twentieth century. The cataloging associated with these accessions is contemporaneous and reflects the period as well (Figure 1). The language and terminology are dated. Names of everyday objects, used as analogues for ethnographic objects, changed and fell into disuse. Much of the period language in common use for culture group identifications is now recognized as insulting and has been replaced. Place names have changed with changes in geopolitics and the growth of population. The ledger entries are handwritten

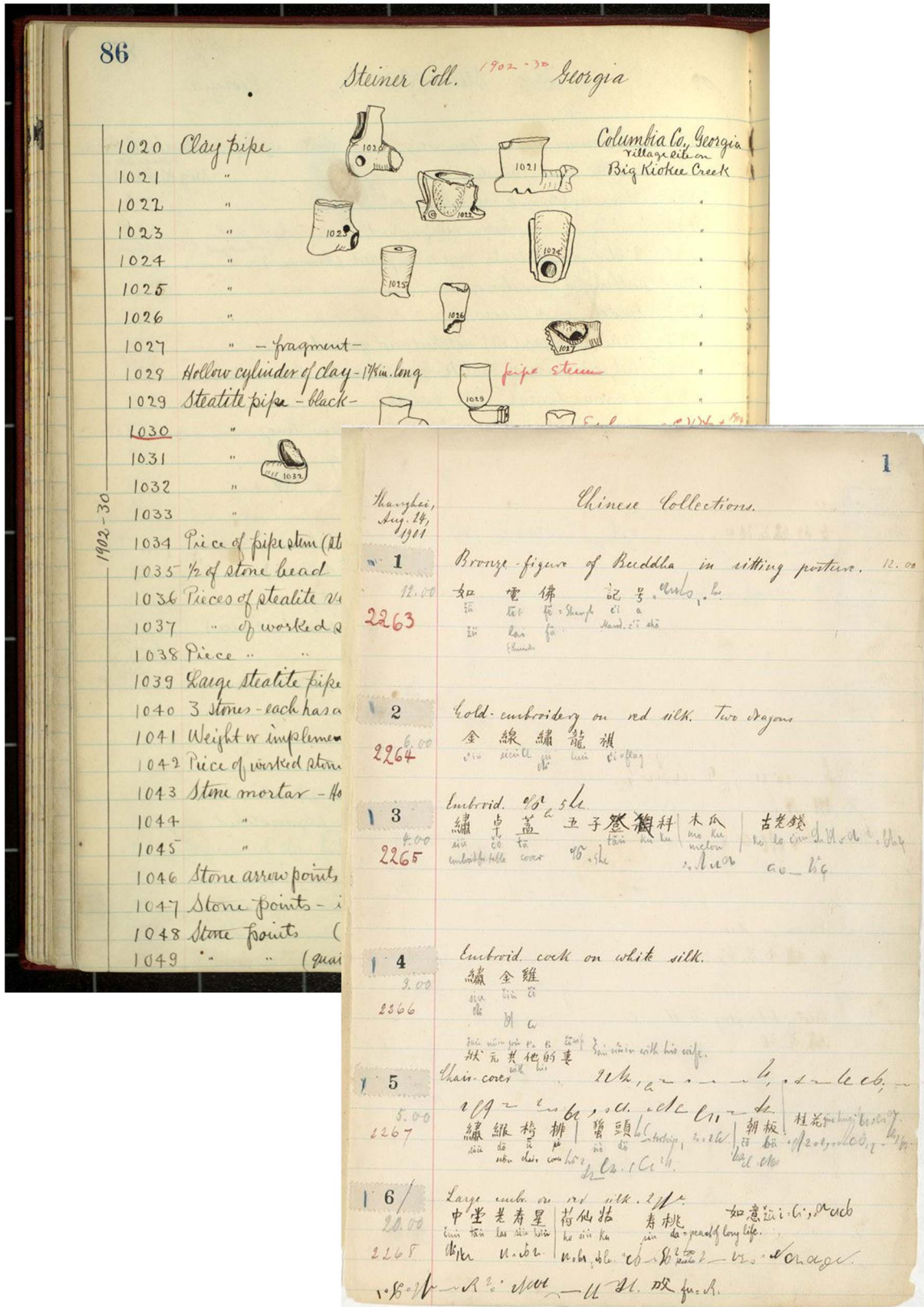


FIGURE 1. Original catalog and field notes scans. (Courtesy of the Division of Anthropology, American Museum of Natural History.)

and sometimes difficult to read, if not illegible. Sometimes the choice was made to create a brief generic entry in the catalog, using the catalog number to refer to an entry in the collector's field notes. In rare instances, the entries are in the language of the source community and are not translated. Although it was probably an effort by the collector anthropologist to capture precise terminology, since entries are in a language without standard orthography—and likely unknown to most readers—the entries are unintelligible to everyone but experts.

While the original catalog information provided many opportunities for error and inconsistency, the process of data entry added to the confusion. Many of the early databases were entered from typescripts of the manuscript catalogs made by office typists in the mid-twentieth century. The workers had no background in anthropology or museum collections, which contributed to many errors in transcription. Inadequately prepared, some failed to identify and reproduce what seemed to them to be insignificant variations in the original catalog. Therefore, much of the primary database entry was based on flawed secondary sources.

As part of the grants, funding was received for the scanning of most of the original ledger catalogs. In subsequent projects, the Division has had opportunity to scan some of the most significant field-note sets. A major purpose of the scanning is preservation of the source document by minimizing handling and creating a "backup" copy should damage occur to the original. But the digital imaging has affected the text aspect of the database by making original source documents available. Researchers now can view the foundational documents with information provided by the collectors. Scans of the original catalogs have also provided an opportunity for database correction. Fully trained collections management staff can now compare the original document and the database object image with the database record for confirmation and, if necessary, annotation.

## Inconsistent Data Quality

The period 1984 through 2013 was one of great progress for AMNH-Anthropology Collections Management, largely because of the grant awards. Each project built on the previous one. There was a relentless feeling of anticipation of and focus on the next project. Following the grants were periods of preparation for the next project. Having decided to build within existing storage spaces, collections had to be relocated before the new grant-funded construction could begin. Similarly, data entry of the archival catalog documents would be performed to facilitate the rehousing and digital image association funded by the grants. This focus resulted in a lack of time for review and correction of previous data. Technology continued to develop in power, broad application, and ubiquity.

The terms and constraints of the grants, the procedures the Anthropology Division followed to fulfill the grants, and the scope of technological change in combination with the pattern of irregular activity resulted in cyclical effects that are still reflected in the database.

Today the AMNH-Anthropology website presents a high-quality database with unpredictable individual record quality. Misassigned datatypes might show up in different fields because of legacy database structure changes. Object names, even for

identical objects, can be presented as standardized, artificially structured, and/or natural language. A single culture might be referred to by several different names. Queries in different collections in the database can produce inconsistent results. Despite the image focus of the database, changing digital imaging capabilities and standards resulted in initial images that are practically unusable. Fewer, smaller data fields in the earliest computerized collections sometimes forced inconsistent entries and abbreviations. Later, improved capacity permitted full text, which resulted in further variants of core data records. Ironically, grant-funded, better digitized records allowed for easy identification of data issues of inaccuracy, ambiguity, and inconsistency, even as the grant schedule disallowed the time to perform the corrections.

The addition of a highly skilled programmer to the divisional staff in 1994 greatly affected the abilities of the Division to integrate new technology. Although the programmer was hired in response to the demands of reporting related to the Native American Graves Protection and Repatriation Act (NAGPRA), the position was permanent. As database manager and developer, the programmer dramatically influenced digital information handling in the Division. The continued progress in collections digital assets would have been difficult without the degree of adaptability in the computer system afforded by the programmer. Not only could new technologies be employed as they developed, but as specific needs arose, supplemental functionalities could be added to the database and websites.

Maintaining the integrity and individuality of database records meant many data problems could not be dealt with programmatically. The scale and scope of the issues altogether is overwhelming. But in the same way that the problems grew slowly, it was possible to slowly develop considered mitigations. Questions of data inconsistency and variability could be approached as data classes that could utilize structured vocabularies to improve query results. Significantly, the process of resolution allowed for a better understanding of the groups using the database.

## Recognition of Multiple Audiences and the Challenge of Specialized Data

Although the underlying database has remained relatively unchanged through the various collections projects, the online public interface has undergone repeated stages of development. Some website issues arise from the focus of the grants; others from qualities inherent to the ethnological, archaeological, and biological collections themselves; and still others from user expectations. The initial ethnographic focus of the collections projects meant a smaller number of relatively more attractive and easily identifiable objects were the first to be available for Web publication in 1997. The initial push to put the material online was driven by the body of images, so the interface was oriented toward—and maximized—database records with associated images. Searchable fields were limited in number and aimed at information that casual users could understand without explanation. Objects without images and sensitive materials were excluded from this initial interface.

It is assumed that the nonacademic general user will be our primary audience and will be interested in some piece of data such as a general object type, a culture, or a location. As a result,

AMNH developed an interface known as the [General Access website](#) to provide users with the ability to explore the collections online. The link below provides the best illustration for the appearance and utility of the General Access website. Individuals with more technical interest or experience, or those wishing to narrow the query, can search by catalog number or accession number. Following the selection of a broad, geographically based collection area (i.e., continent) and type of collection (archaeology vs. ethnology), countries and cultures are automatically narrowed for a focused selection list. Specialized archival or exhibited contexts can be selected through a checkbox list. The abbreviated thesaurus provides an alternative means of querying the collections ([Figure 2](#)). In either case, once a query has been performed, the results can be narrowed by means of the Exclude/Include fields at the bottom of the results window.

Formal user experience testing has not been performed for the Anthropology database. Exhibit hall visitor studies provide valuable insight into criticisms of the interface and feelings regarding the database as a supplement to exhibition visits (Slover Linett Audience Research 2014). Google Analytics provides very broad user statistics. Voluntary comments, both positive and negative, regarding the database have been received, but they are certainly not an adequate sample. The most positive and consistent responses note the number of images and thoroughness of the database. Despite its lack of guidance for beginner user searches, repeated and consistent user volume is a significant indicator of visitor acceptance of the General Access website.

Almost as soon as the General Access website became available, users began to ask about other collections, especially archaeology. As part of NAGPRA inventory requirements, the Division had performed a full database entry of all the North American archaeology materials, our largest single collection. Also, during the course of the grants projects, Collections Management had continued data entry of the remaining archaeological and biological collections. The result was a large body of text-only records for which no images existed, a situation common in anthropological collections.

It is the nature of archaeological collections, with selective survival of objects dependent on material and environmental conditions, that the variety and completeness of objects are limited. Current archaeological practice has required the exhaustive collection of contextual and environmental material as well as artifacts and by-products for further study to gain insight into the past. The results are exceptionally large collections containing many fragmentary artifacts that require some degree of experience to understand and appreciate. These qualitative differences in the appeal and utility of archaeological collections, in combination with the volume of objects, make visual survey difficult and exhaustive digital imaging prohibitively expensive.

In addition to the ethnology and archaeology collections, the last major category of materials in AMNH-Anthropology holdings are the biological anthropology collections. These collections are significant in their appeal beyond anthropology to other sciences. Fitting within the formalized classificatory systems of biology, the elements compose a set group of anticipated components. Improved and recent analytical technologies have made the collections significant in unprecedented ways. Dating, genetic, and

trace element analyses are depending understandings of human history, such as population movements and interrelationships. But there are many perspectives surrounding the materials. Like archaeology, the material is potentially difficult to understand without significant training or description. And one cannot lose sight of the special consideration that needs to be given to the sensitivities of descendants and descendant communities. As a result, research on these collections is strictly monitored, and data relating to them cannot be made freely available without some level of access control.

The bulk of the archaeological data and all the biological data are unavailable on the General Access website, and realistically, they could not be placed there. AMNH-Anthropology staff, however, were aware of individuals with the requisite training in the academic disciplines and experience with museum holdings who would not only benefit from access but were making regular, insistent queries regarding the availability of archaeological data. The unpublished database information was an untapped albeit potentially problematic resource. This issue of sensitivity is one that affects outside researchers as well as AMNH-Anthropology staff, so care must be taken regarding the records. The potential for accidental misinterpretation as well as misuse or abuse of the data dictates stringent control. Our existing General Access website was insufficient for making this information available online.

A new interface was developed by our programmer to address this audience of users. Referred to as the Advanced Research website, the interface would address professional and experienced researchers. As an alternative route of access to data, it was viewed as less of an endpoint for research and more of a tool to assess the potential utility of AMNH-Anthropology collections for further research. It was hoped that the website would provide a means of project development and focus for on-site visits.

The Advanced Research website is available only via curatorial approval, after submitting a proposal online and outlining a project or clearly defined area of inquiry. The access code provided expires after a predetermined period of up to six months. This password process ensures that the appropriate AMNH-Anthropology curator knows who has access to sensitive information and that the researcher is aware of the types of information that will be available. The hope is that this will circumvent potential confusion and frustration.

Given the security issues discussed, an active link to the Advanced Research website cannot be provided here. A review of the graphic composited from the website demonstrates the similarities between the Ethnology, Archaeology, and Biological Anthropology interfaces and the General Access site. [Figure 3](#) demonstrates the similar structure of primary field entry/selection, narrowing selection capability, and subcategory checkbox option.

## The Need for Context and Multiple Voices

The AMNH-Anthropology database can appear static and rigidly hierarchical. Such an impression reinforces a growing need to facilitate communication between various stakeholders and integrate information from them. Although presented primarily as a representation of the information in the AMNH-Anthropology catalog, many individuals have contributed to the collected

**FIGURE 2.** General Access website search with thesaurus. (Courtesy of the Division of Anthropology, American Museum of Natural History.)

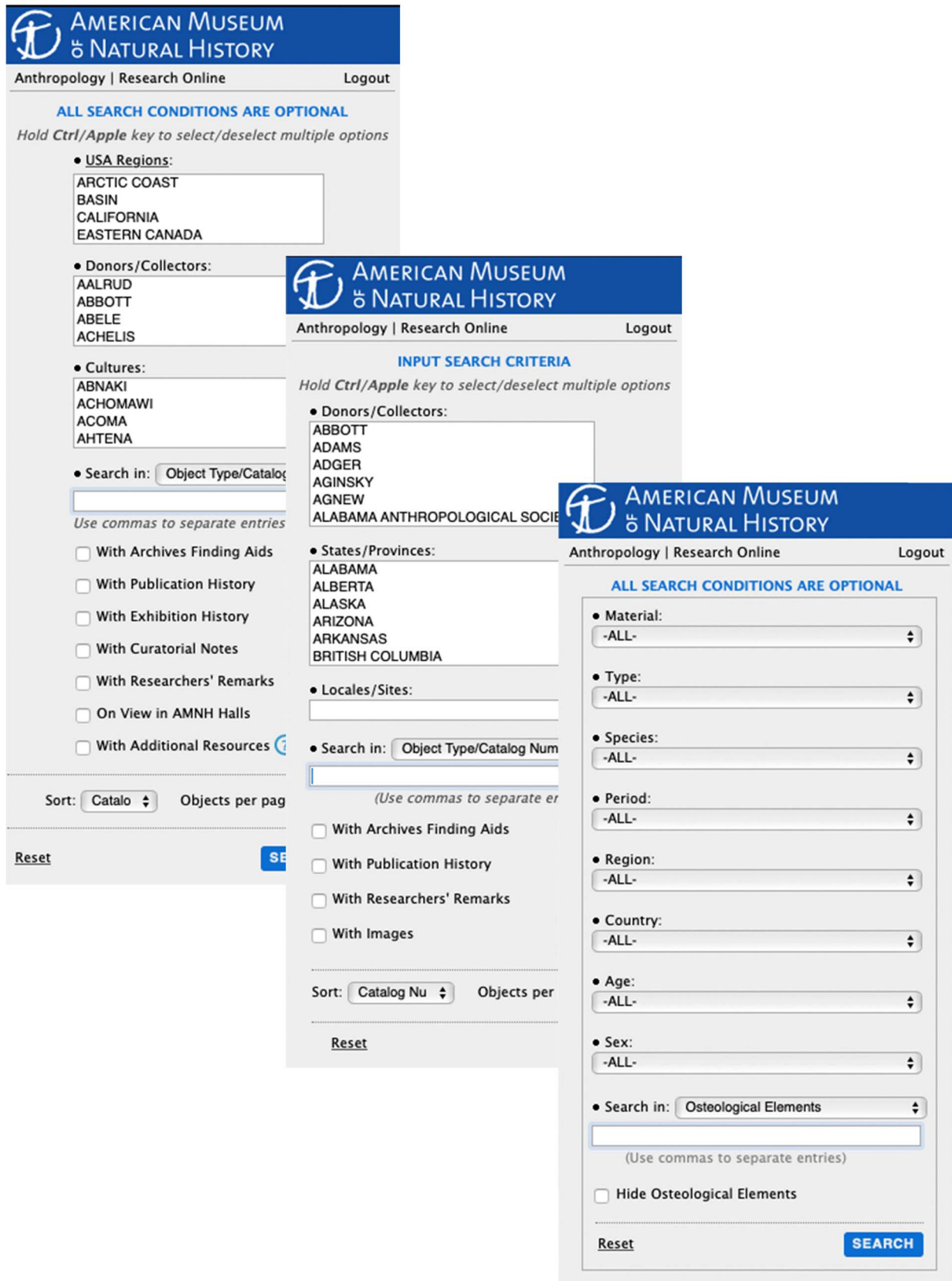
knowledge in the database. This information can represent changes in core data, questions and annotations from researchers (including descendant communities), and notes from curators. To accommodate different contributors and different categories of remarks, three principal means of annotation have been developed. Flexibility in the way information is presented is necessary for accuracy, but any changes must be carefully archived to maintain data integrity.

Where there are factual corrections or indispensable annotations, the information can be added to a field in the database, and the appropriate changes can be made. Remarks from online researchers are automatically posted to appropriate staff for review before they are attached to the file and uploaded to the online database. All the database core changes are handled by Collections Management staff with curatorial approval. The online interface is then updated.

Curatorial Notes allow curators the freedom to attach extensive notes to an online object relating to subjects of special interest (Figure 4). This category is especially oriented toward comments that do not necessarily affect the basic catalog database information. This form of comment can assist in ameliorating inaccuracies or obsolescence in the original cataloging. The direct contribution of the curator helps bring the knowledge and role of the curator directly to the user. The form of the comments provides context for visitors and curatorial insight into the significance of the object, satisfying a marked interest of visitors.

### Problematic Terminology and Facilitation of User Searches

Internal AMNH-Anthropology visitor experience studies have recorded the public as describing the database as “frustrating”



**FIGURE 3.** The Advanced Research website showing Ethnology, Archaeology, and Biological Anthropology interfaces by type (composite). (Courtesy of the Division of Anthropology, American Museum of Natural History.)

The screenshot displays the AMNH Collections Database interface. The search criteria are: Search: 16/8802, Object Type: (dropdown), Collection Areas: NORTH AMERICA, Collection Type: ETHNOGRAPHIC, Countries: -ALL-, Cultures: -ALL-. The search result is for 'BOX WITH LID' (Catalog No: 16 / 8802), a wooden Haida chest. The page features a grid of 23 image thumbnails, with the first one showing the chest. The right sidebar contains detailed metadata: Culture: HAIDA, Local: BC, Country: CANADA, Material: WOOD, PIGMENT, MICA, Dimensions: L:160 W:84 H:67.5 (in CM), Technique: CARVED, Subject: MOON REP AS BIRD, MOUNTAIN GOAT & GRIZZLY BEAR (CHIEF'S CRESTS), Acquisition Year: 1901 [EXPEDITION], Donor: NEWCOMBE, C. F., DR., Keywords: BOX, BOX LID, CEREMONIAL BOX, Category: CONTAINERS. The main content area is dominated by 'Curatorial Notes' which include exhibition history, publication history, and researchers' remarks. The researchers' remarks note that the chest was initially meant for the burial of Chief Skedans but was repurposed as a receptacle for blankets. Additional resources include the Reciprocal Research Network and a manuscript catalog entry.

FIGURE 4. Curatorial notes screenshot. (Courtesy of the Division of Anthropology, American Museum of Natural History.)

and making them feel “overwhelmed” (Slover Linett Audience Research 2014). Some of the fault lies with our admittedly utilitarian online interface. The most fundamental source of the difficulty is largely the conflict between database information oriented to a specific object and the need of users to approach collections using material culture terms that are familiar to them. The complicated object descriptions go back to the original cataloging, which is sometimes very technical or archaic. As noted above, the catalog was often an expression of the collector and, as such, reflects the personality as well as the theoretical and chronological context of the time of collecting and cataloging. All of these factors act as a hindrance to contemporary casual accessibility.

The use of an online interface facilitates filtering of data and synonymizing through tables or keyword vocabularies, maintaining data integrity while facilitating user experience. Some filtering

for contextual information is in place for “Culture” name (eliminating dated, inappropriate terms) and “Locale” (making easily understood information contemporary and generalized). For example, groups identified in the catalog as “Thompson Indians,” “Thompson River,” and “Thompson” could be conflated under the contemporary name “Nlaka’pamux.” The significant geopolitical term “German East Africa” might be represented online as “Burundi,” “Rwanda,” or “Tanzania,” depending on associated information.

### Keywords

The “Object Name” in the catalog is a fundamental hurdle to reaching a wide user base. It also fails to be satisfactorily functional for divisional needs. The use of the derivative “Keywords” permits the creation of associations with identifying terms that



might be more commonly understood. This system satisfies several needs: maintaining the original object name and archival material association; allowing multiple keywords to associate to different facets of knowledge; and providing a term that can satisfy both curatorial desires for accuracy and public needs for recognizability.

The link of the Anthropology database to the thesaurus is the “Keyword.” All objects in the AMNH-Anthropology collections have at least one representative keyword that is integrated into our customized thesaurus. Additional keywords can be added, correcting and expanding on the “Object Name”—based on other resources, especially curatorial input—and reflecting the different individual elements of multicomponent objects. For example, an object in the catalog might be described as a “bow and arrows.” This can be more explicitly identified with keywords: Arrow:Arrow Quiver:Bow:Bow Case for association to “Weapons” and “Containers” hierarchies.

The keywords become the first steps toward a polyhierarchical thesaurus. The hierarchy allows for groupings of larger, more generic, and generally understood (and definable) categories of objects, which in turn are likely to be more user friendly for casual visitors.

## The Getty Art and Architecture Thesaurus

The underlying structure of the [Anthropology thesaurus](#) is based on the Getty Art and Architecture Thesaurus (AAT). The AAT is standardized and expansive. It is intended to be used as a controlled vocabulary for cataloging, data retrieval, and research, with the data structured along eight conceptual facets ranging from the abstract to the concrete (Getty Research Institute 2017). The Getty provides an impeccably researched structure into which to fit our particular terminological system. Flexibility in terminology and structure facilitates customization. The faceted model used by AAT more realistically allows objects to be described and retrieved based on the different ways in which objects with behavioral associations exist within a culture and are explored by anthropological researchers.

The objects thesaurus, as currently employed on the public website as part of the database query section, is an extracted and condensed version of the full structure. What is presented as a search component of the database online is a selection of common search terms hierarchically structured in a shortened list to facilitate information discovery. This focused search application shows some of the adaptability of a full thesaurus (Figure 5).

## The Future of the Thesaurus

Thesaurus development is an ongoing process. As the Getty AAT intended, the Anthropology thesaurus can be used to simplify terminology and suggest terms or concepts that might be useful to a user. Terms considered inappropriate or too technical can be replaced in general searches with a “preferred keyword” to make the database more accessible. Beyond the current “Objects” facet, the Anthropology thesaurus can be expanded into other conceptual areas including “Materials,” “Styles and Periods,” “Activities,” and “Agents.”

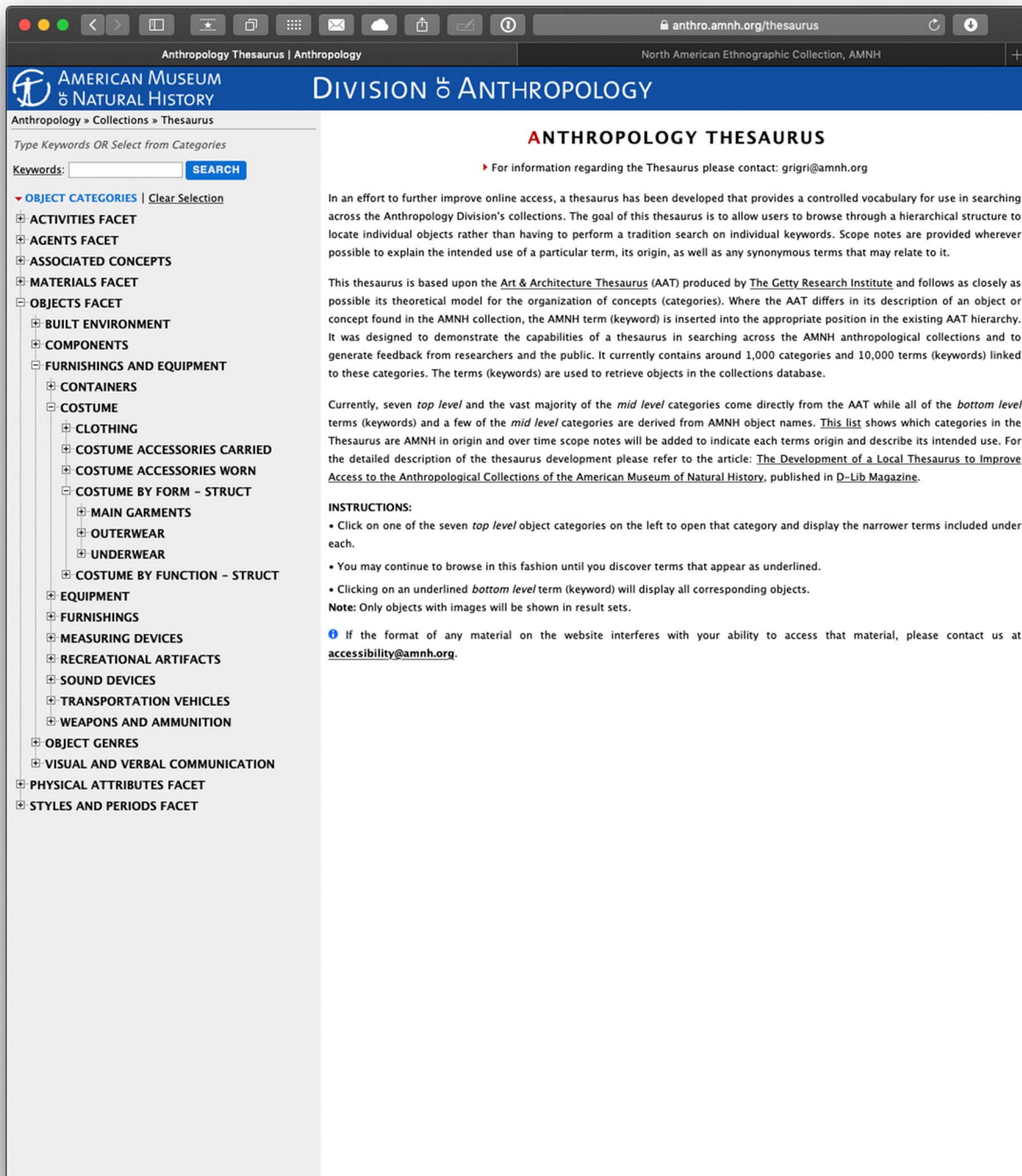
The resulting summary reports can be a guide to strengths of collections in terms of depth and breadth, and they can redress the particularistic tendencies of databases (Figure 6). This will be a valuable utility of the structured data, especially for individuals not familiar with AMNH collections.

## THE FUTURE OF THE DATABASE

Many of the assumptions long held by museums, and anthropology in general, are being reconsidered. The question of who represents an appropriate presenter and interpreter of culture is particularly significant and has evolved from a centralized authority to multiple voices. The role reappraisal has a particular impact on a public website, which by its nature appears didactic. This situation requires a rethinking of not only who speaks but also how things are said. This transition can be facilitated in the database by creating flexible data structures with appropriate interfaces and features to gather and publish these new voices.

By the 1970s, museums had recognized the importance of descendant communities’ involvement in collections and interpretation. The collaboration grew through an increasing awareness of indigenous issues, and real progress began to be made with governmental acknowledgment (with potential funding effects) through NAGPRA. Communities’ involvement in the AMNH-Anthropology database has continued to grow since the 1980s. Consultation visits and a growing institutional acceptance and expectation of input have become commonplace, but even those changes are not made in such a way that the public is aware of them. Descendant communities have been involved in correcting and contributing to the AMNH-Anthropology database for decades, but their contributions need to be made more apparent. Only now are the Web and digital audio and video technology facilitating an active community presence. The growth of social media and very fine-grained control of personal data have resulted in new technological accommodations for sharing. Coupled with strong concerns for privacy rights, data security, and curated information groups, recent developments hold great promise. The technology will provide the paths for contextual connections that many visitors crave, and it will provide new, authentic perspectives on the objects. Meanwhile, the secure communications will give communities a greater sense of ownership and control of knowledge shared regarding the objects and their roles in society.

The Division’s need for a system that easily integrates different types and sources of information and allows for development to utilize new technology cannot be met by the current database. Users expect a resource that can be easily used and accessed on their devices. All the needs indicate the focus of the Divisional database should be beyond that to which the old, original server-based database can be adapted. The database itself needs a complete structural overhaul. Although the programmer has added functionalities, they are not fully integrated with other elements of the database. A full reorganization is the only way to deal with structural as well as some content legacy issues. The systems developed for dealing with weaknesses in the earlier iterations of the database and data themselves will be integrated and further developed for the newly reimagined database.



**FIGURE 5.** Full thesaurus interface. (Courtesy of the Division of Anthropology, American Museum of Natural History.)

The ongoing debate of how to handle non-imaged collections should be reassessed. Alternative methods of searching, retrieval, and discovery need to be explored. Color tagging (Hincliffe and Whitelaw 2015; Rowe and Moore 2018) and crowd- and auto-tagging (Hindle 2017) are among the means being used to increase user engagement in cultural institutions. Most of these

applications have been within the context of art museum collections (Brenner 2015; Solas 2010). The nature of anthropology collections dictates a carefully considered path, taking into account not only the physical complexities of object types and forms of informational content but also the many different stakeholders' associations with the materials presented. Extreme care must be

**Object Type Summary Report: MEXICO AND CENTRAL AMERICA - ARCHAEOLOGY**

**Category:** CONTAINERS, CONTAINERS BY FORM OR TYPE,

Type Group	Occurrence count
BAG, POUCHES and SACKS	0
BASKETS	4
BOTTLES	68
BOWLS, BASINS and PANS	2692
BOXES and CRATES	4
BUCKETS and PAILS	0
CANS, CANISTERS, BARRELS and KEGS	0
CASES and QUIVERS	1
CUPS and GOBLETS	96
DISHES, PLATES and TRAYS	757
ENVELOPES, PARFLECHE and WRAPPERS	0
JUGS, PITCHERS and EWERS	152
POTS, JARS, URNS, VASES and OLLAS	1973
TUB AND TROUGHS	0

**FIGURE 6.** Proposed summary report format. (Courtesy of the Division of Anthropology, American Museum of Natural History.)

exercised not to trivialize these concerns or the materials being described.

As is the case with many large contemporary databases, physical storage of data is a growing issue, exacerbated by the explosive growth of photographic documentation. This situation is only likely to increase with the growing number of means of interacting with digital information. Video is already an excellent way to bring the presence of descendant communities into the interpretation of collections. The possibilities of augmented reality and virtual reality are still being explored, but they seem to be a promising way to integrate other data sources.

Digital platform proliferation and fragmentation have brought advances as well as challenges. Although the AMNH-Anthropology website is responsive, it is not yet optimized for a wide range of devices. Users trying to access the online database on smaller mobile devices are invariably dissatisfied and frustrated. Once this lack of flexibility is addressed, the usefulness of a mobile database will increase substantially. Links to increasingly distant and descendant populations will be easier and make it possible to move virtualized objects beyond the walls of the museum to the communities, which can study them more directly as well as bring new insight and perspectives to them. Staff will have the ability to take database information, including images, to objects in storage. Direct comparison of all resources without having to relocate the objects will facilitate data improvement while minimizing object handling and potential damage. Record accuracy and notations will be improved and have a direct effect on the quality and depth of database records.

Data maximized for mobile devices and connected via the Web provide an easy means for interaction with other institutions, individuals, and distant stakeholders (Ludden 2013; Spellerberg et al. 2016). The question remains of how to utilize all that the modern Web has to offer to attract and engage these different communities with better integration of media as a means of

presenting and communicating subjects of interest. One clear user preference is to provide additional information that contextualizes an object, particularly in this era of changing social standards and new engagement in contemporary issues. Achieving this goal with the key component of a flexible database will be a means of maintaining currency. The database can then move beyond simply delivering information, old and new, to the virtual visitors and instead create an environment that fosters discovery and interest—the kinds of activities that both engage visitors and make the experience more memorable and exciting.

## LESSONS LEARNED

This history of the AMNH-Anthropology database demonstrates that the specifics of the situation as a whole are unique to time and institution. However, the results—problematic information, irregular data, and standard images—are all too common in online databases today. Ultimately, the grants period allowed us to work with the most recent technology at a level that otherwise would be difficult to imagine. There were problems that resulted from using developing technology. Nevertheless, the difficulties created can be addressed through the foundations of good collections organization, a powerful digital database, and the excellent documentation that the grants permitted. The slower rate of growth resulting from the grants schedule better prepared us to find lasting solutions to the problems.

The AMNH-Anthropology imaging projects have demonstrated the value of using media to supplement the text database. Graphical information is an outstanding way to engage nonacademic database users. The addition of digital scans of any document, ledger catalog, field notes, or object is widely popular and is a good investment in terms of document preservation and broad utility in every aspect of anthropological collections work. These scans serve to address many questions from all levels of users.

Across the projects, we found that any improvement to a collection is a new standard that will be expected for all collections. This is true for improved storage and object organization, database creation, or digital image collections. Any unimproved collection will be the focus of special interest and a source of frustration for users.

The scope of the AMNH-Anthropology collections projects also revealed several basic principles that have guided the development of its databases. A database is an efficient way to work around the disorderliness of information while maintaining the essential association with the original source documents. Creating a database requires careful consideration of the underlying information sources and clear understanding of the data's weaknesses. Determination of fields to be included in a database requires thought, not only about the information but also how the data will be used. Even initial forms of a database will raise new issues of content and structure for reconsideration. Continuing database use, both internally and externally, will reveal needs for correction and annotation, as well as help identify common uses of the data and potential user audiences that ought to be accommodated. A database does not provide solutions to problems, but it can help make problems clearer and more defined in terms of what needs to be done and what the scale of the issue is (i.e., how many records are affected). Finally, regular use of a database forces one to accept the reality that databases continually change.

There can and must be a continuing process of development. Transformation may come from technological developments such as the addition of images or catalog scans that will force data changes. The development may consist of corrections of records after the recognition of issues from the database or improved data standards. With these improvements, there will be a continuous impetus for growth and improvement from user expectations.

The continuous state of change is the principal reason rigid data integrity and the archiving of changes are necessary. In the midst of the cloud of stakeholder voices and with the ease of modification of digital information, there is a real danger of losing sight of the context of the original object.

Modifications of data can only be performed confidently if there is a strong foundation of data integrity and active archiving of any changes. These twin positions, stability and perpetual change, reflect the natural tension between the preservation aspect of collections management and the natural course of developing a knowledge base.

The creation of any database is fraught with fear of inadequacy in the present and unanticipated problems in the future. There is never sufficient time or resources. But with the knowledge that change is part of the process, a digital database can be a powerful, flexible tool to mitigate those changes.

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## Data Availability Statement

No original data were presented in this paper.

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