Visual Access to Visual Images: The UC Berkeley Image Database Project

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ABSTRACT

DESCRIPTIVE TEXT IS USUALLY inadequate for finding the precise visual image for which one is searching. Though a search can be narrowed by using basic terminology (such as subject, date, country, format), its outcome will then often require visually inspecting hundreds of images in order to find the desired one. This creates work for the library/repository (which must retrieve many unneeded delicate images), wear and tear on the collection, and a great deal of inconvenience for the user.

The author proposes a solution to this problem—emphasizing visual browsing tools on high resolution computer workstations. In this model, a user can perform initial online queries using descriptive text, then visually browse through high quality surrogate images of the query results. Several dozen images can be displayed simultaneously, and any single image can be enlarged for closer visual inspection. The University of California at Berkeley prototype implementation of this model is discussed in detail.

THE PROBLEM

The management of image collections in a large organization poses a number of access problems. Chief among these are the intellectual access (finding the image[s] that might meet the user's needs) and the physical access (bringing the user and the image together when collections may be spread across a large physical area, and material may require delicate handling).

Many institutions have large collections of images that need to be managed. Photographs, slides, diagrams, charts, maps, signed documents, security photographs, and slide collections for public speaking are all materials that pose physical and intellectual

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organization problems which cannot be answered by unmodified systems designed solely to answer those problems for collections of books. For the most part, these collections cannot be converted into ASCII text, so adequate representations of them cannot be placed in traditional databases. The objects themselves are difficult to store and handle, and using them tends to be difficult and to accelerate deterioration. Finding the appropriate objects becomes an arduous task, and browsing is almost impossible.

Two interrelated aspects that make the cataloging of images different from that of books are the deliberateness in their creation, and their richness and complexity. Most books are written with clearly defined purposes in mind, and catalogers can expect that most potential users of these books will approach them from that standpoint.

Authors and publishers go to great lengths to tell us what this purpose is, citing it in the preface and introduction, on dust covers, and often even on the book's cover. Images do not do this. To paraphrase one prominent author speaking of museum objects, unlike a book, an image makes no attempt to tell us what it is about. Even though the person who captured an image or created an object may have had a specific purpose in mind, the image or object is left to stand on its own and is often used for purposes not anticipated by the original creator or capturer.

Historically, text-based intellectual access systems have been woefully inadequate for describing the multitude of access points from which the user might try to recall the image. Images are rich and often contain information that can be useful to researchers coming from a broad set of disciplines. For instance, a set of photographs of a busy street scene a century ago might be useful to historians wanting a "snapshot" of the times, to architects looking at buildings, to urban planners looking at traffic patterns or building shadows, to cultural historians looking at changes in fashion, to medical researchers looking at female smoking habits, to sociologists looking at class distinctions, or to students looking at the use of certain photographic processes or techniques.

Both in descriptive cataloging and in providing access points, even extensive text-based descriptions of the images are seldom sufficiently descriptive for the researcher to determine which images are likely to be relevant to his or her needs. Even an enormous amount of descriptive text cannot adequately substitute for the viewing of the image itself.

Yet handling the images can hasten deterioration. Photographs, slides, and objects are not designed to be handled like books. Even a single fingerprint can seriously harm these. Because of this fragility, most image collections will only provide users with what mounts to archival-like access. Pulling items for users requires library staff time, and, in an era of scarce resources, often results in further limiting access to the collection. This kind of limited physical access, necessary for conservation, coupled with a lack of extensive bibliographic description and intellectual access, is one of the key problems posed by collections of images (Lynch & Brownrigg, 1986a; Besser, 1987).

A Case Study: The UC Berkeley Problem

The University of California's Berkeley campus faces image collection access and management problems consistent with those outlined earlier. UC Berkeley has scores of image collections housed in different buildings spread out over more than a square mile of territory. These include photograph or slide collections in the areas of art history, botany, geography, and history, as well as museum or archival object collections in anthropology, art, historical manuscripts, and paleontology. Most of these collections are outside the jurisdiction of the main campus library; though many of the collections are managed by librarians, almost all of these collections are officially administered by individual departments, museums, or other bureaucratic units (Besser & Snow, forthcoming). Less than a handful of these collections have any kind of automated catalog access to the materials, and the few that do have automated catalogs have incorporated only very minimal cataloging. Only the materials belonging to the campus library are cataloged at AACR2's second or above, and most of this material is reflected as collection-level records rather than as individual items. By and large, the intellectual access and description of this material suffer from the same problems outlined in the first section of this article.

On the other hand, the Berkeley campus has promoted the notion of remote access to all campus materials. In recent years the notion of a "scholar's workstation" has become the dominant vision for how scholars on a university campus will do their library-type research in the not-too-distant future. According to this model, all university information resources (online catalogs, bibliographic databases, statistical databases, and eventually even full text of documents) should be available from the researcher's own workstation (Curtis, 1988; Moran et al., 1987; Lynch & Brownrigg, 1986b). Researchers from university campuses and in large organizations which are promoting the idea of a "scholar's workstation" have come to expect intellectual access to all the institution's holdings from a single point.

The Berkeley campus and UC Systemwide Libraries, in cooperation with the campus computer center, have already taken some steps toward the implementation of this model. Journal indexes (such as MEDLINE) as well as bibliographic information on holdings in thirty-six of the campus' library collections are available through

MELVYL (the UC systemwide online catalog) from public terminals throughout the campus, from office workstations connected to the campus high-speed network, and via modems from PCs in individuals' homes (Lynch & Berger, 1989; Lynch & Brownrigg, 1989). The same workstation can be used to search an index or the libary catalog, find a bibliographic citation, and insert the citation into a word-processing document (though the software to do this smoothly has not yet been fully developed and distributed). Researchers are anticipating a situation where all campus resources will be available from any workstation connected to the campus network. Students and faculty have already become accustomed to exercising intellectual access in a single convenient location before having to visit the collection where the material is actually housed. But, while the campus and systemwide libraries have made great strides toward providing remote access to text-based materials, precious little work has been done for access to collections of images.

PROPOSED SOLUTION

The key elements that would lead a user to the appropriate images are text-based cataloging and indexing sufficient to allow the user to narrow a retrieval set to a reasonable size, coupled with some kind of procedure for browsing through the retrieved set of images. But, as stated earlier, handling images to identify which ones are relevant both adds to their deterioration and takes up valuable staff time.

To solve this problem, a proposal was made to use surrogate images for the browsing portion of the access process. The use of reasonable facsimiles allows the user to determine whether a particular image is relevant or not without having to remove an actual image from storage. The viewing of a surrogate as part of an intellectual access system provides the user with a powerful description for which adequate verbal substitutes may be obtained only at a great, perhaps prohibitively great, cost (Rorvig, 1986).

The proposed solution merges a form of online public access catalog (OPAC) with tools for visually browsing surrogate images. From any networked workstation the user would be able to use relatively standard OPAC-type techniques coupled with more extensive indexing terms than normally provided by LC subject headings to find an initial set of relevant records. The system would then allow the user to browse visually through the group of small surrogate images associated with that initial hit list. Any particular image could then be enlarged and displayed in high resolution on the user's workstation.

Such a system would allow the user to take advantage of the power of indexing terms to identify potentially relevant documents quickly yet still give the user the capability of examining visual representations of the images in the retrieved set to determine which are really relevant. If indexing terms were used by themselves, they would likely turn up many images not quite relevant to the user's search (that is, low precision); if visual browsing tools were used alone it would take too long to look through an entire collection. When combined together, these two tools will offer the potential for the most efficient retrieval of relevant images.

Such a system would also help with conservation problems. By inspecting surrogate images (and even being able to enlarge these to examine them closely), the user will be able to eliminate all but the most relevant images before even visiting the image repository. Only the images that are absolutely needed will have to be handled.

The Berkeley Implementation

In 1986 the managers of image collections on the UC Berkeley campus began concrete discussions with the campus computer center over how such a system might be designed and implemented. This resulted in a "proof of concept" which was exhibited at the ALA conference in 1987. In 1988 the Advanced Technology Planning Group of Berkeley's Computer Center, in association with a number of these colelction managers, began concrete work on the development of "IMAGEQUERY," the software for a prototype system. Collections modeled in the prototype include those of the University Art Museum, the Architectural Slide Library, the Geography Department's Map Library and (later on) the Lowie Museum of Anthropology's collection of photographs of their objects.

In the following pages this prototype and how it would operate, if fully implemented, is discussed. It should be emphasized that this is still only a prototype, and, due to a wide variety of factors (see Besser & Snow, forthcoming), it will be a number of years before it is fully implemented.

The system is based upon the proposed solution outlined in the previous section with a number of extensions designed to match the computing plans and collection needs of the Berkeley campus. The system is designed to work in a distributed fashion on a high speed computer network. Any bit-mapped workstation running X-Windows and connected to the campus network should be able to access the system (currently supported workstations include SUNs, DEC's MicroVaxen, IBM's RTs and PS/2s running AIX, and Apple's Macintosh running AU/X).

The user first uses text-based information to narrow down a search, then can browse through the surrogate images for that initially retrieved set. The user begins by invoking IMAGEQUERY with the name of the collection he or she wants to search (currently art museum, architecture slides, anthropology museum, or geography). A blank spreadsheet is displayed (see Figure 1) where the user will compose his or her query. This is done by using a mouse to pull down menus from the boxes at the top (see Figure 2) in much the same way as on a Macintosh computer. Assume that we want to look for images from particular towns in Italy which are part of the architecture image collection. In this case, we activate the fields menu and see a list of possible search fields offered by the architecture database. We then indicate Place in the menu. When we release the mouse, the name of the field (Place) is then displayed in the menu portion of the spreadsheet.

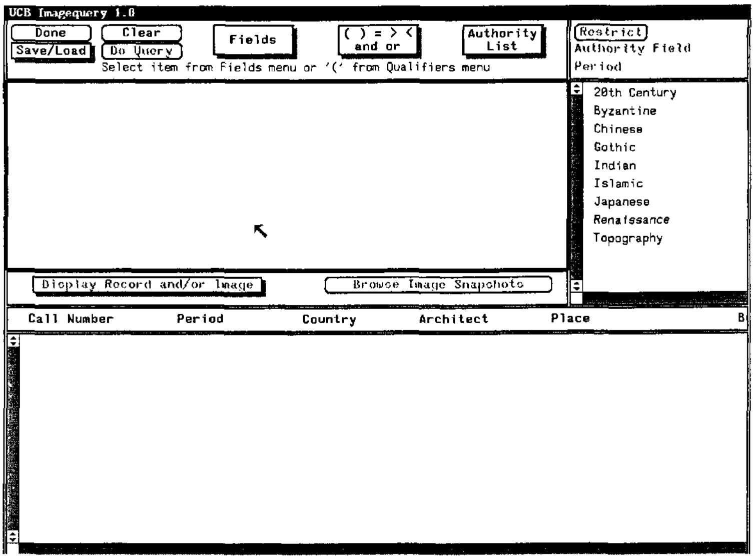

Figure 1

In a similar way, if we pull down an = from the comparison operator menu, the system will place that operator in the main portion of the spreadsheet. If date instead of Artist had been chosen, we might want to choose > or < =.

Having displayed the query Place = in the spreadsheet, the keyboard can now be used to type in the query (wildcard searches are accepted), or the "Authority Values" box can be used to preview the existing entries currently in the catalog/database and selections can be made from there. By merely clicking the mouse on the listing VENICE, for example, that place will be entered into the query on the main portion of the spreadsheet (see Figure 3). This feature both prevents misspellings and allows the user to see what kind of entries are in the database before actually querying it. This should help prevent queries where nothing is retrieved.

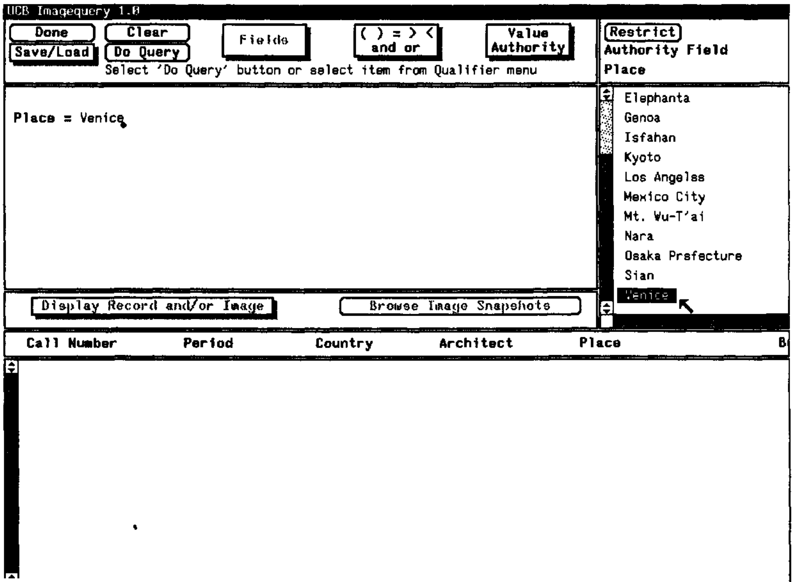

Figure 2

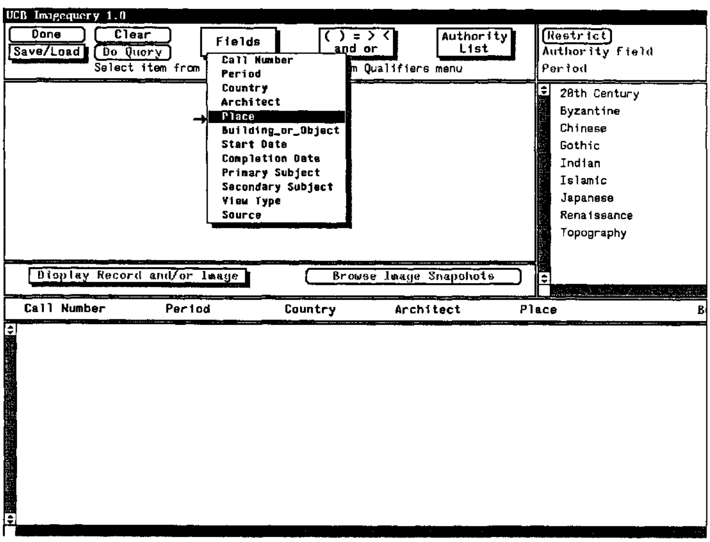

Figure 3

At this point, we can continue building a more complex query in the spreadsheet using Boolean operators from the "comparison operators" pulldown menu, or the "do query" button can be pressed and the results of a query will be displayed as shortened records at the bottom of the screen (see Figure 4).

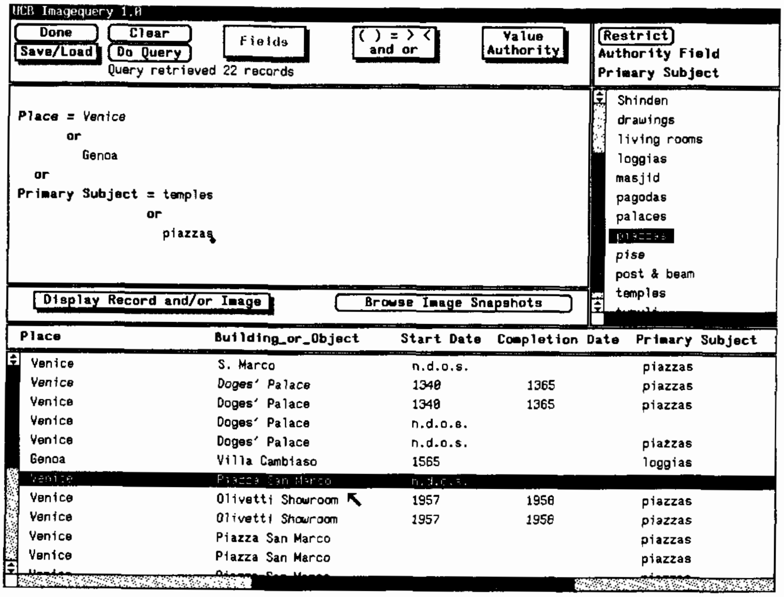

Figure 4

To browse through surrogates of the image records that were found as a result of the initial query, we simply select the "browse" button and slide-sized color images will be displayed on the right portion of the screen (see Figure 5). If brief information about any of the surrogates is needed, we can click on that image and it will be highlighted, as will the corresponding shortened text record underneath the spreadsheet. Or, if we want to see which image a particular text refers to, we can click on the shortened record and both that record and the associated surrogate image will be highlighted.

If we now want to browse through more surrogate images, the screen can be filled with them (see Figure 6). This feature allows quick viewing of several dozen images at once and we can zero in on those that are most relevant. We can then point to any particular image on the screen, pull down a menu and see the complete text record associated with it, or see a high resolution color enlargement of it (a much better surrogate) (see Figure 7).

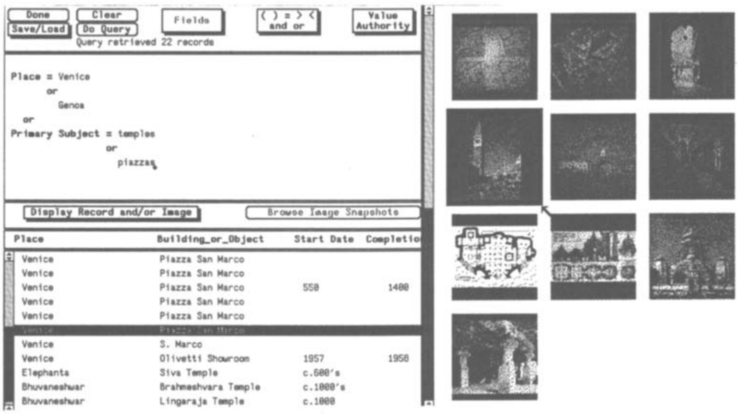

Figure 5

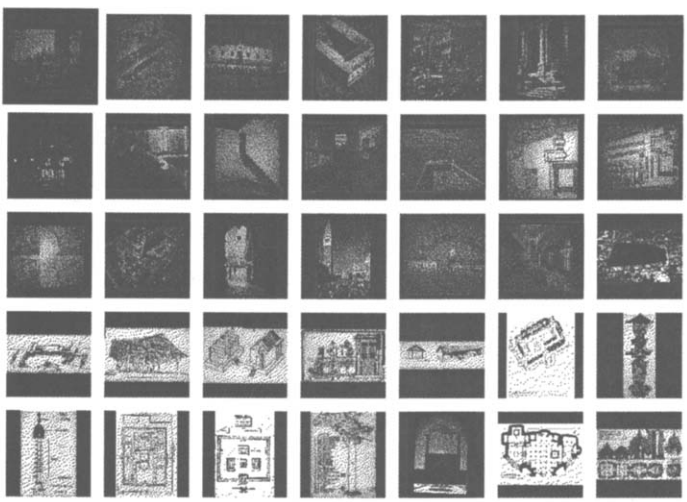

Figure 6

If we want to narrow the query visually, a new set of surrogate images can be created by merely pointing to the ones to be saved, and giving the new group a name. Then the same software can be used to look only at the members of that group, allowing us to pinpoint only the most relevant material.

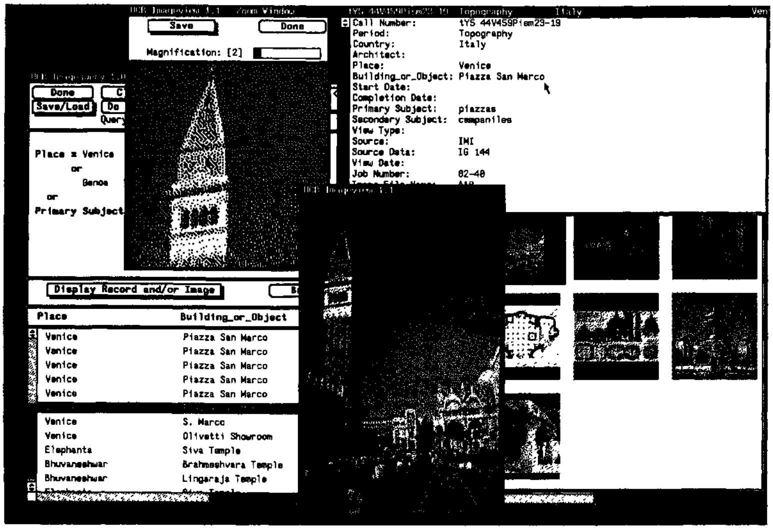

Figure 7

The system provides a uniform user interface to different collections, yet allows each collection to maintain its own set of descriptive and indexing terms; the "look and feel" of searching remains the same, but the searching and descriptive terminology used changes with each collection. Compare the user interface for the anthropology museum (see Figure 8) with that for the architecture collection (see Figure 2). Terms such as *architect* and *building* are irrelevant to the anthropology collection, while terms like *tribe* and *collector* are not very helpful for the architecture collection. The system is based upon a common user interface to independent relational databases (rather than MARC records), which allows descriptive and searching terms to be fine tuned to a particular collection at the expense of not being able to join records from different collections or search across collections. This choice was made because of the widespread availability of, and support for, the relational systems on campus, the perceived lack of suitability of MARC for these kinds of collections with minimum-level cataloging, and because none of the units involved falls under the jurisdiction of the main campus library (see Besser & Snow, forthcoming).

This structure should eventually allow indexing and searching on terms from the *Art & Architecture Thesaurus, Chenhall's Nomenclature,* and other thesauri designed for more specific types of material than the LC Subject Headings.

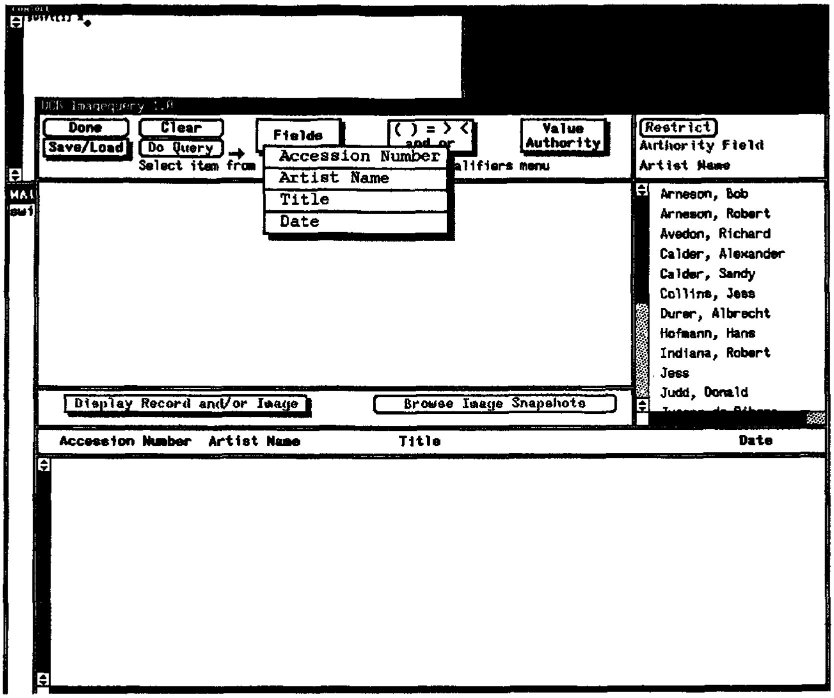

Figure 8

CONCLUSION

If fully implemented, this prototype would solve a number of the problems outlined in the first section of this article. It would allow the user to retrieve an initial set of records using text descriptors that are more closely adapted to that collection than one would normally find in an online library catalog. It would then allow the user to browse through surrogate images for each of the records initially retrieved, providing visual tools with which to compare and examine them closely. It would allow the user sitting at any workstation on the campus to identify precisely which images he or she would like to view and hence reduce the risk of overhandling the originals. It would also provide a common user interface for searching the various campus image collections.

But, as this design is in the prototype stage, there are still many questions left unanswered. Practical questions include: What revised considerations in design will be necessary to prevent the campus network from becoming overloaded? How should the display be handled when initial retrieval sets are very large? Conceptual questions that need to be resolved have been raised elsewhere. These include: how to link the descriptor terms in different collections to one another so that a single search could be done across multiple image collections (Besser & Snow, forthcoming); what kind of changes will take place in researchers' habits and the way the average person perceives visual images (such as art) as the result of a widespread implementation of systems such as this (Besser, 1987)? None of these questions can be adequately answered without more widespread implementation.

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REFERENCES

Besser, H. (1987). The changing museum. In C. Chen (Ed.), *Information: The transformation of society* (Proceedings of the 50th annual meeting of the American Society for Information Science, 24) (pp. 14-19). Medford, NJ: Learned Information.

Besser, H. (1988). Adding analysis tools to image databases: Facilitating research in geography and art history. *Proceedings of the RIAO* (held at Boston, MA, Oct. 4-8, 1987), 2(March).

Besser, H., & Snow, M. (1990). Access to diverse collections in university settings: The Berkeley dilemma. In P. Moholt & T. Petersen (Eds.), *Beyond the book: Extending MARC for subject access to non-traditional materials.* Boston: G. K. Hall.

Curtis, H. (1988). The scholar's workstation: Networking on campus. *Wilson Library Bulletin, 63*(2), 46-51.

Lynch, C. A., & Berger, M. G. (1989). The UC MELVYL MEDLINE system: A pilot project for access to journal literature through an online catalog. *Information Technology and Libraries, 8*(4), 371-383.

Lynch, C. A., & Brownrigg, E. B. (1986a). Conservation, preservation, and digitization. In D. A. Nitecki (Ed.), *Energies for transition* (Proceedings of the Fourth National Conference of the Association of College and Research Libraries) (pp. 225-28). Chicago: Association of College and Research Libraries.

Lynch, C. A., & Brownrigg, E. B. (1986b). Library applications of electronic imaging technology. *Information Technology and Libraries, 5*(2), 100-105.

Lynch, C. A., & Brownrigg, E. B. (1989). Public access bibliographic databases in the multicampus university environment. In L. J. McCrank (Ed.), *Databases in the humanities and social sciences 4* (Proceedings of the International Conference on Databases in the Humanities and Social Sciences, Auburn University, July 1987, pp. 411-19). Medford, NJ: Learned Information.

Moran, B. B.; Surprenant, T. T.; & Taylor, M. E. (1987). The electronic campus: The impact of the scholar's workstation project on the libraries at Brown. *College and Research Libraries, 48*(1), 5-16.

Rorvig, M. E. (1986). The susbstitutability of images for textual description of archival materials in an MS-DOS environment. In H. Strohl-Goebel & K-D Lehmann (Eds.), *Proceedings of the second international conference on the application of microcomputers in information, documentation and libraries* (Baden-Baden, FRG, March 1986). Amsterdam: North Holland.