



## *Man versus Machine*

# Are We Prepared for the Technological Revolution in Scholarly Research?

by Roger S. Bagnall and John B. Hensch

**The information revolution has found its way to the library and the researcher's world. What will the new technology mean to the scholar?**

**T**here has been a revolution in scholarly work habits. As recently as fifteen years ago, scholars in the humanities rarely encountered any machine more complicated than an electric typewriter in the course of their

research and writing. Humanists were seldom aware of the technological world inhabited by the scientist. Computer-oriented humanists were few and looked upon with attitudes ranging from bemused tolerance to suspicion by most of their colleagues.

The greater accessibility of computer technology to the non-technical user has already altered irrevocably the scholar's world; and the changes felt already are small compared to those that are to come. Economic hard times in the world of higher education add to the pressure to adopt automated solutions to both old and new problems. It is in libraries and in the information services which they have traditionally provided that change is most obvious now; the major research library has lost the ability to be autonomous as it

once was. No one collection has the resources to acquire and preserve everything and to make it available to its users. Only cooperative ventures will make the libraries of the future work for scholars, and most of these ventures will involve technological links between scholars and sources of information.

Of the many areas of activity, three seem to us of particular interest to scholars and their organizations: microforms, videodisks, and computerized data bases.

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## Microforms

Most researchers of whatever discipline have used microforms at one time or another in their academic careers, mainly in libraries. They were the precursors of the information age. Libraries are concerned with acquiring and preserving materials, and they have depended heavily on microfilming. Libraries constantly face the problem of decaying books printed on acid paper. Huge quantities of this crumbling material must be recorded. Microfilming has been the answer. Books and periodicals can be filmed quickly using equipment that is relatively cheap. Roll film can, moreover, be processed very rapidly with automatic equipment.

Commercial firms, which have moved increasingly into microforms in recent years, have seen the advantages of microfiche to the individual and institutional user: its ease of storage, its high density of pages to the cubic inch of space occupied, its convenience for quick reference use, and its ease of mailing. Unfortunately, their interest is in items which they can sell in sufficient quantity to make a profit. The bulk of library materials, rotting away, have no commercial interest. Commercial prices tend to be ten to fifteen times unit cost, a margin which ensures recovery of filming cost on very few copies indeed, but deprives microfiche of much of its cost advantage over printed material.

Much can still be done in the non-profit sector to preserve the ease of microfilm use. Learned societies and universities, while short of capital to invest do have the ability to tap professional expertise at little or no cost, selecting titles that are important for scholarship—both a scientific and a commercial advantage. They also have large bodies of members with interests in a particular field and make regular mailings to them which can publicize what is done without much extra cost.

Learned societies need to find a way of cooperating with libraries. The National Endowment for the Humanities, for instance, recently announced new programs for preservation of library materials. One useful role which learned societies might play is to

bring scholars together with librarians from major research libraries to develop preservation programs in which the societies supply the expertise to allow informed judgments about resources.

It is also essential to avoid the costly duplication of filming. The Research Libraries Group (RLG), a consortium of major libraries, has recently enlarged its Research Libraries Information Network (RLIN) to include information about microform masters and copies in member libraries. If the National Register of Microform Masters can be automated and its backlog of a quarter-million items eliminated, it can, in conjunction with RLIN, provide the basis for avoiding duplicate efforts.

Many, if not most scholars, remain suspicious of microforms. Learned societies must educate their members to the use of microforms. The issue of preservation technology and its availability goes far beyond merely the technical. The question is tied to the acquisition of material by libraries and individuals (collection development, as the librarians call it; book buying, as scholars would). In microforms, availability and cost converge: in saving from destruction a large part of our printed heritage, we can put it in a form which can be duplicated cheaply and sold at very low prices. In short, the imminent destruction of much of the contents of our libraries, although a grave possibility, is at least as great an opportunity as it is a problem.

## Videodisks

Microforms may be only a temporary solution to the problem of preservation and availability of data. Microforms may soon find themselves replaced by disk storage for most purposes. In theory, the new videodisk technology offers almost unlimited potential for imaginative uses in all scholarly disciplines. In practical terms, however, vexatious technical and economic questions cloud the future use of the medium in the humanities at least, perhaps, in the present decade.

A videodisk looks much like a common long-playing phonograph record

but is capable of playing back pictures (through a television set, or cathode-ray tube) as well as sound. When linked to a small computer, a videodisk player gives the user the opportunity to manipulate, or direct, the player's responses in astounding ways.

Although videodisk systems have been under development for several decades, they have reached the market in reasonable supply only in the last two or three years. Of the several different systems developed, two dominate the market. Unfortunately, the two are incompatible. On the surface, one seems better suited to home entertainment, the other for the industrial, educational, and scholarly markets.

The first system, a contact, or capacitance, system, most closely resembles the traditional phonograph record. The disk contains minute grooves and is "played" by a needle travelling in the grooves of the disk which spins at 450 revolutions per minute. Marketed by RCA under the name SelectaVision, it is the simplest system, with the fewest features. It is at its best as a medium for playing back motion pictures or other linear material.

The second system is a non-contact, or optical system. The images and sounds are encoded not in grooves but as varying patterns of reflected light in microscopic pits in the videodisk surface. Playback (at 1800 rpm) is achieved by a laser beam "reading" the different light patterns rather than by a needle tracking grooves. Since nothing actually touches the surface of the disk during playback, non-contact videodisks theoretically should never be worn out from being played. Videodisk players of this sort are marketed under several brand names, including Magnavox's MagnaVision, Pioneer's LaserVision, and MCA's DiscoVision, the last of these being intended primarily for industrial and educational uses.

The optical systems offer the greatest versatility and potential for educational and scholarly applications. In the realm of education, videodisks offer, in addition to films or lectures by leading teachers and scholars, exciting possibilities for interactive learning through videodisk-linked, computer-

assisted instruction. A prime example of this is a Brigham Young University project which adapted the classic Mexican film, *Macario*, used in Spanish-language classes. The film was abridged with slides and a voiceover narrative covering gaps in the story line. A two-channel audio track carried Spanish and English dialogue and narration. Added as "appendices" at the back of the disk were a glossary, a transcription of the Spanish dialogue, and a set of self-test questions.

Even more elaborate are the Data-land films produced by the Architecture Machine Group at MIT using a multimedia room fitted with several small TV monitors, a large video projection screen, and a chair equipped with joy sticks, all linked to a micro-computer. One application of this equipment, the "Aspen Project," used a car equipped with four cameras set at right angles to each other to film every street in Aspen, Colorado. When the resulting videodisk is linked to the computer, the operator of the system can simulate the act of traveling by car all over the town. He can control his speed and his direction. At each intersection he can choose to go straight, go backward, turn right or left, or stop. The MIT researchers who developed the system are interested in it for its applications for cultural mapping. Historical or other data can be easily loaded in the videodisk for playback. For example, historic photographs of an Aspen house can be entered so that the surrogate traveller can see the house at various points in the past. Photos of buildings taken at different times during the year can provide the armchair traveller with a four-season view.

More recently the electronic publishing division of Arete Publishing Company, Inc., has developed a prototype videodisk version of its *Academic American Encyclopedia*, whose articles combine printed text, sight, and sound in intriguing ways. The article on Beethoven, for example, includes contemporary illustrations and recorded excerpts from some of his major compositions, while the article on the Gettysburg Address features Carl Sandburg reading Lincoln's timeless words.

Such sophisticated videodisk programming has great potential for language instruction, architectural history, art and music history, and historical simulation games. The problem? These programs are highly complex and expensive to produce.

When used in libraries, videodisks offer great potential benefit for

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scholars in the humanities as well as in other fields. As a medium for the storage of information, videodisks provide staggering capacity. The Library of Congress has embarked on a project to scan its 5 million non-machine-readable catalogue cards (many in non-Roman alphabets). These cards can then be reproduced on demand for other libraries through a high-resolution laser printing system or they can be stored and retrieved online. The staff of the Library of Congress estimates that it will take twenty-four optical digital disks to store this gigantic card catalogue.

Videodisks may also be a practical medium for the storage of library materials themselves, not just the catalogue cards that describe and locate them. Another Library of Congress pilot project—now in the early stages—will convert library materials, both print and non-print, to videodisk form, to head off future preservation problems. The Library's plans for non-print materials (prints, photographs, motion pictures) include retrospective conversion, but its plans for printed materials are limited to capturing cur-

rently published material, not periodical backfiles or large caches of moldering monographs. Nevertheless, a Library of Congress expert predicts that we are probably at least five years away from the time when digital storage systems will be really applicable to the preservation of library materials.

It is this retrospective conversion of printed materials that offers perhaps the most excitement for humanists, nearly all of whom work in one way or another with historical materials. Unfortunately, significant technical problems limit the potential of videodisks in this area, at least for the near future. The major drawback is the low-resolution of the conventional television screens on which the videodisk programs play. The pictures on these conventional monitors are formed by an electronic beam scanning the screen in 525 lines, a degree of resolution inadequate to display a page of printed or typed material without reformatting. The problem is that 525 lines are not enough to define clearly each of the hundreds of characters that make up a printed or typed page. There is also an inherent incompatibility in transferring an essentially vertical medium (the printed page) to a horizontal one (a television screen). It takes about four frames on an optical videodisk to store the text of an average printed page, about six frames for the average typed page. The problem of resolution is a serious one when the material to be played back consists of twentieth-century machine-printed books and periodicals. It is all the more so when it is the hand-printed imprints of the eighteenth century and earlier. High-resolution cathode-ray tubes (up to 2000 lines) are technically feasible, and are being developed. But the costs, at least until 1986 or 1987, will be much greater than for the conventional CRT.

The resolution problem is not a significant one when text need not be captured, stored, and displayed in facsimile form. For example, the characters in a new book typeset by computer already exist in digital form. That digitized information can easily be stored on a videodisk and played back in a manner that is legible on a CRT, even if in a format different from the printed book itself. It is thus easy to

understand why the Library of Congress in its proposed preservation-through-videodisk project is limiting itself to current materials. The preservation of large research collections through videodisk (analogous to the many retrospective microform collections of books and serials offered by commercial and non-commercial publishers) is a matter of interest to many librarians and scholars, but effective and economical solutions for storing and playing back such material are not on the immediate horizon.

What can learned societies and humanistic scholars do to help shape the development of videodisk technology, or at least to benefit from the research and development being carried out by others? Unfortunately, humanists' dreams may far outreach reality. The chief problem is that where the technology offers its greatest promise for humanistic learning—in the realm of complex programs where the user interacts with a videodisk player through a computer—it is also most costly. Such programs must be developed professionally at great expense. As yet there is no ready means by which videodisks can be recorded at home or in the classroom, as video cassettes may be. The scholar's dream of having a large research collection on videodisks linked to a machine-readable catalogue is also some distance away. Commercially produced retrospective research collections, on videodisk, as a substitute for conventional microforms, are also probably some time away. Publishers are having enough trouble selling traditional microform collections in this era of severely reduced library budgets. If libraries cannot afford to buy fiche and film, how can they afford to buy videodisk collections?

The future of videodisk technology for humanists may well be influenced by trends in the consumer marketplace. It is unclear just what connection there might be between the development of home markets for videodisks and the education market. It seems reasonable to assume, however, that if the home market boomed, there would be benefits for the educational and scholarly fields. The problem, however, is that the home market is not strong. As in so

many things, the catch is that the market—any market—for videodisks is unlikely to skyrocket until there is an ample supply of useful, imaginative software to play on the machinery. But software, which is costly to create, is unlikely to be developed in the absence of an assured market.

The new technology is unlikely to have much of an impact on the humanities in the 1980s. The humanities, poverty-stricken as usual, have traditionally been the last of the scholarly disciplines to benefit from advances in technology. Is there nothing that humanists can do? Perhaps the most important thing that humanists can do is to begin to encode their writings in digital form. Only if they do that can they take advantage of any other technologies that build on digitized information. In concrete terms, this means that humanists should produce their dissertations, their articles, their book reviews, and their books not on their trusty old Olivettis and Smith-Coronas but on word processors or similar equipment, and that publishers of humanistic scholarship should typeset their publications directly from such machine-readable media. Such prospects recently were discussed at meetings of the Association of American University Presses. Some problems of standardization remain to be solved, but machine-readable copy would allow for full-text search and the electronic transfer of information. One study has shown that about sixty per cent of all articles published in scientific journals originated on office word processors.

### Computerized Databases

We turn now to a means of storing information that has close affinities with what we have been saying about storage on disk—automated databases. These differ from videodisks in that they allow storage and dissemination of material recorded directly in machine-readable form rather than converted to digitized machine-readable form. In particular, we are concerned with automated databases that are principally bibliographic in character. There are, to be sure, non-bibliographic databases, even in the humanities, but they are less developed

than bibliographic ones at this point. One exception is the *Thesaurus Linguae Graecae*, a data bank of all ancient Greek text material now being created at the University of California at Irvine. This repository, now at about 42 million words and projected eventually to reach 80 to 90 million, will be textual in character rather than bibliographic.

There are many bibliographic databases and the world of on-line services is becoming so large and complex that keeping in touch with developments is practically a full-time job in itself. In the humanities, however, the number of such databases is not large. Some are created and sponsored by commercial firms. These do not seem very well regarded in professional fields. What can the nonprofit sector, as opposed to the commercial sector do?

A few databases now exist: the Modern Languages Association bibliography, the RILM (for Music), the *Philosopher's Index*. Currently in preparation are the RILA (for art history), one for theater research, and a project of the American Theological Library Association. Almost all of those now operating began as attempts to computerize the composition of the printed version of an annual bibliography to cut the cost of printing. Only later did these become material for an on-line database. As a result, the older ones are not always well constructed for automated retrieval. The Modern Language Association has recently taken elaborate measures to provide an indexing system adequate to the complexity of the database.

This accounts, too, for the small size of the available database. It has been only a few years since the creators of these humanities bibliographies decided to create an on-line bibliography as well; hence, only the most recent years are available. As a result, the use of these databases is only marginally attractive for most scholars in the humanities, whose view of scholarship is rightly cumulative. Being limited to the scholarship of the last five years or so is not always helpful. In the sciences, the situation is different; almost all relevant material would turn up in the last five or ten

years of a bibliography. This situation, however, is changing. MLA has decided to include the five years previous to what is now available, and is editing existing tapes created for composition. For earlier years, adding to the bibliography would mean entering data from the printed version, and this addition, though desirable, is only in the planning stage.

At the same time, the number of scholars with ready access to these databases is fairly limited. At present, all of the bibliographies use Lockheed's Dialog system, which has the biggest facilities and network; it is the only really international vendor. But because usage of these databases at present is rather small (by the standards of a vendor of on-line databases), they are not now profitable to Dialog, and Dialog in consequence does not put much effort or money into promoting them. The fundamental economic problem is that the income is not yet sufficient to make these ventures attractive to industry. The biggest problem of all is to make access to these automated databases truly international and not parochially American. At the moment, there is no direct European access to these databases, except by transatlantic telephone.

The universities and learned societies can play an important role in the development of this relatively new form of disseminating scholarly information. The creation of a bibliographic database is a natural activity for any society which is already involved in a bibliographic enterprise. It is a fundamental economic fact that for the cost of creating a book, one can have both the book and the database, simply by producing the book via computer tape. Just any computer tape for composition does not make a database. But the MLA's experience shows that by creating the bibliography in the computer, with proper programming, the same master file can be used both to drive the photocomposer and to make the on-line file.

One key point which should be stressed is that no one going into this business would be well advised to invent a new system. One of the fundamental difficulties of getting humanists to use automated databases is the

different languages used to extract information. Learning these codes takes time, and few scholars are willing to learn a different code for each different database. Consequently, a new system created with a protocol borrowed from a database already in use in a related field stands a much better chance of being used, and of avoiding the inevitable period of working out bugs in the software.

As in the case of microfiche, the learned society can be a means of dispelling fear and ignorance in its constituency. Even more than microfiche readers, computers still have a mystique for many humanists. That aura of incomprehensibility—well deserved in the case of many systems of access—is beginning to be dispelled, but

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there is a great deal yet to be done in teaching our colleagues that the computer is merely a tool like a typewriter or a duplicator, and that everything depends on what we do with it. Those who cry in fear that computerized bibliography will prevent people from actually reading the current literature needed to see that all that is really eliminated is drudgery; the computer (at least in this realm) is not a mind but a machine.

Universities, societies, or a consortium thereof, may at some point want to get into the business of providing on-line services of some sort. This is a tricky area. It is relatively simple to provide a service which involves receiving mailed inquiries ("Give me a list of all of the articles on James Joyce published in the last five years which mention the world 'structural' or a derivative in the title"), running a search, and mailing the results to the inquirer, all for a modest service fee. The MLA

is considering beginning such a service. On the other hand, this technologically simple service takes a great deal of staff time and could be an economic quagmire. The University of North Carolina at Chapel Hill Classics Department will be providing this service for Greek tapes acquired from the Thesaurus Linguae Graecae, but they have made no real study of the hidden costs of such a service.

## The Revolution

Those who fear technology are right about at least one thing; life will never again be the same for those who let these machines into their lives. Whether we like it or not, things are changing. The major research library must change its traditional systems. But the decline of the autonomous library may mark the rise of the independent scholar with microfiche reader, disk drive attached to a computer terminal or home computer, and printer, all linked to outside resources by telephone. Library catalogues, bibliographic data bases, materials in university libraries in machine-readable form, tapes of textual materials, disks or microfiche will provide the scholar with a range of resources beyond anything even the wealthiest book buyer today can afford. All this will take some getting used to, but on balance individual scholars should benefit. The information revolution may also be a great boon to the academic world in another sense. Because of the current economic situation, many younger scholars have found positions in institutions of the third or fourth rank, with no good research facilities at their disposal. Their sense of isolation and alienation is growing, and we run the risk of losing most of an entire generation to the scholarly profession. The kind of democratized access to scholarly materials which the technological changes can offer gives us a chance to do something to retrieve not merely information but people.

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