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What Hath Technology Wrought?*

I BELIEVE IT WAS Adali Stevenson who said: "Man does not live by words alone, but he sometimes has to eat them." No one wants to be reminded of anything but his successes! So, I sense that in putting together their papers for these proceedings, my colleagues have squirmed at least as uncomfortably as I. Librarians know that the inventory of failures in library automation is long and dismal. However, this is not intended to be a series of obituaries; rather, my purpose is to review the period of transition from completely manual to nearly fully automated systems, to try to see what can be learned from analyzing the failures, and to extract some general observations in answer to the question: what hath technology wrought?

It is written that the earth was formless and void in the beginning. The world of bibliography and library science, however, was far from chaotic twenty years ago when computers first began to make an impact beyond pure science. In fact, the theory, methods and procedures of bibliography were well defined and clearly articulated, if admittedly imperfect. What has sent the field reeling in the past two decades is not the computer but the worldwide social changes leading to enormously increased publication output and service expectations far beyond those we

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had been prepared to meet in the past. If we can fly from New York to London in three and one-half hours, send people to the moon, print thousands of lines of text per minute, obtain a fully developed color picture in a minute or two, and take instant movies, why must it take months or years to acquire, catalog and put into the hand of users a variety of library materials? Surely technology could help solve such a seemingly simple problem.

Before a problem can be solved, however, it must be defined. In this area the library profession was inexperienced and ill-prepared. Into this atmosphere, composed of equal portions of good intentions and ignorance, came three forces: "computerniks" with little exposure to libraries, librarians with little experience in defining problems quantitatively, and federal money. When the protective amulet of outside fiscal sponsorship is available, it is a fact that it becomes difficult to refrain from going forth either to explore regions unknown, to heal the sick or to bring the faith to unbelievers. There was no shortage of unbelievers.

A popular cliché has it that many modern problems stem from the difference between the paces of technological and social development. Systems change by months or years, people by lifetimes, and with so many contemporary generations out of phase with technological development, conflict is inevitable. It is easy to look at the broad picture historically and exculpate ourselves for failures of library automation by pointing to the forces larger than ourselves, to the circumstances of which we are the victims. It is quite another thing to take individual responsibility and see how we may have contributed separately and collectively to those larger forces.

Word v. Deed

One immediate failure, or human frailty perhaps, was the confounding of word and deed, of concept and reality; or less obliquely, of the promised schedule and the actual schedule. Fifteen years ago I recall hearing Calvin Mooers say why there were so few truly operational information systems. He ascribed this lack to the simple ability of people to distinguish work from fun. Designing information systems was fun; making them operate was work. Some people are interested in intellectual challenge as a game, others want to create production systems to perform work. When these two types cooperate on the same project, disaster is bound to ensue.

The Immodest and the Modest

Although conventional wisdom would have us all be self-effacing, there are some good words to be said about the immodest people who

began to shake up this profession. It takes a lot of nerve and substantial self-confidence to be an upstart, to try to crack the traditional structure of a naturally conservative establishment—and until recently, systems of bibliographic control changed at an undeniably glacial pace. These immodest people possess vision and a powerful imagination; they are a creative force. Immodesty, like many creative qualities, has a double edge. Its second perspective is the deplorable mixture of elitism and naïveté which initially afflicted some librarians and computer experts alike. Talk was cheap, slick and glib. One pioneer in library automation was heard to say: “To the arm-wavers goes the credit.” While assigning to hapless but talented programmers the pleasures of staying up all night to write code, test and debug programs, the self-promoters made hay in the sunshine. Many of the talkers wore the emperor’s clothes; some designers liked to play God. They were sure they could tell librarians what was good for the library even though they didn’t make much use of libraries themselves.

Lack of Direction from the Profession

For a long time the library profession permitted the technological tail to wag the bibliographic dog. This lack of direction from top management may have been the most serious of all our failures. It led to tremendous waste of financial and human resources. But let us not blame the technicians. They came from mission-oriented environments where the rewards go to the strong. Most librarians came from educational backgrounds lacking strength in management science and technology. Thus, it is no wonder that technicians, sensing a lack of authority, ran amok, setting their own goals and priorities. The worst cases ended in utter failure. Most came out in the middle with powerful strengths and enervating weaknesses side by side, and by the mid-1970s, none even approached the system features and facilities forecast a decade earlier.

After these excesses of the 1960s and early 1970s, I hope that the library profession will exert its leadership and never again permit technology to become the driving force in system development. To employ an analogy from air transportation, we permit designers and engineers to test and build aircraft, but responsibility for determination of routes, hiring of pilots and marketing of an airlines service is assigned to management and not delegated to technicians. It is recognized that in the early stages of any technological development, the technical and managerial functions are commonly combined in one person or a small cadre. As a field matures, however, technical and managerial aspects inevitably split and are assigned to persons with different talents. In library automation too, this division should occur as the field matures. In this way we will be certain that technology will always be the servant, never the master.

Failure to Achieve Cost Advantage

We grossly underestimated the cost-effectiveness of some manual library systems. With automation we have still failed to realize significant staff savings (especially in cataloging), and more remarkably, we have—with one or two notable exceptions—ignored the much greater potential for savings in acquisitions where the transaction volume is five to ten times greater than in cataloging. Acquisitions require that we search, order, receive, cancel, claim, pay, post vendor reports, and execute a host of other purchase-related transactions, meaning that the total activity is far greater than that in cataloging.

We probably have been further seduced by the falsehood that falling unit costs in computers would save us from rising personnel costs. It is true that the falling unit cost of computer hardware is one component of saving. Unfortunately, as computers and systems become more sophisticated, they require an ever-increasing staff of highly sophisticated and expensive software people for maintenance and development. The rise of this personnel component of the computer far offsets any personnel savings in actual library operations. Ignoring the self-generating character of automated systems has further contributed to the failure to achieve cost savings: success breeds accelerated use. Increased use costs more money, so the bottom line is bigger. An automated system is always required to do more than the manual system it replaced; it is this "doing more" which costs more.

To some extent we also have been attracted by the appealing argument of "around-the-corner-ism." By this I mean the promise of tomorrow's technology—whether it be in the form of satellite transmission of data, distributed computing, higher storage densities, or the like. It has led us to believe that technological advances will continue the downward spiral of costs. For every decline in hardware costs, there appears to be a correspondingly greater increase in the cost of the staff required to support that hardware, a point alluded to above.

Failure to Achieve Simplicity

We have not succeeded in making life simpler, easier and cheaper for ourselves. We have designed rigid, deterministic styles of interaction with the computer—a far cry from Licklider's procognitive system.¹ Highly restrictive protocols for person/machine communication impose huge training loads and require massive amounts of documentation, which is often neither well written nor of sufficient quantity or depth. Yet another consequence has been across-the-board reclassification of operating personnel with greater total personnel cost resulting even when the staff is reduced. The bottom line has become larger, not smaller.

In asking, "What do you want?" during the development of MARC, we may have been asking the wrong question. The predictable response, "We want everything," may have led directly to the complexity and expense we now face in handling MARC, a format which continues to grow in theological complexity. In the developmental stages, no one appears to have asked these three questions: (1) What do we need in a machine-readable bibliographic format? (2) Why do we need it? (3) How much can we afford to pay for it? Had these questions been answered, we might have had a quite different and less elaborate MARC. These same questions naturally apply to the entire system design process.

I have always felt strongly that we needed one or more standard subsets of the MARC format, subsets selected for a variety of purposes. This might have saved the expense and complexity of processing the full MARC format for simpler applications and would also have encouraged local input in accordance with national standards. While serving on the RECON Working Task Force, I urged adoption of a simple, fundamental subset of MARC for converting retrospective records, a subset which could be upgraded on demand. It seemed that given a defined subset, RECON might have been achieved at costs considerably below the then-estimated \$10 million. Although at the time librarians in this country were not ready to agree on a standard subset, our Canadian colleagues successfully defined and implemented a mini-MARC format. It seems ironic that while we have worried so much about exponential growth of our collections and their appetite for dollars and space, we have been oblivious to the ever-escalating costs of data input and conversion for titles having very little potential for actual use or access. Why waste money inputting records in full MARC format when there is little or no evidence of demand? The mini-MARC or subset idea would at least permit minimal access to the total bibliographic record and later, appropriate data management systems could tell us which records are vital and worthy of update to full MARC. Massive conversion to the full format, however, does not appear to be economically justifiable.

The Bibliographic Balance of Payments—A Failure in Pricing

We have failed to develop satisfactory price algorithms. In the case of OCLC, the price algorithm stimulated a proliferation of similar entries into the data base by those shortsighted persons who wished to evade a first time use charge. In the case of BALLOTS, there was a bewildering mixture of charges for telecommunications, connect time and batch outputs. In the end we seemed so caught up in the novel aspects of the computer that we didn't wish to recognize the simple fact that resources are finite, that computer transactions—like people transactions—cost

money. Some balked at the notion of paying for a service. The idea that one ever pays for anything related to an information service seems an anathema to a good many librarians and is guaranteed to elicit an emotional response. We pay for books but want our cataloging and access for free. In this connection we will face continuing challenges from the commercial sector which is working very hard to deliver information and data, while libraries and library networks are still delivering citations.

We have indulged in a good deal of talk about shared cataloging and enjoyed some limited implementation—but no network has yet succeeded in establishing an equitable arrangement for a supplier/benefactor relationship which parallels the emerging charge system for interlibrary loans. Just as the largest research libraries can no longer continue to subsidize interlibrary loan for the have-not libraries, neither can they continue to input expensive original cataloging into a data base only to have other libraries obtain a free ride on it. Somehow the balance of bibliographic payments has to be realized, and I see this as a major future challenge for all networks.

Scheduling Problems: Slippage

As with many computer projects in other fields, we have demonstrated a total inability to get anything done on schedule. This failure is partly attributable to traditional underestimation of task difficulty and partly attributable to poor management. In the latter area, our inexperience in system design has kept us from understanding the reality that by a given date every system must be closed to all further design change. That means, of course, that the analysis upon which the new design is based must be as complete as possible; something important that has been overlooked until programming is well underway naturally has a harmful effect on the schedule.

Aside from insufficient analysis, overcommitment of resources has been a troublesome contributor to late delivery. Some people believe that it is always possible to take on one more task, to add one more “goodie” to the design. It’s possible, yes, but it’s not possible to do this and also maintain a schedule.

Designing and programming are activities quite different from digging ditches or hauling freight, where more can get done by adding more diggers or trucks. That this can be done with intellectual work is a terrible misconception! Some have learned the hard way that adding staff does not accelerate schedules. In fact, it has exactly the opposite effect, because it introduces additional managerial and internal communication complexities. Frederick Brooks, Jr., author of *The Mythical Man-Month*, has expressed this phenomenon succinctly and accurately: adding staff to a late software project makes it later.²

Scheduling Problems: Sequencing

Although we recognized that the name authority problem had to be solved in order to manage massive bibliographic files, we worked first on a format for the dissemination of bibliographic data. From the hindsight of today's knowledge, this sequence was undoubtedly wrong, and it is interesting to speculate how the MARC format might look today if the authority control problem had been addressed first.

Lack of Perspective

In a period of rapid development it is common to confound a first-generation system with the ultimate. Yet we may have allowed a kind of parental pride to foster emotional loyalties to our creations, loyalties which beclouded perceptions and permitted us to ignore obvious limitations or disadvantages. We have handled these newborn systems as if they were personalities rather than mere tools to exploit. The history of technology demonstrates conclusively that the first system or device in any development is crude and unsophisticated, no matter how wondrous it may appear to its early users. The Wright Flyer is not the Boeing 747. Today's hand-held minicomputers rival or surpass the power of the first electronic computers which took up a whole roomful of space and consumed tons of air conditioning. Today \$400 can buy a palm-sized television set that weighs twenty-six ounces. Perhaps librarianship may be forgiven for its initial, overenthusiastic response to its first automated tools. After all, except for typewriters and telephones, there hasn't been much mechanical aid in librarianship. And we have only enjoyed comparatively inexpensive photocopying within the past twenty years. Perhaps it is too much to expect a parent to cast a cold eye on his or her offspring. But isn't it time now to take a dispassionate and objective look at our systems?

Looking Backward Instead of Forward

We continue to build great computerized bibliographic empires based on the tottering foundations of aging control systems and antiquated concepts. Our systems are conceived and organized conservatively—they have to be, because their purpose is to maintain the established order. Our designs are largely retrospective, based as they are on the ideas of continuity and integrity of the bibliographic control apparatus. These noble concepts are admirable, but I wonder if they have become sacred cows! Where are the users and the patrons in all of this? Users are interested in obtaining library materials; they show little interest in the niceties of elegant bibliographic superstructures.

The computer is a totally new and revolutionary tool for biblio-

graphic control and access. It threatens an established bureaucracy. We have tried to graft it to existing library procedures and methods. The card catalog is an example. What has driven us to consider closing our card catalogs is not the computer's potential, but ever-increasing labor costs. Most of our systems, however, have been geared to using the computer as a giant, fast card-printer. In his *Annual Review of Information Science and Technology* article on on-line systems, Davis McCarn says: "We still remain disconcertingly far from closing the card catalog. . . . Even more disconcerting is the lack of thought on how to take advantage of the new computer technology."³ He goes on to complain that we have not used imagination in applying the computer to subject access, agreeing with Bates that the profession has taken as a given the structure of the card catalog with its impoverished approach to topical retrieval.⁴ Commander Edward Whitehead, the distinguished British marketing representative of Schweppes Ltd., has formulated a dictum which might be observed as profitably in the library profession as in the beverage business: "Excessive virtue is as difficult to sustain as none at all. . . . Perfection tries the patience of one's family and friends"⁵—and I might add: of one's professional colleagues. I have maintained elsewhere that perfectionism is a sickness of librarianship. It is as if the penalty for spoiling a bibliographic record were to be shot at sunrise. Our continuing preoccupation—one is almost inclined to say mania—with the cosmetic aspects of card production may be further proof of the myopia of perfectionism. It seems ironic that this preoccupation continues in the face of certain closure of card catalogs within a decade or so. Is this another demonstration of the profession's confusion of appearance and substance, a failure to distinguish between the medium and the message? We seem to forget that the public prefers library materials to good-looking catalog cards. I hope the demise of the card catalog will redirect the attention of the profession toward the real information needs of our clientele.

We might profitably ask another basic question about our approach to bibliographic access. Have we failed to distinguish a document from its surrogate, library materials from their bibliographic records? Early in the application of mechanical accounting machines to librarianship, we bewailed the fact that these machines could print only uppercase letters. Once we had acquired advanced machines to print upper- and lowercase letters, we bemoaned the fact that we could not represent diacritical marks and special characters. Now that we have that capability, we complain that they are not displayed in the correct position on the CRT. Yet no investigation has ever been undertaken to determine the essentiality of such luxuries to the purpose for which the catalog exists, nor has

anyone analyzed the incremental cost of providing these extra features and whether we could afford these increments or not. It is an incontrovertible fact that the library market is too small and insignificant to stimulate major equipment manufacturers on their own to produce the highly complex graphic character representations we would *like* to have but for which proof of need has never been given. Only when the industry at large perceives a condition of readiness in the market beyond librarianship is the point reached at which an aggressive response is forthcoming, one from which the library profession can benefit. Instead of being grateful for a new but limited capability, however, our attitude has often been that "if we can't have everything, then we don't want anything." This attitude may be linked to the tradition of perfectionism in librarianship and to cosmetic rather than substantive aspects of performance. For a service-oriented organization it is an attitude that is neither healthy nor realistic, and I hope it will soon change.

Concept of Development Imperfectly Understood

Development is a comparatively new concept in the library profession. There wasn't much of it prior to the computer and what there was occurred at such a slow pace that it was imperceptible to most librarians. Unlike Spinozistic ethics or biological growth, development is not a deterministic process, yet some people expected library automation systems to hatch fully formed, the way a butterfly emerges from a chrysalis. Few will disagree today that library automation simply *has* to be one of the most complex and challenging professional assignments of the century. We also know that highly complex processes develop comparatively slowly, at about the same pace as human growth. We librarians sometimes take for granted the depth, complexity, magnitude and sophistication of what we do in libraries. From time to time we ought to remind ourselves that we deal with every script, every language, every period of history, every intellectual discipline, every country, every region, innumerable forms of material, and a time span exceeding half a millennium for printed materials (and well beyond that for manuscripts)—an incredible array of human communication media covering an almost unlimited time span. The integration of this into computer procedures invokes a technology that cannot be implemented in a fortnight. If my contention that computerized bibliographic systems mature at the same pace as human beings is accepted, then our on-line production systems are operating at about the level of an eight-year-old child. As we do not expect eight-year-olds to behave as if they were mature adults, we should likewise cultivate patience and enjoy one of the great pleasures of parenthood—watching a being grow and develop. At the same time, we had better behave like responsible parents

and not believe that our child can do no wrong. A 1967 report on computers in higher education begins by stating: "After growing wildly for years, the field of computing now appears to be approaching its infancy."⁶ Library computing is now well past infancy and is approaching a sturdy adolescence. But let's not delude ourselves into thinking it has reached maturity. We have a long way to go.

Has Our Conceptual Scale Been Too Grandiose?

Almost eighty-five years ago, there was founded in Brussels the International Institute of Bibliography, an organization dedicated to the idea of universal bibliographic control through the then comparatively novel card catalog. By 1911, sixteen years after the institute was founded, its master catalog contained 8 million cards, copies of which could be ordered for 10 *centimes* each. The mission of the institute was no less ambitious than worldwide bibliographic control. Fortunately for this country, the Library of Congress's card printing program was much less ambitious, and perhaps thereby more practical and durable. The Brussels institute may be an early example of technology's reach exceeding its grasp. Had the world remained steady-state, there might have been hope. But as this favorable condition never exists, we always ought to recognize that systems, like people have definite lifetimes; new problems arise to which the old systems can no longer be responsive. Only a new system can help in such cases. Eventually, that new system becomes unresponsive, dies and is replaced. Bibliographic systems are merely mortal. If the International Institute of Bibliography could not succeed in controlling the pre-World War I literature, and if the Library of Congress recognized the limitations of its own control system, why do we continue so audaciously to believe that we with our computers now have the power to control the millions of new titles with their tens and hundreds of millions of access points, all emanating from hundreds of countries and thousands of jurisdictions? Are we demonstrating some colossal gall, some unjustifiable *chutzpah*? Do we really know enough to take on the universe? Assuming we do know enough, what makes us so sure that society will finance such massive systems? The time may have come for us to consider scaling down our goals to more realistic enterprises. Like NASA, should we reach for the moon and some of the planets instead of the stars?

In an address prepared for last year's conference of the American Association for the Advancement of Science, Dr. Lewis Thomas, author of *The Lives of a Cell*, said:

These are not the best times for the human mind. All sorts of things seem to be turning out wrong, and the century seems to be

slipping through our fingers here at the end, with almost all promises unfilled. . . . Just think, two centuries ago we could explain everything about everything, out of pure reason, and now most of that elaborate and harmonious structure has come apart before our eyes. We are *dumb*.⁷

One way of getting smarter is perhaps to scale down our goals and expectations to a more realistic level. In this connection I may cite the extraordinarily difficult design challenge faced by Japanese software designers in attempting to build a completely automated hot standby dual processor for a nationwide bank control system. The designers hoped to develop a system in which one processor would take over instantaneously when the other went down. The design chief reports: "As the system design work progressed, however, we found that software development was a lot more difficult and complex than anticipated. Therefore we lowered our objectives to a more realistic level."⁸

One of the things to think about is the comparative isolation of bibliographic systems from society at large. Until recently I think it fair to say that, bibliographically speaking, many of the librarians and faculty in academe really resided in a walled medieval city, living out a manorial economy of self-sufficiency in collection development and technical processing. Meanwhile, a money and mercantile economy was growing because of improved roads and vehicles. In modern terms, the walled cities begin to lose their walls when a communication network develops to the point where commerce and exchange becomes a more vital social force than self-sufficiency. That is where I believe we are today in our biblioconomy. The walls are tumbling down. Our technology is reaching the point where the vision of the nation's libraries as a single, national bibliographic resource can be realized, but only if we can sell the idea to the funders. This is the vision which the National Commission on Libraries and Information Science is trying to promote. It is a vision many of us may see turned into reality in our lifetimes, a reality built upon both our failures and our achievements.

Janet Flanner, the well-known writer for *The New Yorker*, at the age of eighty-six recently stated: "Nothing is improved by chance. Nothing grows better by error. Everything always grows better because someone says: 'I can't stand this any longer!'"⁹ A counterpart of such a statement in library systems development might be: "This no longer works," or "We can't afford this solution any longer." The massive union catalog projects of the 1920s and 1930s are an example. These were, after all, not new technological solutions but merely the continuation of the concept begun three-quarters of a century ago by the International Institute of Bibli-

ography. We gave up those concepts because they had become dysfunctional. We ought to ask of our current enthusiasms: "What elements of dysfunction are embryonic within them?" In my opinion a major component of the response is *overcomplexity*, fueled by funds, ambitions, distorted perspectives, and perhaps even misplacement of priorities. Yet a mistake is not a tragedy. We should not berate the past for our mistakes, but rather build constructively upon them. After all, we do not fault the baby who stumbles while learning to walk. The mistakes of the past must be used for construction and reconstruction, and not for pinning the blame on any one person or institution.

Will we face again the mistakes of the past—lack of humility and an overbearing sense of self-importance? We talk as if automated bibliography were one of the most important things in the world. Yet the world goes on without it, thriving. Most citizens have no concept of bibliographic control and access systems and probably wouldn't care about them even if someone were to take the time and trouble to explain them. Yet we specialists want public funds to pay for the development and operation of large systems we claim will benefit all people. Thus, the challenge of the future remains where it has always been—not in technology per se, but in our human adaptation to it. When resources are limited, we have to sell librarianship and bibliography to the funding agencies. We have to convince them that our services are essential elements of public policy. Libraries can no longer survive just because dedicated professionals and some high-spirited citizens believe they are intrinsically "good." There are many other "good" things in the world competing for resources. Our future responses to social and technological challenge must not resemble what I have described in this paper.

A scenario I would like to see in librarianship should resemble that described by Yuzuru Abe, the designer responsible for the Japanese on-line banking system mentioned earlier: "This February, our new on-line system centered around three super-scale computers went into operation. . . . It took three years and 3200 man months [267 man years] to develop the . . . system. Currently, our terminal system consists of 700 minicomputers and 4000 terminals, all up and running. At the time of this writing, we were in our 150th day of continuous service without downtime."¹⁰ This level of operation represents an exceedingly high standard worthy of emulation.

I would prefer to title some future review "What Have We Wrought?" in the hope that some day, we'll be wise enough to have exercised adequate professional leadership—which will not only assure our survival but also guarantee that we survive as the masters of technology, not as its slaves.

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