Serials & Information Technology
CD-ROM And Beyond

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Introduction

This paper is to some extent a follow-up to the recent article by Derek Law and myself in the *Library Association Record*[1]. This has aroused a great deal of excitement, and no fewer than three follow-up articles[2,3,4]. Among other things, I hope that it will go some way to contradict the suggestion that Derek and I are in some way anti-CD. To set the record straight, the BMA Library has two sets of the CSA Medline discs; our CD-ROM workstations are used every day, mostly by members but also by staff putting together "quick-and-dirty" literature searches; we are about to buy a third disc drive to replace an antedeluvian and out-of-maintenance Philips unit; if we had no CD-ROM Medline subscription, we would place one tomorrow.

What we were trying to convey was our feeling that the profession had gone a little over the top in its enthusiastic reception of this new technology, and that in the process was paying too little attention to both the substantial technological limitations of CD-ROM, and the technological and commercial alternatives for achieving some of the benefits currently regarded as exclusive to CD products.

The argument underlying this paper is *technological.* No criticism is intended of anyone's attempts to enhance CD-ROM systems, of anyone's purchasing decisions or of anyone's talent for producing profitable products. The paper should also be taken as applying only to what might be called the portable bibliographic database applications, which form the backbone of CD-ROM usage in libraries.

The Argument

Our *LAR* article lost its subtitle in the sub-editing process. To the questions "Is CD-ROM a transient technology? *And does it matter*?" We provided the answers *Yes* and *No* respectively.

With most advances in computing, there is an initial phase of great excitement for system developers. The new capabilities and opportunities seem limitless, and one's imagination is challenged to come up with ideas which will harness them effectively. Only after a considerable period of time will advances in related areas turn what seemed like unlimited scope into constraints that can only be overcome by further bursts of ingenuity. To give an example: in recent years, PC applications have been increasingly hamstrung by the 640k workspace limit inherent in the MS-DOS operating system. Microsoft, the company that put the M in MS-DOS, have been castigated in the computer press for imposing such a low limit. However, it was only after six or seven years' revolutionary change in microcomputer applications that this limit became a serious problem.

With the perspective of someone who was involved, at the British Library, in the earliest days of CD-ROM system development, I can say for sure that there was no such period of technological grace. The serious limitations of the technology, when matched against the application requirement, were there to be overcome from the very first. These limitations fall into three general categories:

- **Small capacity**: This seems an odd criticism to make of a medium which offers 550Mb disc drives, but this capacity still dictates multiple disc solutions for most of the major databases we need to use. In most applications this in turn requires swopping discs in and out of drives, which is at least an inconvenience. For development into multimedia applications, it imposes restrictions that even the most sophisticated data compression/decompression routines cannot entirely alleviate.
- **Slow drives**: CD-ROM drives offer very slow access times - in the 350- 1,500 millisecond (ms) range, with a typical modern drive giving 600ms. In contrast PC hard discs offer response times of 18-40ms, and solid- state memory chips 60-120 nanoseconds. (1,000,000ns = 1ms). This is important not, as has been suggested[5], because the busy librarian's day makes a half-second wait intolerable, but because of the contraints such a response time will impose on system and network design.
- **MS-DOS limitations**: Commercially viable CD-ROM products are, with the exception of a few Apple Mac implementations, limited to the MS-DOS, IBM PC/AT computing

environment. Despite increasingly innovatory and creative programming, the characteristics of MS-DOS place a limit on system functionality. Computer pundits tread a hazardous path between derision and guru-status, but I would find it very surprising indeed if database systems designed to run on lowest common denominator ATs could be stretched to include either serious knowledge-based systems or retrieval engines substantially more powerful than the online and CD systems with which we are now familiar.

Running CD-ROM systems under MS-DOS throws up countless set-up and incompatibility problems. At the British Library, the best technical whizz-kid in my Group spent a good deal of his time sorting out this type of problem and running CSA Medline and the *AIDS Library* on the same PC has certainly caused us headaches at the BMA. I was relieved to read recently that even the most celebrated PC experts have their problems in this area[6].

It must be emphasised here that in saying CD-ROM falls short of the ideal and that technical and marketing factors make it unlikely that many of the problems will be developed away, I am not saying that CD is useless or a blind alley. But in information technology, where limitations are seen to exist in a product it is very likely that new solutions will be developed which will blow them away.

The Speed Of Change

Readers with a dislike of the elegantly turned truism should skip this paragraph. Librarianship is a world of slow change; a world where continuity and consistency are substantial virtues and where the steady accumulation of knowledge and experience help us to lift our readers' services above the routine. Our training and everyday work drum into us the conviction that discontinuity and radical change carry a very high tariff. The world of microcomputers is not like this at all. Change is (almost) always rapid and absolutely for the better. Last year's innovation is this year's commonplace and next year's white elephant. A quote from a March 1991 review of a Compaq laptop computer illustrates this perfectly: "Although we awarded this system Editor's Choice status in our issue of March 13, 1990, and gave it another enthusiastic review in the Otober 8th issue, we believe it is no longer worth your consideration"[7].

A Case Study

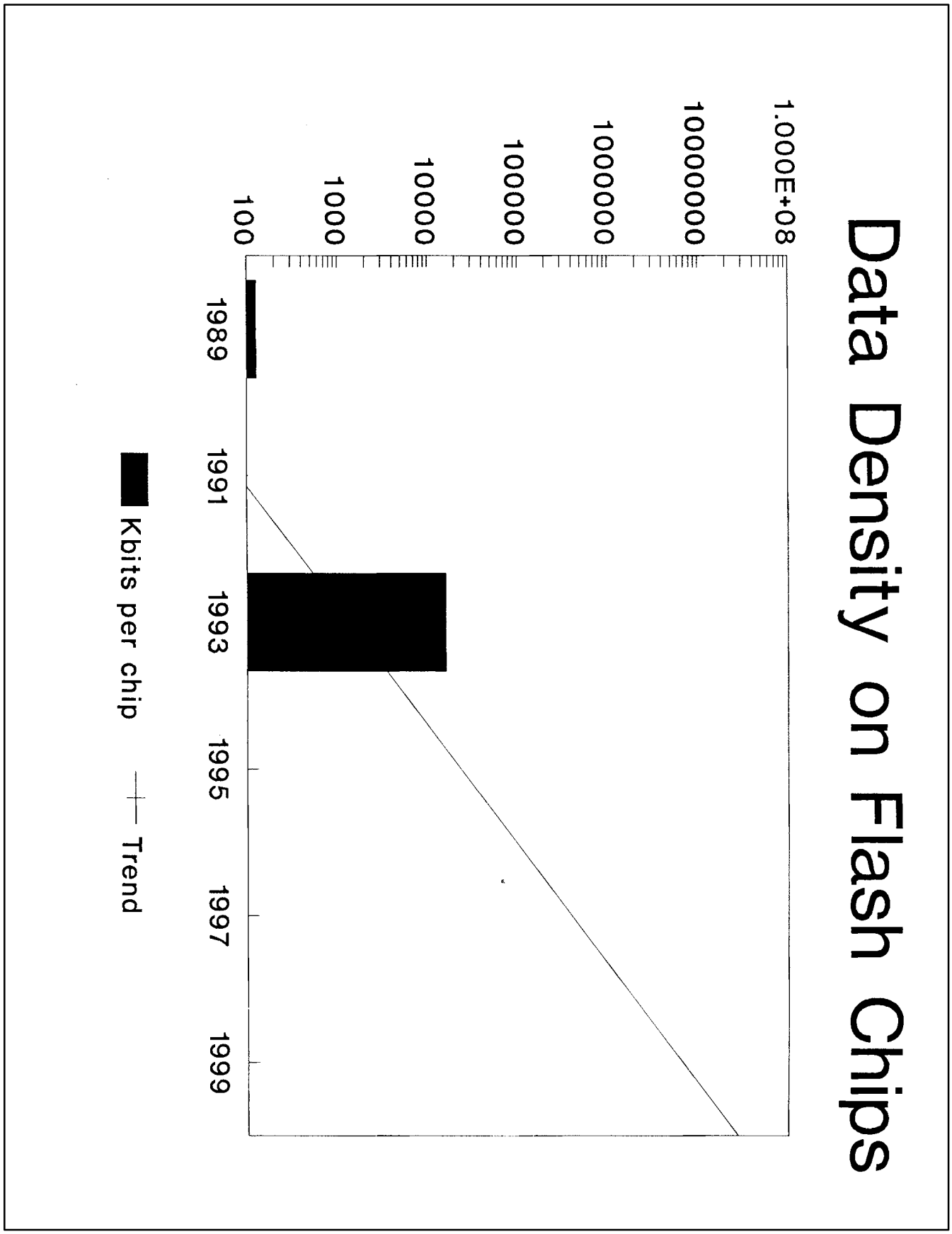
The speed and scale of change is quite beyond our ken, professionally speaking. A contemporary practical example is the development of the so-called "flash" chip. These devices are EEPROMs (Erasable Electronically Programmable Read-Only Memory chips) which are erased electronically, (conventional EEPROMs are erased by exposure to ultra-violet light). The great advantage of electronic erasure is that it can be done in situ - inside the computer - and this is what gives flash chips the potential to replace disc drives in personal computers.

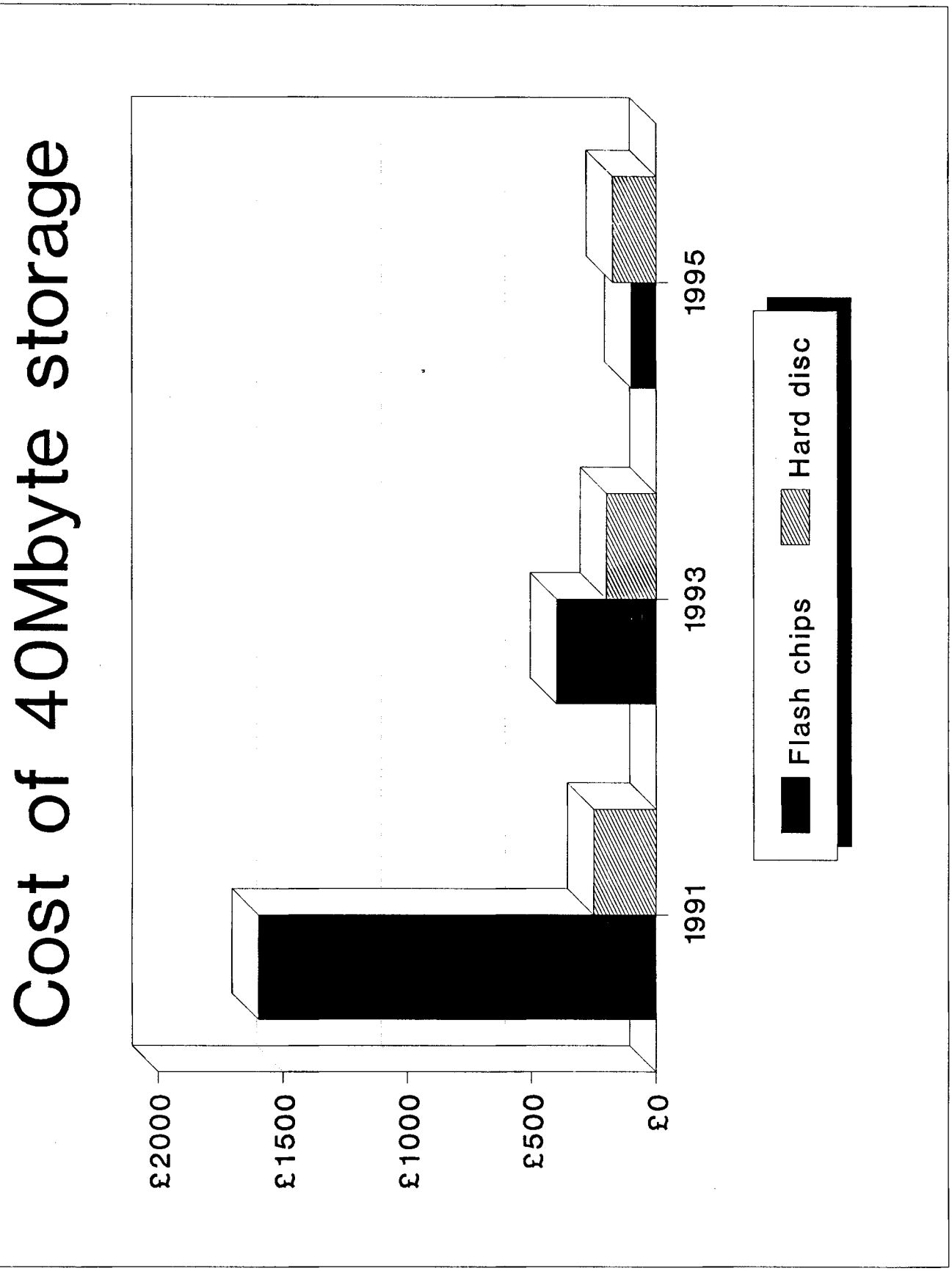
Two recent news articles[8,9] have described the speed with which the improving price and performance of flash chips are bringing them towards our desk-tops. *Figure 1* shows the amount of memory that can be packed onto a single chip - 128k bits in 1989, 16,000k bits today. Data density is important both in squeezing capacity into manageable units and for bringing down costs. Like most computer development graphs, it can only be plotted on a logarithmic scale, but the trend line beyond 1997 should be regarded as highly conjectural. Of more practical interest is the point at which solid-state devices will begin to oust conventional disc drives. *Figure 2* charts the declining cost of 40Mbyte of storage in both media: disc drives staying relatively constant in price, as can be expected of a mature technology, while flash chips tumble from £1,600 to £100 in four years. Goodbye hard and floppy discs.

My purpose in pursuing this case study has not been to suggest that flash chips will replace CD-ROMs (although they very well might in some cases) but to show that in this maelstrom of change, it is likely to be a waste of effort to spend too much energy tweaking up mature technologies. (*Mature*, by the way, is techno-marketing speak for "established but about to become unsaleable".) Bear in mind that flash chips are a mainstream, conservative development. Radical, breakthrough technologies are likely to produce shifts which are orders of magnitude faster.

Emerging Technologies

In ten years time, goodness knows what sort of machinery our readers will using to get hold of the information they need. When I left library school nearly 20 years ago, the standard computer terminal was a chattering teletype, with or without a punched paper tape accessory. Programs lived on 80-column cards and the Computer had memory measurable in hundreds of k and ran almost entirely on a diet magnetic tape. Today's bread and butter computing was, in retrospect, just beginning to appear on the far horizon: "manageable" minicomputers, screen-based terminals, 10Mb magnetic discs, real-time computing, software that was actually useful - all were the basis of speculation, rumour and research papers. The system on which this paper is being written


Data Density on Flash Chips
1.000E+08
10000000
1000000
100000
10000
1000
100
1989
1991
1993
1995
1997
1999
Kbits per chip
Trend


Cost of 40Mbyte storage
£2000
£1500
£1000
£500
£0
1991
1993
1995
Flash chips
Hard disc

(a perfectly ordinary Compaq running Word Perfect) has a just- discernable line of descent back to the 1974 state-of-the-art.

To discern what might conceivably be the commonplace information system of, say, 2001 I have looked at the technologies and trends which are in the same state as the 1974 technologies mentioned above - ie hovering somewhere between techno-fantasy and pre-production demonstration. No doubt everyone has their own list of favourite candidates, but for what it's worth, this is mine:

- **Voice-input systems**: Just beginning to emerge from being an exhibition-stand gimmick and to have a few real applications in primary schools and elsewhere.
- **Pen or stylus systems**: You can already buy pen-input computers with more-or-less effective handwriting recognition algorithms. My guess is that there will be little mainstream take-up of this type of system, but you can never tell.
- **Multimedia**: In recreational software, teaching and research there will certainly be a high degree of integration of conventional data, high- definition video and still graphics, sound and new forms of text document.
- **Networking**: We are still some way away from the all-pervasive mega- network defined by William Gibson[10] but particularly in academic circles there has been an explosive growth in wide- and local-area networking. It will soon be commonplace for a user to be unaware of where and on what style of machine an operation is being processed.
- **Knowledge-based systems**: What used to be called "expert" systems before the experts started to feel threatened. With the sort of processing power likely to be offered by turn-of-the century micros, I confidently expect that systems will be available which can guide readers through the formulation and execution of a search in exactly the same way as an experienced reference librarian or information scientist does at present.
- **Huge, high-resolution displays**: Various alternatives to the conventional CRT display are now appearing, in laptop computers and elsewhere. To accommodate multi-tasking systems and other developments already mentioned, it is likely that we will be using desktop-sized displays within the foreseeable future.
- **Chip technology**: An example of the speed of chip development has already been given, and there are plenty of development avenues down which might come a revolutionary integrated-circuit juggernaut.
- **Data broadcasting**: The BBC already provide data broadcasting services to closed user-groups. The signal is either dribbled out alongside normal service broadcasts or blasted out at unimaginable speed during the night. This is already a technically (and possibly commercially) viable alternative to CD-ROM for the distribution and updating of large databases.
- **Magnetic storage**: 1,000Mb drives for PCs are already available at not much over twice the price of the equivalent capacity in CD-ROM drives[11]. With the growing market for PC network servers, capacities are likely to rise and prices fall, but not by orders of magnitude.

Conclusion

When CD-ROM products first became available they bundled together three new and exciting elements, and in understanding the long-term for CD *per se* it is probably useful to untangle them:

- **CD-ROM technology**: Like any technology, it has its inherent advantages and disadvantages, and these have been covered *ad nauseam* in the literature of librarianship in recent years.
- **Good user interfaces**: After a time, it is easy to take for granted that CD products make effective use of colour, split screens, mice and all the various other tricks of the PC programmer's trade. However, with a bit of effort I can remember how impressed I was when I first saw an early version of the *Books in print* CD-ROM six or seven years ago. These interfaces are impressive, and they do make bibliographic databases easier and more exciting to search - but they have very little to do with CD-ROM. They can be applied to any database system where the workstations can be guaranteed to be at least as powerful as an IBM AT. The user interfaces on the latest proprietary database systems for the Apple Mac and the PC are beginning to make CD-ROM systems look a bit drab.
- **Distributed databases**: CD-ROM technology was the first to provide a good enough price/performance equation to enable the mass distribution of large databases. For the first time, libraries other than those in US mega-universities have been able to provide their customers with unfettered access to the core bibliographic databases - and to do so free at the point of use. This is without doubt a revolutionary change, and will become even more so if and when we are able to provide a seamless link between the beefed-up citation and the information as our users want it. To link the signpost and the destination. However, as with the user interfaces, CD-ROM products

manifest this phenomenon but they do not monopolise it. The initiative between CHEST and the Institute for Scientific Information[12] shows that it is possible for online systems to be made available on an equivalent basis, without the interface but at a lower marginal capital cost per terminal in networked campuses.

It is my contention that the latter elements are the revolutionary change and that CD-ROM is just the vehicle. The pace of change makes guessing the future of information technology a high-risk activity. If put on the spot I would guess that CD-ROM will be fading fast in five years' time, and a curiosity in ten. It will be replaced either by something so new that no-one has yet thought of it, or by a cocktail of the emerging technologies, mentioned above - the cocktail extended (as meat-pie makers like to phrase it) by a leavening of rampant purchaser power.

If you have no CD-ROM product, go out and buy one straightaway. They are very good value and will do wonders for your public relations. Just remember, though, that it's access to the collections that will pack'em in, not playing with the rainbows on the discs.

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