

(C)D DAY FOR MAP LIBRARIES: Coming to terms with optically stored mapping in the map library

Alastair Pearson

Cartography has gone through a number of phases of technological innovation throughout its history, such as the development of colour printing, the application of air photographic techniques in map production and the development of computer assisted cartography. The development of optically stored mapping is just the latest technological innovation that cartographers are now embracing. This article considers the potential impact that this new technology may have on map libraries and map librarians in the light of two years evaluation of existing CD ROM and videodisc packages in the department's map library. An evaluation of available CD ROM and videodisc mapping applications will be part of a forthcoming British Library Research Report (Pearson and Sherren, forthcoming). Those applications under evaluation are listed at the end of this paper.

Optical Disc Publications from the Ordnance Survey

Theoretically, the availability of CD ROMs and videodiscs containing large data sets of map data would be an extremely valuable asset for virtually any map library. In the United Kingdom, the Ordnance Survey is a potential source of such mapping.

The Ordnance Survey's early involvement with videodisc technology was largely in an advisory capacity. Early application experiments with British Telecom led to the Ordnance Survey defining and publishing a set of standards for the capture of printed maps onto videodisc. Their role became one of advising and supplying maps to those who wanted to produce videodisc based products. Videodiscs such as Mapmaster produced by Action Information Management and the BBC Domesday Discs are two examples. British Telecom have subsequently pulled out of using videodisc technology in favour of other media such as CD ROM.

The Ordnance Survey views CD ROM as a cheaper medium where digital data can be stored and where coding structures can be maintained. Potentially, there is a wider market than for videodiscs as CD ROM drives are becoming cheaper and variations, such as CDI will soon be available for home use. The Ordnance Survey's philosophy has been to investigate the use of CD ROM for storing digital maps and to collaborate with publishers and software houses in the development of new products. One key limitation to this approach is that the sales of existing Ordnance Survey products should not be threatened. Moves by Nimbus Records to provide a national set of large scale digital plans on CDs was deemed impractical due to the small potential user base for what would be an expensive product. Its marketing would also have undermined the existing sales of large scale digital maps. There is also a continual fear of wholesale breaches of copyright that even sophisticated software locks would be unable to prevent.

Alistair Pearson is Lecturer in Cartography, Portsmouth Polytechnic.

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One idea would be to charge customers for the disc with an additional charge per digital file as they are used. Plans could only be used if the unlock code for the plan were bought. The Ordnance Survey however, still view this as too high risk. Revising large scale map data stored on CD ROMs is also a problem. New CD ROM discs would have to be cut and supplied which, for the customer, is bound to be an expensive way of maintaining an up to date map collection.

The prospect of CD ROM based large scale plan coverage becoming available in the foreseeable future is therefore remote. Large organisations such as local authorities will continue to buy digital files on magnetic tape, having the option of storing digital data on optical disc (ie WORM Disc) if preferred. Map libraries could adopt the same approach.

The Ordnance Survey has moved away from evaluating the supply of large scale maps (high value/high cost) on CD to small scale maps (low value/low cost) and totally new products that would appeal to a much wider market. In order to do this PC based software to drive CD ROM applications is needed. The Ordnance Survey has never regarded itself as a software developer and has looked to third parties to collaborate on joint ventures. It recently supplied large scale centre line road network data for the OSCAR in-car navigation system based on CD ROM. This is a joint venture between the Ordnance Survey and Bosch and is regarded as an ideal application of CD technology having a large potential market (emergency services and taxis etc.). The Ordnance Survey have recently been working on a prototype CD ROM version of the County Street Atlases, a joint venture between the Ordnance Survey, George Philip and Clarinet Systems. This was primarily developed to illustrate the practicality of such a package, largely replicating the function of the printed atlases but using raster scanned images of the existing maps together with additional digital information (eg stations, police stations, hotels etc) for overlay on the raster image. The specification was very simple with operations such as zooming being simulated by scanning the maps at various scales and resolutions. To use a software zoom of one image is not feasible due to the current speed limitations of PCs. Scanning at 400 dpi is the minimum resolution required if names are to be legible in urban areas and normally

the user would only be viewing 1km² window. A 200 dpi scanned map is used for views of 3 x 2 km areas. The atlas gazetteer forms the basis of the search system enabling the user to find the required section of map. Even with the minimum resolutions used, the slowness of the image drawing on screen is a major drawback of the system. Consequently, functions such as pan and zoom can take in the region of 10 - 20 seconds for each map to be drawn. According to the Ordnance Survey, future publication of the atlases using desktop publishing techniques would avoid the use of scanned images, thus speeding up the draw time. The Ordnance Survey and George Philip are pushing ahead with the project and it will be available sometime in 1992.

Future optical disc based products from the Ordnance Survey will most likely be 'special products' such as the examples described above. Huge sets of structured digital files becoming available to map librarians, arguably the most eagerly anticipated benefit of optical disc technology, is only a distant possibility. Though technically feasible, the Ordnance Survey do not feel that there is a sufficiently large market for such a specialist and expensive product.

Multimedia for interactive individual instruction

As many map libraries are part of educational establishments they may be considered as appropriate locations for multimedia systems for teaching. Interactive video (IV) is seen as the base for most interactive learning packages. Ayre (1990) suggests that:

"Multimedia is increasingly being hyped as something which will lead to a revolution in learning, communication, presentation - even consciousness and the way we think."

He goes on to point out that revolutions are more usually driven by a few fanatics and that:

"revolutions rarely come in cardboard boxes trailing press releases."

Continuing on this same theme, one might also suggest that revolutions tend to come about due to there being fundamental problems that require radical change. Is there a case for changing completely or fundamentally the way information is stored and presented and will it revolutionise your own map library? If we consider some of its more popular applications can we predict the likely impact on the map library and the map librarian?

The NIVC describes Interactive Video (IV) as:

"the fusion of computing and video technology in which a videodisc or tape player acts as a peripheral to a computer, to combine the processing power of computing with the audio visual resources of a television."

De Bloois (1984) more simply defines IV as

"any video system in which the sequence and selection of messages is determined by the user's response to the material."

Potentially, the user of IV training applications can control both the videodisc and the microcomputer in a highly complex way. Typically, users are invited to respond to images and the consequences of their actions are then visually demonstrated. The Ecodisc and Countryside Discs are, perhaps, familiar examples. IV can therefore be seen

as a very versatile medium, often at its most powerful when used in simulation exercises, illustrating visually the results of 'what if?' questions.

A recent survey of the use of Interactive Video (Sprunt, 1990) found that there is increasing enthusiasm for the use of IV in the training sector, one indication being that over 65% of all IV applications were in the training sector in 1988. The advantages of IV have been well utilised in the development of training packages for workforces of major companies such as the Ford Motor Company, B & Q DIY and British Telecom. The use of IV in this way provides high quality teaching courses that can be copied and distributed over a wide geographical area with no travel or subsistence costs with the added benefit that learner retention using IV is estimated to be twice that for other teaching media (Sprunt, 1990).

Indications are that the popularity of IV based training packages in industry will grow as the effectiveness of the training and the cost benefits are realised. However, its popularity within the higher education sector is more limited to vocational training programmes and short courses rather than undergraduate and postgraduate degree courses where the aims and objectives are more educational than for training. There are perhaps three major problems:

- Undergraduate teaching programmes are generally designed for large classes of students. The introduction of single user systems, such as videodisc, in support of core course teaching is unrealistic both in terms of its effectiveness and in its cost benefits. Currently, Computer Assisted Learning (CAL) techniques based on multi-user mainframes are still favoured.
- The courses taught in higher education are often very individual as they reflect the ideas and preferences of the academics responsible. Existing videodisc packages such as Ecodisc and Countryside Disc cannot easily be integrated within the context of current teaching approaches and styles.
- IV is still an unfamiliar medium to the vast majority of academics and designers of educational packages. There are, therefore, relatively few working examples.

A videodisc which can be authored locally and designed for specific instructional and tutorial applications using a specially selected set of data could offer a more suitable use of IV in higher education and, more specifically, map libraries. For example, optical disc based atlases created as resource discs could provide a valuable tool for teaching basic cartographic concepts as well as providing a large geographical database of the local area. However, there is a very strong case for a greater input from the cartographic world in the development of such systems than has been the case so far. The medium itself presents great potential for the storage, manipulation and presentation of data. Map makers, map users, map librarians and teachers of cartography will have to be involved if successful applications are to be developed.

The 'Queenscliff Video Atlas' (Cartwright, 1990) has been developed by a teacher of cartography to provide a resource for the teaching aspects of geography and the development of mapping skills.

Cartwright (1990) suggests that:

"cartography has traditionally embraced new technology in order to produce better maps in more convenient formats"

The main aim of the Queenscliff Project was to produce a master Video Atlas 'proof' of Queenscliff, Australia. As with the Domesday Discs, maps and plans, photographs, film footage and accompanying graphics and text were included on the disc.

A major part of the project was to develop the interactive video mapping applications software suitable for the authoring of teaching applications. The ability, through the software, of being able to address any frame in whatever sequence facilitates the development of interactive teaching units and packages (an area already fully exploited in other areas of multimedia). The user of the package would therefore be able to choose the images he or she wants to view, but more significantly, be able to create interactive teaching units. It is hoped that a more dynamic and flexible teaching package would appeal to students of varying abilities and backgrounds and such concepts as spatial orientation, scale, symbolization, map design and map production would be taught far more effectively (Cartwright 1990).

Lobb and Cartwright (1990) suggest that the

"sheer flexibility of these on-demand, self paced packages (which are able to be structured and developed with multimedia systems) offer an exciting tool to those committed to excellence."

One of the major drawbacks of ventures such as Domesday is that they sacrifice depth for breadth. If the new technology is to be seen as revolutionary then it must provide fresh and innovative solutions. The development of more localised optical disc applications which are more specific in their approach, theme and geographical area may well improve the prospect of their use in map libraries. However, the responsibility for its conception, design, development, implementation and funding rest fully with the department or institution within which the map library exists.

Databases for teaching and learning

Can optical disc technology assist in the day to day running of a map library? Whilst currently available CD-ROM and videodisc applications may be of questionable direct value to map librarians (Sherren, 1990), the potential of the technology should not be ignored. The development of videodisc databases such as the Naga Disc, developed by Cambridge University Department of Social Anthropology, illustrates a potentially valuable application of optical disc technology for map libraries. The Naga videodisc contains approximately 6,000 pictures of artifacts (axes, arrows, ornaments etc) which relate to the Naga tribe. Each picture can be accessed by computer via a database using conventional database queries, in this case using the CDS 2000-V database developed at Cambridge based on an IBM com-

patible PC. This software is ideal for use in any archiving or catalogue application where large quantities of video material, which may include photographs, paintings, sketches, museum objects, films, recorded sounds, texts, manuscripts, maps and printed books, is held on disc. Search time as you might expect is very fast, typically 1-20 secs for searching through 20,000 records. The developers of the software claim that CDS 2000-V is an "economic yet sophisticated and very competent solution to video database control."

The Interactive Learning Centre based in Southampton University recently transferred the Naga database records to Hypercard running on an Apple Macintosh SE. The same Naga videodisc could then be accessed and searched by Hypercard thus illustrating that the creation of a videodisc does not limit the type of database that is linked to it.

Substituting the pictures of artifacts on the Naga disc for maps would seem to be a route worth considering for the map librarian. The same principles that influenced the development of the Naga disc may well apply to a map library collection that contains, for example, valuable antique maps that are currently unavailable for public reference. Capture of these maps on video disc and the creation of a database linked to it would open up a part of the collection that had hitherto been unavailable to the user, without any risk to the original document. The creation of the database alone would greatly enhance the capabilities of the map library as a base for academic research. Publication of the videodisc and its distribution to other map libraries and libraries would increase the availability of the collection still further and perhaps also promote interest in maps as a research source. Simple authoring software would allow the creation of user guides to the collection and also present the opportunity to develop specially designed teaching packages, such as a "Brief History of the British Map Making." There would seem to be infinite possibilities. However, there are problems.

Taking video pictures of highly detailed, colour printed maps and displaying them on comparatively low resolution systems that use a completely different method of reproducing colour has been shown to have a detrimental effect on map use. Research by Gooding and Forrest (1990) shows that map reading ability is affected by this change in media. The format and resolution of computer graphic displays is at present limited, typically to 640 x 480 pixels with a screen area of 260 x 180mm. The net effect of this is to limit each picture of a printed map to a 5" x 4" format. Instead of one picture for each map, or for that matter for each air photograph, several would have to be taken to produce a readable reproduction of the original. Problems experienced using the Domesday Community Disc set of Ordnance Survey maps (Sherren, 1990) would persist, perhaps with greater detrimental effect, if finely engraved maps were used. Gooding and Forrest conclude that:-

"As technology advances, larger, higher resolution displays should reduce problems such as limited coverage per frame, colour fidelity, etc, but it still seems likely that video capture of printed maps will pose difficulties in perceptual response."

Perhaps these potential difficulties in perceptual response are a small price to pay for the benefits that a videodisc of a map collection would provide. The cost of producing videodiscs is certainly not as prohibitive as it once was. For example, one agency offers a mastered videodisc, including the capture of the video images at between £2.00 - £3.00 per image. A small collection of 1,000 vertical air photographs would therefore be available on videodisc for around £3,000. If they were to be used for any type of interpretation, four images would have to be taken of each air photograph due to the low resolution of the video display. Costs consequently go up dramatically.

Despite the limitations of videodisc resolution, there would still seem to be great potential for evaluating the creation of a videodisc database of maps. Portsmouth Polytechnic, Department of Geography is planning to test the technique with sample sets of air photographs and maps from its map library.

CD ROMs are now seen as an alternative for storing large data sets and large collections of pictures. They have developed a niche by offering an alternative economic storage and distribution mechanism. As databases outgrow the capacity of hard discs, CD ROMs are taking over. Each 5" disc can hold up to 550mb of data, the equivalent to one ton of paper or eight trees! (Green, 1990) The BBC are currently putting their Gramophone Library Catalogue of 1.5 million recordings on to CD ROM. This will be available to the public on 3 CDs and distributed to BBC centres nationwide.

CD ROM storage is eminently suited to bibliographic databases. The bookseller's catalogue, Whitaker's Bookbank was an early publication on CD ROM. Jane's Information Group is putting its defence and aerospace yearbooks on 14 CD ROMs. Many libraries are acquiring CD ROM products such as COMPENDEX (engineering index), ABI/INFORM (business database) and GEOREF (bibliography and index of geology).

Perhaps map librarians should evaluate the feasibility of transferring index card information to optical disc. Whereas the cost of producing a CD ROM would be prohibitive, except perhaps for the major map collections, the storage of data on a WORM optical disc drive is a realistic possibility. The durability of the discs and the security of the data make the distribution of optical discs to other systems within the same institution and to outside organisations a realistic possibility thus promoting the use of the collection.

The capacity for CD ROMs to accommodate pictures in digital form may also be of benefit to the map librarian. CD ROMs can store large numbers of pictures. Image Folio produced by NEC Home Electronics in the United States contains over 4,000 pictures that can be displayed on any PC with VGA graphics. Pictures are selected by keyword and can be printed using a laser printer or copied on to hard disc as a TIFF file for use in a desk top publishing system. The 4,016 images on the CD ROM only occupy 183mb of memory. Could, therefore, CD ROM offer an alternative medium to videodisc for storing images of maps? Again, this will depend on what is taken to be the acceptable

resolution for their display. Most picture databases available on CD ROM are frame grabbed by camera limiting the resolution to the display screen (640 x 480 pixels). Scanning maps or air photographs provides a very high resolution alternative for inputting on to CD ROM. There is, however, a catch, if we were to scan a 9" x 9" colour air photograph at 300dpi each air photograph would occupy approximately 21.8mb. Each CD ROM would only be able to store only around 25 air photographs. A black and white air photograph would occupy approximately 7.3mb at 300dpi. Uren and Young (1990) state that a typical A4 (?) air photograph would require more than 100k in a TIFF format and 500k in DXF. They do not state the resolution of the scanned image file. The developments of new formats such as CD-ROM XA which interleaves audio, video, text and still images indicates that new data compression techniques are beginning to give CD ROM a true multimedia status. The Joint Photographic Expert Group (1990) developed a compression algorithm with a 30:1 compression ratio. This algorithm is currently being used on the NeXT multimedia workstation. Therefore our 21.8mb air photograph image could conceivably be compressed to 720k (one floppy disc). The nature of air photographs may prevent such dramatic data compressions from being quite so successful. Nevertheless, experience shows us that frontiers in the computing world are being pushed back at an ever increasing rate. It may be only a question of time before this becomes a practical solution.

Conclusions

Considering the efficiency of optical discs for storing huge sets of data in a compact, durable and secure form it must be only a matter of time before we regard the storage of map data on optical disc as the norm rather than the exception. It is worth stressing that the main benefits will be in the provision of map data, not maps. Currently, the single entity in the map collection is the map. In future, the single entity will be the individual map feature. The range of possible use of digital map data as opposed to static printed maps will be far more difficult to support than the digital map data sets themselves. Use of small scale CD based data for use in a variety of mapping packages is likely to be the most immediate benefit of optical disc technology. Therefore, one of the most important questions that map librarians should address is how should this data be made available to the user. The 'Digital Chart of the World' on 23 CDs is a joint venture between the United States Department of Defence and ESRI. Based mainly on TPC charts, the digital data will be supplied with a 'cut down' version of ARCPLOT, one of the modules of the ARC/INFO GIS package. Should the whole ARC/INFO software be made available for an enquirer to handle the digital data?

The future of optical disc technology seems assured. However, map librarians who are tempted by the hype surrounding the industry should assess very carefully the whole spectrum of optical disc technology in the context of their own applications before making any moves. Standards have yet to be finalised and the full potential of the medium has not been realised. There is a strong case, therefore, for adopting a 'wait and see' approach.

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GLOSSARY

This glossary has been taken from 'A Beginner's Guide to Multimedia' by Ayre (1990) and the NIVC's 'Interactive Video Yearbook 1990'.

CDI (Compact Disc-Interactive)

Digitally based. Combines still and moving pictures, computer text, graphics and animation with computer programmes. Over 100 titles under production initially aimed at home consumer. Many are purely for entertainment, but education and training titles are planned.

CD-ROM (Compact Disc-Read Only Memory)

Format for digitally encoded data. 600Mbyte of data, or 25,000 'pages' of text. Several hundred titles now available - bibliographic databases, encyclopaedias etc.

Interactive Video (IV)

The fusion of video and computing and video technology in which a video disc or tape player acts as a peripheral to a computer, to combine the processing power of computing with the audio-visual resources of a television. In interactive video, a computer controls a video player, and the person in front of the screen controls them both.

Laserdisc

Term used to describe 12" reflective optical discs.

Laser Vision

Used by Philips to describe their reflective optical disc system that supports analogue video and stereo analogue sound. Other manufacturers are licensed eg. Sony & Pioneer to produce LaserVision. Training applications and public information services.

Optical disc

A storage medium in which information is written by a high powered laser beam in a disc mastering facility, and read by a low powered laser beam in the disc player.

WORM (Write Once, Read Many)

An optical disc on which the user can write and read, but cannot erase recorded data and record new information in its place. Particularly useful for archiving digital data.

CD-ROM APPLICATIONS UNDER EVALUATION

MundoCart/CD Version 2 (Chadwyck-Healey/Clarinet Systems/Petroconsultants)

A world digital map database. Can be used to create maps on different projections at scales ranging from 1:150 million to 1:250,000 at various levels of detail. Data can be added to the maps using dBase III, AutoCAD DXF or ASCII files. Data from Mundocart can be transferred to other software packages such as ARC/INFO, Intergraph Microstation and SPANS.

Supermap 1981 Census: Small Area Statistics for England, Wales and Scotland. (Chadwyck-Healey - Space-Time Research)

Data from the 1981 Census with population estimates from 1987 together with ward level boundary maps for England and Wales and postcode sector maps in Scotland. Choropleth maps can be produced and data imported from other sources.

Supermap U.S. Census Data (Chadwyck-Healey/Space-Time Research)

Complete data from 1980 Decennial Census of Population and Housing. Enumeration and block group mapping for the whole of the country. Tables and time series from 1965 to 1980 mappable to county level are also included.

OTHER AVAILABLE CD-ROM APPLICATIONS

CD-Atlas de France (Chadwyck-Healey France/Argo Infographic/GIP Reclus)

Over 500mb of statistical and political data from 1982 census of France and from electoral results plus information on local facilities such as supermarkets and post offices in towns and cities. Boundary map data is provided at town, canton, arrondissement, region and department levels.

Belgium CD-ROM (Clarinet Systems/Philips)

Street level maps of every town and village throughout the country. Includes route finding facility and a series of overlays to locate and describe, with superimposed text, points of interest - hotels, restaurants, police stations and tourist attractions.

LASERVISION APPLICATIONS UNDER EVALUATION

BBC Domesday Community Disc

Contains images from several scales of mainly Ordnance Survey mapping in association with both ground and air photographs, satellite imagery and textual information. Maps and data relate to the U.K. only. Locations may be selected visually from the map images or by searching the on-board O.S. 1:50,000 gazetteer.

BBC Domesday National Disc

9,700 statistical data sets, over 30,000 photographs, 2,000 articles, 500 selected maps and 60 minutes of film clips, all of which relate to British life in the 1980's. Data from sources including the ESRC Data Archive and the OPCS may be displayed in tabular or chart form, or mapped at up to 1km resolution for 33 different regions such as counties and TV regions.

BBC Ecodisc

An interactive disc that allows the user to assume the role of reserve manager at Slapton Ley Nature Reserve, South Devon. Side one provides surrogate walks around the reserve, opportunities to sample the vegetation and wildlife and the ability to submit a management plan for the site. Side 2 contains the BBC TV programmes "Ecology and Conservation".

BBC Countryside Disc

A farm management simulation with video sequences and sound. Having studied the issues via surrogate walks, film, photographs, text and data, the user can develop and submit a plan for the 300 hectare farm. Side 2 includes two case studies - arable farming in Lincolnshire and upland sheep farming in the Lake District - together with a large database that is similar in nature to that found on the Domesday National Disc.

BBC Volcanoes Disc

A combination of film, commentary, photographs, maps and animated diagrams explain the topic of volcanoes and vulcanicity. Textual content includes the complete work "Volcanoes" by Dr. Peter Francis and 1,500

words related to vulcanicity with their Oxford English Dictionary definitions. Six major case studies come from Hawaii, Iceland, U.S.A., Colombia, Sicily and the Jovian moon, Io.

Mapmaster from Action Information Management

U.K. mapping from a variety of sources which may be viewed at several different scales, rather like the Domesday Community Disc. The user may generate up to 16 different symbols in 3 sizes and colours which can be overlaid on the base maps. Selection of any generated symbol on the map will reveal a 'record card' that may contain data for that particular location.

EXHIBITION OF HISTORIC MAPS TO COMMEMORATE THE 500th ANNIVERSARY OF COLUMBUS' VOYAGE

Maps and the Columbian Encounter, an exhibition of rare maps from the 14th through 17th century is now on a national tour of the States as part of the public program marking the 500th anniversary in 1992 of Christopher Columbus' first voyage to America. The exhibition uses 43 maps and other contemporary illustrations, shown in facsimile, to tell the story of the Old World's encounter with the New World.

In the exhibition the maps are read as a text on the clash of cultures, ideologies, imperial ambitions, and geographic concepts that followed in the wake of Columbus. Native American and European maps are used to reconstruct the world views of these societies both before and after 1492. The American lands - previously unknown to the Europeans - were rapidly incorporated into their world map. Rather than being innocent documents of discovery, maps were instruments of European power. The American Indian presence was often erased from the landscape as the new territories were claimed, named, and recreated in the paper images of Europe. This historic transformation has far reaching consequences for the contemporary world view, the birth of which is vividly portrayed in the exhibition.

Touring in a specially manufactured facsimile exhibition which combines 43 maps and over 150 additional illustrations *Maps and the Columbian Encounter* opens a unique window on the events which brought America into being.

For further information on the national tour contact the Office for Map History, University of Wisconsin-Milwaukee, PO Box 399, Milwaukee, WI53201.

From an Office for Map History press release
