European Research Libraries Cooperation

ERLC

The LIBER Quarterly

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Hans-Albrecht Koch and Heiner Schnelling
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ERLC, the Quarterly of the *Ligue des Bibliothèques Européennes de Recherche (LIBER)*, covers all aspects of research librarianship: preservation, bibliographic control, document supply, library management, data processing, library architecture, etc. Special attention is given to library cooperation in Europe and to the comparative approach to librarianship.

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Dr. H. Schnelling, Universitätsbibliothek Gießen, D-35386 Gießen, Germany

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Preface

A report about the conference titled *Mapcuratorship in Transition* has been published in Volume 4, 1994, number 4 of this journal.

As some of the authors refer to the reader which was distributed prior to the conference it is reproduced here in full:

Competencies for electronic information services / John Corbin
In: The Public-access Computer Systems Review 4, no. 6 (1993) p. 5-22 [10 p.]
What is a map? / I. Vasiliev ... [et al.]
In: The Cartographic Journal, journal of the British Cartographic Society, Vol. 27, December 1990, p. 119-123
Cartography, GIS and maps in perspective / M. Visvalingam
In: The Cartographic Journal, journal of the British Cartographic Society, Vol. 26, June 1989, p. 26-32
Accessing the world of digital spatial data / by Mary L. Larsgaard
In: Information Bulletin Western Association of Map Libraries, Vol. 23, no. 3, June 1992, p. 188-207
Includes 14 p. dictionary of technical terms.
Glossary [of terms and definitions for spatial digital data]
Appendix to: Content standards for digital geospatial metadata (June 8) / Federal Geographic Data Committee, 1994
The standards are available from anonymous FTP server *fgdc.er.usgs.gov* in directory *gdc\metadata* or can be requested by electronic mail on *gdc@usgs.gov*.
Exploring the impact of digital cartographic data on map librarianship using data use models / by Ming-Kan Wong.
In: Bulletin 173, September 1993, SLA Geography and Map Division, p. 2-14
Configuration of computers in map libraries / by Robert S. Allen.
In: Bulletin 173, September 1993, SLA Geography and Map Division, p. 15-23
"Automation and map librarianship: three issues" / by Christene Kollen & Charlene Baldwin.
In: Bulletin 173, September 1993, SLA Geography and Map Division, p. 24-36
Report on THE MAP LIBRARY IN TRANSITION : a joint conference sponsored by the Congress of Cartographic Specialists Associations and the Geography and Map Division of the Library of Congress, October 18 & 19, 1993, 10 p.
From: MAPS-L (Maps and Air Photo Systems forum, an American discussion list on Internet)
The state of map libraries and archives / [statement by the CCISA]. 2 p.
From: MAPS-L (Maps and Air Photo Systems forum, an American discussion list on Internet)

Exploring the Internet / Tony Addyma.
In: Serials : the journal of the United Kingdom Serials Group, Vol. 7, No. 2, July 1994, p. 133-141
What a tangled web they wove ... / Kurt Kleiner
In: New Scientist, 30 July 1994, p. 35-39

Thanks are due to Andrew Tatham and Marco van Egmond for their aid in editing these articles.

I hope that these articles make the research library community aware of the far-reaching changes with which traditional map collections are faced. Above all, however, I hope that library managements find ways to cope with these changes, either in their own library or in cooperation with other libraries.

Jan Smits

Secretary Groupe des Cartothecaires de LIBER

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Maps and Spatial Information: Changes in the Map Library

PAT MCGLAMERY
University of Connecticut, U.S.A.

I'd like to thank you for inviting me to speak to you this morning. Opening a meeting of this type is a daunting task; one that I take very seriously. An opening talk should stimulate and excite. It should introduce and invite. It should also be provocative and challenge comfortable ideas. I hope to present you with all these, but I will also remember that we are librarians, and presumably we did not become librarians in order to be either stimulating, exciting, provocative or even, perhaps, inviting.

Like many of you, I'm a fairly solitary worker, and as I began preparing for this talk, I wondered what kind of message I could give you that might have some value as we go through this week's exciting schedule. I've decided to talk from my strength; who I am, a librarian, and what I'm doing, dealing with the changes in information technology. So, forgive me if I give a personal understanding of the situation, and suggest that it can be a model for change. We are map librarians, and like it or not, we are in the forefront of library information technology.

This morning I will briefly ground the changes in our discipline, geographic information, to changes in our shared medium, maps, to the history of printing. I will then posit the notion that our shared mission as librarians is to collect, describe and make accessible geographic or spatial information. That mission is the same for digital spatial information as it is for paper geographic information. Finally I will offer some examples of change.

My area of interest is not the history of cartography. The University of Connecticut's Homer Babbidge Library's collection is not rich in that subject. It is not an area of study at that university. Before I came to the University, however, I worked at the United States Library of Congress Geography and Map Division for five years, and while there had plenty of opportunities to study and discuss the evolution of cartography and to handle exemplars of the cartographer's skill.

I continue to be impressed by geographic information's dependence on the medium, and how print technology has advanced to keep pace with information-gathering technology. Hachuring evolved to contour lines. Vegetative symbology became colour. Difficult and expensive updates on copper plate were performed more quickly with lithographic technology. At the same time, maps have proliferated in libraries as print distribution has increased. Though procuring maps can be difficult, it is possible. Facsimile print technology allows scholars the ability to study good copies of the originals. Opening trade channels have allowed my library to buy current maps of, for example, Poland. Connecticut business men doing business in Poland arrive with a understanding of the geography. This evolution of the expanding map collection has been described as the "greening" of map libraries. Over the past fifty years we have seen map collections grow and mature.

My library, the Map and Geographic Information Center at the University of Connecticut, is an example of the "greening of map libraries in America_. That is Dr. Walter Ristow's label for the growth of map libraries in the United States after the Second World War. It parallels the growth of public higher education in America. My library is a state university library. The University teaches 20,000 students on its campus in the rural community of Storrs. Storrs is about 1½ hours from Boston and 2 hours from New York. The map library is staffed by only one full time professional, ME! I get some help from about 1½ full time equivalent student employees. The map library serves not only the university community, but also the spatial information needs of the people of the state of Connecticut. It can be a busy place. I tell you this so you can see the reality of my library, and not support any fantasies that it is either abundantly funded or staffed.

Right now, while I am here speaking to you, the library is in the hands of the newly trained, "don't-know-much-about-libraries", and "less-about-maps". Poor, poor hands, indeed!

The map library houses more than 150,000 sheets of maps and charts, over 25,000 air photos and 2,000 books and atlases. It is a moderately sized collection for the United States. After World War II, some 250 libraries were offered extensive collections of topographic maps from the U.S. Army Map Service. These collections seeded the idea of large map collections in libraries. The government's Federal Depository Library Program, a programme to distribute government publications free to the citizenry of the United States, continued the growth of the map collections by depositing an average of 5,000 sheets a year in libraries. Lately, the number of CD-ROMs has been growing. These are the lithographs of the future. The CD-ROM in America is democratising spatial information at the end of the 20th century in the same way offset lithography did at the beginning of the century. As the amount and detail of information has grown, the U.S. Geological Survey is developing technologies of distribution. We have reached the point in spatial information evolution where the amount of spatial information available outstrips the ability to represent it cartographically.

These maps of the Tolland County in Connecticut show a small percentage of the spatial information available for the region in cartographic representation.

Difficult and expensive updates on lithography are performed more quickly computer screen redraw rates and plotters and printers. At the same time, digital spatial information has NOT proliferated in libraries because libraries have not been ready for the transfer in technology and the print distribution has decreased because printing multiple copies is costlier than plotting a few copies for elite decision makers. Though procuring print maps can be difficult, it is possible; procuring print files, or image files can be next to impossible.

I have really just skimmed the surface of the impact of print technology on cartographic representation; and data collection technology on innovations in map printing technology and map collections in libraries. It is only important, aside from my scholarly interests, because libraries are the depositories for print information. As librarians it behoves us to keep an eye on the publishing community as much as we do the user community. I see the publishing community limiting map output, and, in the United States, increasing the digital output. I see a user sector hungry for spatial data, both digital and paper, as conventional map, of course; but also as tables, and computer reports.

So, how do we deal with these map *things*? These map *wanna-bes*? These map *gonna-bes*? I maintain that as librarians we do three things.... just three.

We collect information for use by a community, we describe that information in a catalogue and we make that information accessible. That's it. Let me speak from my experience at the Map and Geographic Information Center on these three areas.

At the map library I have written a collection development policy which reflects the research and teaching interests of the faculty, staff and students at the University of Connecticut. The collection development policy helps me prioritise my spending strategy. Obviously, Connecticut is a first priority.

For paper maps I collect maps through my federal and state depository programmes. I get maps of towns and local areas by asking, or by picking them up. I buy maps, such as the maps of Poland at 1:100,000. I store them, index them and circulate them.

For digital material it is not as straight forward. The distribution facilities in my state and country for paper maps have been developed over decades of discussion, legislation, co-operation and coercion. Digital material is only just beginning to find its way into the distribution process. From the federal government is a steady flow of data on CD-ROM and more recently on the Internet. These data follow very clearly defined federal mandates for the democratisation of information. From the states the situation is not as clearly defined. Only recently has the Department of Environmental Protection, the most data-rich state agency, deposited data in the map library. That deposit was a tentative one of 150 megabytes. There are several hundred megabytes waiting to be uploaded on the map library's fileserver.

It really is the FILESERVER which makes storing the data in the map library so attractive. The fact that it is a library doesn't really matter. As interest in spatial data has grown, users have pressed the data producers for access. The data producers' main mission is to produce, not to collect, or catalogue or make accessible. The agency has become a bottle-neck and that is a bad thing for a bureaucracy to be in America. In the United States, the people own the information: it is in the public domain. Free access to information is seen as a fundamental freedom. So the agency shifted the responsibility of distributing the information to the library. It becomes an economic imperative.

In many ways what comes into the library drives collection development, but I have to say that with digital material I have been actively pursuing the state agencies, as I will pursue the local governments as they begin to produce spatial data. Building collections is a key component of library services and without clear guidelines and goals it is up to the librarian to develop them.

What is a fileserver and why is it in the map library? The fileserver looks like a relatively passive computer. It is a big box that sits in an out-of-the-way-corner of the map collection room. In fact, it sits between the horizontal atlas shelving and hydrographic chart cases. But looks are deceiving. It hides 1.2 gigabytes of storage and serves up to ten users at a time. Our server is called MAGIC, for Map and Geographic Information Center. It can be accessed from all over the campus as an interactive reference tool and as a research collection of spatial data of Connecticut. It can be accessed using a software programme, called FTP, from Zürich. It is a virtual map shelf, and the data is arranged on that shelf using a modified Library of Congress schedule G classification scheme. Later in the week I hope to have a chance to welcome you to MAGIC.

The mission of the library is to create sophisticated and standardised catalogues or finding aids. We in the States use USMARC to catalogue. The catalogue record is entered into OCLC and our on-line public access catalogue, HOMER. Cataloguing maps has been a controversial issue for too long. The Map and Geography Roundtable of the American Association spends a lot of time teaching non-map librarians how to catalogue maps. Perhaps UNIMARC will resolve some of these issues. In any event, map librarians are not generally happy with text-based catalogues of maps, but it has been the only game in town.

Data is handled in the same way that maps, or books or journals or sound recordings are at my library. The clear attempt is to normalise this oddball. I am using the USMARC computer files format with Library of Congress schedule G scheme for classification.

I suspect that over time GIS and other spatial data handling techniques will allow us to run parallel catalogues that provide for graphical spatial queries. I expect that in time we will be working with spatial metadata, an emerging technique for describing large numeric databases which, when sorted, annotated and printed, become maps, images or reports. I also anticipate a time when librarians will be providing the spatial metadata for the data producer. Nobody, but nobody describes material as well as libraries. In any event, the catalogue description that will evolve will have the same Janus-like quality as conventional bibliographic control/bibliographic access, that is, the descriptive record will provide control of the spatial data and access to the spatial data. We need to keep a sharp eye out for developments in database management systems.

All this work to collect and describe, and finally provide access to the material. Most users see this as the only component in our mission, overlooking the getting and describing. A research library should be able to answer any question, at any time. Ironically, good libraries are rarely noticed, it is only the bad ones, when the user has to work very hard to get the material. Is the map in the library, or checked out; when are the hours, how can copies be made? These are all problems of the paper map library. Access to paper material is limited by space and time. Only one person, at one place at one time can use the map.

The digital collection in the virtual map library is not limited by those constraints. It has its own constraints, of course, but several users can share material, from several places simultaneously. We can log on from Zürich while the data is being used in Storrs. The Virtual Map Library, housed on the MAGIC Fileserver, is accessible from ten places at once, a limitation applied by the network software. It exists in the virtual or cyber space of the Network. The Network is a series of collections connected by various telecommunications devices. The InterNet is part of the Network.

There are several constraints of the Virtual Map Library. As we gain experience and study the phenomena, librarians will be able to develop strategies for dealing with these constraints. As I see them now they are user abilities, network abilities and fiscal abilities.

User ability, or literacy, is dependent on not only the knowledge and intelligence of the user, but their hardware and software. Without a computer, the user cannot "get at" the data. Without software, the user cannot "do anything" with the data. So, with digital data, where does the access start? Many of my colleagues believe that we should simply supply the data, and the user is responsible for the software. I feel there is a role for the library to supply the software as well, at least for the emerging user. MAGIC supplies a number of GIS and computer aided programmes. There are two licensed seats of MapInfo for Windows, five seats of MapInfo for DOS and two seats of IDRISI. In addition, there are ten seats of ArcView to provide 1990 cencus data for Connecticut. I expcect that as the user community develops, they will begin to purchase their own copies of the programmes rather than compete for the limited seats on MAGIC... I hope. Programme support is difficult and uses a lot of network resources.

Access to the data and programmes is dependent on the network's ability to readily transfer large datasets. Because the University's network does not support graphic file transfer particularly well, MAGIC relies on batch transfer rather than real time. So I have zipped the files and expect the user to down load the data onto their machine. This accomplishes a few things. Zipping files is a term which means to compress the data into a smaller packet. In this case it is compressing a number of files into one very dense file. It conserves space on my storage drive, by about 50%. It allows for more effective use of a network that is still emerging on our campus. Perhaps the most subtle accomplishment, however, is that it forces the user to take ownership and responsibility of the data. One of my issues is that I want to build an independent client group. I really want them to use the data on their own scholar's workstations. I want them to buy and maintain their own machines. I don't want to turn into a computer lab manager. This seems like a good strategy for now, but I will monitor it carefully as the network capabilities develop.

Here's the rub. How do we pay for all this? Well, not easily. Here are some of my strategies. Limit the cost to the library missions, collection, description and access. I put the data on a fileserver, transferring the burden of manipulating the data to the user. Work with software companies. I have attained a lot of software by selling the influential role of libraries as information distributors. ArcInfo has donated hundreds of copies of ArcView and ArcData to American research libraries. Canadian research libraries are getting theirs this year. Develop a similar programme in Europe. ESRI is a champion of spatial information sharing.

I hope I have given you a foundation, a framework, for this conference. Later I hope I can sit down at a terminal and show you some of this; take you to my virtual map library. If the technology co-operates. I look forward to joining with you this week; the papers sound stimulating, the company looks gemülich (my daughter says "angenehm"); and the planning has been good. We have a rare opportunity here, we are map librarians, leaders of technology in the library community.

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Some Problems with the Use of Electronic Atlases

ERNST SPIESS
Institute of Cartography, Swiss Federal Institute of Technology, Zürich

1. New challenges for map libraries

Being involved primarily in the production of maps by digital technology we are concerned also with the question, whether one should continue to produce maps on paper or provide the market also or exclusively with digital maps and atlases. This contribution is based on some of our experience with maps on the screens of monitors. It is an attempt to interprete the role of the mapcurator under these new circumstances. Going through the reader prepared by the organizers of this conference, one comes to the conclusion that much concern has been given already to the role of the map librarian under the aspects of the new digital map products. It seems that among map librarians there is a strong will to cope with these new challenges. In addition to what they offer already they may include a very broad palette of new services, ranging from rather simple to highly demanding ones, if we follow the information in the reader.

These duties include:

- to catalogue all available digital map data
- to collect all available digital maps and databases and electronic atlases
- to let the clients view on a screen the geographic information contained in these products
- to offer the users an opportunity to explore the potentials of digital data such as searching for specific information
- to provide hardcopies of these digital products according to user's needs
- to circulate digital map files or electronic atlases like maps or books
- to help the user in manipulating digital map data (e.g. feature selection, changes of symbolization and colour, creation new data levels, merging different files, etc.)
- to produce paper maps on demand on the basis of digital data files

- to scan or digitize analogue maps that are needed in digital form
- to allow the user to import its own files and export data in various data formats
- to help the user in the analysis of spatial data
- to assist the client in the production of maps based on available data
- to allow for the whole range of GIS activities

In view of the expensive equipment and high level of competency of the personal and large amount of assistance involved, libraries might have to charge clients for their services like any commercial organization. If all these services would be included, the competencies expected and the infrastructure needed by librarians would be equal to or even larger than those of a professional map producing or GIS organization, because such a library will have to access an extremely wide range of very heterogeneous and technically complex materials. What then is the difference between these institutions and such an upgraded map library? In fact it seems that we are heading towards a *National Centre for Geographical Information* and away from the traditional map library.

2. The physical form In which digital spatial data are available

Spatial digital data are made available by their producers or publishers in a variety of different physical forms and data formats:

- diskettes (relatively small data sets only, 2 sizes of drives, various data formats)
- DAT-streamer Tapes (digital audiotape with 2 GB of uncompressed data, various tape drives)
- CD-ROM (600 MB read only memory for text, graphics, audio, video); e.g. one disk may store approx. 25 map sheets of a map (format 70 x 50 cm) stored with a resolution of 20 pixels per mm
- optical disks
- on-line through communication networks

Therefore, if a map library intends to offer only a minimum of services, it has the be prepared to accept all these import media and provide for all drives needed to read or write these data. To do this usually specific software is needed as well. One will have to acquire know-how to handle many data formats and to convert them according to user needs. Furthermore - what is missing in the reader so far - one has to gain knowledge also in some important graphic aspects, when working as an adviser for the use of digital map data.

3. Comparison of the potentials of paper maps and atlases with digital databases and electronic atlases

Usually the advantages of digital spatial data over paper maps is emphasized. The relevant keywords are:

- quicker and easier to revise
- manipulable
- suitable for overlays
- flexible base for the creation of new map products
- presentation of dynamic phenomena, etc.

The following is a comparison of the potentials of paper maps and atlases versus digital data bases and electronic atlases. These potentials, however, are depending on the type of storage medium, with which the data are delivered and on the hard- and software available in the library to access the data.

paper maps / atlases

- proper scale for each map, usually only one scale for all items
- fixed sequence of the maps in a bound atlas
- juxtaposition only with loose leaf atlas
- overlays with tranparancies only
- large formats (70 x 100 cm) at fine resolution
- temporal sequences, by juxtaposition of maps
- highlighting by stressing previously fixed items graphically in a purely static mode
- referencing other data only with the actual content of the map (names, grid, graticule) or external media

digital databases / electronic atlases

- variable scales can be derived from the same data, however, useful only within a restricted scale range or if data are aggregated or generalized for larger areas
- sequence may be arranged according to individual needs
- limited juxtaposition by windowing sections
- overlay of feature classes on the screen limited, as within a paper map
- small formats (30 x 40 cm monitor) at a resolution of 0.3 mm only (size of a pixel on the screen); this corresponds to a paper map section of 9 x 12 cm only, but there may be a possibility to scroll through the map

- temporal sequences by juxtaposition of windows or animation, as well as adding and deleting objects in a time mode
- highlighting by blinking on the display any chosen item in a dynamic mode
- referencing also to hidden information, multilayer information, if internally structured; reference buttons, etc.

4. Resolution of digital map data on a screen

When a whole large data set is fitted to the window or a limited part of the window of the display, usually part of the data is lost. The practically infinite number of discrete xy-locations of the stored geodata shrinks down to some 1024x1258 possible pixels on the screen. The effect is that of a scale reduction. Nobody hesitates to complain about overhead or slide projections with too tiny details, but apparently people seem to accept more easily unlegible views of the full data set on the display, which are far from ideal for interpretation.

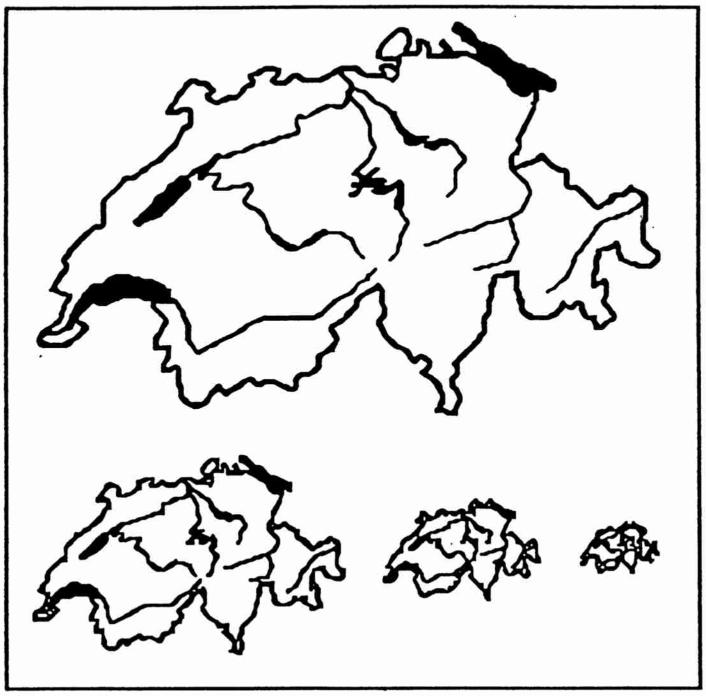

Fig. 1: Pixelresolution on a screen and scale reduction

Minimal dimensions are rather coarse on a screen in comparison to a paper map with line widths of 0.1 mm. A pixel on a 19" monitor (385x287 mm) with 1184x884 pixel resolution measures 0,28 mm. This causes rugged lines, an effect that to some extent may be mitigated by the arising technique. In a number of tests it has been shown that for clear identification of a topographic pixel map on such a screen, the paper map has to be enlarged at 250 %. In other words on such a display we can work only with sections of 12x9 cm, spread over the whole screen, of any scanned paper map. This means that we have to split up a toposheet for inspection into 30 segments. Any map image larger than 12x10 cm and displayed as a whole by pixels on the screen at its original or even reduced scale lacks for identifiable information and produces instead nothing but noise. The only remedy for such a situation is generalization. After all vector data are easier to present when the scales become smaller, because the attributes of the objects can be changed easily. But some effort has to be made to leave away those features that are not absolutely needed and to improve on the symbolization. Nevertheless the image collapses when the scales become considerably smaller.

We should not forget in this context about the need for an overall view on the entire map for quite a number of other map interpretation tasks. For all general questions the eye has to scan over the whole area, as e.g. recognizing

- he most congested areas
- he highest concentrations
- ll empty spaces
- the total evidence of a certain feature

or comparing

- regional densities
- distribution patterns, etc.

It is this kind of interpretation tasks, which can be performed most efficiently by humans. But they cannot be successful, if the overall image is illegible. Scrolling around is often a means to overcome such deficiencies, but not appropriate for this purpose.

5. Different levels of use of digital material and map library services

The library may have to cope with material for three levels of users, i.e. novice, advanced and expert users depending on the amount of interaction allowed. The data may consist of ready.amde images, **maps and images that cannot be modified,** sometimes not even zoomed in or copied. Buttons allow for simple selection. There may be referencing possibilities to comments or annotations like texts or sounds. The user is thus presented with some kind of slide show, with a guided your or a free choice of the image sequence. Opening windows in parallel for comparisons is usually not possible in this case. The advantage versus a series of paper maps is just the quicker access but with a resolution that is worse.

A more advanced step in using such spatial data is reached when the **digital data may be edited,** amended, updated and completed. Possible operations include changing variables, regions, diagram and map types, colours by using buttons, menus and forms. The existing data may be copied and overwritten by new information. Raster data are split up for this purpose into a number of layers each of them with one feature only, which may e.g. be individually colour coded. A raster editor is needed, if such changes ought to be realized. If a vector editor is available, feature codes vector data may be edited and overlayed on raster data.

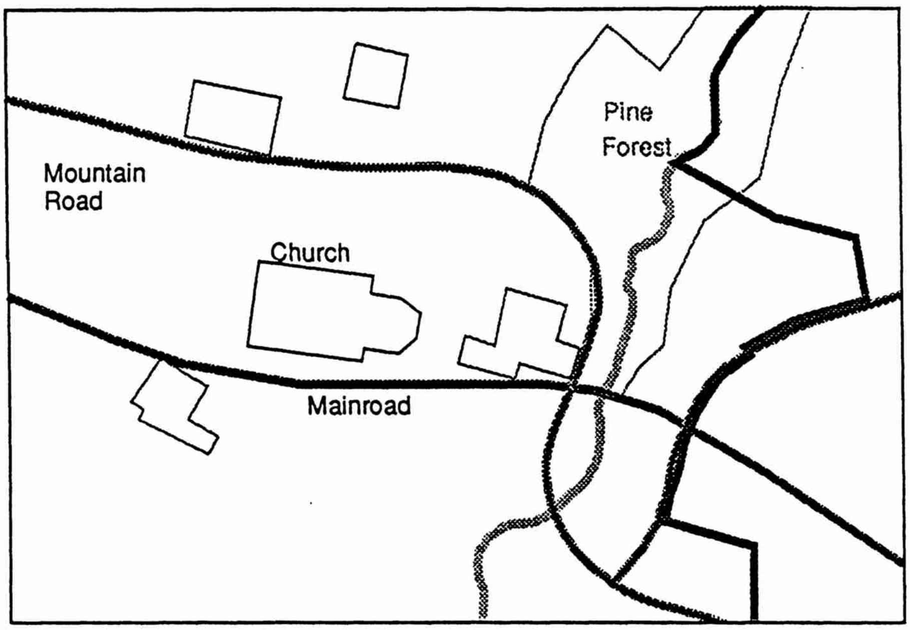

Fig. 2: Form under which a digital database is delivered

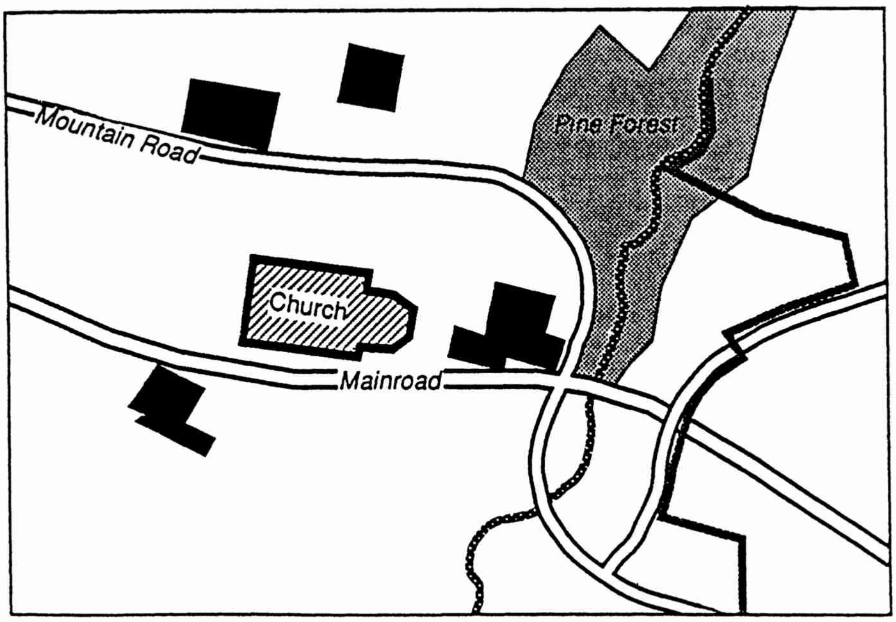

Fig. 3: Symbolized map on the base of the digital database of fig. 2

There is a gradual transition to a workstation with vector and raster editing and functionalities that allow for **statistical and spatial analysis**. It will be needed, if the spatial data to be handled includes both types of image formats and statistical background information.

One step further on the hard- and software side, including scanner and plotter allow the user to **produce ones own maps** on the basis of the available data. This means, however, a big step forward in **cartographic competency** of the staff of such a library. Digital cartography so far has not realized systems that can be left to the average user without a considerable amount of assistance. The fact is that clients will have to rely largely on staff of the map library. On the whole it is to be doubted that it is a map library's task to help unexperienced users to make their maps. Sophisticated users on the other hand will usually operate in their offices their own systems and will be looking in a map library mainly for data. It may therefore be sufficient to give them an opportunity to use the library's facilities to inform themselves on the type of data available or to gather and retrieve information from this material.

The situation may be slightly different for **users that wish to make use of a GIS**, in order to gain information for some specific purpose. They might be assisted in logging in, querying and analyzing data that is resident in such a system set- up by the library. Its staff might help also in getting remote data through network channels onto the system. For the library this means to dispose of a powerful GIS, that is not dedicated to a limited group of applications and has access to large amounts of spatial data, databases and electronic atlases. To install such a system means asking considerable funds, and much more if we have in mind to serve more than one client a time. To be sure, people will stay the whole day searching for and browsing through all interesting data.

6. Requests for output and the copyright problem

In most cases there will be definitely a need for hardcopies of digital files, whenever possible also colour plots. Quite often clients of map libraries are not only interested in specific information to be retrieved from maps, but are looking for source maps for their own map compilations or productions. To handle these requests has been a serious problem up to now, as the necessary colour separation films or other map originals are difficult to get hold of and as access is somewhat restricted. This situation has favourably changed since digital base maps have appeared on the market.

In connection with the editorial work on the Atlas of Switzerland we have developed a set of digital base maps for the scale ranges 1:800,000 to 1:1.250,000. (rivers and lakes, administrative boundaries, hill shading) and 1:300.000 to 1:700.000 (hydrography and administrative boundaries). These features are differentiated by a number of attributes that allow for an individual design of each base map in relation to the map topic and purpose.

The librarian that disposes of such digital databases will increasingly be confronted with requests for copies of digital data sets on diskettes, tapes etc. This raises the problem of copyright. The owners of the data usually wish to see some feedback in terms of money they have spent in creating the data sets. Most of them do not allow to pass on the data to third parties. There are presently different systems of licensing or selling such data. How dramatic the situation of copyright fees in certain cases is, may be illustrated by the following figure: The cost of a vector tile for the main elements of the four sheets of the map at the scale 1:200,000 is SFr. 31,000.-. By what mechanism can the owners be assured that their data is not illegally copied and commercially utilized without their knowledge? Some distributors have found an easy means to solve the problem by protecting their data sets from being copied. However, to look at the information only cannot be the final goal of the whole exercise.

7. Examples of digital data bases and electronic atlases

The *Global Change Encyclopedia (GCE)* project of the Canadian Space Agency and the Canada Centre for Remote Sensing (CCRS) consists of more than 2 GB of digital RS data and relevant ancillary digital data (maps, demographic information, etc.). It is available on CD-ROM and a subset of their content as a diskette version. It works on an IBM PC-AT, or compatible, with VGA graphic adapter, a minimum of 40 MB hard disk, mouse, CD-ROM reader and colour printer. The GCE contains continuous-tone images in a georeferenced raster format, maps (coastlines, land cover, climate, vegetation etc.) in vector and/or raster format, socioeconomic and environmental statistics in tabular and graphic map format by country. Photographs illustrate the local flora, fauna and landscapes and support text. Vector line work can be overlayed on raster imagery and maps. A limited set of GIS raster functions is available too. The data can also access vector data of the DCW (Digital Chart of the World). The user can access the GCE in four different modes. In script mode he is opposed to guided tours including practical exercises by varying the input parameters. The explore mode allows to select data by theme or region before downloading them to the hard disk. With the analogue functions the data can be analyzed and with the edit functions the user can prepare the data for presentation in map form.

The *World Geophysical* CD-ROM von Chalk Butte inc. contains a world map in a simple plate projection with topography and bathymetry in 24 bit colour for use on Macintosh-hardware. This same information is divided and can be enlarged into 4 and 24 fixed quadrangles. Another set of 24 files of 68 Kb each shows a circular aspect the world in an equidistant, cylindrical projection, centred 15° of latitude apart. These 53 images have a fixed size and cannot be changed in any way. The heights are divided into contour intervals; one of them may be selected at a time and coloured. Further operations are reading the elevation of a location pointed at, asking for the great circle distance between two points, overlaying the plate boundaries, plate tectonic velocities or coast lines and simulating plate motions along small circles with linear boundaries. Images may be exported with a screen shot in PICT format. The usefulness as well as the precision of some of these functions must be doubted. There are severe limitations in every respect.

The *World Atlas - a multimedia view of the world* of Software Toolworks Inc. presents video sequences and 270 photo scenes of 47 cities in colour. It contains a series of ugly topographic maps of the continents and one map for each country with 10 city names and sound tracks for their English names and the national anthem. Furthermore statistical data of more than 300 topics may be shown in statistical maps that cannot be changed in appearance. Again the limitations are severe and the printed products are not very persuading.

Since a number of years an electronic atlas project for Switzerland called *Mediorama* is in discussion. At first the intention was to produce one or two CD-ROMs with the existing national map series and the thematic maps of the national atlas. The composition of the study group led later on to a new plan with 9 CDs on various topics including a large variety of items but no maps at all. The user groups to be addressed by this project largely depend on the hardware to be adopted. In this respect CD-I-hard- and software is considered a must for this undertaking. It is only recently that we had contacts again with the project leader, the corporation that was founded under the name of MEDIORAMA AG. In our opinion a major problem, as far as maps are concerned, is that the maps to be contained on such disks cannot all of them simply be copied from existing material, but have to be prepared specifically for this purpose taking into account the observations made above with respect to viewing conditions on computer or video screens.

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The National PC-Atlas of Sweden

GÖRAN BÄÄRNHIELM
Kunglige Biblioteket, Stockholm

The new National Atlas of Sweden is a set of 17 volumes presently being published in Swedish and English editions. The books cover various themes, e.g. mapping, forestry, population, infrastructure, environment, agriculture etc. They are produced by digital methods, so the contents can be made into a geographical database, accessible to a program for PC systems running under DOS or Windows: The National PC Atlas of Sweden.

The PC Atlas is intended to be an introduction to GIS (geographical information systems), to support the digital processing of maps and spatial data in schools and libraries, and to be a supplement to the Atlas books as well as being a stand-alone system.

The PC-Atlas = program + data sets + presentation ideas.

The presentation ideas, expressed in scripts, are ASCII-files which can be edited by the advanced user and which determine the selection of data and the display of them on the screen.

The data sets are in dBase format and the user can easily manipulate and add his own data.

The main functions are:

1) show data (vector maps, diagrams)
2) allow visual comparison of data from different sources
3) display time series
4) enable simple analyses (calculation of differences and ratios etc.)

The users are not expected to know anything about GIS, so simplicity rather than flexibility has been a guideline. There are three levels of sophistication:

The first is a simple 'read and browse' mode. It is based on readymade 'pages' which are turned over by clicking a button.

The second level is for the more advanced user who can change variables and areas, select diagram types, etc.

At the third level the user can modify the scripts controlling the program and make his own PC-Atlas.

There are mainly two types of maps: the base map and choropleth maps, both in vector format. Raster data can be handled by the program, but are not included at the present stage because of the large file sizes, which demand CD-ROM distribution. This means that hypsography, vegetation, etc., are not visualized.

The base map, called the 'place-name map', is the *National Atlas Map of Sweden*, scale 1:700,000. The user can select area and add or remove objects (e.g. roads, railroads, various typs of boundaries, lakes and rivers, etc). Cartographic data is managed as objects rather than in layers, so it can be easily adapted to different scales. The user can also measure distance and area, locate place-names, display coordinates, and search in the map catalogue. There is a test module for road planning. The map catalogue contains the official printed maps and charts of Sweden and also the annual national cartobibliography produced by the Royal Library. The user can select a specific map series or catalogue file and enter specific conditions for the various fields (e.g. a scale or year range, a code for the contents, etc). The search area can be defined as a square, a point or along a line, e.g. a road. The maps are represented as squares against the background of the base map and in a short list, and one can also view the catalogue entries. The principal advantage of the PC-Atlas for our library is a simple graphic interface for our map catalogue, if only for Swedish maps. The same would be desirable for other maps also, for example on the basis of the Digital Chart of the World.

However, the main purpose of the PC-Atlas is to display statistical data at the municipality, county and national levels on small scale maps. This is useful as a demonstration tool for the general public at the library, but it demands quite a lot of instruction. The advanced user can design his own maps by selecting data sets and combining them into choropleth maps or diagrams combined with maps. It is possible to export maps in the form of screen-dumps in Windows to be handled by an imaging program and pasted into a word-processor, as is demonstrated by the illustrations in this paper.

Examples of thematic maps as displayed in a demo

Railroads - roads
Built-up areas 1980
Name search (dialect differences)
Ownership of forests 1985-89 (Crown/other public/companies/private)
Tree types, share of total timber volume 1985-89
Timber volume total 1985-89
Forest felling 1973-81, 1986-90, pie charts
Employment corporate / private forestry

Effect of migration on age structure
Proportion of children to aged people
Population density, 1810-1990, historical series, agrarian / urban regions
Migration to and from urban regions 1990
Proportion of immigrants 1990
Acidification of groundwater
Lime-treatment of water against acidification
Arable land and agrarian enterprise
Active and inactive arable land
Effect of agrarian politics on landscape
Crops: Cereals / Pasture / Potatoes / Oil-plants / Peas / beans.
Regions of agriculture

The PC Atlas is distributed on floppies or CD-ROM at a price of SEK 3,500 for the parts already published or SEK 7,000 for the whole set.

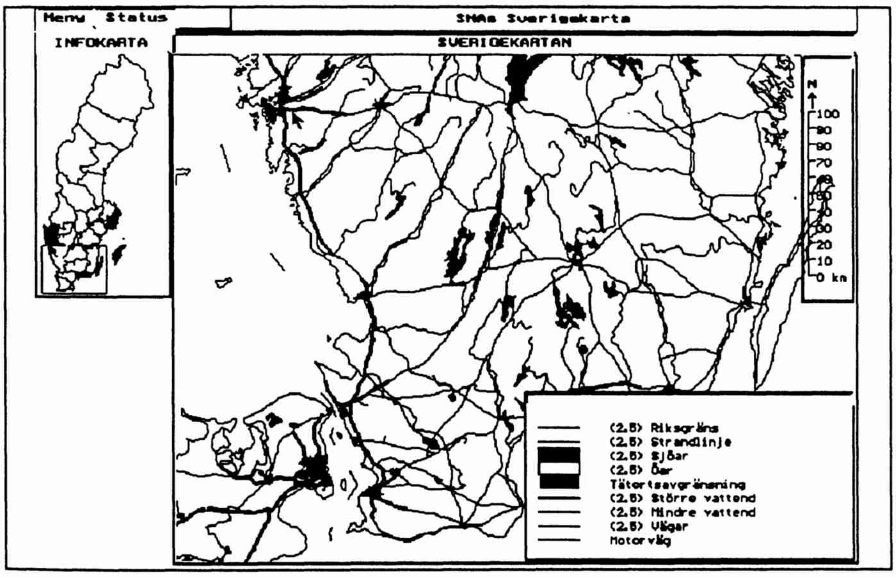

Figure 1: Base map (without place-names)

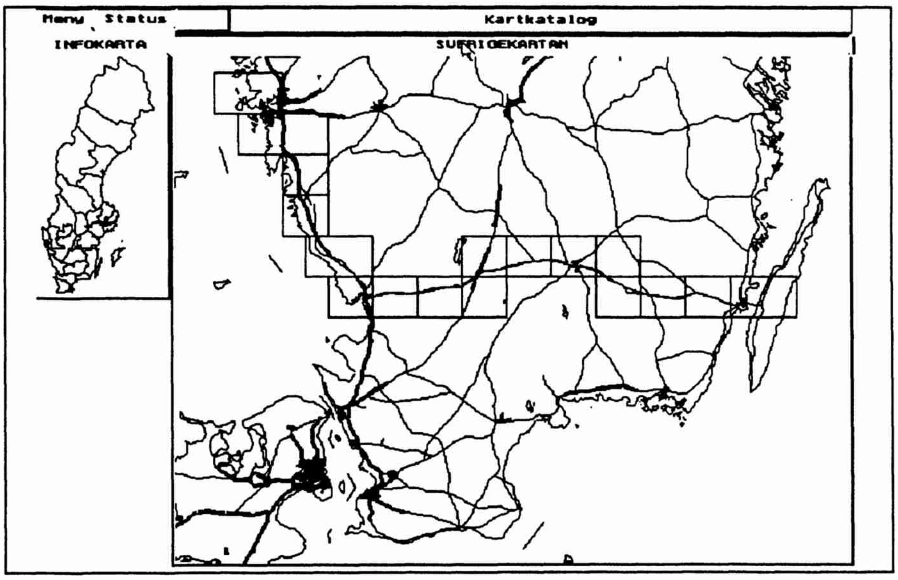

Figure 2: Topo maps covering the road Gothenburg-Halmstad-Kalmar

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Digital Cartographic and Topographic Products from the Swiss Federal Office of Topography

LORENZ HURNI
Bundesamt für Landestopographie, L + T, Bern

The Swiss Federal Office of Topography

The Swiss Federal Office of Topography ("Bundesamt für Landestopographie, L+T") is commissioned with the production of the Swiss National Map series. To fulfill this task the office maintains a nationwide geodetic network. Aerial photogrammetry and extensive topographic field checks allow the contents of the maps to be compiled. Cartographic and reprographic processing provide print-ready map originals. During the last few years, a new demand for digital cartographic products has arisen along with the continuing need for analog printed maps.

The office was founded in 1838 by G.H. Dufour. Under his directorship, the first geometrically exact map of Switzerland was published between 1844 and 1864. Updated versions of the original topographic surveys 1:25,000 and 1:50,000 were published under the name *Topographic Atlas* between 1865 and 1901. In spite of the high graphical quality of these maps, the need for a new map series at different scales arose at the beginning of this century. Precise geodetic networks also had to be measured and calculated. After long discussions, officials and experts finally decided in 1935 to produce and publish new countrywide topographic maps in the scales 1:25,000, 1:50,000, 1:100,000, 1:200,000, 1:500,000 and 1:1,000,000. The most detailed maps, in the scale 1:25,000, were finished in 1979.

Since 1968 all maps have been updated every six years. Based on aerial photographs, stereoscopic models are evaluated on special stereo plotters in order to determine the exact position of each topographic object. Together with information collected in the field, these compilations serve as the source material for producing the cartographic originals. This work is still done manually by scribing on specially coated glass plates. Each printing colour requires a separate original. Finally, the printing department makes printing plates from the completed originals and prints the maps on paper, using multi-colour offset machines. The 1:25,000 map has eight colours, the 1:50,000 map has six colours and the 1:100,000 map has ten colours.

Digital cartographic datasets

Computer technology has also found its way into topography and cartography; geodetic data is collected and calculated almost exclusively by computer. The stereophotogrammetric compilation of aerial images depends largely on computer-assisted hardware and software. Three map sheets have been updated with excellent results using a digital cartographic system. Due to several reasons (e.g. the age of the system) no further work has been done. Map updates are still done manually, but a new cartographic system is being evaluated at the moment. As already mentioned, during the last few years a new demand for digital cartographic products has arisen along with the continuing need for analog printed maps. At the Swiss Federal Office of Topography, several such products have been created from existing analog maps. They can be used by private clients, researchers and governmental agencies. The datasets have been produced for professional use for possible applications ranging from basic data for GIS (geographic information systems) to scientific modelling.

The Digital Height Model **DHM25** describes the earth's surface (elevations only, without forests, buildings, etc.). It is extracted from the height information of the National Map 1:25,000 (**NM25**). The height content of the complex map image is represented in three colours: brown (contours for the normal surface), black (contours for rock, scree and spot heights) and blue (contours for glaciers and lakes).

In order to produce the DHM25, the first step is to extract the DHM25 basis model (vectorized contours and lake contours, digitized spot heights) from the NM25. All spot heights were previously digitized manually on a digitizing table. Extracting the linear elements from the map image is a much more complicated process. The original colour-separated films are first scanned with a resolution of 16 lines/mm. The complete contour and lake contour image is extracted from the pixel maps using image processing methods. The margins to neighbouring map sheets are edited and the raster data is transformed into vector data. Each contour is then assigned its value. This part of the work, as well as the entire extraction process, is carried out both automatically and interactively.

The basis model contains the following digitized height content from the NM25:

Linear elements:	- vectorized contours
	- vectorized lake contours
Dot elements:	- digitized spot heights

In the second phase the basic model is interpolated with the program CONGRID (written at the Swiss Federal Office of Topography) resulting in the DHM25 matrix model with a 25 m grid. Independent tests are carried out and if necessary, the basic model is corrected. Before the final matrix computation, the adjacent zones on neighbouring sheets are included to ensure that the values along the map margins are accurate.

The 25 m grid of the height matrix corresponds to a mm-grid overlaid on a NM25. The complete matrix of an entire NM25 contains 701x481 height values (a total of 337,181 values or 1.600 values per square km). Both models are available in an ASCII format.

Project **RIMINI** was started in the mid-60s by the Defence Technology and Procurement Agency and the Joint Chiefs of Staff in collaboration with a private company. The data file is a regular array of height values in a 250 m grid and it is the first height model covering all of Switzerland. The heights of these grid points were read manually out of the National Maps 1:25,000 (NM25). Since it is intended to replace RIMINI with the DHM25, it is no longer updated or corrected.

A scanned map in a raster form is called a **Pixel Map (PM)**. It is simply the transformation of a normal map into a digital form. The information is separated only according to the printed colours and not according to any thematic structure. The Pixel Maps are scanned, processed and delivered with respect to the sheet numbers of the Swiss National Map series. All map series are available as Pixel Maps. The Pixel Maps are scanned with a resolution of 20 lines/mm which means, for example, that the actual size of a pixel at the scale of 1:25,000 is 1.25 m (Figure 1). The map sheets are transformed onto the Swiss national coordinate system which is defined by a conformal, oblique cylinder projection. The Pixel Maps are available in SCITEX T30, SCITEX HANDSHAKE and TIFF raster formats.

VECTOR200 is a vectorized version of the Swiss National Map series 1:200,000. Vector data consists of points, lines and area elements represented by their vertex coordinates (national coordinate system). The dataset is divided into 11 subsets which contain roads, railroads, forests, buildings, rivers, spot heights, map symbols, control points in the corners, a graticule, boundaries and place names. It represents, with some exceptions, the contents of the National Map 1:200,000. Single houses in villages and towns, for example, are replaced with generalized representations. Each subset is divided into several levels, thus allowing the even better separation of information (for instance into different road classification). VECTOR200 is available in AUTOCAD DXF, INTERGRAPH DGN and SIF and ESRI ARC/INFO formats.

Besides these digital cartographic products, the Swiss Federal Office of Topography produces several other datasets which are mostly used for thematic mapping applications. One example is a base map 1:1,000,000. It was vectorized and manually edited at the Institute of Cartography of the Swiss Federal Institute

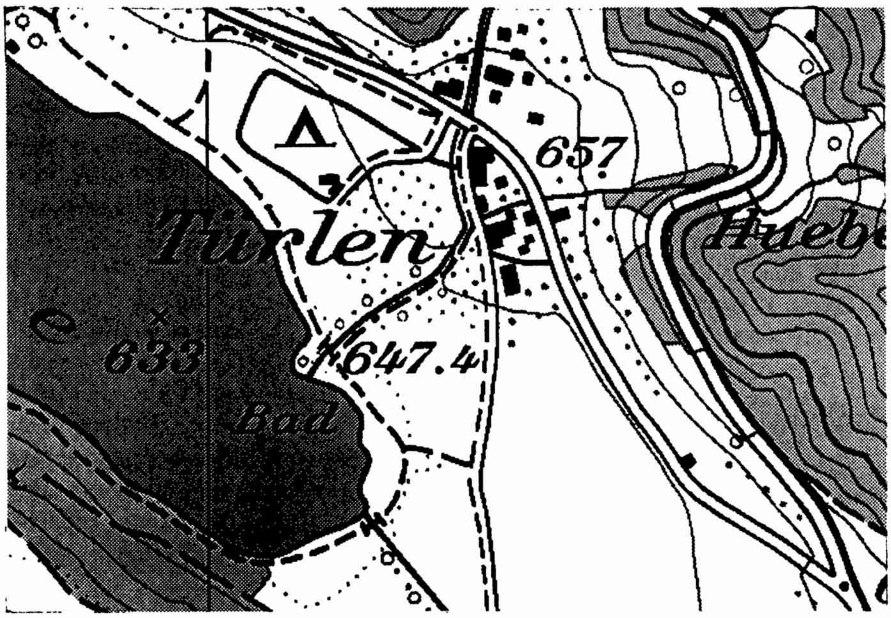

Figure 1: Enlarged extract of the Pixel Map 1:25,000

of Technology (ETH) in Zürich, based on existing conventional sources. This original data is stored in the INTERGRAPH DGN format. The L+T has converted it into MACINTOSH FREEHAND format and has included further manual editing and symbolization of the vector elements. The dataset is also separated into several layers covering administrative boundaries, lakes and rivers in different 'densities' according to their importance. A shaded relief is also added. Another example of such a special digital product is a placename database of Switzerland.

Situation in other European countries

National surveying agencies in other European countries offer similar digital cartographic products. Pixel maps and digital height models are available in almost every country. Some countries have projects to collect digital base data at large scales. The Institut Géographique National (IGN) in France collects such data in vector form using photogrammetric methods (project BD TOPO). In Germany, the aim of project ATKIS is to digitize all 'basic maps 1:5,000'. These data sets can be used -after generalization- for the production of topographic map series at smaller scales.

Future projects in digital cartography at the Swiss Federal Office of Topography

The aim of project CADKARTO is to update existing analog maps by digital means. Therefore, all these maps have to be scanned with a resolution of at least 40 lines/mm. The editing is done in hybrid (raster and vector) mode using photogrammetic and field data. The evaluation of a suitable computer graphics system will be completed in mid-1995. Project TIS (Topographic Information System) is the counterpart to the above-mentioned French and German projects ATKIS and BD TOPO. At the moment this project is still in its specification phase.

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GEOSTAT: the Service for Spataial Data in the Swiss Federal Administration

HANS-ULRICH ZAUGG / VALERIE BORIOLI SANDOZ
Swiss Federal Statistical Office, Berne

The Federal Statistical Office maintains with its GIS (geographic information system) infrastructure a specialised user communications team which concentrates on data diffusion, advice and information in this field. GEOSTAT contains a federal GIS database of geocoded, spatially relevant data sets coming from various, mostly governmental, sources. Services offered to official, research, as well as private customers, include dissemination of raw, digital data in various formats, custom analyses of specific data and data combinations, presentation of data and of analysis results in the form of customised computer plots as well as generation of statistical data tables for specific, but traditionally unresolvable spatially defined and related questions. This data preparation and delivery centre meets an increasing demand and tries hard to complement, update and improve the existing data sets within its GIS. Further significant enhancements may include innovative data like satellite imagery or environmental information.

Background

With the transfer of a Swiss geographical database for regional planning purposes from the Department of Planning of the Federal Technical Institute (ETH) of Zurich in 1976, the Federal Statistical Office made the first step towards the establishment of geo-referenced statistics independent of the traditionally used administrative boundaries. Since then, the information content of this grid or raster system has been systematically expanded and enhanced and the data disseminated to an ever growing group of interested data users from various fields of research, education and administration. Increasing amounts of data, greatly widened and multiplied data needs and requests, and technological advancements in computer hard- and software and data processing methods made a complete redefinition of the project and an infrastructural refurbishment mandatory. In connection with the considerable data management tasks for the new Swiss land use statistics, the installation of GIS was extensively evaluated and finally decided upon. Based on a specific analysis of users' needs, a formal concept report, as well as a survey among producers and owners of geo-referenced data within the federal administration, the Swiss Interior Ministry finally decided in 1987 to formally establish the new project GEOSTAT.

Geographic information systems?

Under the term *geographic information system* (GIS) we understand, according to a recently published definition by the GIS working group of the Swiss Informatics Conference[1], an information system containing geographical or spatially referenced data, especially on the atmosphere, the earth's surface (vegetation, land use), the soil and the lithosphere, including its technical and administrative infrastructure as well as its economic and ecological framework. A GIS facilitates systematic data capture and storage, actualisation or updating, processing, analysis and combination of such data on the basis of a common spatial reference system. Offering these capabilities, GIS is destined to support the decision finding process in administration, jurisdiction and economy as well as many other spatially relevant planning endeavours.

Statistical data?

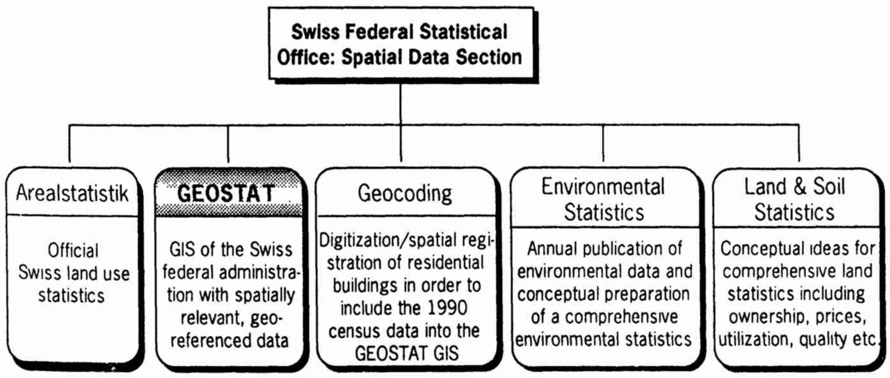
In Switzerland, the activities of the Federal Statistical Office and the other producers of statistical data belonging to or associated with the federal government administration are defined and legally delimited by a new federal statistical law which was passed by parliament in October 1992 and has been in effect since 1st August 1993. Its third and fourth articles describe the objectives and tasks of federal statistics and the principles for surveys and data generation. They explicitly list land use and spatial data as relevant and legitimate federal statistical information. According to the official message of the Swiss Federal Council accompanying this law, statistical data includes, among other things, information on persons, households, enterprises, but also on land parcels, buildings, apartments, hectares and spatially defined points as well as on spatially referenced administrative areas and other parameters. We can conclude from this that practically all data generally kept and analysed in GIS can be considered to be statistical or statistically relevant data as well.

1 Schweizerische Informatikkonferenz, Arbeitsgruppe Geographische Informationssysteme: SIK-GIS Empfehlungen 1992. Bern, September 1992 = Conférence Suisse sur l'Informatique, Groupe de Travail 'Systèmes d'information géographique': Recommandations SIG 1992. Bâle en août 93.

GIS concept of the Federal Statistical Office

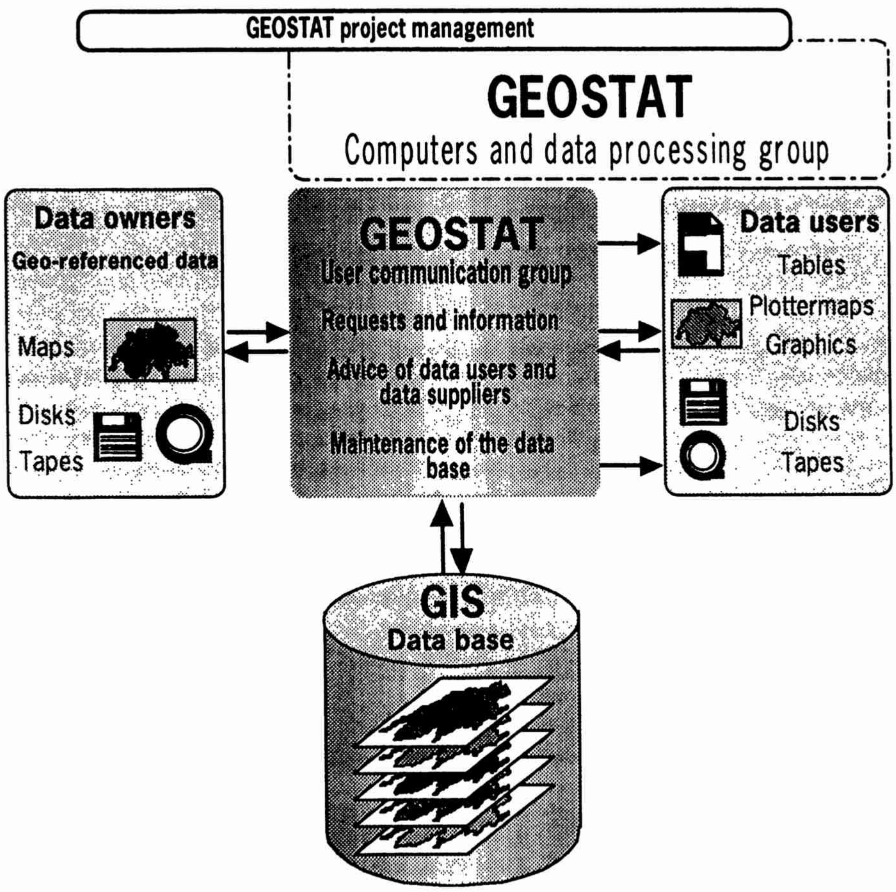
With the framework of the federal law on statistics in mind, it is only natural that the Federal Statistical Office has tried for many years to assemble a solid basis of geo-referenced (GIS) base data, to explore the capabilities and potential of available GIS for the management, analysis, presentation and diffusion of GIS data, and to satisfy the needs of a wide range of interested data users for such data and derived products and results. In order to reap the full benefits offered by GIS it is, with the presently available and installed technology, inevitable that the Office brings together and centrally combines a variety of relevant geo-referenced statistical data which is, however, usually generated or digitized decentrally by different organizations and institutions. A national statistical office is expected to serve as an optimal location for a general data repository attracting the collaboration of data producers by offering them technical and marketing advice and by relieving them of administrative and legal overheads necessary for a professional and user-oriented dissemination of their data. This approach also offers the unique possibility to data users obtaining data combinations and the results of analyses involving several independent data sets rather than being forced to assemble each and every required piece of information from its original source and invest in the infrastructure, skill and time necessary to perform every required analysis independently.

Fig. 1: Projects and activities of the Spatial Data Section



The *Spatial Data Section* is one of the youngest sections of the Swiss Federal Statistical Office (Fig. 1). It had its origin with the launch of a comprehensive statistical investigation on land utilization in Switzerland, but has meanwhile extended its scope and activities beyond the single aspect of land use to encompass a multitude of data and information that are available or need to be analysed within a specific geographical or spatial context. The publication and regular updating of the official Swiss land use statistics still makes up one of the major projects of the section, while the other one is the geographic information system of GEOSTAT.

Fig. 2: Organization and data flow model of GEOSTAT



Organisation

The core of the project GEOSTAT is a GIS which aims to store spatially relevant, geocoded data from a variety of fields and from a variety of data owners at a central location in order to make them available for user-defined analyses, combinations, intersections, overlays etc. The project consists, besides project organisation and management, of two project units: the user communication group on the one side and the computers and data processing group on the other. Within the Spatial Data Section, GEOSTAT is fully integrated and collaborates closely with the Swiss land use statistics and the other projects of the Section. The *user communication group* takes care of the data flow to and from the GEOSTAT GIS (Fig. 2). Therefore it maintains close contacts with data owners and data users and has institutionalised an exchange of information and of experience on geographic and spatially relevant data and information systems. In 1992 the first edition of a new, comprehensive users' manual describing all the data available within GEOSTAT was published[2], and GEOSTAT is engaged in various efforts to compile information registers on the available GIS installations and GIS data in Switzerland.

Objectives

The main targets and objectives of GEOSTAT have hardly changed since the formulation of the original project concept in 1987. The installation of an efficient, modern GIS and the hardware upgrades and extensions of the past years now allow GEOSTAT to prepare analyses of combined data sets efficiently and fast. They were also a prerequisite for the successful verification, conclusive analysis and finally the publication of the *Arealstatistik 1979/85*. The most essential tasks and objectives of GEOSTAT may be formulated as follows:

- Integration, administration and maintenance of different geocoded, spatially relevant data available with the Swiss federal administration. For this data, coverage of the entire country and a spatial resolution of 100m, a map scale of 1:25,000 is envisaged.
- Integration of geo-referenced data from any data owners willing to collaborate with the target to make them accessible for administration, research and other purposes in Switzerland and to deliver desired data combinations to an interested public.
- Processing and analysis of available data according to the specific requirements of users, as well as advice to and support of users for their own analyses and projects.

2 Bundesamt für Statistik: GEOSTAT - Benützerhandbuch. Bern, 1992 = Office fédéral de la statistique: GEOSTAT - Manuel de l'utilisateur. Berne, 1993.

- Cooperation with researchers and interested institutions to develop and test analysis methods and processing algorithms.
- Coordination, guidance and help for data collection, digitisation and use as well as for the establishment of a local GIS infrastructure, in regard to data formats, methodological aspects and later analysis, especially for federal government institutions.

Data sets in GEOSTAT

With the most recent data acquisitions, GEOSTAT can be said to have reached a somewhat mature state and to offer a basic complement of the most essential GIS data sets in high demand. The data presently available cover the multi-purpose needs of a majority of data users and can serve most of them as sufficient input for compiling reasonably detailed and diversified base maps, upon which they can easily assemble their own, specific, specialised thematic data layers. In addition, the data allows a multitude of interesting and challenging analyses to the user communities in federal, cantonal and local administration, in research and education as well as to a large number of private consultancy companies in the fields of planning, environmental issues, agriculture, sociology etc.

The table below provides an overview over the data sets presently available with their most important characteristics which are all described in detail in GEOSTAT's comprehensive user manual which is available through the Federal Statistical Office in German and French and is periodically updated[3].

Data category, thematic	Data set	Data structure	Resolution or generalisation level
Administration, Surveying	Administrative boundaries of Switzerland (communes, districts, cantons)	Polygons	1:25,000
	Generalised administrative boundaries	Polygons	1:300,000 1:500,000 1:1,000,000
Topography	DTM, height, slope, exposition; absolute and classified	Point or grid	Hectare
Geology	Simplified geotectonic map of Switzerland	Polygons	1:200,000
Hydrology, water resources	Swiss lakes	Polygons	1:25,000
	Swiss rivers and streams	Lines	1:200,000
Land cover, land use	Swiss land use statistics 1972	Grid	Hectare
	Swiss land use statistics 1979/85,		

3 Rainer Humbel: Geographical information systems for the analysis, presentation and dissemination of statistical data - the Swiss experience. In: Statistical Journal of the United Nations ECE 11 (1994), p. 19-33, IOS Press.

	15 or 24 aggregated categories Thematic background layers derived from the Swiss land use statistics 1979/85, 3 levels of generalisation, 17 aggregated categories	Point or grid Grid	Hectare Hectare
Population, buildings	Swiss census of population 1970 (3 variables, classified results, 750 communes, approximately 60 % of Swiss population)	Point or grid	Hectare
	Swiss census of population 1980 (54 variables, 620 communes, 50 % of Swiss population)	Point or grid	Hectare
	Swiss census of population 1990 (4,300 variables, entire country covered)	Point or grid	Hectare
Planning	Legal construction zones (residential and industrial zones; approx. 1980)	Grid	Hectare
Protected areas, inventories	Federal inventory of landscapes and natural features of national importance (BLN)	Polygons	1:25,000
	Federal inventory of bird reserves of international and national importance	Polygons	1:25,000
	Federal inventory of prohibited hunting areas	Polygons	1:25,000
	Federal inventory of upland and transitory moors of national importance	Polygons	1:25,000
	Federal inventory of river meadows of national importance	Polygons	1:25,000

Future perspectives

GEOSTAT will continue to collect, harmonise and evaluate georeferenced data and to make it as widely accessible as possible. The most difficult part in the future will be to guarantee free or reasonably priced data access to anybody. Copyright and property issues on digital data and the ever more complex juridical situation for data gathering projects will further slow down or in certain cases stop our efforts to prepare data for public use. The financial pressure on government agencies and the trend to implement market rules in the state administration make it already increasingly difficult to include digital data from government sources in the GEOSTAT framework. These circumstances may force us to shift our emphasis from data supply to function rather as an information centre providing free information about what geocoded digital data is avilable, on which terms, to which price, and where. Public libraries and services like ours will have to work together and share resources in this field of common interest.

European Research Libraries Cooperation:
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The Electronic Map Library: New Maps, New Uses, New Users

R.B. PARRY
Department of Geography, University of Reading

Why do we need an electronic map library?

Given the acquisitive habits of map librarians, the fact that digital data "are there" may seem adequate justification for building an electronic map collection. However, the cost of digital map acquisition, and the implications in terms of new technology and new staff expertise require more serious consideration. In this paper, three reasons for the acquisition of digital maps are suggested: firstly that they provide opportunities to create new maps (and to replace old ones); secondly that they provide new and valuable ways of visualizing and using spatial data; and thirdly that they will satisfy new kinds of users.

New maps

A growing problem for traditional map libraries is that many maps are no longer routinely published in conventional printed format. Many national surveys are now focusing their attention on the production of digital data rather than paper-based maps. The Ordnance Survey of Great Britain, for example, is no longer committed to providing printed copies of its largest scale maps, although plot-on-demand is available from OS agents through the so-called Superplan service. This trend has been even more evident in the case of thematic mapping, where the use of digital data in geographical information systems has reduced the need for expensive print runs of conventional soil, geological and other kinds of thematic maps.

Two examples, again from the UK, are apposite. A number of map library enquiries concern land cover information or climatic data. Such enquiries are now hard to fulfil from conventional printed paper sources. The last field-by-field survey of land cover in Great Britain, the Second Land Utilisation Survey, was carried out in the 1960s, and this, although largely completed, was never published in its entirety. Similarly with climate, a number of maps of Britain and the UK have been published in the past by the Meteorological Office or the Royal Meteorological Society, but many of these are out-of-print and the most recent detailed printed rainfall map was based on the International Standard Period 1941-1970.

Yet contemporary *mappable* data in both these thematic areas are available in digital format. Land cover data with a 25 metre resolution are available for Great Britain as a *Land Cover Map* derived by the Institute of Terrestrial Ecology from multitemporal Landsat imagery from 1988–91, while at the University of East Anglia, the Climate Research Unit has recently prepared a new baseline climatology of the UK using 1961–1990 averages. A common feature of these two products is that they are primarily digital data sets, designed to be used in a GIS environment. They may be utilized with a PC and both are designed for applications best achieved through the medium of computer software. The land cover map also forms part of a more general *Countryside Information System* (Department of the Environment, 1993), while the baseline climatology forms an element of a package called *SPECTRE*, designed to model the consequences of climatic change.

Many socio-economic data sets have commonly not been mapped in the past, presenting the map maker with many difficulties, both theoretical and practical. In digital form however they can now be mapped more readily, using the digital boundaries of the spatial referencing systems (EDs, postcodes, grids) used for their collection to create choropleth maps. The British census, carried out decennially since 1801, generated relatively few maps before 1970, and those few covered only a modest range of themes. The gridded data of the 1971 census however heralded the birth of many digitally produced census atlases, while from the late 1980s, and especially following the release of the 1991 census data and related digital boundary files, the printed census atlas has effectively been replaced by the do-it-yourself census mapping package epitomized by SCAMP-CD (Schools Census Analysis and Mapping Package), from Claymore Services, a low-budget set of key census statistics, digital boundary files and topographic detail which can be combined into customized maps using Claymore's MAP91 software.

New applications

The nature of of some of these datasets and the way they have been formulated hint at some intended applications. The digital land cover map provides a baseline for a programme of monitoring change in the countryside, while the climatic dataset contributes to the predictive modelling of climatic change. Geodemographic information from censuses and elsewhere can now be used to reveal a wealth of spatial correlations and co-variations, and is in regular use for market research. Digital road networks have provided a basis for route planning and optimization and for automatic vehicle location and in-car navigation systems. Not all these applications are appropriate to map library use of course, but they illustrate how the information formerly locked in static maps or tables can, in digital form, be manipulated to solve many problems more easily.

New users

The user base and the customary usage of different map collections vary greatly, but Figure 1 shows the four main pools of enquiry at the University of Reading's map collection. These categories are reflected in the nature of this kind of collection, whose stock-in-trade for the last twenty-five years has predominantly been modern topographic and thematic mapping world-wide. The share of usage between the four groups is not equal, however, being heavily weighted in favour of "reference" and "research".

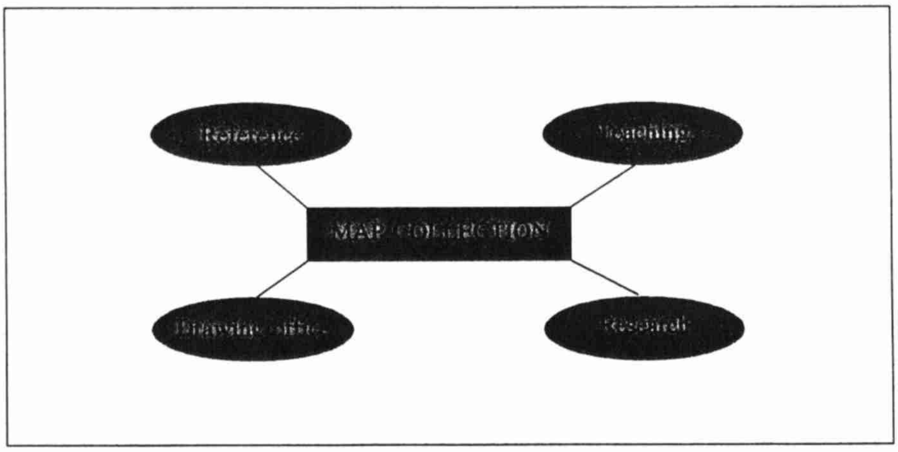

Figure 1: Pricipal pools of map collection users of a UK university map collection

The reference use attracts a widely spread range of users whose requirements are both eclectic and unpredictable. Research use on the other hand is characterized by a consistent use of specific spatial information over an extended time period, and research is increasingly making use of digital rather than analogue data.

At present, rather few from the pool of reference users arrive at the map collection expecting to gather information from digital maps (many are still uneasy about using conventional maps). But user profiles *are* changing, and there is a growing tranche of users who are both computer-literate and who *do* expect to find digital data in the contemporary map library (and often have high and unduly optimistic expectations).

Map collections must also be prepared for the up-coming generation. Young people presently in secondary (high school) education are not only veteran arcade gamers, but are also increasingly familiar with using CD-ROM based reference material both at school and in the home. Many of the new multimedia educational products (like Microsoft's *ENCARTA Encyclopedia*, for example) have attractive and interesting user interfaces, and entertaining and helpful ways of navigating through the rich files of data using Boolean logic and hypertext. Many of these products include maps. Within three years, Dorling Kindersley, a pioneer publisher in combining education and entertainment for young people, expects to have ceased publishing books in favour of interactive CD-ROM based learning products. Map curators therefore must also prepare to meet the expectations of the next generation.

Setting up the electronic map library

Having justified the need for electronic or digital maps in map libraries, one may consider how such mapping could or should be introduced. Two models are suggested for doing this, one radical and the other more cautious. The radical model, which has emerged primarily in North America, amounts almost to a paradigm shift for map libraries and the role of their curators. Although the new paradigm is as yet far from clear, at the very least it implies a comprehensive redefinition of user needs and the transformation of institutional and practical policies (see, e.g., Allen, 1993; Wong, 1993; Wood, 1994). This model has been catalyzed by the ready availability, and indeed the free distribution on CD-ROM to many American libraries, of public domain digital data, and by the enormous growth in a very short time span of data distribution through electronic networks, especially the Internet. Many subscribing to this model believe that unless redefinitions take place, there may be no future role for map collections and their curators (cited by Wood, 1994)!

In UK map collections, however, a second, more cautious model has been more typically adopted. Here, the introduction of digital mapping facilities has been tempered by government attitude to ownership of digital data. The UK government's Tradeable Information Initiative advocates full cost recovery for both the collection and dissemination of government data. This has led to a commodification of spatial data by government departments, resulting in high prices and tiresome copyright restrictions.

The consequence has been that map libraries have so far lacked the funds (or the influence) to become major players in the acquisition of digital spatial data. Indeed government mapping organizations such as the Ordnance Survey may have been wary of entering a serious dialogue with libraries on this issue because of the danger of data leakage to users who would otherwise be required to pay for it. Academic use of some government-supplied datasets has been facilitated by special terms for acquisition negotiated through a CHEST (Combined Higher Education Software Team) deal, but such arrangement are made for institutional research and teaching purposes and have tended to by-pass map collections. This situation causes immense frustration for map libraries, and it seems that any initiative must come from the library community. One possible solution is being explored by the University of Edinburgh Data Library; this involves the formation of library consortia for purchasing or leasing digital data, and the provision of controlled public access points to the data through a networked data service (Burnhill, 1994).

In practice, however, and pending further developments, many map libraries in higher educational institutions have taken a modest and independent route to digital map acquisition by purchasing a range of moderately priced electronic atlases and data sets which are available complete with retrieval and mapping software on CD-ROM or floppy disk. There is perhaps a further advantage in acquiring these kinds of products in that curators can catalogue, curate and control the use of them and so retain them unequivocally in the map collection's domain!

At one time, the high cost of computer hardware was also a major impediment to the acquisition of digital maps in map libraries. But now many mapping applications may be run on low-priced stand-alone PC or Macintosh systems. The hardware components need however to be chosen carefully since they determine to a large extent the digital capability of a map collection. In the USA, the government has defined the minimum workstation for Federal Depository libraries for its own CD-ROM products as a 486SX machine operating at 25 MHz, with 16 megabytes RAM, 3.5" and 5.25" high density disk drives, between 120 and 210 megabytes of hard disk memory, an IDE or SCSI interface and VGA display capabilities. Also required are a CD-ROM drive, Windows environment and colour printing or plotting facilities (Kollen and Baldwin, 1993). Already these specifications seem limiting. A 486DX machine with a faster clock speed and higher capacity hard disk would probably now be regarded as a necessary entry level specification, and a larger than usual screen size is advantageous. The message is clear: investment in hardware is not a once only cost, since it will inevitably require periodical upgrading. And while these costs may compare favourably with those of installing a few new metal map cabinets, the funding structure of the institution may not be adjusted to this new demand for high-end technology from the map library!

There are other institutional considerations for a university collection, where the map curator may be but a small player in the development of an overall information technology strategy. There are many vested interests: the university's computer services may wish to have control of the distribution of digital, including spatial, data, or the social science or economics library may regard geodemographic data as its own preserve. Map curators need therefore to promote themselves as experts in the handling of spatially related data sets.

What is available?

Computer map packages do not form a single tidy class, but straggle across a range of data and software programs in various combinations. There is much variation in what can be done with diverse packages, ranging from the simple screen analogue of the paper map or atlas, providing ready-made graphics with minimal possibility to modify the data or its presentation, to packages which have much of the functionality of a full-blown geographical information system. But whereas a GIS is essentially a software program (or suite of programs), most of the packages considered here are also rich in data and come ready to use.

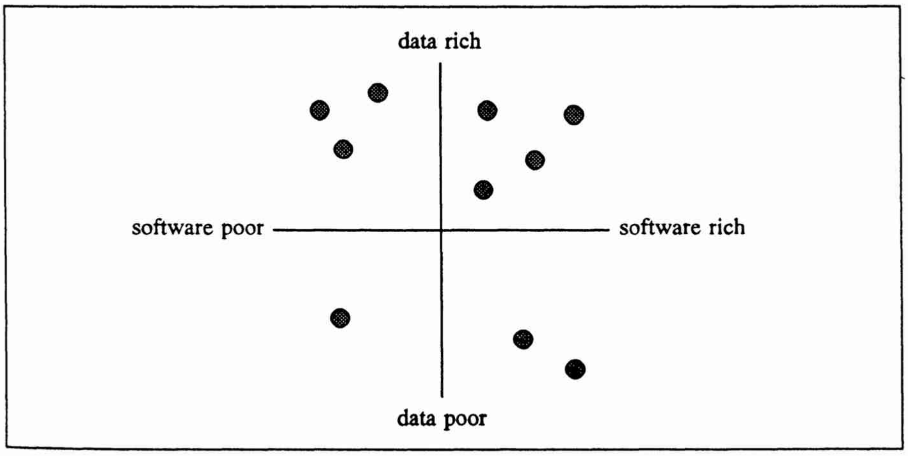

Figure 2: Classifying mapping packages by data and software properties

The best of them fall into the north east quadrant of Figure 2, being data-rich but also able to use the computer's power to explore and interact with the data and to customize their graphical presentation.

Regarding the functional capabilities of the packages, it is evident that there is a progression from static maps ("slide shows", or in Muehrcke's terminology "whole image" maps) such as the original *Electronic Atlas of Arkansas* to packages such Chadwyck-Healey's CD-ROMs of the 1991 population census of Great Britain, which allow a measure of data analysis and the construction of potentially unique thematic maps. There is not however a simple continuum from software poor to software rich packages. Software may be engineered for different kinds of application, as can be seen in Figure 3. Packages which are dedicated to on-screen drawing and design for example are quite different from thematic mapping packages which marry statistical data to an area-polygon base map.

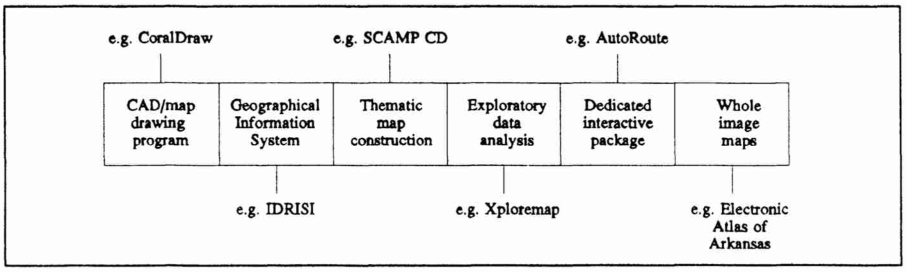

Figure 3: Types and examples of computer mapping packages

Of the sixteen stand-alone electronic map packages currently held in the map collection at Reading, most fall into one of three broad categories, namely electronic atlases, route-finders and statistical (thematic) mapping packages. Although GIS facilities are available in the map collection, these have not –so far– been integrated into the general map room services. Similarly, CAD-type drawing packages remain in the domain of the drawing office. While almost all these packages have potential for fulfilling both simple or more complex map enquiries, it is probable that the more complex the task, the more likely it will benefit from a "software rich" package.

Map users - what do they want?

A number of researchers, including (among those writing in English) Board, Castner, Morrison, Muehrcke and Sandford, have considered the nature and ordering of map reading tasks. Most studies however have been undertaken in the context of a map-communication model, or the learning of map reading skills, and have been more concerned with how the map is decoded than the nature of the enquiry which led to the map being read. Thus map reading complexity is defined in terms of the interaction of visual perception and map design rather than the sophistication of actual map enquiries. Sandford (1986) and Board (1984) are among the few who have given some limited attention to the nature of map enquiries, and Gersmehl (1981) suggested a graded series of behavioural objectives in topographic map reading on which Figure 4 is based.

Map curators, of course, know all about the nature and variety of map enquiries from their own professional experience! But they too have published little about this. As Gillispie points out (Gillispie, 1990), published studies have mainly made use of the circulation statistics of map type and user profile, such as are routinely collected by large libraries. But curators know that most map collection users seek information rather than a specific map, and, more often than not, it is the curator who defines the appropriate map source.

Map curators need to assess their users' needs if they are to find digital solutions to their enquiries, and they need to "think digital" in order to identify those kinds of map enquiry which can better be met by electronic rather than conventional paper map-based solutions.

Matching electronic maps with user needs

Map using tasks, whether of low or high order, may require either qualitative or quantitative information. While both may be provided by the conventional paper map, the digitally based electronic map or atlas has the potential to deliver *quantitative* information more efficiently than by conventional map reading.

Perhaps the simplest, low order map reading enquiry concerns the location of places, for example the country in which a place is located, where in a country a place is located, or increasingly, where in geographical space a coordinate reference (collected using GPS instrumentation) is located. Electronic world atlases are well equipped for dealing with some of these questions, with ability to search for a name and find the relevant piece of map, or to identify latitude and longitude by simply placing the cursor on the site. Their current limitation is in the poor resolution of screen maps, which is insufficient to meet many requests, and the absence of indications of data quality (many packages are vague about their sources, and are known to contain many errors). Furthermore, users looking for a location often require more than a spatial reference; they need a qualitative description of the place and/or its relative location.

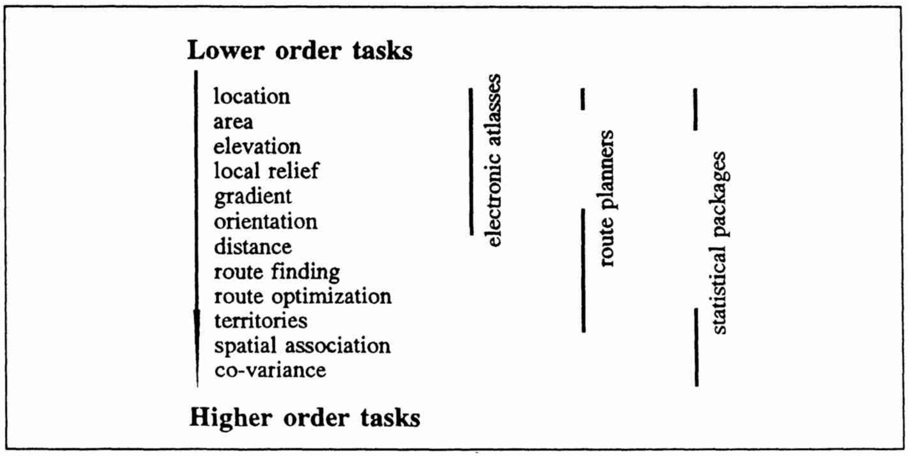

Figure 4: Relation of electronic map packages to map reading tasks (after Gersmehl, 1981)

This rather more sophisticated map reading task also needs a level and range of detail still only to be found in large conventional atlases or on topographic maps. Some compensation may be offered by the ability of many such packages to link maps to statistical or written descriptive information. In some recent products (for example DeLorme's *Map'n'Go*) the multimedia concept is exploited to provide slide shows, videos and speech to enhance the cartographic representation of place.

One not uncommon request is for the correct spelling of a place, and there is perhaps scope for an electronic gazetteer with a spell checking facility for standardized geographical names!

Many map reading tasks require the extraction of metrical information from maps such as altitudes, orientation, gradient, distances, and areas. Even some of the simpler electronic atlases have a capability to extract *some* of these data. A useful feature in the "utilities" menu of *PC-Globe* for example, is the calculation of direct line (Great Circle) distances between locations identified either by name (from the package's gazetteer) or latitude/ longitude coordinates. What these packages will not do is to select, filter and relate values in the way a real GIS would be expected to.

Route finding packages are generally more interactive than the electronic atlases just discussed. *AutoRoute,* has been the market leader in the UK, since its launch in 1988 by the company NextBase (now part of Microsoft), which used the Ordnance Survey 1:625,000 scale resolution digital road map as a basis for an intelligent route planner which calculates and displays fastest, shortest and preferred driving routes (Anthony, 1991). NextBase has subsequently produced packages for a number of European countries and the USA. Route planning may seem a trivial use of a map collection, but it is also a very common one and this and similar route planners provide a useful introduction to the "added value" which can be supplied by computerized maps. NextBase also recognized that the package had the potential for many other applications and has developed a companion package called *MapBase* which can be used to plan territories, calculate drive zones and add thematic information. But even the basic route planner is amenable to more than simple route planning, and was recently used at Reading to calculate a matrix of driving distances between 180 European cities.

The map displays for route planning packages are usually limited in content and design, since their function is to show the route calculated by the package, rather than the range of information needed when planning and navigating with a conventional atlas. This limits their use for general purpose map reading. A recent CD-ROM version of *AutoRoute* incorporates excellent 1:250 000 scale raster digitized Ordnance Survey maps of Great Britain, but these cannot properly be integrated with the route planning network, which is at a coarser scale. One of the most interesting packages to be launched recently, however, DeLorme's *Map'n'Go*, has succeeded in incorporating relatively high quality maps which adjust automatically and well to different zoom levels and on which route selections can be highlighted.

The most interactive electronic mapping packages in the range under discussion are the census mapping products which, for Great Britain, have been produced by Chadwyck-Healey and by Claymore Services. These are dedicated specifically to the retrieval and analysis of census variables, and combine the convenience of a stand-alone system with the potential for serious research with a major thematic data set.

One further kind of map use can sometimes be accommodated by electronic mapping packages: the user who requires a simple A4 sized base map which can be taken away for use in a presentation or written report. Requests of this kind are often extremely difficult to fulfil, notwithstanding the existence of a number of printed collections of reproducible outline maps marketed for this purpose. Electronic atlases offer a potential solution here, and are already much used for this purpose. The software for creating maps from digital data can be regarded as a set of map making tools. They do not offer the flexibility of a pen or a CAD package, but they do make the technical side of the operation one which requires relatively little skill.

Conclusions

The scenario of digital map use presented in this paper is one which involves map curators in a more rather than less interactive role with the users of their map collections. The gentle introduction of digital mapping into the traditional structure of the map room gives both curator and user an opportunity to discover and accommodate, to relate and compare the functionality of digital maps to that of their hard copy counterparts.

The ascendancy of digital maps has meant that the map collection's function and the curator's role have become less distinct. It has been suggested that map curators should be redesignated as "spatial data librarians", dropping the word map from their title (Lai and Gillies, 1991). But there is surely a danger here, because something which remains very important in the digital age is the appreciation of the power of the map as a graphic image more revealing than the data on which it is based. While completing this paper, a postcard from Canada announced the arrival of the *National Atlas of Canada* on the Internet. As Patrick McGlamery has observed, perhaps soon nobody will feel it necessary to visit a map room any more! Yet there are still plenty of people who need to understand and make sense of those graphic images, whether on screen or paper, and map curators are the mediators who can provide that essential guidance.

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Archiving Electronic Information: Some Aspects

NIKLAUS BÜTIKOFER
Swiss Federal Archives, Bern

Introduction[1]

Everybody who has been using computers for some years is no stranger to messages from the suppliers like: "Now, we are able to offer you our new enhanced system. Unfortunately, our support of the old system cannot be guaranteed later than 1996. Due to engineering changes the new system is not downward-compatible". Such messages are the beginning of the inevitable end of your system. You have to buy a new system and to migrate your applications and your data. By doing so you are likely to lose not only a lot of money, but also a lot of information. This example illustrates what difficulties archivists and librarians are facing today in dealing with electronic records, electronic books or electronic maps.

The revolution in computing and communication brought us new fascinating information products and more comfortable ways to disseminate these products. The revolution is steadily going on, it is transforming our work, our profession, and our institutions. We are all aware of that and cannot even imagine how our archives and libraries will look like in twenty years from now.

In this article I would like to show you how an archivist is approaching the issues emerging from the revolution of data processing. As an archivist of the Swiss Federal Archives I have to deal with records produced by the bodies of the Swiss Confederacy in conducting their official business. Records are in many ways different from books and maps, no matter if they are stored on paper or on digital media. Records give, or should give, evidence of communicated business transactions. In order to understand a record you have to know not only its content and structure, but also the context in which the transaction has taken place.

1 I thank Hugo Schwaller for his helpful review of this paper.

I do not want to stress the difference between archives and libraries. On the contrary, I believe that our issues and our methods in the electronic age are converging, as I will point out when preservation of online GIS (geographical information systems) are treated.

Objectives of archives

The mandate of archives is essentially to preserve information with a permanent value over time. There are three fundamental requirements for the preservation of information:

1) The preserved information must continue to be **accessible and retrievable**. It must be possible to find the information searched for and to output it. These requirements address principally the technology used for preservation and the finding aids available for research.
2) The preserved information must continue to be **understandable**, so that it can be correctly conceived even in hundreds of years. This requirement addresses principally the relationship between elements of information content.
3) The preserved information must continue to be **authentic** in a way that a user can be sure that the information he is getting through the system is the same information which the author originally has created.

While these requirements are quite trivial for long term preservation of paper records and paper books, they become critical in an electronic environment.

Below, I would like to point out on a general level, problems, consequences, and possible solutions. The first part is focused on preservation issues regarding technological change, the second concentrates on the issues of historicity and authenticity as they arise mainly in online databases like GIS.

Preservation regarding technological change

In order to make electronic maps accessible and retrievable, e.g. on a CD-ROM, one needs a complete system that is capable of reading the CD-ROM and finding and displaying the view of the map the user is looking for. Consequently, we have to preserve not only data on a storage medium, but a complete system if we want to keep electronic maps accessible. By rigorously reducing the complexity of the matter in hand, we can say that the system we need consists of data, software and hardware. Each of these elements has its own life cycle. Figure 1 shows a possible succession of hardware and software, as they become obsolete within 3 to 10 years. Reality, however, proves much more complicated; there you have a lot more components that are undergoing technological change in their own rhythm. Data for permanent preservation must follow the innovation cycle of hardware and software, and it is necessary to convert the data time and again to new technological environments.

```
| data A                   # conversion 1           # conversion 2
| software 1 | software 2 | software 3 | software 4 | ...
| hardware 1    | hardware 2 | hardware 3 | hardware 4  ...
|------------|------------|------------|------------|------------|---------> time
             5           10           15           20           25        years
```

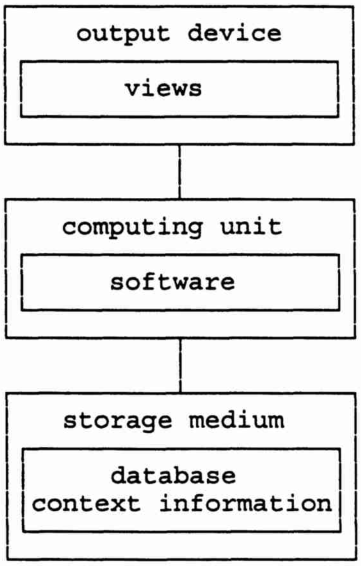
Figure 1: Succession of hardware and software generations

Although the time scale I use in Figure 1 is pure speculation, we can draw an important conclusion from it. We have to understand that we will not escape the necessity of spending a lot of our resources on converting data and migrating applications. I cannot see any possibility of archiving computers and software and keeping them running our electronic maps. Components of a computer do not have a long life, they must be replaced from time to time, and if each single component of a computer must be manufactured outside mass production, this becomes so expensive that we cannot afford it any longer.

If we cannot preserve computers and software we can, at least preserve what is essential, and that is information. It may already be commonplace that electronic information is not bound to a physical medium. A given piece of information can be transferred or copied from one medium to another with no significant consequences whatsoever at the logical level.

Information in electronic maps consists of all possible views of a given database and - as an archivist I have to point this out - of knowledge of the provenance, i.e. the context of the production of the database in order to be able to judge the reliability of the views. (Figure 2)

Figure 2:



There are three principal different ways to archive such a system:

1) Create and capture all possible views of an electronic map, or at least the most important views, and print them on paper or microfilm. This is the traditional method of archiving. The views can be preserved by conventional means, but the users will not be very happy with it because they all would like to work with computers and, consequently, they have to digitize the view whenever they want to work with it.
2) Preserve only the raw data in a form that is software independent as far as possible. Future users will have to import the data into their own system whenever they want to work with them. By archiving only raw data we are probably losing the original views because future systems will not have exactly the same software functions as the original system, and they will, therefore, not be able to create the same views as the original system.
3) Convert data and software functions into the successor technology whenever a system has become technologically obsolete. This method provides us with the possibility of shaping succeeding systems so that they can create views equivalent to those of the original system.

Each method has its advantages and its shortcomings. Method 1) may be a practicable way to archive systems with a complicated database on the one hand and few possible views on the other. Method 2) may be good enough for systems with a very low frequency of access, while method 3) yields the most comfortable result of archiving. But this last method is also the most expensive one.

Keeping historicity and authenticity

Electronic maps distributed on removable storage media will probably only be of transitory relevance. They will soon be succeeded by huge online GIS which are given access by using public networks. GIS consist of numerous datasets from different sources, and these datasets are continuously updated.

Such systems present both the archivist and the librarian with an enormous challenge. How can the historicity of information be kept and how can evidence of information authorship be kept? Both are essential for scientific work and for any future use.

There are, as far as I can see, two different ways of keeping historicity in GIS:

1) We can periodically make a 'snapshot' of the whole database and preserve the state of the database at that moment. After a certain lapse of time there will be a series of databases in our archives that will allow the reconstruction of historical change and evolution.
2) We can implement a facility in our GIS which automatically writes a record of every modification of the database in a history file. This file would allow us to reconstruct exactly the state of the database at any time we want. This is an essential requirement for systems which serve as a basis for official decisions. For audit purposes responsible authorities have to be able to show what information has been available when a certain decision was taken.

Authenticity as well as historicity is an important point in big GIS which contain information from different sources. Users both now and in the future want to know by whom and when the information they are reading was produced, and moreover, they want to be sure that the information is the same the author originally produced, and the same a colleague made reference to in his footnote. This is not trivia in a system that is continuously updated.

There are two means which both can ensure authenticity:

1) Secure the system from unauthorized alteration.
2) Create metadata of each modification so that we know author, time, and content of each modification.

Role of archives and libraries

To conclude I would like to ask about our role in the field of GIS. GIS usually are not produced and updated by or in archives and libraries. They are maintained by other profit or non-profit institutions which normally provide access to users. What roles should archives and libraries play in these circumstances? I can see four different roles:

1) Do nothing and concentrate on paper fonds. Leave the problem altogether to those who are producing and running GIS.
2) Transfer GIS to archives or libraries when they are abandoned by their producer and preserve them. In this case we are not able to ensure historicity and authenticity of the GIS because we have to take what we get, and that is the final state of the database.
3) Acquire regularly 'snapshots' or history files from producers and preserve them together with the initial state of the database. This method should be based on an agreement with the owner of the GIS.
4) Charge producers of GIS by law or by payment to ensure historicity and authenticity of their system and to provide access to any user. In this case, archives and libraries would reduce their functions to information locator services providing only reference and access information of available information systems.

There can be no question what I recommend to do. Only by playing role three or four can we preserve our profession over time.

European Research Libraries Cooperation: The LIBER Quarterly, 5 (1995), 280-286.

Maintenance and Archival Storage of Digital Media

KARL BÖHLER
ETH-Bibliothek, Zürich

Mr. Klöti has introduced me as the killjoy of this day. Somehow I must agree with him, but please, don't think that I would discourage you - I really do not hate computers and I'm also not a frustrated operator. But experience taught me to be very mistrustful when installing peripherals or software.

Mr. Bütikofer just explained very interesting problems concerning data conservation, as they arise in big archives and libraries. My following remarks deal with two aspects: firstly with the beginning of a CD-ROM career, and then with conservation of the digital trash, when new products replace today's digital maps. Of course this will not be in great detail, but only in some selected aspects, that I often met with myself or in discussions.

Let us assume that most of you are not yet lucky owners of cartographic computer systems and that you came to this conference because you have already some experience in this matter or because you intend to introduce digital map media into your collection on a little, local base; on floppies or, in particular, on CD-ROMs. If this happens in the near future, my following remarks may help you to avoid some discouraging afternoons and evenings, when you have no PC-freak at hand, who installs everything for you.

And do not laugh too loudly, if you are already running cartographic programs on your PC - you may be assured that the next software update is bound to come. Even when the publishers promise solemnly that there will be absolutely no problem with the totally revised version, you can be sure to meet some unexpected problems.

There is generally only one qualified exception: If you own a Macintosh, one year old or more, with integrated CD-ROM drive and adapted software approved by Macintosh, you can be happy that all components fit together and your system will work. Power Macintoshes work quite well, but too fast for most commercial programs; you really need power brakes; we are actually testing several models. But all the others will meet some problems. Therefore, in the next minutes I shall talk only about MS-DOS, IBM-compatible stand-alone systems; networks and other widespread systems are omitted.

We know that in most libraries PCs are already in use, and now software for CD-ROM installations and hardware peripherals like a CD-ROM drive are being bought. As you know, there is a route between the CD-ROM, where the maps are digitally stored, the CD-ROM drive, the cables, the host card, the CPU, the software on the hard disk, and the screen, where you should see the digital maps, as shown in the glossies of the map publishers - and everywhere along this route a hazard may happen.

Let us talk first about the PC. There are several basic needs for a PC to run complex programs such as cartographic systems. A 286-class CPU is powerful enough for most text- and data-based applications. But it runs out of snuff when you want to start programs working under Windows. Windows will work on these PCs in an enhanced mode, but you may wait minutes until the next action follows. In other words: you need at least a 386 or, better, a 486. Of course, when you want to save money, you can buy a CPU upgrade board or chips for many 286 systems, though you want to be careful about investing too much money in an old, worn-out system.

There is still another important reason for replacing your old PC which you should note, if you intend to buy a new one. You never can have enough memory and storage. Most of today's programs require a minimum of 4 Mb RAM, but for cartographic applications that are near to a multimedia level, you should realistically have 8 Mb at least, preferably more.

In any case the hard disk must be replaced if you still have a common one with 40 Mb, as they were sold until 3 or 4 years ago. Today they are absolutely insufficient. Windows alone needs up to 30 Mb to work! Most CD-ROMs load various files with 5 Mb and more additionally on your hard disk and it adds up as you install more and more CD-ROMs, updates and additions. You can get away with an 80 Mb or even a 60 Mb hard disk drive if you are dealing only with text-based applications. I recommend at least a 100 Mb hard disk, for multimedia and map applications better 160 Mb and more is better.

The next component in our chain is the monitor. Many graphical programs need a Super VGA monitor, but they generally work also with a common VGA-monitor. But it's recommended not to save money when you buy a new one: a good and wide screen, at least 17" diameter, takes care of your eyes. Spend a lot of time testing several monitors, concerning colours, sharpness and flickering suppression.

The link between the PC and peripherals is normally the so-called "card" inside the PC. Every stand-alone CD-ROM drive is sold with an interface card, a cable connection you have to plug in, and a software disk. Refer to your PC handbook how to install the card. It may be replaced instead, for example, by a SCSI host adapter - this will allow you to run multimedia applications. But other problems arise which we cannot discuss here.

By the way, cards are good for surprises, too. on my last adventure I intended to set a new SCSI card into a 4 year old Olivetti PC. Everything worked well - only the PC couldn't be screwed together anymore, because the card is so overfilled with ICs and transistors that it exceeds the inner space of an aged PC.

The next component is the CD-ROM drive. It is a myth that they were subjected to worldwide standards on which any CD-ROM would work on. You will have no problems when you choose an integrated CD-ROM drive, but then you get another disadvantage: when your PC is defective you have neither a PC nor a CD-ROM drive and vice-versa. Stand-alone CD-ROM players can be exchanged or replaced at any time.

The physical installation of a drive should not cause too many problems, even to a novice, taking not more than an hour. The major reasons for a failed installation are ill-fitting interface cards, incorrect cabling, or wrongly installed software. Once installed and screwed together, you will start up the PC and get some messages on your screen. When a mistake happens, they may be one of the following two most frequent:

"INCORRECT DOS VERSION"

There is a DOS-file named MSCDEX.EXE that controls the CD-ROM drives. As CD-ROMs are relatively young peripherals, this very important but originally not preseen file has already reached many updates for fitting to DOS-versions. Each version of MS-DOS requires specific versions of MSCDEX.EXE, as you can see here. Driving with an older version than MS-DOS 5.x is practically hopeless. In any case you should update older DOS versions to DOS 5 or 6. Otherwise you will always have trouble, because actual CD-ROM applications are not intended for versions below - and always copy the latest MSCDEX.EXE version you can catch!

Versions of File MSCDEX.EXE

X = compatible
- = not compatible

	DOS 5.X	DOS 6.X
MSCDEX.EXE Vers. 2.23	-	x
MSCDEX.EXE Vers. 2.22	-	x
MSCDEX.EXE Vers. 2.21	x	x

"CDR 101: READ FAIL"

This is the most terrible message you ever can get, because several problems produce it. Here are the most frequent two:

First: Incorrect drive identification. Most CD-ROMs have installation software. Nevertheless it may occur that the drive's name in the CONFIG.SYS and the name in the AUTOEXEC.BAT may differ. Generally the software gives a name like CDROM001 for the CD-ROM drive. If you update your files or if you try the installation again, the installation software finds already a CDROM001 and consequently gives the next a new identification, as CDROM002. Starting up, the system finds in his CONFIG.SYS a drive 1 and in his AUTOEXEC.BAT a drive 2. Therefore: compare the names of the drive in the two files; they must be identical.

File CONFIG.SYS (sample)

```
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\DOS\EMM386.EXE NOEMS X=D000-D7FF
DEVICEHIGH /L:1,12240 =C:\DOS\SETVER.EXE
DEVICEHIGH /L:2,9088 =C:\DOS\ANSI.SYS
DEVICEHIGH /L:2,14160 =\DEV\HITACHIA.SYS /D:CDROM001 /N:1
/P:320
DOS=UMb
LASTDRIVE=G
BUFFERS=40,0
FILES=40
COUNTRY=041,,C:\DOS\COUNTRY.SYS
INSTALL=C:\DOS\KEYB.COM SG
STACKS=9,256
```

File AUTOEXEC.BAT (sample)

```
@ECHO OFF
LH /L:1,7792 nlsfunc
LH /L:2,32096 \BIN\MSCDEX.EXE /D:CDROM001 /M:8
LH /L:0;2,45984 /S C:\DOS\SMARTDRV.EXE 1024 512
LH /L:2,16832 C:\mouse\mouse.com
LH /L:2,6512 C:\DOS\DOSKEY
PROMPT $p$g
PATH C:\DOS;C:\WINDOWS;D:\PCTOOLS;C:\BAT
SET TEMP=C:\temp
```

Second: Conflict with DMA. When you install the interface card, you will see that there are still many other slots you can put in other cards. Each slot has an internal address. It may occur that your interface card is adjusted to an address already occupied. Try it again by setting your interface card into another slot; otherwise you have to consult your installation handbook how to change the default address on your card. Do not forget afterwards to check again the CONFIG.SYS and the AUTOEXEC.BAT file for identical drive names!

Finally a word about the CD-ROM disks themselves. It is also a myth that they run in standardized modes on MS-DOS, Macintosh, UNIX or hybrid systems. Most standards were set by the industry, which has been generally good about following them. Others, such as the ISO 9660 standard, have become more formalized. But be aware, the famous ISO 9660 deals only with the file system, which means the manner in which information is indexed on the disc. Do not get too enthusiastic when you put in a CD-ROM for the first time and you type the DIR command. You may get the whole filelist, but you can not run any programme, because they are not written on a compatible platform. On the other hand you may get the message "DISK IS NOT ISO 9660" and the disk runs in spite of it.

It may depend on the CD-ROM drive, too. Panasonic drives, for example, often refuse CD-ROMs that run without any problems on any other drive, only because the disks are not fitted to the Panasonic software subsystem; on the other hand I own a Philips drive that digests practically every CD-ROM, even when all the others refuse disks as not ISO 9660.

A hint: before you purchase any cartographic system on disk or floppies, read carefully the small print about the technical needs of the software. The indication "ISO 9660" or "IBM compatible" or "MS-DOS Ver. 3.0 and higher" is not enough. Whenever you see something like "Panasonic", "Sun" or other trade names of producers, you should be careful because the program may need appropriate hardware! In any case you should bargain for the right to give back the program set when it cannot run on your machines. A good dealer must guarantee for the compatibility of your PC, your CD-ROM drive and the applications and let you see how it works, directly on your own PC before you subscribe to a deal! !

Now some remarks concerning the future.

In the past the map librarian had few problems. There was only one technology available for presenting information and its access tools for the library's user; maps were generally printed. The new technologies will bring many new problems because they depend on machines. You can read more and more, so that not only the good old paper, but also floppy disks and even CD-ROMs will be replaced soon by datahighways and other on-line systems like e-mail and so on.

I am not gifted with prophecy, but I dare say that not only map librarians will work on in quite conventional procedures. They will, however, be forced to observe some additional tasks. For those charged with archival collections, here are some tips on how to conserve electronic maps and systems, using PCs:

1. Always make safety copies of your programs, before you install them on your PC. Copy each floppy disk. If you have access to a WORM system, duplicate your CD-ROMs or play them on a streamer. Even if you locked the floppy-disks, it may happen in a confusion or a crash that your programs getdamaged. With a copy in a safe place, losses can be avoided. Copy your floppy disks after 5-7 years on new ones or store them on a tape (and copy this tape onto a new after one some years, too). A tip for Swiss participators; the new Swiss Copyright Law explicitly allows a safety copy of every software disk, even when the producer or publisher threatens jail and other punishments.
2. Do not trust your PC's hard disk. Even if you intend to use your most sophisticated PC for years and years, you will be required one day to refresh the hard disk for several technical reasons. It is good to know how the software and the data for your digital maps can be restored at any time. It is better to build up the original systems; backups always include all the corruptions that happen while using systems, in particular if you work with Windows.

   Make (besides the above mentioned disk copies) a documentation of all software needed by the map programs, e.g. the DOS-version, the Windows version and any system platform you need for your digital maps. Do not forget to keep a safety copy of these programs. Finally, do not throw away the handbooks of these programs after use, even if they are greasy orvery fragile.

3. The estimations of a disk's life vary extremely. Floppies are said to fall into decay after 5-10 years, aging tests claim up to 100 years. It will depend on the quality of disk, as has been proved by the CD-ROMs. Estimates vary from 5 to 30 years.
4. Take care of your CD-ROMs! Do not put labels on them for two reasons: CD-ROMs revolve at up to 30,000 r.p.m and eccentric labels may throw the disks out of balance, which causes mis-readings and damages the player; the adhesive of the labels can seep through the protection layer and damage the information surface. Do not write on the surface with a felt-tip marker; do not scratch them; store them out of direct sunlight.
5. A last tip for a not so distant future: do not forget that today's systems will be antiquated one day. When you work with an old fashioned globe, you need only your eyes and expert knowledge; in the year 2014, when you want to work with the digitized map you ordered just yesterday, you will need a machine that can read the old-fashioned disks, and a software that may convert the programs and print out the maps.

And a last, pre-nostalgic comment:

It is quite funny to put a zinc disk, recorded by Mr Edison himself, on an original "speaking machine" with an enormous bell and to listen to Caruso. You may buy the same records, digitally remastered, on audio CDs, but can you really understand (in front of your Hi-Fi tower) why our predecessors had a passion for Caruso, even if the audio quality is out of discussion?

For the same reason I recommend that curators keep at least one set of today's PC, CD-ROM drive and printer. In the for-mentioned year 2014 it will be easier to run on the original machines one of the exciting cartographic map program system we were shown - and you and your students will better be able to understand why people at a meeting in Zürich, 20 years before, were so filled up with enthusiasm when they admired so-called digital maps on giant and finger-driven grey boxes...

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The Colour Microfilm as Preliminary Stage of Digital Maps

MARTIN GUBLER / THOMAS KLÖTI
Stadt- und Universitätsbibliothek, Bern

In the following text you will find first some general information about the Ryhiner map collection and research project by Thomas Klöti. In the second part Martin Gubler, a specialist in colour microfilms, will give information about the technical aspects of the topic 'colour microfilms as preliminary stage of digital maps'

The map collection and the research project

The Bernese statesman Johann Friedrich von Ryhiner (1732-1803) collected 16,000 maps, townplans and topographical views of the whole world[1].

The legislative assembly of the Canton of Berne in Switzerland decided in the year 1993 to start a research project on the ' Ryhiner map collection '. The initiators of this project are the Institute of Geography of the University of Berne (Prof. Dr. Klaus Aerni), the City and University Library of Berne (Prof. Dr. Robert Barth) and the Bernese Cantonal Archive (Dr. Karl Wälchli).

The following persons are on the staff of the project: Dr. Thomas Klöti (geographer, head of the project), Martin Kohler and Caroline Hablützel (map librarians) and the restorers of the City and University Library of Berne (mainly Monika Lüthi and Gabriela Grossenbacher). The colour microfilm is made by employees of the Fotolabor Martin Gubler.

In February 1994 we started the Ryhiner project in the City and University Library of Berne[2]. For the whole project we will need four and half years. The main parts are to create an online map catalogue, to restore the collection, to

1 Thomas Klöti, Johann Friedrich von Ryhiner (1732-1803): Berner Staatsmann, Kartenbibliograph und Verkehrspolitiker. (= Jahrbuch der Geographischen Gesellschaft Bern 58/1992-1993. Bern 1994.)

2 Thomas Klöti, Karten in der Stadt- und Universitätsbibliothek Bern. Die Erschliessung der Sammlung Ryhiner. In: Berner Zeitschrift für Geschichte und Heimatkunde 56, 1994, p. 179-189.

produce colour microfilms and to publish results of this research project. The map catalogue is part of the on-line catalogue DSV SIBIL (Deutschschweizer Bibliotheksverbund Bern-Basel). You can access this catalogue from everywhere through INTERNET[3].

We also intend to publish this catalogue. For the publication we have to establish a separate plan to finance it. As yet we have not taken a decision about the form of this publication because we need first to review the technical progress. The possibilities are, for example, to publish a printed book or a microform without or with images, to make a CD-ROM or CD-I, but also to distribute digital images and data through World Wide Web. Use of the colour microfilm CIBA-Micrographic in the preliminary stage will make all these alternatives possible.

However, the first objective of this colour microfilm is to have one security copy and one copy for general use. In this way we can achieve an optimal protection of the Ryhiner Collection. In archives and libraries the method CIBA-Micrographic is recommended. The Federal Office of Civil Protection of Switzerland, for example, only subsidizes this method of colour microfilms. During the preparatory stage of the project we examined various contractors' offers. The high quality offered by the Fotolabor Martin Gubler has convinced us of their suitability, which was confirmed by references from Swiss archives and libraries for which this firm also makes colour microfilms.

The path to the digital map via colour microfilm

Description of the problem

Archivists and librarians throughout the whole world have done valuable work in that they have, in a time of naïve belief in progress and throwaway mentality, saved from destruction irretrievable cultural possessions. These are being stored and well protected in safe depositories. If it is necessary that these treasures of art and culture are made accessible to experts or the general public only minimal physical strain should be put onto these original artefacts.

Approaches to Solutions

There is no question that one should take advantage of the most modern technologies available. The problem can be approached in a linear fashion by applying one single method. However, systematic approaches are equally

3 Telnet access: telnet as3.afibs.ch, application cicsub. No Password or UserId. Gopher access is also possible.

noteworthy. The possibilities of digitisation incorporate the tremendous advantages with which you are familiarising yourselves in the other contributions in this issue of The LIBER Quarterly. Questions of permanence, of compatibilty and of uncertainties in price trends have to be answered if one is thinking for the centuries to come. It is here that colour microfilming provides a noteworthy piece of the puzzle within the archiving system.

Colour microfilming

In a short overview we would like to show you how a colour microfilm is made. The most important prerequisites are a camera system, film material and the developing process. All parts of the camera system consisting of camera base, head, and table are operated and controlled by integrated multiprocessors. The camera operator is guided via monitor and is informed about the current state of operations. Part of the camera base is a vertical column with a height-adjustable, factor-controlled carriage and a high-quality lens. Thanks to exchangeable heads different formats like 35 mm, film-card, and whole fiche can be used. Originals are placed onto the 'book-seesaw' or the level table and are for the short exposure illuminated by filtered halogen spotlight. Books, maps, plans, blue-prints, etc., or three-dimensional objects can serve as originals.

Another important link in the microfilming chain is the film material. Ilford Company produces the high-resolution film we are using. This product is based on the silver-dye-bleach process utilising dies with a high stability concerning non-fade properties and archival conditions. The resolution of the film is more that 300 line-pairs per millimetre (lp/mm). In terms of sharpness, it can therefore be significantly better than chromogenic material (approx. 80-100 lp/mm). Tests concerning light and archival stability conducted by independent institutions have yielded results of at least 500 years which is comparable to black and white material[4]. This microfilm contains that much image information when a reduction factor of up to 30 times is used that it can be called an 'inter-original'. The microfilm can now be the basis for further applications, be they conventional or digital. The actual original artefact can now confidently be stored in a safe place. The microfilm can also be stored in an archive or it can serve as basis for digital scanning. Once in the form of a digital database all possibilities of electronic data processing are applicable. As files in different formats the images can be altered, improved, ordered, transmitted, etc. What one is left with in any case is the inter-original that can again in 50, 100, or more years be subjected to the latest technologies.

4 Wilhelm, Henry (1993), p. 6 and 199-200: The permanence and care of color photographs : traditional and digital color prints, color negatives, slides, and motion pictures. Grinnel (Iowa), Preservation Publishing Company.

Example of Archiving the Ryhiner Collection

When the City and University Library in Berne wanted to archive the 16,000 old maps, plans and topographical views they opted for a system based on colour microfilm as an 'inter-original'. The maps are transported in batches of approximately one month's worth of work by the company Fotolabor Martin Gubler to Märstetten (Switzerland) and there are microfilmed on 35 mm roll film. After a final control both films and folios are returned to Berne.

Advantages and possibilities of the 'inter-original'

Based on the 35mm inter-original all options are available; the original maps are all of different sizes, while now on the 35 mm film, they are all equal. This simplifies the digitisation considerably. How the images are digitised is a question of purpose and cost. The most inexepensive variant is the KODAK Photo-CD, where one can scan without special treatment costs for about Swiss Francs 1.- per image. The Photo-CD not only offers financial advantages but, thanks to its format, can be processed in practice on most hardware as well as large-format bubble jet prints. The data transfer is made through existing networks as it has been done for a long time in text processing. Other variants of digitisation exist in the area of lithography. Based on the digital lithograph any printed material can be produced. Even the 35mm film-scanner incorporated in relatively inexpensive colour copiers can quickly produce hard copies to be used as work prints or archiving aids.

So far we have looked at colour microfilm from a conventional point of view. Looked at from the digital side the inter-original represents a data base with several advantages.

- It is very cost-effective: 10-20 Mb storage space only cost approximately Swiss Francs 5.-.
- It is forgery-proof because any manipulation of the inter-original is visible.
- It is system-independent, i.e. it can be utilised even after decades with technologies that are hitherto unknown.

Summary

Whether you as curators of maps are optimists, realists, or pessimists, with the colour microfilm you have a depository of information in your hands that, on the one hand can be utilised as basis for digital processing but, on the other hand, is still of use if only a candle and a magnifying glass should be available.

Colour microfilm offers every protector of cultural assets a possibility to save unique valuables in the form of inter-originals. Based on this all forms of digital processing can be applied.

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Describing Geomatic Data Sets with ISBD and UNIMARC: Problems and Possible Solutions

JAN SMITS
Koninklijke Bibliotheek, The Hague

Identification and retrieval

"O brave new world, that has such people in it. Let's start at once", exclaimed the Savage in Aldous Huxley's famous novel when he met the first representatives of the new society. However, his new acquaintance retorted: *"You have a most peculiar way of talking sometimes. ... And, anyhow, hadn't you better wait till you actually see the new world?"*[1] Before we fall for the magic of a new possibility we have to check if and how we can control it to make practical use of it.

Since the first appearance of the ISBDs in the early 1970s many have been published for specific materials: monographs, serials, non-book materials, cartographic materials, music, antiquarian items and, only recently, computer files[2]. All of them fit well into the ISBD(G) in which only area 3 (material, or type of publication, specific area) is not defined specifically. All these ISBDs were primarily developed "to aid the international exchange of bibliographic records between national bibliographic agencies and throughout the international library and information community"[3]. This was a laudable goal except that the exchange of bibliographic records was intended to be realised electronically. For

1 Huxley, Aldous. Brave new world, Chatto & Windus, 1932. The implication of this quote might be that map curators, like the Savage, could revert to old ways because they are daunted by the new technologies.

2 The first draft appeared in 1986. As there was not then much experience with computer files in libraries areas 3 (type and extent of file) and 5 (physical description) were still causing many problems.

3 ISBD(CM) : international standard bibliographic description for cartographic materials / recommended by the ISBD Review Committee. - Rev. ed. - London : IFLA Universal Bibliographic Control and International MARC Programme, 1987. P. 1: purpose.

this purpose MARC-formats were created from the late 1960s onwards. Unfortunately, as this depended on available hard- and software many different MARCs were developed, albeit on the same basis and with the same functions. IFLA tried (and still tries) to alleviate the problem of exchange by creating UNIMARC with the primary purpose of putting an exchange format at the disposal of the library and information community.

However, the MARCs have more functions than only supporting the exchange of bibliographic records. Indeed they code information within a bibliographic record in such a way that electronic retrieval is made possible. This function is even more important than the exchange function as it makes our bibliographic records machine-processable and allows us to query the contents of a bibliographic database in such a way that we can trace information according to most of our requirements. Here lies the added value of MARC compared to ISBD. Where ISBD is primarily developed to identify specific publications, the MARC is primarily developed to store and process information contained within these ISBD-records and beyond. To enlarge this function of retrieving information most MARCs have been complemented with a "coded information block" and an "intellectual responsibility block". In this respect, UNIMARC is possibly one of the most complete standards so far available[4]. But it also creates many problems. As information needs to be standardised, especially in the coded information block, and be acceptable in the user community when new codes are added, the revision cycles are too long for practical use. I shall try to propose a possible solution to this problem in the course of this paper.

Published and unpublished materials

Up to now we have described cartographic materials which have been published as finished products, e.g. maps, globes, aerial photographs, CD-ROMs, etc. However, in our field there are many remote-access cartographic databases which are dynamic and available to the public. If we do not possess a certain cartographic item we usually refer our client to the organisation which has it at its disposal. The same is true for digital cartographic databases which are only available online or from which one can order a part or the whole on request. It is highly unlikely that we shall ever possess the bigger databases ourselves (I am

4 UNIMARC manual / ed. by Brian Holt with the assistance of Sally H. McCallum & A.B. Long. - [London] : IFLA Universal Bibliographic Control and International MARC Programme, 1987. Coded information block: p. 52-134; Subject analysis block and intellectual responsibility block: p. 289-347.

A second edition of the UNIMARC manual has been issued in 1994: UNIMARC manual : bibliographic format. -2nd ed. - München [etc.] : K.G. Saur, 1994. - (UBCIM publications - New series ; Vol. 14).

referring mainly to base maps, etc., of official organisations) because we cannot afford them financially[5]. There is a real danger that some of these base maps may no longer be published in hard copy in the future or only on request[6]. Will that make our holdings into collections of old maps or will they evolve into cartographic information centres? As far as I can glean from developments in the U.S.A. and Canada and within the Koninklijke Bibliotheek I think the latter is the more likely[7]. If so, this means we have to know the contents and potential of these databases and integrate them as metadata descriptions into our bibliographic apparatus[8]. This may make our field of work more diffuse than it is, at least for the time being. So far we have occupied ourselves with

5 The total update of the "Topographic subjectmap of The Netherlands" of the topographic survey will cost appr. NLG 420,000.-. The "Photographic map of The Netherlands" of the private firm ROBAS in hardcopy costs now NLG 518,000.-, and will be flown every two years; when the colour aerial photographs will be digitized the price will not be less. The Netherlands is a small country, so I presume that larger countries have to think in millions.

6 See: James D. Elliot: Digital map data: archiving and legal deposit implications for U.K. copyright map libraries. In: ERLC The LIBER Quarterly, Vol. 2(1992), No. 2, pp. 119-127.

The municipalities of The Hague, Utrecht and Amsterdam have now ceased to publish large scale maps (1:1,000 and 1:2,000). Also The State Service for Road- and Waterways Management has ceased to publish the 'Waterstaatskaart van Nederland 1:50,000' (Water Management Map). My experience up till now has shown that hard copy of remote-access dynamic digital maps on request is far more expensive than traditional analoguous material, because there is no large print-run anymore and because production has to be more cost-effective. Whereas an A0 analoguous colour map would cost something like NLG 15.-, the same map, but now digital, will cost at least some NLG 35.- for an A4 hard opy, which is a differential rate of almost 20.

7 Chris Perkins of Manchester University believes that the differences in the level of service will increase. On the one hand there will be a few well-equipped map collections which can offer a large array of conventional and digital services (the elite groups in society), on the other hand a large majority of map collections will continue to offer only analogue products to their clients.

See: Chris Perkins: De kwaliteit van kaartbeheer en kaartdocumentatie in het GIS-tijdperk. In: Kartografie in het GIS-tijdperk / red.: P.G.M. Mekenkamp. - [Amersfoort : NVK, 1994]. - (NVK publikatiereeks ; nummer 11). Pp. 59-68.

8 I do not agree with Chris Perkins who suggests in his paper [see above] that the only short term solution would be to set up separate bibliographic databases for digital and analoguous cartographic materials. Especially since there are as yet no descriptive standards for digital material, this suggestion may even widen the gap between the elite and the poorer map collections. In view of the continuity in time of cartographic (geo-referenced) information I feel that his proposal shows the same kind of bias as that of people wishing to create separate bibliographic databases for old and modern cartographic materials, merely because present use seems to indicate such a course (which I doubt). If this is realised, inevitable problems will arise when modern materials become old materials, as separate databases tend to diverge in standards and contents.

cartographic materials. But when it comes to databases, our scope will be enlarged to the whole field of geospatial data[9]. Many databases do not contain maps. They contain geo-referenced data and can also contain programmes with which one can create maps. If not, a separate programme has to be added to create maps. Though it is in visualisations of spatial data where our main qualities as map curators lie, we have to upgrade our knowledge in order to handle the underlying unprocessed data to be able to (help) create such visualisations. This in its turn will probably show itself in the descriptions we will add to our cataloguing apparatus[10].

ISBD

Let us first try to see whether the present ISBDs can be used for describing electronic documents and what problems they might pose.

9 Part of the title of this paper derives from the the Canadian publication Geomatic data sets : cataloguing rules. In this publication 'geomatics' is defined as follows: "The scientific and technical domain concerned with methods, procedures and technologies associated with computer systems for the collection, manipulation, display and dissemination of geographically referenced data". This may be the field with which map curators in future will occupy themselves, thereby broadening their field of work to include production and use.

See further: Velma Parker (ed.): Geomatic data sets : cataloguing rules / prepared by the Canadian General Standards Board ; approved by the Standards Council of Canada. - Ottawa : Canadian general Standards Board ; Canadian Library Association, 1994.

10 It would be a great help if throughout the world initiatives were taken as are now taken in the United States of America. In President Clinton's Executive Order of April 11, 1993, titled: "Coordinating geographic data acquisition and access: the National Spatial Data Infrastructure" he called upon the Federal Geographic Data Committee (FGDC) "... [to] adopt a schedule ... for documenting, to the extent practicable, geospatial data previously collected or produced, either directly or indirectly, and making that data documentation electronically accessible ...". This has resulted in the following standard which is meant for producers: "Content standards for digital geospatial metadata (June 8). Washington D.C., Federal Geographic Data Committee, 1994". [I could not ascertain why extra-terrestrial spatial data are for the time being excluded.] These standards describe in minute detail how a producer should create a metadata record of a certain digital set and what kind of information the elements should contain (including as to fitness of use). However, the standards are not meant in the first instance to provide for ISBD- or MARC-descriptions. But certain elements are analogous to or can be used in MARC formats as was pointed out by Gary Fitzpatrick of the Library of Congress. I think it worthwhile to consider whether European producers can match this initiative in cooperation with supranational bodies, maybe also at the instigation of map curators?

The standards and related documents are available from anonymous FTP server fgdc.er.usgs.gov in directory GDC\METADATA or on the Internet by electronic mail on gdc@usgs.gov.

When describing cartographic materials we can work with ISBD(CM), ISBD(A) and ISBD(CF). Of course it is possible to use all three for one cartographic data package[11], as the ISBDs are not mutually exclusive. Though the ISBDs are created for the description and identification of certain kinds of materials, where the material is more specified by its form than by its contents, future developments can be incorporated. Should one cataloguing agency decide to use only one of the ISBDs the same material might be described by another cataloguing agency with a different ISBD. In this way arbitrariness is introduced, and that is one of the possibilities we want to prevent by using the same kind of rules for the same kind of material. It would be wise for the ISBD Review Committee of IFLA to put more emphasis on the possible integrated use of the ISBDs with reference to these problems in the next revision cycle of the ISBDs.

When describing cartographic materials I usually emphasise that I do not describe a certain document for identification purposes[12] but that we are mainly interested in analysing its contents and putting them it in a form which helps us meet the demands of our clients. For me the ISBD is a vehicle to give such form to a description that it is internationally understandable. Which does not mean that ISBD has no inherent value: it provides us with a structure.

As soon as we are able to describe digital maps and databases there are two more or less defined types that we will have to handle. There are the products which are finished and there are dynamic databases. Finished products have a certain lay-out and have identifying data like more traditional materials, like a title page, credits, physical data, edition statement etc[13]. They can be treated in roughly the same way as traditional maps. But dynamic databases lack most of these features, so we have to do some creative cataloguing to incorporate them.

11 It is possible that one has to describe an old map (CM and A), a modern map (CM), a computer-map (CM and CF), and a scanned and computerized old map (CM, A and CF).

12 If cartographic materials are described for identification purposes it is mainly for historical reasons and usually concerns old or antiquarian maps. My practical experience is that hardly any client demands a modern document by title or other discriminatory bibliographic data. Not to mention the fact that, for instance, titles in many modern cartographic materials are hardly relevant because of their generic contents. I assume that even if map producers had been more creative with titles it would not have made much difference to the demands of our clients.

See for further information: Jan Smits: Report on the 'Inquiry into map-use and user-habits in Europe'. In: ERLC The LIBER Quarterly, Vol. 1 (1991), No. 3, pp. 283-310.

13 ISBD(CF), paragraph 0.5.1 Order of preference of sources: "Sources internal to the computer file shall be preferred to all other sources. Such information must be formally presented and can usually be found in title screens, in the main menu or prominently in the listing of the file's programme statement".

Form

As the form in which information can be published[14] proliferates through time -currently more quickly than ever before- and as the amount of information seems to grow exponentially, the form becomes less meaningful to those who are seeking information. At a later stage form might be important if they can choose between different formats of the information, though they might also prefer to opt for more than one form. But first and foremost they are probably interested in the content of the information. This may lead to the question whether form should still be the decisive aspect of the ISBDs. I can imagine that the ISBDs will be remade in ISBDs for contents and that they will have a special field for form-attributes. To begin with I would look to area 5 (physical description area) to fulfil this function. Area 3 (material specific area) will still be reserved to distinguish the different kinds of information[15]. This would mean that the ISBD(CF) first of all would be reserved for describing pure computer programmes, etc. Fortunately the ISBDs include the following remark: "Each ISBD is intended to embody a coherent set of provisions for its own type of publication, but there has been no attempt to make any ISBD exclusive. Users will, on occasion, need to refer to several ISBDs when, for example, the item for description exhibits the characteristics described in other ISBDs, such as a computer-readable item published as a [map], or with an accompanying monograph"[16]

ISBD-Description

When we combine ISBD(CM) and ISBD(CF) the description of a finished dynamic digital map may look as follows[17]:

14 "Published" should be read here as information that has been made available to the public in one way or another. Even if this has some restrictions, as may be the case with copyrighted or trademarked commodities, as to purpose or group of people for which it is intended, I have defined it as 'published'. Thus it includes analogue information, computer files, audio and video packages. In contradistinction to former definitions, which usually refer to finished articles, it can also include intermediate forms of publication.

15 In this I disagree with the Canadian rules (see note 9). Although this element is repeatable I would opt, if possible, for only one GMD (General Material Designation), which is also in field 3 of the ISBD. This to discriminate between form and contents of the described material.

16 ISBD(CF): international standard bibliographic description for computer files. - London : IFLA International Office for UBC, [1986]. - Draft for worldwide review. Paragraph 0.1.1. Scope.

17 Most data have been translated for this article.

Transport atlas of the southern North Sea : display programme / Rijkswaterstaat ; Delft Hydraulics. - various scales (W 005-E 012/N 063-N 050). - [The Hague] : Rijkswaterstaat, Service for Tidal Waters ; [Nijmegen : Mooren, dist., 1987]. - Computer data (1 file, 260 Kb) and programmes (6 files, 93 Kb) on 1 computer floppy disk : 5¼ inch, DS,DD ; 14 cm + 1 atlas.
Optional auto-scaling: a. logarithmic; b. reversed logarithmic.
Maps can be presented in black and white as well as in color.
By means of the programme one can create maps in an infinite number of scenarios by manipulating influx as well as concentration-factor (of substances); the programme offers the possibility of creating detailed and general maps in which are depicted how the effluents of rivers entering the North Sea and the substances dissolved therein will, on average, be distributed over the North Sea.
System demands: IBM (-compatible), MS-DOS, colour/graphic adaptercard; Olivetti, MS-DOS, colour/graphic adaptercard
ANNEX: Transport atlas of the southern North Sea / W.P.M. de Ruiter ... [et al.] ; graphic design and production: Mooren. Scales vary from [ca. 1:2,750,000 to ca. 1:8,000,000]. Contains maps of the North Sea with the influx of respectively The Channel, Firth of Forth, Tyne, Tees, Humber, Thames, Schelde, Rijn/Maas, IJsselmeer, Ems, Weser and Elbe; the maps show the distribution of various watermasses over the North Sea, with predominantly southwesterly winds of 3.5 m/s and 4.5 m/s. The atlas contains technical information about how to start the programme.
Classification: <3.113>; 543.54
Sign. DNP: KC3.113 -0000/001/00000/00/1987/1 D870000

Title and credits are derived from the title screen.

As accuracy is probably not crucial for small scales it is not given in this publication.

The physical description area is a combination of areas 3 (type and extent of file) and 5 (physical description) of ISBD(CF). As certain drives do not accept certain floppy disks it is advisable to specify the kind of floppy disk (DS, DD, HD or other).

To be able to interpret the data on the screen well, it is necessary to use the atlas as the distribution of the water masses depends on the wind speed and wind direction.

In 1992 we have made some experimental ISBD descriptions, describing the publication as an atlas with a floppy attached (CM), and as a digital publication with a hard copy atlas (CF) and (CM) + (CF). My present position is that it should be described as shown above (CM) with computer-related data in area 5 (physical description) and area 7 (notes).

A description of a remote-access dynamic cartographic database could look as follows[18]:

[Digital topographic subject map of The Netherlands] / Topografische Dienst Nederland. - Situation on 31-12-1992. - Representational scale 1:5,000 to 1:25,000, standard deviation 1.8 m ; with coordinates of the shifted Dutch triangulation system (E 3 20-E 7 15/N 53 35-N 50 45). - Emmen : Topografische Dienst Nederland, 1991-... - ca. 1,980 Mb data.
Mapping scale 1:10,000.
Update: depending on area 4, 6 or 8 years; the update programme is drawn up according to the present requirements of the Ministry of Defence.
Extent of database: urban area ca. 1.6 Kb per hectare; rural area ca. 0.3 Kb per hectare.
Format of delivery: SUF2, DGN (microstation format), DXF, DWG (autocad format); 9 inch magnetic reeltape, Exabite (8 mm cassette); small files on diskette.
Deliverable on 31-12-1992: Sheet 9W, 9O, 14W, 14O, 15W, 19W, 19O, 20W (excl. Texel); delivery per sheet or part thereof.
Language: English
Contents: Coded vector-database with all topographic point-, line- and area-information, as is represented on the present maps of 1:10,000 and 1:25,000; classification of several topographic features ('layers') such as roads, water, buildings, etc.; within each theme there is subcoding.
Structure: All line-segments are noded and, when they have an identity of their own, fitted with their own coding; the polygons (objects) which thus are created are coded with a centroid.
Literature: Van basisbestand naar kernbestand : de Topografische Dienst als producent van een kernbestand 1:10.000 / P.W. Geudeke. In: Kartografisch tijdschrift, 1993.XIX.2, pp. 24-28.
Classification: <4.210>; 273
Sign. DNP:KC4.210 -0000/001/00000/00/1991/1 D9400001

There are some differences with a traditional description. The first one is the title. Almost always this title will not appear on the screen, which means that the bibliographic agency has to create one, if possible in cooperation with the producer. To make the title relevant it should include a statement of both subject and area and, when applicable, a contents date. A lot of other information could

18 Data derived from: De Kaarten van tafel : aanbod en gebruik van digitale kaartbestanden en andere ruimtelijke gegevens bij de waterschappen. - [Den Haag] : Unie van Waterschappen, 1993. See Appendix 1 for a description of this map. All data have been translated for this article.

be put between square brackets, but one may also use accompanying texts as source (see note 3: sources). I guess that most producers will publish instructions explaining the uses of their databases. For argument's sake I shall assume that this has happened. As with traditional material we can always put in a note to indicate the source from which the title has been derived.

A second problem is the continuous update of these databases. One can, of course, make an open description which would only show in area 4 (publication, distribution etc.). However, in that case the history of the database can only been shown by continuously adapting the description. I would prefer to include a description of the database annually in the national bibliography and to show this in area 2 (edition). If necessary I even can make a three-level description, describing on the first level the database in general, on the second level a specific sheet and on the third level the situation at the end of each year. I agree that this is arbitrary, but it need not confuse the user of the bibliography or bibliographic database. This may become even more obvious when we decide to archive a copy of the database (though that is many Gigabytes for each year) and have to justify this bibliographically.

In area 3 (mathematical data) the representational scale is given, as this is the scale clients would be confronted with when they want to view the map[19]. I agree with Chris Perkins that accuracy is even more important than scale and I have given this as a specification[20].

In area 4 (publication, distribution etc.) the data concerning the producer are stated as well as the date(s) when the database is (was) in active use.

As it concerns a dynamic database, only an approximation of size is given in area 5 (physical description). In the ISBD(CF) it is usual to put this data in area 3 (type and extent of file) but for obvious reasons I have put this in area 5 and reserved area 3 for mathematical data.

Some of the more important information has been relegated to area 7 (notes). The ISBD does not compel us to structure the notes in terms of the areas of the ISBD, though for practical use this is advisable. As most of the notes refer to ISBD areas (except mapping scale, update and extent of database) the sequence here is accidental. However, it would be wise if a future ISBD could try

19 This would probably never be a single scale denominator, but give a range of scale denominators, as this is somewhat dependent on the screen used. Some might want to put the mapping or input scale here. As scale and standard deviation provides an indication as to the fitness of use of the data I think that producers will give a scale range which gives the user optimum possibility of using the particular dataset. In this I also differ from the Canadian rules (see note 9) as they prescribe 'input scale', which I relegate to the notes as 'mapping scale'.

20 "Though digital maps can be presented on any scale, in practice this is not very significant. Accuracy and level of detail determine on which 'scale' a representation has fitness of use." From: De kaart van tafel. See also note 18.

to structure these to make them more transparent. The notes should at least include a statement about the 'format of delivery', 'contents' and 'structure'.

Should the database include a specific application system then this should be described in a note which also contains information about its size (number of programme files and bytes).

Contents

If one were able to create a very practical (national) bibliography with ISBD-descriptions and with enough indeces it might even serve certain research purposes. However, in this instance one could only access the material by title, area, subject and name or a combination thereof and if finances permitted, also include scale and year of publication. This may seem quite a lot of possibilities to find the information one needs, if it were not for the fact that many modern cartographic information packages seem rather generic, e.g. aerial photographs, remote sensing images, etc. To increase retrieval possibilities several MARCs have included a 'coded information block'. The information is defined in terms of classified values at fixed positions within a specific field. The positions are filled with codes which are defined in the MARC manuals. Though this coded information is not yet used for retrieval purposes, the more than 50,000 descriptions which the Koninklijke Bibliotheek has processed in the CCK (Dutch Union Map Catalogue) have all been supplemented with all the coded information which can be provided by UNIMARC. For a description of the coded information I refer to the UNIMARC manual (see note 4). As a lot of these codes refer to the specific contents of the cartographic item, it sometimes presumes a wider knowledge of techniques than is normally required for describing these materials.

Below I shall try to point out in what way the contents of these coded fields might be used and/or amended to include digital geospatial information.

tag 120: general

The codes for index, narrative text, relief, map projection and prime meridian are all applicable.

The codes for colour should be extended, as some digital maps can be shown in black and white as well as in colour. The following codes would then be needed:

a = one colour
b = multi-colour
c = one/multi-colour, optional

The CCK has added a code for triangulation system, as many base maps use this as reference. More codes may be added for relief and projection as computer cartography creates more possibilities, but we can also use tag 131 for this kind of information.

tag 121: physical attributes

The codes for physical dimension, primary cartographic image and geodetic adjustment in subfield $a and all codes in subfield $b (aerial photograph and remote sensing) are applicable. We can add to the codes for physical medium, creation technique, form of reproduction and physical form of publication in subfield $a, so that digital information can be accommodated. However we can also create a subfield $c specifically for digital information. This should then contain coded information on the physical presentation of these files. It could contain the following elements:

(1) kind of presentation system used:	a = standard b = commercial u = unknown
(2) kind of programme used:	aa = Arc/info ab = Atlas GIS ac = Smallworld ad = etc. uu = unknown

tag 122: time period of item content

This field contains a formatted indication of the period [down to the hour] covered by the item. For research purposes it is a very valuable field as it provides a better specification of the possible use of the item. I believe this information to be more important than the year of publication and advise including it in the description independent of the kind of material one describes. I think it will come in especially handy with remote sensing images and aerial photographs and any material which depicts a historical situation. The manual gives as possibilities:

single date
multiple single dates
range of dates.

The CCK has altered this into:

single date
two dates
three dates
period between two dates
estimated period between two dates

Of course all these are also applicable to digital items

tag 123: scale and coordinates

In this field there are subfields for all kind of scales and coordinates. For scales there are the subfields:

a = linear scale
b = angular scale
c = other type of scale

Though it is possible to put it under 'linear scale' or 'other type of scale' I would like to add:

d = Representational scale (digital maps)

This could be complemented with "standard deviation" with the contents:

(a) = number (0 to 9)
(b) = metric unit codes
c = centimetres
i = decimeters
m = metres
d = decameters
h = hectameters
k = kilometres
x = not applicable
z = other[21]

tag 124: specific material designation analysis

"This field contains fixed length coded data relating to the characteristics of photographic, non-photographic and remote sensing image types of cartographic materials". This quote from the UNIMARC manual does not exclude digital materials and a lot of the subfields are applicable. However, I would like to see them being amended with the following subfields:

structure:
a = open vectors
b = polygons
c = points
d = etc.
u = unknown
z = other

encoding:
a = standard 1
b = standard 2

21 There are standard deviations, especially with large scale maps, which read like '0.2 times mapping scale'.

c = etc.
y = not encoded
z = other (company encoded)[22]

tag 131: geodetic, grid and vertical measurement

For specific collections this coded data field is created, which has not yet been implemented in the CCK. Presumably that is because some of its contents are already implemented in a more general way in tag 120. But I can imagine that some institutions with large scale base maps might want to use this for specific purposes.

tag 135: computer files (provisional)[23]

This tag is described very briefly, probably because in 1987 (the publication date of the UNIMARC manual) there was not enough practice and knowledge about the kind of coded information needed by the library and information field. In the manual the code consists only of 1 position which can be filled in as:

a = numeric
b = computer programmes
c = representational
d = text
u = unknown
v = combination
z = other

As we may describe a multi-media package which contains computer programmes, audiovisual and text data the number of positions in this subfield could be enlarged to 4 (u and z can be one position with three blanks, while v can be deleted). Should any of the coded information for digital publications not be incorporated in fields 120, 121, 123 and 124, this should be incorporated in field 135.

As the data transfer format is a specific computer- or programme-related item it might be advisable to include it in this tag as a subfield[24]. However, I am

22 Code 'a' to 'w' should be used for standards. However it is possible that many official organizations and private companies use their own encoding system, especially when it takes many years before accepted standards are in common use. Though 'z' in UNIMARC is used for unforeseen categories which do not fit the coding, here it seems wise to use this also for company encoding.

23 The Permanent UNIMARC Committee will reconsider this field with its revision of the ISBD(CF).

24 The FGDC metadata standards (see note 9) gives a list of 35 data transfer formats. Another requirement is that a number must be added which signifies the version of the format.

not sufficiently knowledgeable to give an indication how this subfield might be formatted. Some of our GIS-colleagues might be able to help here.

One could also think about the possibility of including a subfield that contains codes which stand for the minimum hardware needed to use the digital item, but here again I lack the specific expertise. I would include at least the following:

system demands:
position 1-2: platform (kind of PC/microcomputer, computer etc.)
position 3: operating system
position 4-8: internal memory: 3-7: number
8: kind (K, M, G, T etc.[25])
position 9-12: external memory: 9-11: number
12: kind (K, M, G, T etc.)
position 13-14: special additions

All other data which cannot be incorporated in the ISBD-tags (tag 200-225) can be written in tags 3xx (note block = ISBD note area[26]) or 4xx (linking entry block = ISBD note area)

UNIMARC-description

The UNIMARC-description of the "Digital topographic subject map of The Netherlands" might look something like this:

TAG	*1 2 SF*	*TEXT*[27]
001		D9400001
020	$a	NL$D9400001
100	* * $a	19940101i19919999u**a*engy01******BA
101	1 * $a	eng$cdut

25 K = kilobyte, M = megabyte, G = gigabyte, T = terabyte.

26 I think it would be advisable to create special note-tags for structure and encoding of data and system-demands and the like. In this way the note area structure would be improved. One could follow the structure given in the Canadian rules (see note 9) which state under rule 7B1 'Nature and scope and system requirements': a) nature and scope; b) System requirements; c) Mode of access; under rule 7B16 'Other formats'. But this still is not very satisfying.

27 1 = indicator 1; 2 = indicator 2; SF = subfield. * = blank. Italics in the TEXT means additions to the present Unimarc format. For explanation see 'Unimarc manual' (note 4) and the preceding chapter.

Should I have made any mistakes in coding certain kinds of information, this would be due to the fact that the CCK format is more elaborate [i.e. the structure of tags, indicators and subfields have a more logical construction and sequence in the cataloguing-module than the format the computer works with or that which is used in exchange] than the Unimarc format and thus that I have to translate my everyday practical experience into Unimarc.

102	* * $a	NL
120	* * $a	byygk**afaa***ba*[28]
121	* * $a	a*ahyyxz
122	2 * $a	d1986******$ad9999******
123	3 * $a	*D*$b00005000.000025000$de00320**$ee00715**$fn5335**$gn 5045**[29]*$o2M*
124	* * $a	abdcacai*hbciz*
131	* * $a-$l	?[30]
135	* * $a	c
200	1 * $a	[Digital topographic subject map of The Netherlands][31]$b[Cartographic Material]

28 Grid/reference system could be incorporated here (as it is in the CCK), when field 131 is not used.

29 For retrieval purposes these will not be geographical coordinates, as these have positive and negative values. Behind the screen a conversion program can work which converts the geographic coordinates of tag 206 (mathematical data) into vector coordinates. See further: E.H. van der Waal: The application of geographical co-ordinates for retrieval of maps in a computerized map-catalogue, In: International yearbook of cartography, XIV, 1974, pp. 166-173.

For the sake of clarity the subfields for coordinates have been enumerated.

30 I can imagine that this field is widely used where base maps and e.g. DEMs (Digital elevation model) are concerned, as these data are of interest for those who want to use these maps for specific purposes.

Appendix F of the UNIMARC Manual (p. 396-412) gives very extensive code-lists for spheroid ($a), horizontal datum ($b), grid and referencing systems ($c), vertical datum ($f), and unit of measuring height ($g). As far as I know even the Content standards for digital geospatial metadata (see note 10) does not incorporate such extensive listings.

For less specific purposes fields 120 and 121 can be used.

31 It is a pity that in UNIMARC subfields $c, $d cannot be exchanged for a second indicator as is done with the CCK:

0 No specific bibliographic relation with preceding subfield

1 Parallel title proper or statement of responsibility (ISBD '=')

2 Title proper by another author (ISBD ".")

3 Second or further title proper by same author (ISBD ';')

4 Second part of title when making a one-level description of a series (ISBD '.')

For further information concerning the CCK format see: G.J.K.M. van der Velden et al., CCK: making cartographic materials accessible. In: ERLC the LIBER Quarterly, Vol.2 (1992), No. 2, pp. 192-208.

As far as I have understood UNIMARC only recognises the function of the data in a given subfield, but thereby does not structure the whole tag. It is my experience that titles and statements of responsibility in complicated maps need structuring to make sense to users of the bibliographic record and to make this structure computer-processable. If not, the construction of title keys may be a hard job.

$fTopografische Dienst Nederland

205 * * $a Situation on 31-12-1992[32]*$r19921231*

206 * * $a Representational scale 1:5,000 to 1:25,000, *standard deviation 1.8 m*, stereographic proj., with coordinates of the shifted Dutch triangulation system (E 3 20-E 7 15/N 53 35-N 50 45)[33]

210 * * $a Emmen$cTopografische Dienst Nederland$d1991-...

215 * * $a Ca. 1,980 Mb data

305 * * $a Update: depending on area: 4, 6 or 8 years; the update programme is drawn up according to the current requirements of the Ministry of Defence

307 * * $a Extent of database: urban area ca. 1.6 Kb per hectare, rural area ca. 0.3 Kb per hectare

310 * * $a Deliverable on 31-12-1992: Sheet 9W, 9O, 14W, 14O, 15W, 19W, 19O, 20W (excl. Texel); delivery per sheet or part thereof

315 * * $a Mapping scale 1:10,000

327 1 * $a Contents: coded vector-database with all topographic point-, line and area-information, as is represented on the present maps of 1:10,000 and 1:25,000; classification of several topographic features ('layers') such as roads, water, buildings, etc.; within each theme there is subcoding; structure: all line-segments are noded and, when they have an identity of their own, fitted with their own coding; the polygons (objects) which are thus created are coded with a centroid

337 * * $a Format of delivery: SUF2, DGN (microstation format), DXF, DWG (autocad format); classic 9 inch magnetic tape, Exabite (8 mm cassette); small files on diskette

488 * * $a REFERENCE LITERATURE[34]: Van basisbestand naar kernbestand: de Topografische Dienst als producent van een

[32] For second indicator see comment in note 31. There should be a subfield for sorting purposes, e.g.:

205 * * R 19921231

The text could either be an alphanumerical code chosen at random or a date which is encoded as in field 122.

[33] It would be better for each information unit to have its own subfield so as to facilitate identification of its contents. Coordinates would then get a fixed length with precursor zeros when necessary, e.g.

206 * * $b E 003 20$cE 007 15$dN 053 35$eN 050 45

As the coordinates are in a fixed position with a fixed length it is easier to have a programme running behind the screen which converts these coordinates to vector-coordinates. Then the cataloguing agency does not have to put these data in coded form in field 123, subfield $d to $g for the second time. See further note 29.

[34] This would be a computer-generated text linked to this specific field when showing an ISBD.

		kernbestand 1:10.000 / P.W. Geudeke. In: Kartografisch tijdschrift, 1993,XIX.2, pp. 24-28
675	* * $a	273$v3$zDUT
686	* * $a	<4.210>[35]$dcck
710	0 2 $a	NA098714$aNederland (state)$bTopografische Dienst Nederland$c(civil service)$4180
801	* 0 $a	NL$bCCK$c19940901$gISBD(CM)

Manual update

One of the problems in an ever changing world is that the contents of certain codes become obsolete or that codes have to be added for new developments. A standard like UNIMARC still takes too long to incorporate changes which take place in the actual world. This is mainly due to the evaluation and consultation stage being a very arduous one. I can understand that this is necessary when new fields or subfields are added as they may be hard to incorporate in existing programmes. However, when the coded contents of a position or positions have been defined it should be possible to add to the range of contents more quickly. Examples are subfields $f (name of satellite for remote sensing image) and $g (recording technique for remote sensing image) in field 124 (specific material designation analysis). Subfield $f has a two-character code where these codes signify a certain platform, e.g. for earth resource satellites:

ga	=	ERTS
gb	=	Landsat I
gc	=	Landsat II
gd	=	Landsat III
ge	=	Seasat
gf	=	Skylab
gg	=	Spacelab

But by now we have many images of Landsat IV and V (where has Landsat VI gone to?), SPOT (of which subsequent platforms will be launched) and several Russian platforms. The coding allows for 1,296 alphanumerical codes (if I am right: aa-zz, 00-99, a0-z9, 0a-9z) which should be enough for some time to come. The same is true for subfield $g, the codes for map projection (tag 120, subfield $a), physical medium (tag 121, subfield $a), and presentation techniques (tag 124, subfield c) as well as a new subfield $c in tag 121 as proposed by me. With the current and future possibilities of electronic communications it should be possible to create new codes fairly quickly. I can imagine the UBCIM office[36] to be in touch with launching bodies (like NASA, ESA and Russian or other organisations) and even without consultation to designate a specific code to a specific platform when this is functioning or to a new recording technique. The

35 CCK area code for The Netherlands

36 Office for the IFLA Universal Bibliographic Control and International MARC Programme.

information would then be made available to users through some Internet-function like the IFLA-gopher[37]. For coded information regarding specific cartographic items (like tag 120, tag 121, subfield $b, and $c of tag 124) I can imagine the UBCIM Office to be in touch with an ICA[38]-commission (or ICA-IFLA commission) responsible for defining the new techniques and applications and communicating them in the same manner. Of course the other MARC-offices could offer the same service to their clients.[39]

Conclusion

When discussing the problems of how to catalogue digital material with colleagues, so far we have not gone much further than looking at the ISBDs. In order to be able to use the descriptions for cataloguing purposes and in OPAC environments, however, we have to adapt the MARC-formats at the same time. To keep up with developments in the practical field we will have to adapt, to use the electronic communication networks in order to be able to amend part of the MARC-formats more quickly.

I would like to thank Professor Dr. Fer-Jan Ormeling jun. for checking the part of the draft concerned with digital cartography. He prompted me to rethink some of my statements[40]. I would also like to express my appreciation to Brian Holt (National Bibliographic Service, The British Library) for his comments and advice on the part concerned with the changes I propose in UNIMARC. He was so kind as to edit the UNIMARC-description to bring it in accordance with the new edition of the manual. From his comments I understand that I may also thank Jim Elliot of the same department for the thoughts he has given to the problems I have discussed. I would also like to express my thanks to Govert van

37 The IFLA-gopher is available through: gopher.konbib.nl

It contains currently information pertaining to the different bodies and the functions of IFLA and is managed by IFLA Headquarters in The Hague, The Netherlands. My proposal would add to its possible contents.

See further: IFLA Headquarters and the Internet. In: IFLA journal, Vol. 20 (1994) No. 3, pp. 369-370.

38 International Cartographic Association

39 UKMARC and USMARC already have a kind of facility like this. When there are sufficient changes new pages to the loose-leaf manual would replace the old ones with its manuscript additions. Now they only need to go electronically.

40 He posed the interesting question as to how I would describe electronic atlases like the National Atlas of Sweden. Would I mention all statistical subjects, aggregate possibilities and combinations of the two? And would I mention all analytical tools and, if necessary, GIS-functions? In the absence (yet!) of a Content standards for digital geospatial metadata I think I would try to dissect this electronic atlas as we did with the second edition of the analogue National Atlas of The Netherlands, creating multi-level records. See further: Jan Smits: Automation and multi-part description. In: ERLC the LIBER Quarterly, 2.1992.2, p. 128-136.

der Velden (former Manager CCK) for rousing my interest in the kind of problems addressed in this paper and for the way he has constantly guided me through these difficult matters. It feels good to have been working with somebody who truly knows about cartography and about the problems of automating bibliographic databases for cartographic materials. The English text has been edited by Mrs. Lysbeth Croiset van Ughelen-Brouwer.

Based on a paper read during the 9th Conference of the Groupe des Cartothécaires de LIBER in Zürich, Switzerland, 26-29 September 1994.

APPENDIX 1

Information concerning a remote-access dynamic digital geospatial database (see note 15)

Supplier:	Topografische Dienst Nederland (Topographical Survey)
Product:	Topographic subject map
Description:	Coded vector-database with all topographic point-, line- and area-information, as is represented on the present maps of 1:10,000 and 1:25,000. Classification of several themes ('levels') such as roads, water, buildings, etc., and within each theme there is subcoding.
Mapping scale:	1:10,000
Representation scale:	1:5,000 to 1:25,000
Standard deviation:	1.8 m
Structure:	All line-segments are noded and, when they have an identity of themselves, fitted with their own coding. The polygons (objects) which are thus created are coded with a centroid.
Encoding:	Company encoding

Relation RD-system[41]:	Yes
Extent of database:	- built-up area: *c*. 1.6 Kb per hectare; - rural area: *c*. 0.3 Kb per hectare; - average 6 Mb per sheet (c. 650 sheets)
Supply:	Per sheet (rectangular cut possible, price per km2)
Price-indication:	Depending on area 3 tariff-areas: price per sheet per area: 1. NLG 1,050 annually 2. NLG 700 annually 3. NLG 525 annually On average NLG 0.12 per hectare annually. One-time costs NLG 100 per sheet; parts are NLG 100 extra per sheet.
Update:	Depending on area 4, 6 or 8 years
Format of delivery:	SUF 2; DGN (microstation format); DXF; DWG (autocad format); magnetic tape (9 inch), Exabite (8 mm cassette) and small parts of sheets on diskette
Continuity:	Guaranteed
Country-wide coverage:	25%
Remarks:	The Topographical Survey strives to have 100% coverage in 1997
Address	Topografische Dienst Nederland Postbus 115, 7800 AC Emmen, The Netherlands, Tel. +31 5910 96911

41 This is the official Dutch grid and reference system.

European Research Libraries Cooperation:
The LIBER Quarterly, 5 (1995), 312-329.

Leave it to the Labs? Options for the Future of Map and Spatial Data Collections

C. R. PERKINS
Department of Geography, University of Manchester

"The ability to provide access to and manipulation of digital spatial data should signal a rebirth and continuance of map libraries and cartographic information centres" (Minton, 1993)

"Digital data is not always the best way to go; in fact often analog products do the job better" (Larsgaard, 1992)

1. Introduction

In his classic road novel *Zen and the Art of Motorcycle Maintenance* Robert M. Pirsig explores the many philosophical dimensions of what he terms '*quality*' (Pirsig, 1974). This elusive property is much admired, easy to perceive but much harder to define. A dictionary definition might be 'the degree or grade of excellence possessed by a thing'. The problem for the protagonist in the novel is coming to terms with the pre-Socratic philosophy and the difficulties of making quality 'work' for himself and other people. A similar difficulty faces map libraries at the turn of our century. Many see the potential 'quality' offered by GIS, but how should the technology be made available?

This paper argues that 'quality' in map librarianship and documentation in the GIS age depends upon appreciating the dual role of the map as functional information bearer, and as a rhetorical form of power-knowledge (Harley, 1990). Map librarians have all too often assumed that there is a rational scientific answer, a solution to delivering service which can exist independent of the context, and the user, in other words we have implicitly subscribed to functional models, and given too little weight to the complexity of socio-political and economic factors influencing the ways in which maps have been used in society. Generalisations have been made about flexible customer-defined specifications, mapped areas, themes and scales in digital mapping systems, which whilst technically correct, ignore social factors. Optimistic comments have been made how easy the transition can be to the bright new digital future. For instance *"the biggest problem in establishing a library capability...may be just getting the approval to proceed"* (North, 1987). Map librarians who have begun to integrate their conventional and digital services proselytize about the benefits and sometimes ignore the difficulties (McGlamery, 1991). Such simplifications and manifestos do not help those wishing to ensure a quality of service to users and potential users, of digital and conventional map products in the GIS age. It is very important to understand, in greater detail, which aspects of digital mapping are significant for map collections and to the users of maps, what implications the digital revolution brings for traditional map libraries and to position this discussion within the context of the organizations delivering this service to different groups in different societies. Questions about whether map libraries ought to alter their services, about the economic implications of change and about uneven social and spatial impacts of GIS are just as important as enthusing about the new kinds of use made possible with GIS. Only by asking these questions and by rooting discussion in contextual study can we begin to appreciate the detail implied in Larsgaard's comment about analog data, and then decide whether to change, and if so how.

2. The nature of digital mapping

Everyone accepts that the digital map is fundamentally different from the hard copy. Dissecting the nature of this difference is a useful starting point in assessing impact. There has, however, been an unfortunate tendency to assume that there is a single solution to the problems and potential of using cartographic materials in machine readable format in map libraries. The terms *digital mapping*, or *maps on screens* are often used, with little attempt by the map library community to understand the great variety of materials of very different kinds subsumed within these broad umbrella definitions. The nature of the digital map profoundly affects quality of use.

The *storage medium* is important because it influences how much data can be accessed, whether that data can be altered, how the data are organised and what hardware and software configurations are required to access the information. For instance CD-ROM is seen by many as offering the optimal medium for the dissemination of read-only cartographic data for use in libraries, because of the large amount of data which can be stored and accessed in a relatively rapid process. If a decision is taken to support access to CD-ROM based data, then decisions also need to be taken about whether and how to network, and about what hardware and peripherals need to be acquired.

The *format* in which the data is stored is also important. Whether the data is raster or vector profoundly affects storage requirements and the level of interaction which is possible. Different software engines may be needed to translate between formats. A bewildering variety of *file structures* are used by different products. Text files might be in ASCII format, boundary files in DXF format, and attribute data associated with these boundaries as CSV files. Raster data might be stored in TIFF format, whilst a a huge variety of file formats exist for more complex maps combining attribute and polygon data in vector databases. Larsgaard (1992) has suggested a new version of Murphy's law for map libraries: *"whatever form you have your spatial data in, the user needs it in the other one"*.

In addition to a great diversity of file formats and media, accessing the spatial data is achieved using a great variety of *software systems*. Very little relevant software will run under all operating environments, and even when a more generic package exists the UNIX version is likely to seem very different to the Windows or PC tool. Interacting with a standalone PC may be very different to interacting with a PC on a network, and using a SPARCstation poses different problems to those faced in accessing data on a minicomputer or mainframe. So it is not simply the problem of learning about different software packages, it may also be necessary to understand basic operating system and hardware principles, even before understanding the graphic conventions governing communication of mapped information. All of these factors make digital mapping less easy to use than the paper map.

Much cartographic data is of course released in raw form with little packaged accompanying software: here the problem is which of a bewildering array of software products to use in order to exploit the data. Most users do not even know where to start, and few map librarians either have yet come to terms with using raw data in the map library. Figure 1 illustrates some of the different kinds of relevant software and is derived from Moulder, (1992) and Perkins, (1993b). Probably the most important factor for the map library is the complexity of the software and the level of interaction it allows. This is important because of the degree of library staff input required, and the nature of the tasks which can be performed. Few map library users probably require very sophisticated software functions in seeking out mapped information. Most are probably quite happy with a hard copy, fixed format map. At the low end of the software hierarchy little user support is needed, whereas at the high end users need considerable help to exploit the value of the product. At the low end only a limited amount of interaction is possible with the data: functions like zooming, panning, or moving to new 'pages' and limited capabilities for output are relatively easy to learn. At the high end complex nested menus and GIS functionality may require a considerable learning curve in order to reach basic skill levels. Another important factor is the specificity of the software: should packages used on the data be general in purpose, like GISs able to perform a wide variety of tasks on datasets? Or should they be specific task-oriented tools, for instance to plan a route through a road network, to draw a thematic map, to search for a specific place and centre the map, to compute distances? Whereas the paper archive supported many different kinds of use, customised tools exist to carry out very different and separate functions in digital systems. Finally the nature of the datasets available needs careful consideration. Different datasets in digital format are targeted at different user communities, because of very different subject coverage.

In addition to this complexity of media, format and software systems comes the inevitable dynamism of data. Whereas paper copy maps 200 years old can still be accessed today, we have no way of knowing what systems will be operating as vehicles for accessing data, even a decade in the future.

Whether the digital cartographic data is continuously updated or is a single static database is also very important. Many national mapping agencies such as the Ordnance Survey are now able to revise their mapping in digital systems on a continuous basis. Whether changes are date tagged becomes very important for any library community interested in data which is not just current. How to archive changes poses a major problem: should fixed intervals across all the areas be archived, or should new versions only be saved as and when the database changes in a specific area? Which (if any) of this data should be held by a library? Static databases on the other hand (like a regular census) pose much less of a problem for a map library.

To summarise: digital cartography *can* mean scale free data, with customer defined specifications, area coverages and content. However, whereas for hard copy mapping the nature of the user-map interaction is essentially the same, a very great variety of different kinds of interaction are possible with many different kinds of digital product when operating a map library in a digital environment. The hard copy topographic map was readily available to all, as an artefact, whereas its digital equivalent might be fluid information only available to those with access to necessary knowledge, software and hardware.

3. The Library Practice

Table 1 reports the results of some of the studies of the use of digital mapping in different collections: a summary of national trends may be distilled from these data.

The most important conclusion is that despite the proliferation of digital cartographic datasets, very few map libraries have yet decided to take on a dual role as a 'cartographic laboratory' and conventional map library (Kollen and Baldwin, 1993). Recent surveys in Canada, in the United Kingdom, and in the USA confirm that the remit of most map libraries remains to provide their users with access to hard copy published mapping, rather than offering the flexibility of digital data use to their customers. No surveys of pan-European practice have yet been published, but papers published in this volume on this theme reveal an even more conservative situation across the major map collections in Europe.

Library involvement in Canadian collections with cartographic software is so far mostly limited to atlas and information programmes, map creation and presentation graphics and map customising packages and Moulder (1992) speculates that Computer Assisted Design and GIS are *"beyond our present capabilities of equipment and staff support"*.

In the UK very few map libraries yet even use electronic atlases in the map room, largely because of the cost constraints. Most libraries remain repositories of hard copy collections. It is the map libraries associated with institutions using GIS for teaching or other applications which have moved furthest towards offering cartographic laboratory facilities, and even here services are often not offered as part of the map library.

In the United States more active attempts to implement a cartographic laboratory in the map room have been made in the more important map libraries. The position in the United States is more innovative, because of the nature of public domain federal data, the willingness of software companies to collaborate with networks of libraries in order to try to create new markets for their products, the more flexible administrative organisation and the greater status of map library staff. Overall though the majority of the map library community in the United States has not yet come to terms with how to integrate digital mapping with conventional services and the evidence from the GIS ARL project is not so far very encouraging (Kollen and Baldwin, 1993). Even in this heavily sponsored project, with the aim of accessing only a few datasets with a few pieces of software, results suggest significant difficulties in moving beyond experimental implementation. A more detailed investigation of library responses is needed in order to explain why.

4. Library Responses

In conventional map libraries cartographic materials are acquired, described, stored and conserved, retrieved in response to user needs, which may be determined in a reference interview. In the digital library some of these processes are similar and some radically different. So the library response can be expected to differ according to the mix of materials available, the nature of the organisation, the library facilities available, the kind of users and their needs.

4.1 Acquisition

Acquisition of digital data is a more complex process than procuring hard copy maps. I will focus on three issues here. First how to identify what is available? Most of the standard acquisition tools used by map libraries ignore digital products, and systematic survey of publishers' catalogues may be needed. Few listings chart availability. An exception is Wolf and Wingham (1992) who evaluate the state of digital elevation datasets. Related to problems in identifying products is the need for more complex evaluative data, particularly when assessing whether to acquire complex software, such as electronic atlases.

A second problem concerns whether an available dataset can be bought. There are less cartographic digital data sets available at present than hard copy maps, this availability is changing very rapidly, but the evidence remains of huge gaps in digital availability which are never likely to be filled. For instance very few third world surveys are even contemplating replacing their hard copy topographic survey production. The vast proliferation of hard copy town maps, of commercial smaller scale tourist and motoring products, of ephemeral media mapping are also unlikely to be supplanted by digital equivalents. Unless there are profound changes in the ways in which societies use computers and in market conditions, it seems likely that this situation will continue. Hard copy equivalents will also probably continue to be available for most of those products which are now digital.

Unlike hard copy mapping, digital data is much more likely to be available for use on a licence basis, rather than available for purchase outright. This may present major problems for libraries who are unable to specify in advance the precise nature of their usage. Costs of digital products may also be prohibitive. The extreme case is the Ordnance Survey in the UK, whose current pricing structure for large scale digital data effectively precludes library acquisition. Steele (1993) documents the huge costs involved at 1992 pricing levels. It is certainly true that the trend amongst national mapping agencies (the bodies most likely to be producing digital mapping) are towards a more market oriented pricing policy (Robertson and Aitkin, 1992).

The third issue is whether the library should buy datasets at all. The digital format makes true data sharing possible, so it may therefore be more appropriate not to acquire digital datasets, but rather to access them when required over a network, to acquire collaboratively and share resources. Data sharing, co-operative purchase and remote access may be the only viable economic route for map libraries to follow if they wish to continue to allow access to current cartographic data.

So it may not be possible, and it may not be a good thing to buy digital data.

4.2 Archiving and storage

Archiving and storing hard copy mapping has required storage and reprographic equipment and the use of preservation and conservation methods. The problem with archiving and storing digital map data is that future users will need to access both the physical entity and also the information contained in the object (Tyacke, 1987). So in order to guarantee future access to digital cartographic data, the format in which this data is stored has to be understood and accessed in future systems - standards for data storage are critical here.

There is conflicting evidence about the archival qualities of the media used to disseminate cartographic datasets. Whereas the long term storage properties of paper as a medium are well understood no one has yet been able to confirm with certainty, for instance, the long term implications of archiving onto CD-ROMs (Cruse, 1985). There may well be a requirement to translate data to new media, in order to preserve its utility in the future.

The current fashion of using optical storage systems and digital technology to preserve images of hard copy mapping has begun to replace microfilm as a means of ensuring both wider dissemination and future preservation of conventional products. For instance the ambitious Opaline project in the Bibliotheque Nationale in Paris aims to link MARC records of map metadata with scanned images of the hard copy mapping (Duchemin, 1990). Any transformation to a new medium results in information loss. Scanned maps have no structure unlike vectorised images. They may be analysed using various image analysis packages. Inevitably, the greater the resolution, the less the information loss, but the greater the storage overheads. The larger the data sets, the more time consuming and expensive becomes accessing the data at future dates. For instance accessing data stored on a CD-ROM is relatively straightforward if there is a single CD-ROM: multiple CD-ROMs may require an expensive jukebox or dedicated drives in order to deliver an effective service. There will almost certainly also be a requirement to compress data, in order to be able to comply with media storage overheads. In contrast vectorised mapping takes up much less storage space and offers a much greater level of flexibility of use, but it is much more expensive to convert into digital format. No map library I am aware of has digitised its hard copy mapping in order to convert to a fully digital map service: any library vectorising which has been carried out has been as a side-product of other in-house activities.

It may be technically possible to minimise the loss of information, but map use is not purely a functional process extracting information from the source, there are more complex elements which are often ignored by GIS propagandists. Users may need some of the qualities of the information which have been lost in the preservation process. They may wish to analyse the colour wash on the map, to feel the weight of the bound atlas volume, to wonder at the quality of the copper engraved lettering, or to display the map on their wall as an affirmation of their status or as a work of art. Archiving the paper map allows these qualities to be preserved, archiving the digital may change the nature of the interaction between map and map user.

4.3 Bibliographic description

In map libraries housing conventional mapping, the documentation of holdings often also served retrieval needs, rather than being concerned just with description. The two functions are much more clearly separated in digital systems. There are undisputed benefits arising from documenting map holdings (Perkins, 1993a). The problem for the map librarian in the GIS age is that the standards created for conventional cartographic materials may be inappropriate because they focus upon a fixed format entity, rather than upon fluid user-defined information. Also very little guidance or precedent exists for interpreting existing standards and applying them to digital products. So should the map librarian catalogue digital holdings and if so how? Relevant issues include the provision of appropriate spatially referenced metadata, the level of the cataloguing and the object to be catalogued.

The nature of metadata for the cataloguing of machine readable cartographic materials is rather different from record standards for hard copy mapping. The most important attributes of machine readable mapping may well not even be available as fields in standard MARC format records. For instance, accuracy tagging of large scale digital products and date stamping of different elements of the database, and geocoding coverage, are fundamental to successful retrieval of items to satisfy search criteria. The user will need to know the source of digitising and its accuracy (rather than the scale) since display scale is more often a function of the software being used to manipulate the data. If metadata is to be used for successful retrieval of digital products it is important that the data is collected in such a way that retrieval needs can be satisfied. For instance co-ordinate data would have to be collected if it was intended to offer graphical as well as textual area access to data sets.

Possibly the most fundamental difference between a conventional map library and a library holding digital data is the issue of deciding exactly what to catalogue. Over six years ago Mary Larsgaard asked the question '*What does the librarian catalogue*' and concluded that '*Sanity suggests the database not the results*'. (Larsgaard, 1987) One can understand the caution: workloads in map libraries and cataloguing departments would inevitably prevent any serious attempt at this Herculean task. The needs of the user must be balanced against the requirements of bibliographic control and common sense administrative constraints.

So should the output, the screen display, the database, or some of the files be catalogued? Once again the flexibility of the GIS age impacts upon standards and practice. Kollen and Baldwin (1993) offer four different examples of the cataloguing of digital cartographic data and raise important questions about this process. They conclude that there are inconsistencies in the cataloguing of CD-ROMs and that different options exist for what to catalogue and the level of cataloguing. The problem is that the degree of output flexibility varies very greatly from one machine readable product to another, and that conventional MARC based cataloguing rules do not discriminate adequately. For the slide show type of electronic atlas, where the screen or hard copy map image is relatively fixed in format, cataloguing decisions may be analogous to cataloguing of hard copy material. It becomes possible to either create a catalogue record for the item as a whole, with content notes to individual slides in the show if appropriate, or to create parent offspring records to the individual mapped displays. More sophisticated CDs with fixed area components, but variable and possibly user-defined content, might also be catalogued as single items, with notes describing the fixed area files or maps. Alternatively offspring records of the fixed elements could be linked to a parent record for the whole database. For instance the SCAMP CD of 1991 Census data for the UK includes read-only files showing district boundaries within each county, ward boundaries within each county and enumeration district boundaries within each district. Whilst these polygon files may be amended on screen, eg by merging of polygons, their fixed read-only structure on the CD suggests at least a rudimentary listing of files would facilitate access.

On the other hand, more flexible GIS products such as the Digital Chart of the World can clearly not be catalogued with fixed listing of file structures, since here the data structures on the CD would be unhelpful for the user. Here a more flexible range of descriptions of output might be needed. As Larsgaard implies it would clearly be an insane waste of time to anticipate the infinity of design, scale, area and content which is possible from products like DCW, or mapped thematic data on census CDs. However there are clearly examples, even from these products, where metadata needs to be created about an output, rather than about the database as a whole.

One criterion might be to try to anticipate which output would be used again and to describe only these maps, either when they are created by users, or to create the files, catalogue these and stimulate likely future demand. To catalogue only those items stored for future use, whether as hard copy or as files in a GIS might be feasible in some library contexts. An obvious example would be map files covering areas of maximum demand in the library. In my collections this would be map files covering the Greater Manchester conurbation. On the other hand, hard copy generated by users would not be catalogued if the ephemeral images were taken away and were unlikely ever to be needed by another user. This approach to cataloguing decentralises the cataloguing process, and devolves cataloguing decisions to the local level, away from the national or international standards.

The conclusion to be drawn is that user needs should determine cataloguing practice, and that therefore definitive answers to the question of what data to collect, the level of cataloguing and the entity to be catalogued are impossible. Another example of GIS removing the 'fixed' and replacing it with the 'flexible'?

4.4 Retrieval

To create metadata makes little sense unless these are used to retrieve information (or groups of information) from storage. There is agreement in the literature that a mix of textual, numerical and graphical methods offers the ideal solution to retrieving cartographic data from collections, whether hard copy or digital (Perkins (1991), Lai and Gillies (1991) and Morris (1990)). A search capability should give multiple access points to data, allow area searching by place name with look-up gazetteer, interfaced to a graphical search capability similar to that offered as the frontend on better electronic atlases. Narrowing down searches by selecting different fields ought to be a standard facility, and output of results as text or graphic indexes should be possible on screen and as hard copy. Such systems are, however, expensive and the full range of facilities may only be needed by a few users. Few map libraries have yet implemented systems which offer such retrieval facilities for hard copy mapping, yet alone coming to terms with accessing digital cartographic data. Advocates of a fully automated retrieval process such as Lai and Gillies (1991), and North (1987) have failed to appreciate the complexity of the descriptive and system issues, and the huge data collection overheads which apply to hard copy mapping and co-ordinate data capture (Perkins and Guest, 1993).

Deciding which digital data set to access will however become an increasingly central issue in the GIS age. The short term solution to retrieval is to set up one system for digital data sets and packages, and another for the hard copy. Thus a front end offers different choices to the user. It may be an OPAC like textual front end, to navigate the user by menu choices through different potentially useful datasets or cartographic packages (McGlamery, 1989). Selection of an option automatically loads relevant software or routes requests towards an appropriate server. The alternative is a graphical front end, operating either as a hypercard stack, or as an icon based system. Neither of these approaches attempts to use the metadata collected about individual products: they simply help the user to access a product as a whole.

4.5 User services

There is almost no reported literature comparing the use of conventional and digital products in a map library context. Gooding and Forrest (1990) contrast different user experiences with raster scanned and conventional hard copy Ordnance Survey mapping, but no one has yet investigated in any systematic way how users of digital mapping can best exploit their data in the map library. Also no one has yet begun to examine who needs which kinds of digital map data, or looked at the skills required to use different digital products. Most people in the world do not know how to use the information in hard copy maps, so why should we expect that them to be able to interpret more 'difficult' digital products? We should be asking whether we need these products, and if so how can we get maximum value for different kinds of users, rather than rushing headlong towards an uncertain digital future. The limited number of library studies undertaken so far encourage caution.

Moulder (1992), for example, reports on experiences mounting and teaching the use of two simple electronic atlases, and concludes that significant staff overheads are inevitably involved in introducing more complex software into the map library. Introduction of digital systems into the map room tends to generate a different kind of inquiry, often related to software issues, rather than to spatial data itself. The early experiences of the ESRI funded ARL GIS project in the USA reported in a questionnaire survey undertaken by Kollen and Baldwin (1993) confirm that using even a simple GIS in the map room can be very time consuming for staff. Their survey reveals an almost overwhelming response that to use Arcview to access digital map data and produce customised maps involves map library staff in a lot of assistance, ranging up to 4 hours per map! Common sense suggests that if full GIS facilities are to be offered in the map library, then user support activities must inevitably increase and that it makes more sense to require users to attend training courses, rather than to teach on an individual basis in response to specific inquiries. Wong (1993) explores three potential models which might be used as a means of seeing how much user support is required: the personal use model in which individuals use digital products themselves with no input from library staff, the chauffeur-driven model in which the librarian as intermediary serves the GIS needs of the user and the intermediate adaptive interpersonal use model. Differing uses, from a range of teaching needs, through to more sophisticated research requirements would mean different degrees of staff support. Users need to be taught to exploit digital mapping systems to the full, and also taught when a hard copy printed map might be a better solution to their map needs

5. The future

What solutions are available to library managers in the light of these complex trends? What kind of quality will they offer to users in the GIS age?

5.1. Leave it to the labs

The easiest solution for many map libraries might be to ignore digital developments, and but to continue to exploit hard copy products. This is an understandable response, given the qualitatively different nature of digital products. Digital products could still be acquired and catalogued blind, for loan to patrons taking them out and using on their own GIS systems. Many US collections take this approach with TIGER files. The problem will, however, grow worse as the digital products become more established and GIS literacy increases. The risks are that map libraries become dying archives for the period up to about 2000 AD, and that responsibility for providing digital spatial data shifts to other divisions of the library, or even outside to other data providers, once digital production becomes the established norm and when large scale hard copy map publication ceases. Technological change is a powerful engine with all sorts of implications, one of which is likely to be a reduction in the resources available to continue to develop collections and services in the traditional hard copy map collection. Also the technical expertise required to interpret and design maps on screen has been developed over the years in map libraries, so leaving it to the laboratories may well be a short-sighted option, even for those concerned only with historical data.

However, given the costs, and a realistic assessment of user needs, it may be the only viable option. How many third world map libraries, for instance, are likely to be able to consider GIS? How many smaller underfunded collections in affluent European or North American societies have the luxury of considering limited moves towards the digital future? For the majority of libraries quality will have to continue to be offered by existing systems.

5.2. Go it alone: separate development

There are all sorts of measures which, given available resources, can be taken in individual collections to improve their own institution's access to digital data. A PC running electronic atlases in the map room shows at least that the map library is aware of the new technology. Experimenting with more sophisticated software packages in collaboration with other in house expertise is the next logical step down this road. McGlamery (1989), for example, reports on one in-house route to accessing census data in the map room, in which the librarian's role is to provide access rather than to interpret data and their use. It may be relatively easy to set up means to access and use some digital data, in tandem with a continuing conventional map library service, but to make little attempt to marry the two into an integrated system.

5.3. Collaborate and introduce the new technology

A problem shared is a problem halved and collaboration may well be one of best ways to introduce digital products to the map library. There are already many public domain digital cartographic datasets available on the Internet, which may be accessed, downloaded and processed (Beard, 1993; Allen, 1994). Co-operative purchase of digital datasets in the UK by CHEST already allow the research community to use Bartholomew World, Ireland and Europe digital databases, and various OS datasets. Such projects have not yet been contemplated by the library community, but the imminent cessation of hard copy large scale production by the Ordnance Survey may well force UK copyright libraries to negotiate a central acquisition of current digital datasets (Fairbairn, 1993). The ARL GIS Initiative is another good example of active collaboration. Few of the participating libraries would have bought into GIS without the framework and support offered in the project. The importance of the project lies therefore not just in the technical issues, but also in the co-operation and sharing of resources and experience it offered.

5.4. Getting it together: integrating with hard copy services

In-house development and collaboration have not yet come to terms with the biggest problem. How do you combine the past with the future, to offer an integrated map library service combining digital with hard copy services. Is such a goal even desirable?

There are certainly major problems for those institutions charged with preserving an ongoing record of changes in the landscape, when a digital production system replaces hard copy publication (Elliot, 1992). A recent conference in the UK addressed the issues of how best to guarantee access to the future history of the landscape when the OS ceases to publish hard copy large scale plans. The situation of national mapping in the UK is not necessarily typical of the challenges facing all map libraries, because of the unique combination of a complete large scale database, with enormous quantities of vector digital data, a formal system of legal deposit, very broad categories of users and a government policy encouraging the Survey to move towards full cost recovery. However some of the conclusions drawn from this meeting and reported in Fairbairn, (1993) are of critical relevance to other map libraries in the GIS age. His paper reports on the range of technical options possible for delivering usable data to the library using community in the UK. Participants at the meeting agreed that a single solution for accessing historical hard copy maps and digital data would be the preferred option, with the digital integrated with conventional into a single service. What to do with the existing hard copy archive was seen as just as much of a problem as ways of dealing with the digital data. A range of technical options were presented and evaluated, not just from technical, but also from economic, administrative and user points of view. These compared different vector, raster and hard copy service options for current information, historical data and integrated solutions (see Figure 2).

Fairbairn's article does not of course address the complexity of accessing multiple formats of data derived from many different production systems, compiled to very different standards. It shows the complexity of issues for a *single publishers'* technological transition.

6. Conclusions: defining quality?

Only by appreciating the complexity of data and systems and their application in different library contexts can we come to terms with offering a quality of service in the GIS age in map libraries. The form of service offered will inevitably vary according to available resources and demands. We can expect that disparities in the level of service will increase, with a few well resourced collections offering a sophisticated range of conventional and digital services, to elite groups in different societies, and the large majority of map libraries continuing to offer only hard copy mapping to their users. The quality of the information provided in a sophisticated digital map library might of course be inferior to that offered in a well run conventional collection, and it is unlikely that GIS in a library context will improve access to geographic information for the majority. Digital mapping will, however, force all map librarians to move to a more explicit definition of their role, to clarify new flexible standards, to quantify the time spent serving particular needs. Old assumptions will be challenged and questions raised about why and how we do things. This paper does not offer easy answers to these questions. Like Pirsig's Phaedrus we will have to pursue our own individual quests for quality, according to our own ethical standards.

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Table 1: Examples Of Library Practice In Using Digital Mapping

1. Canada

Author	Library surveyed	Results
Znamirowski (1993)	14 Ontario libraries.	No correlation between collection size and use of cartographic software. No GIS use in map libraries. Collections with links to cartographic laboratories more likely to use drawing packages in libraries. Electronic atlas use in 14 collections

2. UK

Campbell (1991)	British Library	No acquisition of cartographic publications on disc
Parry (1994)	University of Reading	Use of electronic atlases, route planners, census mapping packages, topographic and base data and limited software in a University collection
Millea (1994)	Bodleian Library Oxford	Use of six CD-ROM based electronic atlas products in a copyright library

3. USA

McGlamery (1989)	University of Connecticut	Pioneering study of accessing and mapping digital census data in map library
Larsgaard (1992)	University of California	Early developments of GIS facility attached to map library
Minton (1993)	64 research libraries across the USA	Reviews the ESRI GIS-ARL Project which aims: "to provide effective access to federal electronic data, to review and evaluate the introduction of GIS into the library community, to assess short term needs of ARL Libraries to provide government information and to develop new initiatives in research libraries".
Kollen and Baldwin (1993)	University of Arizona and review of GIS ARL libraries	Reviews the library or lab. dilemma, the problems of bibliographioc control and the potential of co-operation.
Allen (1994)	Purdue University	Practical aspects of accessing and downloading images over the Internet
Wood (1994)	100 North American collections	Edited review of Map Library in Transition Conference reporting progress towards the digital map library across many North

Figure 1: Types of Cartographic Software

Arranged in *increasing order of difficulty* and *increasing functionality*.

Slideshow Atlas and Information programmes are intended to present fixed pre-defined electronic views of data, together with associated text and statistics. Export to other programmes is possible, but only limited interaction with the data is facilitated. The maps may not be changed or customised. *eg Global Explorer*

Route planners concentrate upon optimising and mapping route choice through a road or rail network and are usually user friendly packages. *eg Autoroute*

Simple Paint Packages allowing manipulation and creation of raster images on screen. *eg Paintbrush*

Map Creation Packages are intended to create simple maps for inclusion in presentations, but allow only very limited user input. They usually include limited boundary files, and sometimes limited thematic mapping capabilities. *eg AAG Map Sets*

Electronic Atlases and Census front ends integrate mapping software with tabulated specific census data. Often allow user defined mapping of census variables on screen, with application of thematic mapping capabilities to these datasets. Usually with a limited range of map design tools and limited export capabilities. *eg SCAMP CD*

Customised Map Creation Programmes include boundary files, worksheets of data and the capacity to link these in order to create user defined statistical graphics. Able to process a variety of import formats and different datasets and to export or create displays of different kinds. *eg Mapviewer*

Drawing packages offer a more sophisticated range of tools for the creation of desktop maps, but usually without the link to worksheets. Often incorporate vectorising modules, multiple layering, fonts, line, point and area symbologies, in order to allow sophisticated on screen desktop map design, and flexible import and export facilities. *eg CoralDraw*

Computer Aided Design CAD Systems for precision drafting, often used in automated production cartography and include basic analytical functions in addition to a sophisticated array of software tools for manipulation of vectors. *eg Autocad*

Geographical Information Systems with the capacity to collect, organise and analyse geographically referenced data, incorporating a sophisticated range of analytical database functions with mapping capability. Supports for instance features such as point in polygon, buffering, geographic query and Boolean searching. Flexible import and export capabilities. *eg ARC INFO*

Figure 2: Options for Data Provision to Digital Map Libraries

(After Fairbairn, 1993)

Shows the mix of hard copy, vector and raster options available for current digital map production and the historical hard copy Ordnance Survey archive in British copyright map libraries.

Options for contemporary data

1. Provide files to library
2. Install Superplan Service in Library
3. Provide paper printouts from Superplan elsewhere at agreed intervals
4. Provide raster images on CD-ROM on standard sheetlines at agreed intervals

Options for historical coverage

5. Vectorise historical coverage
6. Raster scan historical coverage
7. Keep hard copy archive

Options for combining historical with contemporary data

8. All data in vector form
9. Vector-based contemporary data, raster historical data
10. All data raster scanned
11. All data hard copy

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Can the Map Curator Adapt?

ANDREW TATHAM
Royal Geographical Society, London

Introduction

The technological changes at the present time, if not unparalleled in themselves, are at least occurring at an unparalleled speed. They affect all parts of cartography (as defined by the International Cartographic Association, 1991), including our part - the acquisition, preservation and dissemination of cartographic materials. The result of these technological changes is that a different response is required from map curators, a response that is itself subject to change. The question addressed in this paper is whether the map curator possesses the knowledge, the resources and the confidence to make this different and changing response.

One of the articles supplied by the organisers in their excellent 'reader', that by Mary Larsgaard, includes the following statement:
"How fortunate (it is) that we've been working with different formats for many years and therefore - accustomed as we are to concentrating on data and not just format - adding digital items to our collections does not require a massive change in mind set."[1]

This statement, at least from my perspective, seems to be almost totally unrealistic. It is the function of this paper to demonstrate why everything in the (cartographic) garden is not quite so rosy, and why Wong's analysis (also in the Reader) may be nearer the mark:
"However, the path of transition to digital cartographic materials libraries has many obstacles.... Until these obstacles can be overcome satisfactorily, we will be likely to remain confined by paper or printer products whose rich contents are extracted with trained eyes and competent map reading skills".[2]

1 Larsgaard, M., 1992; Accessing the world of Digital Spatial Data, W. Assn. Map Lib. Info. Bull., 23 (3) June 1992, p. 192.

2 Wong, M. - K., 1993: Exploring the Impact of digital cartographic data on Map Librarianship using data use models, SLA Geography and Map Division Bulletin, No. 173, September 1993, p.14.

Were it simply a matter of a change of format, Larsgaard might be right, but even so it is a pretty extraordinary sort of change of format. Technological change in the past has certainly resulted in map curators now being responsible for a variety of formats (figure 1), and some of the 'electronic atlases' of the present are indeed, the same sort of data within a new format.

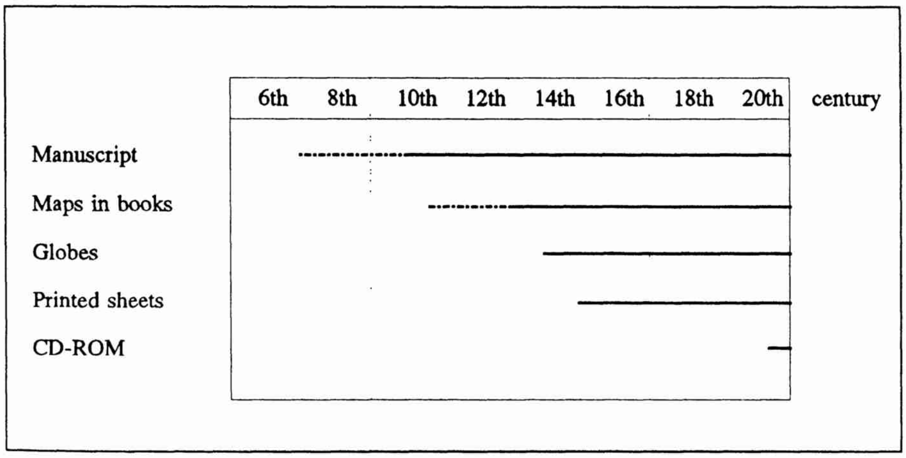

Figure 1: Changing formats of mapping

However we have seen the possibility of staff here at ETH being able to access, via the Internet, US mapping and statistical material to produce maps of population density within a 5 mile radius of protected sites in Prince George's County, Tolland Co, Conn, Maryland or use OSCAR to calculate lengths of different categories of roads in Wales, is to perform tasks not simply on a different format, but an entirely different order. One might as well expect Matthew Paris to produce UNICEF propaganda using Peter's projection.

Furthermore, this change has occurred in an extremely short time. 30 years ago I met one of the last copper engravers to be permanently employed by a British commercial publisher, the last of a profession that had survived for four hundred years. At about the same time, experiments in line-printer production of mapping were the cutting edge of research - now preserved as an example of a technology which barely lasted a hundredth of the life span of copper engraving.

I see no reason to suppose that this accelerating rate of change will rapidly diminish or even stabilise, but rather will continue to increase so that when we meet in four years time, the WWW will seem positively *ordinary*. Consequently the question is

"Does that map curator possess the knowledge, the resources and the confidence to make this different and changing response?"

To which, I must point out, one possible answer must be NO - we may have come to the end of our evolution. However, I do not think that we have yet assembled sufficient information necessary to answer the question. Therefore we need to look at the three components - knowledge, resources, and confidence - in turn.

Knowledge

The knowledge required by a map curator must be acquired. This may happen formally or informally, both before and during employment as a map curator. This formal knowledge acquisition prior to employment could include a geography degree course at university, where both attributes of the geography of the world and methods of collecting and analysing such attributes are purposefully taught. During employment, in-service training courses in cataloguing or conservation, for example, are included in this category of the formal acquisition of knowledge. Informal acquisition of knowledge before employment is most likely to be in map use, especially in interpreting map marks, often in the context of hiking or other route-finding activities. Informal acquisition of knowledge during employment is achieved by looking at, listening and learning form that knowledge which others share, wittingly or unwittingly, about the significance of a particular feature or of a particular map, for example.

Whichever way knowledge is acquired, it must, in order for the map curator to function effectively, include three elements. These are the available material, the user's profile and the processes for fitting these two together. Each of these elements can be divided into two components.

The first element the map curator must know is what material is available and, indeed, something of its quality. The two components of this element are firstly what is available *in toto*, and secondly what is available locally. This implies that the map curator needs to have a broad knowledge of map products through both space and time. The necessary extent and depth of this knowledge will vary with the aims and clientele of the collection. Thus the knowledge possessed by the Curator of Maps at the Royal Geographical Society, which has a collection unconstrained by areal or temporal specifications and whose clientele varies from novice to expert needs to be (and is!) much greater than that of a map curator in a geography department, whose collection is constrained to service departmental research programmes and whose clientele is restricted to a limited and relatively high level of knowledge of what is available locally. In a small collection this may be an intimate knowledge of every sheet; more usually there will be a good knowledge of the different types of material and of the different map series held. With a more detailed knowledge of frequently-requested, rare, or otherwise notable items.

In the element of the user's profile, the map curator must know what the user's needs may be and what capabilities the user brings to the task in hand. Often, both these components can only be acquired by the map curator in the brief conversation sometimes dignified by the description 'reference interview'. Indeed part of the map curator's essential knowledge must allow for the interpretation of the 'reference interview' and the inference of the user's capabilities form the user's statement of needs. "May I see what printings you hold of the Second Edition of County series Surrey 20SE?"is not, for example, the enquiry of a novice - whose opening gambit is, more usually, "I'd like a map".

Given the knowledge, now acquired, of the user's profile, the map curator must attempt to fit that to his or her knowledge of the available material. Sometimes this can be achieved entirely at a theoretical level - "Yes that material does exist, but it is only available to the military of that country"- but more often, a combination of theoretical and practical knowledge has to be brought to bear, to refine progressively the request, combining information from the user with the knowledge of the map curator, finding possible or partial solutions and, ultimately, answering the request with the appropriate material or referring the user to a more appropriate repository.

In the future -a future which, technologically at least, is already here- I suggest that we shall need the same categories of knowledge but, within each category, the distribution of our knowledge will be significantly different.

Resources

In the process of providing solutions to users, we use, in addition to knowledge, resources. These resources include people and money. Although staff costs are the largest proportion of any library budget, it is important to separate the two in any discussion on resources, if only to assert that neither can be entirely reduced to the other. In the light of the technological changes required by the map curator, it may well be argued that the present distribution of resources between staff and non-staff budgets will also change. This, it seems to me, is not yet a certainty. What is a certainty, however, is that map curators will continue to have to work very hard to achieve appropriate or necessary levels of funding and that the paraphernalia of statistics, performance indicators and assessments as well as the political and financial arguments to sustain these levels of funding will become more, rather than less, necessary.

However, as map curators, our main resource is spatial data. Traditionally, we have handled this data in the form of a map. In terms of cartographic communication theory, our job is to attempt to provide the map or maps and the expert knowledge in their use which will ensure that the end product of the communication process, that is the user's mental image of the real world, is as close as possible to the starting point of the process, that is the real world itself. Thus in figure 2, our success is to be measured by the extent of the overlap between symbol [4] and symbol [1].

In the future, while the end result, the overlap, may well be similar in figure 3 to that in figure 2, the role is significantly different.

A major change will occur in our role. We shall no longer provide the users with someone else's selection and presentation of data, but with the data itself and with the means by which the users can make their own selection and presentation of this data to inform or to mould their own or other people' image of the world. By analogy, we are no longer providing the cook with flour, but taking him or her to the field of ripe wheat with a sickle in one hand and a grinder in the other. There is no guarantee that the cook or the data user will use this new freedom to produce the traditional tri-colour-photo-litho maps or the traditional bannocks but that, of itself, does not mean that the overlap between the real world and the user's mental image of the real world need be any less.

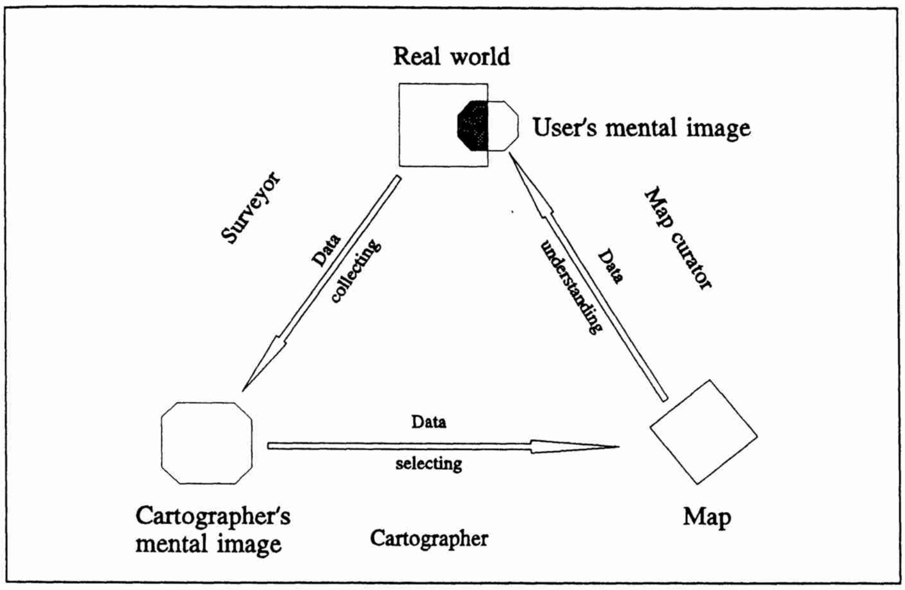

Figure 2: The traditional cartographic communication process

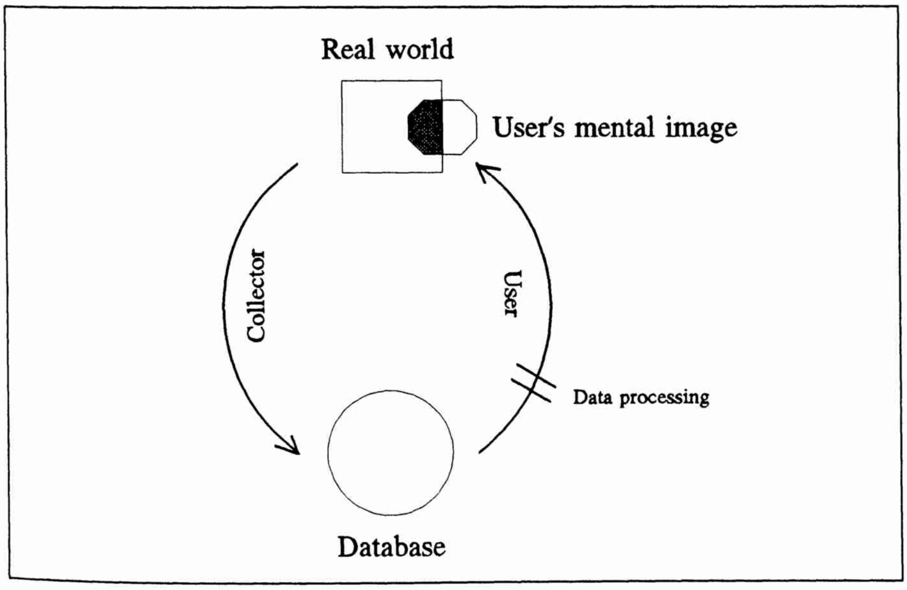

Figure 3: The new cartographic communication process

Confidence

To generalise, I would suggest that for most map curators, the demonstrations that are described in the other papers in this issue are wizardry. To misuse McGlamery's acronym[3] they are MAGIC. This wizard weaves his spell and works his magic and produces the white rabbit from his hat. The audience is spell-bound and then cheers and claps. "How did he do that?" or "I'd love to learn that trick" say people in the audience to their neighbours. But they are all a bit frightened by something they do not understand and when the wizard calls for volunteers, everyone tries to push someone else forward. We are the professional map curators; as soon as we have the knowledge and we have the resources to cope with the changing technology, we will be there. Just now, however is it not easier to say,

"Well, it would be nice, but...."
"... I'm no computer genius."
"... there's no time to learn."
"... we need to get standards."
"... it's all very well, but my interest is to the Dunkirk school."

Or should we not say, as McGlamery has so clearly said, *"I'm going to be part of this; in fact, I'm going to shape the future. I'm going to claim this bit for myself and drive forward. I have the confidence."*

Conclusion

So the question "Can the map curator adapt?" is not about the changing knowledge that the map curator will need to handle the technological changes that are in train. Nor is it about the changing nature of the resource and, in particular it is not about the role of the map curator in bringing spatial data to users. In both knowledge and resource components, map curators do possess the necessary professionalism to make the changing response required by technological change. However, the question "Can the map curator adapt?" is about confidence and it can be restated as, Does the map curator, as an individual, and does his or her institution, have the confidence to help bring about the future?" or, put another way, "Does the map curator, as an individual, and do map curators, as a profession, want to deal in information or in artefacts?"

The choice is, at the moment still in our hands as map curators, but we must answer it soon or someone else will make the choice for us and we shall have come to the end of our evolution.

3 McGlamery, P., 1995: Maps and spatial information: changes in the Map Room, Paper presented at the Zürich meeting on the Groupe des Cartothécaires of LIBER.

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Implementation of the Virginia Technology Library System in the Jagiellonian Library and its Cartographic Department

JADWIGA BZINKOWSKA
Biblioteka Jagiellonska, Kraków

When I last had a chance to speak about computerization, 4 years ago at the conference in Paris, there was no question of the computerization of our collection. Now, I am able to say that we are crossing the borderline of traditional library activities and we have undergone technological changes.

The situation has altered since the appearance of the integrated VTLS system (Virginia Technology Library System) in Polish libraries. It was on January 15th 1992 at the meeting in the National Library in Warsaw that the Jagiellonian Library and the Library of the Gdańsk University agreed to the purchase of the VTLS Inc. software. They were soon joined by the University Library in Torun, University Library in Wrocław, University Library in Warsaw, the Library of the University of Mining and Metallurgy in Kraków, and in 1993 by the Library of the Maria Curie-Skłodowska University in Lublin, the Library of The Catholic University in Lublin, The Library of Technical University in Lublin and the Library of the Agricultural University. So far the network of libraries using VTLS amounts to 11. It is worth mentioning that because of the prominence of these libraries in Poland, the purchase of the VTLS system will have a big impact on other libraries. We already know that this system is due to be introduced in the Municipal Public Library in Kraków (thanks to a grant by the Andrew W. Mellon Foundation) as well as in other Kraków libraries.

There are new inter-library forms of cooperation connected with the implementation of VTLS. As VTLS modules enable network connections with foreign library and bibliographic systems, libraries which had bought the system obtained access to the EARN and INTERNET networks. The NASK network (Scientific and Academic Computer Network) which is sponsored by the government and the Committee for Scientific Research, which has a regional structure, has been functioning in Poland for 2 years now. It cooperates with the public packet switching network POL/PAK. NASK Communication services provide the possibility of connecting to INTERNET. At present there are 21 EARN nodes working in all major academic centres. The X-25 network covers the whole of the country. The main connection nodes of the NASK network are situated in the Informatics Centre of the Warsaw University and in the Astronomy Centre in Warsaw. The main nodes are connected to STAR-MASTER which connects us to INTERNET.

However, let us get back to the computerization of the Jagiellonian Library. Since 1990 this library has been implementing the integrated library system VTLS. The advantages are amongst others:

- the possibility of loading model entries,
- the application of a MARC format,
- the usage of graphic symbols,
- the possibility of coupling with computer software,
- the possibility of network access for different systems.

The heart of the system is a Hewlett Packard H.P.3000 ser.947 XL computer with a capacity of 196 Mb operating memory and 4 Gb disk memory. It is the basis for the computer catalogue and the internal computer network of the library, which again is connected to INTERNET.

On January 2nd 1994 started the creation of the computer collection of the Jagiellonian Library. The basic modules of this system are:

- the collection module AFAS (Acquisitions and Found Accounting System). At this level the first, shortened description of a library item is prepared, called "Class 01".,
- the cataloguing module, based on the original catalogue, comprises also the catalogue of model entries also termed authority control files (in Polish KHW). Data loaded in the base are later rendered accessible in the On-line Public Access Catalogue (OPAC).
- the OPAC module, which functions with the help of Intelligent Works Station (Pro-cite) devices, which allows for searching without commands,
- the "Circulation" module (i.e. lendings),
- the "Journal Indexing" module, for processing and describing journals.

A separate module is being prepared for special collections, which includes the cartographic collections.

This new "Project for providing access to the special collections of the Jagiellonian Library in digital form" aims at working up formats for different special collections, so as to create the data base for manuscripts, old prints, musical requisites, graphics and cartography.

We also intend to develop methods for the electronic copying of our collection. Initial arrangements assume cooperation with "Vesalius" medical publishers, which owns a Crossfield scanner, ensuring good quality colour copies of the photographs of our most precious historic places.

In the more distant future, we plan to consider the possibility of teletransmission which would enable us to watch scanned pictures from any distance. The project will be carried out in cooperation with computer scientists and librarians. An important stage of this plan will be making copies on the compact information carrier rendered accessible by CD-ROM readers. In order to provide access to copies on microcomputers, it is planned to work up software sets based on different platforms and different system environments.

Computerization in the Cartography Department.

The progress in the computerization of the cartographic collection depends at the moment on completion of the Polish bibliographic norm based on US MARC. The norm for the Polish description is being prepared by the team in the National Library in Warsaw and is expected to be ready in 1995.

In 1996 we should start loading map descriptions in the Jagiellonian Library VTLS. We will begin with the descriptions of new maps currently coming to the department, and only then will we start the conversion of our catalogue. (So far we have started the preliminary form of filing the topographic maps catalogue in the ISIS programme).

What has just been said about the implementation of VTLS in the Jagiellonian Library also determines the framework of computerization for the cartographic collection. We are also conditioned by the development of the geographical information system in Poland and the development of regional information systems (Geographic Information System and Land Information System).

In order to present our situation more clearly, it should be mentioned that, paradoxically, Poland does not have an integrated system of geographic information for the whole country yet; a system which could help solve various problems connected with rational land management. We have at our disposal the 1:10,000 scale maps of our country, but not all topographic maps have a uniform coordinate system. It was only recently that the teams selected from the Section of Geodetic Networks and the Cartographic Section of the Polish Academy of Sciences Geodetic Committee decided on a new coordinate system which is to be ETRF-89 (European Terrestrial Reference Frame 1989) with the reference ellipsoid (GRS 80).

In 1990 Prof. Jerzy Gaździcki, a computer scientist and president of the Polish Society of Spatial Information, (author of the handbook "Spatial Information Systems"), prepared a consistent plan for an all-Poland spatial information system. He worked out the project "Spatial information subsystems for the needs of spatial management" for the Ministry of Spatial Management and Building. In the project he distinguished the base and topical subsystems. The data for base subsystems include: the geodetic matrix, the basic map on scale 1:10,000, topographic maps and land cadastre. On the basis of the base subsystems, the topical subsystems for local, regional, and all-country can function. (In the local subsystems, basic maps and land cadastre form the basis; in the regional subsystems, maps on a scale larger than 1:100,000; in the all-country system, maps on a scale larger than 1:1,000,000 in digital and analogue form).

The topical subsystems are integrated with the base subsystems in areas reflecting the administrative division of the country and areas constituting geographical regions. Prof. Gaździcki suggested in his handbook the way of normalization of recording and transferring spatial data and described ten recommended packs for use.

Summing up the task we want to undertake in the field of computerization in our department, we have to say that in the first place we are thinking of the digitization of our maps, beginning with old plans of Kraków and maps of Galicia (i.e.Southern Poland). This will be done in cooperation with different institutions (e.g. university institutes and administrative units). The situation is different with the digitization of topographical maps. At present one of the most important applications of the systems of geographic information in Poland is the system of digital preparation of topographic maps of Poland, based on 32-bit microcomputers, implemented two years ago by the Topographic Department of the Polish Army. The system works with an analytic plotter and a plotter with automatic photosetting. Recently, for the needs of the digital topographic map of Poland, the "Intergraph" system has been implemented, which is equipped with a high quality scanner and software enabling the processing topographic information. In the future we would like to render the digital base of the topographic map of Poland accessible to our readers.

In finishing, it is worth mentioning that cooperation plays a great part in our gaining computer experience. We are cooperating within the framework of the EU. There was a seminar in the National Library in Warsaw in 1993 during which our cooperation with LIBER was discussed (among the participants were: the Director of the National and University Library in Helsinki, Prof. Esko Häkli, and Prof. Hans Albrecht Koch from Bremen). We also set our hopes on the cooperation in the Conspectus programme, which leads to the creation of an information base for a United Europe on the basis of national databases. Such a base should also include maps from Polish libraries. Two persons from Kraków, from the Department of Library Science (Prof. Maria Kocójowa and Dr. Wanda Pindlowa) were present at the last Conspectus and Liber Conference.

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The Development of Digital Cartography in Russia and the Usage of Digital Maps in the Russian State Library

V. I. KAMINSKY / N. E. KOTELNIKOVA
Rosgeoinform / Russian State Library

Today Russia is enjoying a computerisation boom. This boom is stimulated by the recent appearance of a new economic situation. The use of domestic computers is diminishing, and at the same time the market for foreign computers, software and technology is rapidly growing.

Today informatization is a process which is closely related to cardinal changes in the structure and character of economic and social development, with the transition to science-intensive production and to new forms of information exchange. Informatization as an objective reality is for Russia an inevitable development. The transformation of socio-economic relations and the democratization of social life calls for great changes to the structure and character of information support in practically all spheres of activity in society. Despite the general slump in the production of computers and related technologies in Russia a stable demand for computers and software is manifest. A certain reserve for goal-oriented intensification of the process of informatization, with the simultaneous creation of legal, economic and organizational conditions, has been developed. With state support, the federal programme *Informatization of Russia* and other federal and regional programmes have been developed to create information facilities and systems. For the first time in our country, within the Federal Service for Geodesy and Cartography, a new aspect - digital cartography - has started on a production basis and continues quickly to develop. Within a short span of time 6 geo-information regional centres have been established. One of the leading institutions is the Moscow Research and Production Centre for Geo-information 'Rosgeoinform'. The development of digital map-making enjoys the support of the Government of Russia, which has approved the programme *Advanced technologies of cartographic-geodetic support for the Russian Federation*.

In keeping with this programme -which is executed by the Federal Service for Geodesy and Cartography of Russia- the following developments are envisaged:

- creation of a uniform State digital database for cartographic information and for the digital information industry during 1994-1995;
- development of GIS for different purposes and new methods, facilities and technology for the production of digital and electronic maps;
- creation and maintenance of databases for digital and electronic maps at scales 1:200,000 to 1:1,000,000 for the territory of Russia.

The preparation of this goal-oriented Programme was preceded by a long period during which digital cartography matured in our country, and in this process a number of stages should be distinguished.

1. Theoretical studies, which did not extend beyond the framework of faculties and laboratories of educational institutions and research institutes, were directed towards the search for possibilities of using computer technology in conventional cartography (from the beginning of the '60s to the mid-'70s).

2. Production of digital maps for use in the military field (from the late '70s onwards).

With these ends in view, first generation technology was developed and production of digital topographic maps was started. The technology depended on domestic computers and peripherals (devices for manual and semi-automatic digitization of metrical measurements of objects and keyboard input of semantics). This technology is described in a series of articles in the journal *Geodezia i Kartografia* of 1989. During these years some specific problems were solved in principle, relating to the specific nature of cartographical representation and the contents of maps, properties of cartographic information, devices for the digitization of maps, and of the tasks of the operator in an automated cartographic system.

Proceeding from this, requirements for digital terrain models (DTM) and their normative basis in the form of directive documents, logical instructions, classifiers for the coding of the metric and semantic components of cartographic data, and the format of storage of DTM within the aggregate of databases were developed.

This technology, methods of digitisation of cartographic information (CI) and its processing by computer were in effect equal to advanced technologies of that period. Amongst these methods the following deserve special attention:

- parallel input of metrical measurements and semantics, which takes into account such factors as the large volume of digitised data and the necessity to minimise software intended for the processing of digital cartographic information (DCI);

- compacting of metrical measurements of DCI with the fan method;
- taking into account the deformation of cartographic materials;
- cutting and joining of DCI;
- control of DCI of the terrain by profiling;
- attaining topological adequacy of digital maps to maps which were used in creating them;
- presentation of digital data on the terrain both in the matrix and linear contour form and other forms.

These methods are described in detail in *Cifrovye karty*[1].

3. The creation of digital maps in the interests of the national economy (since 1992). The characteristic features of this peiod are:
   a. the start of the possibility to create digital maps with the help of advanced -mainly foreign- computer technology and software;
   b. the expansion of contacts in the field of computer technology and digital cartography between Russian specialists, representatives of well known State organizations and private firms;
   c. the creation of domestic technology for the production of digital maps of the 2nd (manual digitising with PC's) and 3rd generation (scanning of printed maps and automated identification of CI);
   d. the development of goal-oriented GIS on the basis of already existing databases of digital maps on the scales 1:200,000 and 1:1,000,000, and the development of technologies for the production of digital topographical plans;
   e. the appearance, parallel to the state GIS centres, of some one hundred small businesses -and their number continues to grow- which specialise in the production of digital maps and their use in different GIS.

It should be mentioned here that the third stage resembles a boiling cauldron, which contains organisations acting in the sphere of digital cartography, which greatly differ in their potential and purposes. On the one hand there are federal centres for GIS which are well provided with software, technology and qualified staff. On the other hand there are mostly small private firms which are well equipped with the necessary hard- and software. However these latter produce digital maps which are not compatible with each other and with the digital maps of production centres which are part of the Federal Service for Geodesy and Cartography. Moreover, many of these firms do not possess a licence which would permit them to do this kind of work.

1 Zdanov, N.D., E.A. Zalkovski and E.I. Halugin: Cifrovye karty, Moscow, Nedra Publishing House, 1992.

Undoubtedly the main generators of high quality digital cartographical production are the state centres for GIS. Thus the Research Centre 'Rosgeoinform', regardless of its 'youth', is coping successfully with the solution of the following problems:

- the production of digital maps at the scales 1:200,000 and 1:1,000,000;
- working out methods and technologies for the creation of digital and electronic maps of different scales and for different purposes;
- the development of standards for storage of digital maps and exchange with users;
- the development of conversion programmes to make distribution of domestic digital maps possible through more widely accepted international exchange standards;
- the development of GIS to be used on regional (ecology) and municipal (land registration) level.

The centre is equipped with modern computers, domestic and foreign software, and produces digital maps of the 2nd and 3rd generation. It employs more than 200 specialists, including cartographers, mathematicians, programmers and electronic engineers. Currently 'Rosgeoinform' is participating with Canada and Finland in two international projects connected with the creation of GIS.

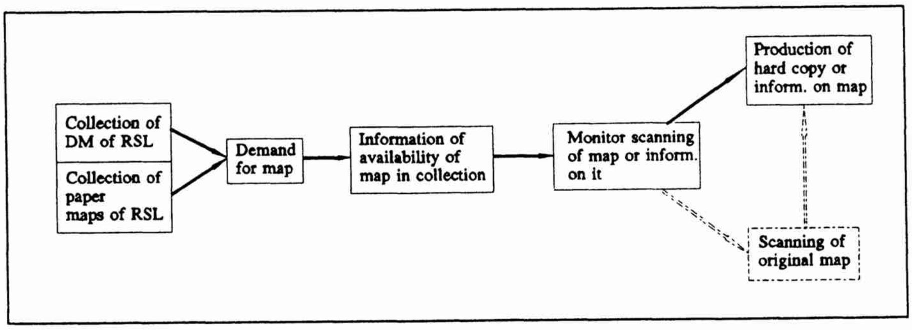
About half of the leading producers of GIS have a presence in Russia. Among them are the two main world competitors: ESRI -which has some 100 users- with ARC/INFO and Intergraph with its line of MGE products. Amongst domestic products for GIS, 'MAG system', developed with the Geographical Faculty of the University of Moscow, 'Geo Draw' and 'Geographist' of the Centre for Geo-Information Research of the Geographical Institute of the Russian Academy of Sciences should be mentioned. These products, as subsystems of GIS, evoke the interest of specialists since they help solve some separate and specific problems.

Scientific conferences, exhibitions and specialized periodicals influence the development of the GIS field in Russia, Thus, in the past 2 years, over 10 conferences on various aspects were held. Most important were the conference and exhibition marking the 75th anniversary of the Principal Geodetic Department of the RSFSR (which now has been merged with the Federal Service for Geodesy and Cartography of Russia), the annual international exhibitions of information sciences, *InterKarta - GIS for Research and Map Production for the Environment* (organized by the Chair of Cartography and Geoinformation of the University of Moscow, 23-25 May 1994), and the all-Russian forum *Geo-Information technologies- Management, Nature Management, Business* (Moscow, 6-11 June 1994). New journals, like the Russian-American weekly *Computerworld*, the newspapers *Open Systems Today* and *Soft Market* have started to appear. The number of articles dealing with geo-information, published in the journal *Geodesy and Cartography,* is growing constantly.

Through a decree by the government of Russia the 'Interdepartmental Committee on Geo-Information Systems' was created in spring 1994. In this way adequate prerequisites for the introduction of possibilities for automation and information technology in different spheres of economy and culture, including librarianship, are available in Russia. Libraries represent the channel through which digital maps, which are usually available only to a narrow circle of users, can find a much wider audience. At present our department is not yet ready, in terms of technology, to introduce digital maps into the readers' service. The available hardware -PC 286- does not permit the adequate demonstration of digital maps; it can display only advertisement reels. However, we are now looking into new possibilities, which will allow us to improve the service to users and promote interaction of the library with other cartographical collections, both domestic and foreign. The fact that the number of digital maps, produced by different organisations, is quickly growing is taken into account.

The digital map of Russia (1:4,000,000) by the Research Centre 'Rosgeoinform' has been published, and the digital map of Moscow (1:20,000) by the joint-stock company 'Resident' has appeared on the market. Thematical digital maps, produced by the State Centre 'Priroda', the Main Research Centre 'Roskomnedra',.and the commercial firm 'Geocentre', etc. have been published.

The Russian State Library in Moscow is now actively working on the conception of introducing automated means into the Cartographical Department and its collection. First we will create an electronic catalogue, which will provide access to 250,000 maps and atlases. In the next stage we propose to create a database of map sheets (or their fragments) and develop methods to make them available to users for monitor scanning and for the production of hard copies. In this way the following scheme can be realized:



We intend to cooperate with state and other organisations, which have digitising technology and the necessary staff, and which are ready to make digital maps in keeping with the appropriate requirements, and thus create a digital database of the map collection of the Russian State Library (RSL). When the requested map is lacking in the collections of the RSL, the user is given information on other collections in which the given map may be present. Undoubtedly in future, the databases and the workstations for users will be united into a local area network, and later, maybe, into a distributional co-oporative network. Finally, the conception of automation of the cartographic collection of the RSL envisages the creation of the *Map Collection of the Russian State Library GIS*.

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