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MULTIMEDIA METHODS FOR EXCAVATION REPORTS AND ARCHIVES USING MICROCOSM

This paper presents an update of the continuing work on developing a tool for multimedia excavation reports, using hypermedia system Microcosm. The background to this project is described in more detail elsewhere (WOLLE, SHENNAN forthcoming).

1. ALTERNATIVE MODES OF PUBLICATION IN ARCHAEOLOGY

The publication of excavation data is crucial to archaeology; but existing problems with publication threaten to fundamentally undermine the discipline (FAGAN 1995; PLATT 1974; RENFREW, BAHN 1991, 480). Without the ability to check the basic information that theories and interpretations are based upon, archaeology will lose its credibility. Technological advances mean that there could now be a solution available to this important problem. The case for using multimedia in archaeology has been argued many times (for example: JAKOBS, KLEEFELD 1995; RAHTZ *et al.* 1989; RAHTZ *et al.* 1992; ROSS 1994; RYAN 1995). The range of data types used in archaeology makes it suitable for multimedia applications. The flexibility of multimedia would lead to wider access to the material by archaeologists. Smith declared that the unpublished archive was an artifact of inadequate technologies for disseminating information (SMITH 1992, 49).

Multimedia is becoming more widespread in archaeology - well know early examples include PERSEUS (SMITH 1992), the Wadi Ziqlab Project (BANNING 1993) and the Electronic Rough Ground farm (RAHTZ *et al.* 1992). Since then, applications have multiplied. However, the effort required to put together these applications means that they are specific additions to the report, with specialists compiling the data and defining the links. All these examples represented individual solutions produced for one site; for every subsequent electronic publication or archive the programming effort has to be duplicated. However, if it were possible to produce a program where the archaeologist could simply insert the data and produce a fully functioning hypermedia application, the number of reports in this format would hopefully increase, making archives more generally available.

Computers have now become widely accepted as tools for accessing and processing the data generated by excavations. There have been attempts at producing specifically archaeological programs which will oversee all the recording needs of an excavation, the Integrated Archaeological Database System (RAINS 1995) is one such example. It provides the archaeologist with a user-friendly linked working environment which allows database data and the graphic and photographic record to be linked. It is based around the Scottish Urban Archaeological Trust recording system, so it will require other archaeological organizations who might be interested in using it to adopt this particular database structure and it cannot utilise existing data sets without major restructuring effort. Specific excavations may mean that additional details will need to be recorded under certain conditions, for example upon the discovery of waterlogged wooden structures. Additional database tables will be required, and closed systems are not able to accommodate this; this makes archaeologists reluctant to adopt structures not designed by themselves.

The need for a different approach which moves away from the monolithic systems has been recognized (RAHTZ *et al.* 1989; RAHTZ *et al.* 1992; RYAN 1995; RYAN 1992). Ryan calls the new diverse approach the complex document approach (RYAN 1995, 213), generally also described as the open approach.

2. INTRODUCING OPEN HYPERMEDIA AND MICROCOSM

Microcosm is an open hypermedia system developed by the Department of Electronics and Computer Science of the University of Southampton. It employs an open perspective in the way it handles data and links. In order to understand what is meant by an open system I will first have to explain the concept of closed systems.

In a typical closed hypermedia system (most hypermedia programs currently available are closed) the information about the links and anchors is held as mark-up inside the data itself, in a similar way to word processors which place the formatting commands inside the text. These codes are usually hidden, but in WordPerfect for example they can be revealed. The problem with this approach is that once the user has entered the data into the hypermedia program, and the details concerning links have been inserted, it is no longer possible to access the data with the original application that was used to create it. Such a system is thus only suitable for static data which will need no further editing and revising. The process of entering the data into a new format requires a special additional effort.

On the other hand, open systems hold the links separately from the data files, which brings with it a number of advantages:

- read only material such as CD-ROM's can be incorporated with no problems;
- the data remains accessible to outside applications as it does not change in format;
- it is possible to manipulate links separately without having to search through the whole material;
- it is possible to have different sets of links covering the same data, to reflect different user's views for example.

Microcosm, which addresses the problems of closed systems described above, has been under development since 1989; the third version, which is also the first commercial version, was released earlier this year (DAVIS *et al.* 1992c; FOUNTAIN *et al.* 1990; HALL *et al.* 1992; HILL *et al.* 1992). Microcosm has attempted to overcome the problems of closed systems like HyperCard or Toolbook which make the data their own. It is not just an authoring or presentation system; it should be seen as an extension of an operating system (HALL *et al.* 1992, 14), organising the access to the documents. It consists of a message passing system, which allows a number of autonomous processes to communicate with each other. The information about the links is held in a database separated from the document files. This separation of links from the actual data files is an advantage (DAVIS *et al.* 1992a), as it allows for far greater flexibility. Files can be updated and accessed from applications that are not part of the hypermedia application itself. This ability to integrate other applications is a major strength of Microcosm.

A Microcosm application comprises a set of documents (individual files in the file system) that the program knows about, together with a set of relationships defined for those documents. Microcosm allows relationships to be defined between objects and ideas in a variety of document types such as text or graphics. The user is provided with a core set of viewers; these are programs which allow the viewing but not the editing of any files of supported formats. These documents are prepared in various software packages and viewed through the Microcosm viewers. Microcosm also comes with a core set of filters. These are programs which provide it with its information processing and retrieval functionality. As Microcosm consists of a set of independent programs which communicate with each other, the functionality of these can be altered according to the user's requirements.

An important way of accessing the documents inside Microcosm is by following links. Most systems provide links between specific items. However, this system emphasises dynamic links which are generated at the user's request. Microcosm allows a number of different actions to be taken on any selected item of interest; links are specified either as buttons or invisible links. A button simply binds two items of information whereas the links can be of four different types:

- *Specific Links*: specific links are similar to buttons, however the link anchor is not highlighted. For example if a section of text has many words as links, highlighting all of them would disturb the reader, therefore specific links are used which will not highlight the available links.
- *Local Links*: if a destination for a local link has been defined in a document, the user can select the anchor anywhere in the current document to follow the link. These are used for links within a chapter for example, in which every reference to 'wall' is supposed to be linked to a specific explanation, but outside this chapter the link will not be relevant. Therefore it is possi-

ble to define a link once which will work for every occurrence of the word 'wall' inside but not outside the document.

- *Generic Links*: the user can follow the link after selecting the anchor in any document in the current application. These links are most useful for glossary and bibliographic entries: once a destination had been defined for an author name for example, selecting it anywhere in the whole application will activate this link and display the reference material.
- *Dynamic Links* (Compute links): this allows the user to follow links not explicitly defined by the author. The available links will be calculated based on the anchor selection anywhere in the application. This works like a global search, the occurrence any word can be searched for in all documents, and the link can be followed straight to it.

With the design of Microcosm the developers have also tried to address the question of what users expect from a hypermedia system (summarised in Davis 1992b, 182); these expectations are also applicable to the archaeological environment:

- Users want a computer environment which is adaptable for the integration of data, tools and services as required. Users remain free to use whichever text editor or drawing package they prefer, without being bound to the one provided for the particular hypermedia system. By separating the links from the documents, this independence has been maintained.
- To maximise exchange with other persons active in the field, a system that is platform independent and allows distribution across different platforms would be an advantage. UNIX and Macintosh versions of Microcosm are under development.
- A system that comes with powerful navigational aids to allow the user (both the author and the reader) to find and update the information without having to wade through large amounts of irrelevant data. Text may be pre-indexed (Li *et al.* 1992) to allow a general search of text files. Other kinds of links also help to reduce the authoring effort. A differentiation between public and personal workspace and links is achieved by using personal linkbases.
- Finally, a system in which all data types are treated in a similar manner. If making links to data of one type or package differs widely from the next package, the learning will be more difficult and familiarity with the more advanced features will progress more slowly.

3. A tool for archaeology

It has to be accepted that nobody actually reads a complete excavation report; they are clearly not designed to be read from cover to cover. They are expected to give an overview of the excavation and allow a fairly detailed view of the data from which the conclusions are derived. However, with the increasing trend towards summary publication all that detail will be lost to the average reader by being kept in the archives. These archives require extra effort for access and in some respects are even worse than microfiche. Excavation reports are supposed to be written with specific reference to the data, acting like an index to the material in the archives. If it is easier to access the data people may change their attitudes and consult and work with them more.

What is needed in archaeological publication is a tool which will give access to the material in the excavation archive for research. I have to stress here that this program will not be aimed at the 'public' level of archaeology, but at research, which will be able to make sense of the mass of fairly unrefined data that will be made more accessible. The computer can improve on access and versatility and is a much more flexible tool than microfiche. For example, images can be manipulated, their brightness and contrast or colour maps can be altered interactively to enhance special features of the image.

Initially I will be aiming at the excavators who have to write up the paper report text. The new system will allow them to organize their data and establish links between the text and the supporting data. It is then possible to release this electronic archive, probably on CD-ROM, upon request. This would be in addition to the conventional printed volume, allowing researchers and readers access to the levels of archive not usually accessible at all unless the archive is visited. There are cases where archives can be split over several locations, making access even more difficult. I do not deny that there are instances where a visit is essential, for example to physically examine an artefact, but generally it can help to disseminate more archival information about a site.

A simple prototype of a computer-based tool for producing multimedia excavation reports has now been developed. This makes the archive easily accessible and enables the publication of computer generated data. It will also allow authors to organise their material whilst preparing the final report, and then give researchers access to the archive. Much of the information in archaeology is already created directly using computers. As an ever increasing part of the excavation record is already held on computer, and requires little modification, it should be possible for this information to be 'slotted' into the system.

The addition of specific archaeological tools, such as a Harris matrix generator, are the elements which will make the program uniquely archaeological. Other possibilities include interactive find distribution plotting from selected finds projected directly onto a plan. While Microcosm already offers good data organization and linking facilities that do not need to be improved further, tools that will aim to solve specific archaeological problems are being added. This involves the writing of a number of Visual Basic programs which will then perform these functions.

4. Archaeological requirements: a method to support interpretation

A survey of recording methods throughout the UK undertaken by myself in July 1995 showed that different archaeological units and organizations usually employ different methods, but all share a common principle which is that of the basic stratigraphic unit, most commonly called the context. The way in which it is recorded may differ in detail, however the overall approach remains the same. Most interpretation is done by establishing the stratigraphic sequence, usually with the help of a Harris matrix, which can be compiled on site while the excavation is in process, or after the excavation has finished. The matrix will then be used to build up a site chronology in relation to which the finds and other details can be interpreted and discussed.

Research has shown that most archaeological interpretation is carried out in sets commonly called groups or features. These are groups of contexts which together make a meaningful unit of interpretation. Therefore multiple selection will have to be an essential part of the overall search structure. Most sites are composed of very many contexts which only begin to have meaning once they are seen as a group, for example a group of postholes which form a building. While an individual fill may contain an important find, only the identification of the context as part of a pit fill for example will add meaning to the overall construct. For a hypermedia system to be useful for archaeological interpretation, searching in terms of groups or sets becomes a crucial ingredient. Multiple contexts are chosen on a plan or matrix, their details can then be extracted from a database and displayed in a table. Or vice-versa, if contexts of similar nature have been identified from a database, these can then be displayed on a plan.

I envisage to support the interpretation process with my program in the following ways, some of the details described below have already been implemented, others will follow. In the previous section I have shown how most archaeologists appear to base most of their interpretative statements on plans and distributions. In order to support the natural interpretation process, a system which supports archaeologists way of thinking would enable them to compare contexts and their details. In the current program, a number of contexts can be selected from a plan, and all the associated information can be displayed in a table extracted from the site database (see Fig. 3). With a specific keystroke such as [Ctrl-Click] a context can be highlighted and add to the search list – the user then selects the 'Database' option and matching entries from the database are displayed in a table. An especially useful option would be to integrate a Harris matrix into the system so that the contexts can also be visualised in their stratigraphic order. The selection process will also be available in reverse, giving the user the possibility to select a number of contexts from the database and be able to highlight them on a plan.

In light of the methods used for interpretation and discussion of interpretation results, it is necessary to provide a tool which will allow the comparison and overlay of plans and features, as these are central to interpretation in the post-excavation process. By emphasising the contexts or features under discussion it will be much easier to visualise proposed solutions and to compare them immediately to alternatives. On overview or phase plans contexts are treated as separate entities based on context numbers to allow a general information-base search. In the text it will be possible to highlight contexts discussed, and then they can be displayed on the plan, so that the user can follow the arguments closely without having to decipher illegible context numbers on plans. Again this action will be possible in reverse so that when they are highlighted they can be found in the text. This interaction has so far been implemented for single contexts but is not yet available for groups.

Overview plans are referred to in the text, so in my program they will always remain available unaltered, but the user is given the possibility to examine different possible contexts by selecting them individually, and overlaying them on top of the overview plan. It would be useful to extend the display and search scheme to sections in the future, but in combination with plans this is currently proving difficult with the tools at my disposition.

5. The toolbar

The toolbar program unites some of the more common functions of Microcosm in a small toolbar (see Figs. 1 and 2), so that the users need not know about all the functions of the individual Microcosm icons along the bottom of the screen. Rather than having to know for example that a double click on the main Microcosm icon is necessary to open the Select a Document Window, it was decided to write a simple toolbar front end which gives a button and menu interface that will stay the same throughout. Direct access to certain core documents which are pre- defined by the author is provided as an entry point (Fig. 2).

The toolbar also includes some functions which will speed up the compilation of new applications, such as: automatic renaming of files and types. Another key element to the usability is the ease of preparation of the archive and therefore it is desirable that the excavator should not need to specify links by hand.

Finally, the buttons repeat selected menu functions, adding ease of use and a visible reminder of some available commands. A detailed description of the commands and functions can be found in Wolle and Shennan (forthcoming).

The major search function which has been added is the database search. In keeping with the philosophy of multiple selection, a search utility that will allow the user to specify which database to be searched and select the tables and fields to be searched has been provided. This is also in keeping with the commitment to flexibility; no database structure is imposed on the archae-

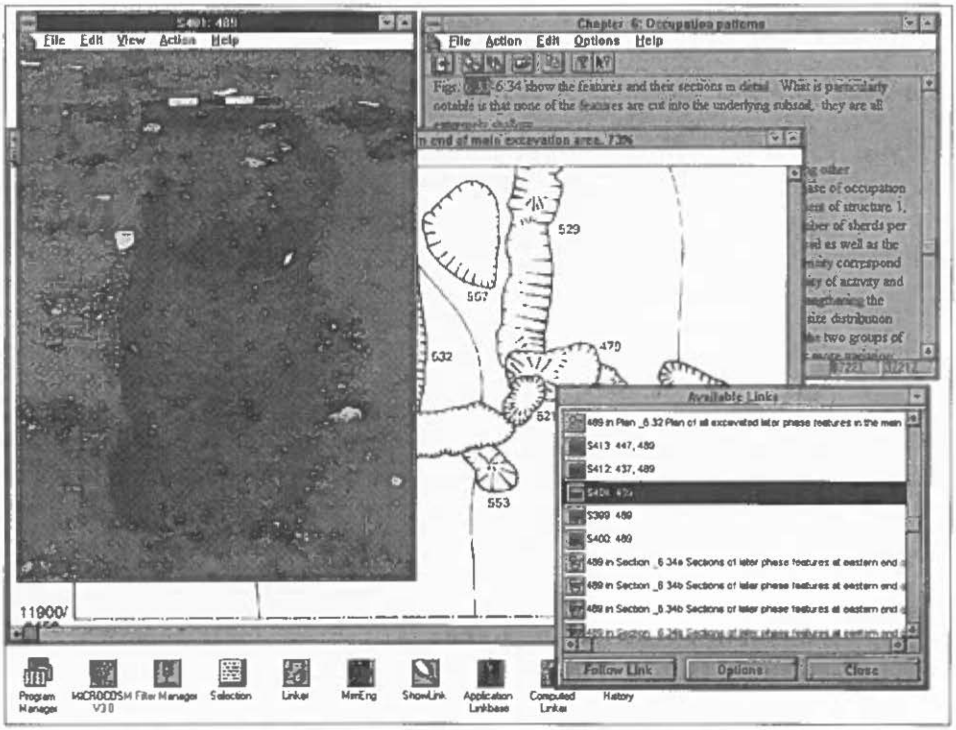

Fig. 1 – A typical screen of Microcosm running with excavation data.

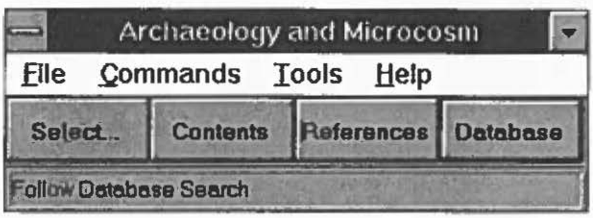

Fig. 2 – The toolbar

ologist, so they will be able to store, for example, their context descriptions in a table called *contexts* or a table called *descriptions*. Similarly the naming of individual key fields is of no consequence.

This search facility removes from the user the need to know how to extract information from databases, for simple search queries the user can highlight the items to search for and the program will list all instances in a particular field (Fig. 3). They will not need to know about SQL (Standard Query Language) or MS Access or any other database package.

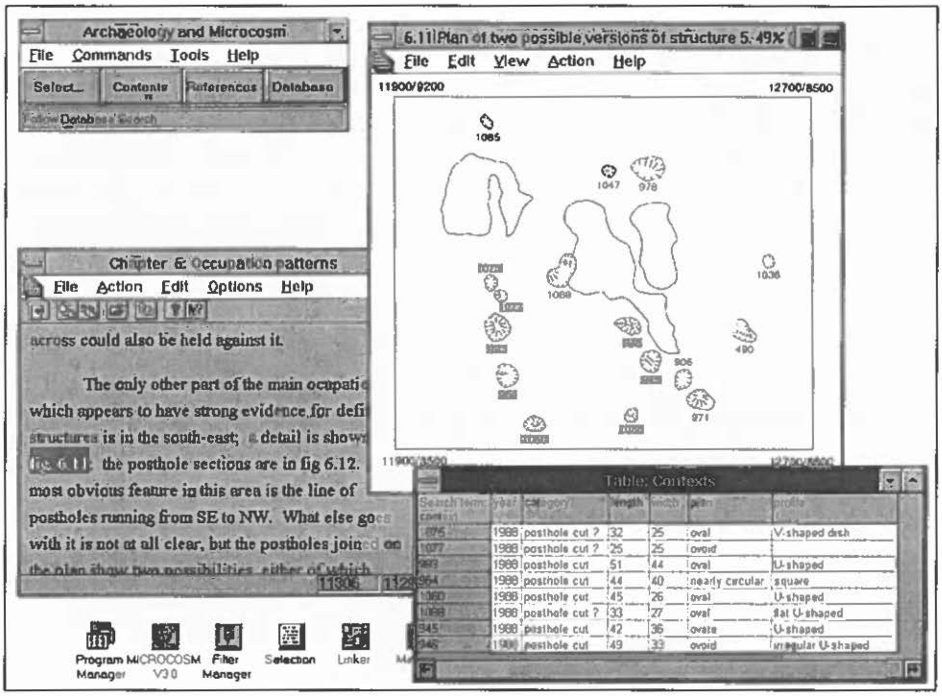

Fig. 3 – Result of a database search based on contexts selected from a plan.

Microcosm and the toolbar have so far been applied to one digitized key study archive. The archive selected is that for the excavations carried out at St.Veit Klinglberg in Austria by Shennan in the summer seasons of 1985–89. The site is situated in western Austria about 60 km south of the city of Salzburg (SHENNAN 1995). The database, written and graphic record have been transferred to computer.

The adaptations I carried out on Microcosm were possible because of it open structure philosophy. The program is composed of many communicating processes or components, allowing for different features or services depending on which components are currently active. The communication between the outside world and Microcosm is done by using the Application Programming Interface (API) used by Windows. Messages are passed to Microcosm components to initiate actions. The Visual Basic application uses API to communicate with Microcosm, to interrogate settings in the Registry, a central file where all Microcosm settings and details of imported documents are defined. In this way details about existing documents can be accessed and specific documents can be opened.

6. Conclusion

The diversity of approaches and programs in use in archaeology in the post-excavation process is vast, database structures are designed to fit the particular needs of the problem, and rightly so. Archaeology is too diverse a discipline to try and force it into a uniform mould. This would place unnecessary restrictions on archaeologists' aims and working methods. Therefore a program has been designed that will be able to cope with the diversity of formats in use and allow most users to continue their existing practices with existing programs and data collections, but with the added functionality and improved data access. I feel, that the attempt to make the system as widely useable as possible is probably the most important point about this work.

I hope that I have shown that Microcosm is ideally suited, and can be modified to incorporate any programs and practices I had not anticipated.

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ABSTRACT

This paper presents an update of my work on producing a tool for compiling and organizing electronic excavation archives with hypermedia function. The key to providing a usable tool lies in its flexibility to be incorporated with existing practices and software. As much data is already being processed and stored on computer, it would be an advantage to be able to continue using this data in its present format, without having to alter it. Therefore a program has been designed that will be able to cope with the diversity of formats in use and allow most users to continue their existing practices with existing programs and data collections, but with the added functionality and improved data access.

The Open Hypermedia System MICROCOSM, which provides a useful and flexible framework to group the data within the excavation report lay-out, is being adapted for archaeological requirements. While MICROCOSM already offers good data organization and linking facilities that do not need to be improved further, tools that will aim to solve archaeological problems are being added. This involves the writing of a number of Visual Basic programs which will then perform these functions.