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An electronic guide to the buildings of ancient Rome

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9.1   Introduction

The Department of History of Art of Birkbeck College is currently developing an electronic guide to the buildings of the ancient city of Rome. It is intended to become a free standing resource associated with the slide library of the Department. Although it will be available for consultation by all, it is primarily aimed at students taking the undergraduate course module 'The Classical Tradition'.

There is a long tradition of guides to ancient Rome, dating from antiquity through the middle ages to present times (e.g. *Notitia Regionum XIV*; Burn 1895; Coarelli 1974; Luciani & Sperduti 1992; Lugli 1946; Nichols 1986 – originally mid-12th century). This richness in itself presents the student with problems. Many of the best guides are not written in English, and most undergraduates do not have the language skills to overcome this barrier. The great volume of published scholarship causes problems of dispersal and only specialised libraries can possibly have the resources to provide a detailed coverage of the ancient city. Quite apart from locating the relevant books, a great deal of time is required to sift the information which they provide. Furthermore the economic constraints upon publishing reproductions of images means that standard texts such as J. B. Ward-Perkins' lavishly illustrated *Roman Imperial Architecture* (1970) can only contain three monochrome images and two line drawings of the Pantheon, the most complete standing building in the city.

Currently students at Birkbeck College depend upon the Departmental slide library to augment printed sources. The Department is committed to maintaining and developing this resource but large numbers of students consulting few, fragile slides creates problems of access and curation. Additional problems lie in the nature of the 35mm slide itself. Slides are designed to be projected and the rewarding activity of browsing through a slide library is both time consuming and disruptive to the collection. Slides are also small and only limited text and cataloguing information can be carried on the frame of a transparency, providing limited information for the student.

The collation and presentation of these disparate visual sources in a computer environment provides solutions to some of these problems, although it also raises new problems of its own. In addition recent advances in the graphic capabilities of low cost computers and the development of flexible authoring software provide new possibilities to integrate and relate various aspects of the ancient buildings.

9.2   Concept

The intention of the development is to link together three principal sources of information concerning the buildings of ancient Rome. These are: maps to indicate locations for the various buildings; images to provide a visual impression of the buildings; and a bibliography to give directions for further reading. These three sources are very different and each requires different approaches to make it accessible.

9.2.1   Maps

A map is a highly structured means of providing spatial information and usually encapsulates a series of conventions, editorial decisions and interpretations. Furthermore, any map is only a representation of the world at a given point in time. Modern atlases need constant updating to keep pace with boundary changes and archaeological maps need to be kept current to take account of both new discoveries and re-interpretations. The abundance of structural remains in the city of Rome causes problems in the compilation of maps of the ancient city, which rapidly become out-dated. A glance at maps compiled in the early part of the twentieth century (e.g. Lugli 1940) reveals identifications of buildings which are no longer generally accepted. Another problem with maps of this sort is the decisions which have been made about what to actually represent on the map. A popular choice (e.g. Lugli 1946, *Tav*.4) has been Rome at the time of Constantine, justified by the reasoning that by this time the city had reached its greatest extent and all of the major surviving 'Classical' buildings had been constructed. However, the presentation of the city 'at the time of Constantine' is something of a fiction as few buildings have been excavated to a sufficient degree to enable an accurate description of the state of the structure in the early part of the fourth century AD. The approach taken to remedy this situation is usually to represent a building on a map in either its original form or its surviving form. Matters are complicated still further by the superimposition of buildings, so that decisions must be taken whether to represent the Golden House of Nero or the Baths of Trajan on the slopes overlooking the Colosseum.

This situation presents problems in the choice of map to provide locations for the buildings of Rome. The remedy adopted in this project is to treat each map of Rome as a cultural artefact in its own right. Thus edited information from a recent archaeological map is used to provide an indication of the current understanding of the known remains. However a renaissance map of Rome is

also used to provide a different, but equally valid, representation of the topography of the ancient city. An equivocal approach such as this is vital since in historical studies there is little point knowing where twentieth century archaeologists thought the Temple of Peace was; what is important is knowing where the Temple was thought to be in the period under study, for example the sixteenth century.

The map is also a two dimensional object, which requires a certain amount of skill and training to interpret. This project supplements the maps by also providing images of the three dimensional model of the city of Rome now housed in the Museo della Civiltá Romana in Rome. The model enables the visualisation of the city and also provides evidence for three-dimensional relationships between buildings and topography which do not readily emerge from plans alone.

9.2.2 Images

Each building is different and unique: any number of images could not fully represent its variety. However for purposes of comparison and standardisation (see below) it was considered desirable to present a uniform range of views of each building. This in itself is a difficult task given the diversity and preservation of the buildings. During development, a standard range of images has been established. This includes a general view, views of details, a plan, a section, interior views, details of construction and a reconstruction of the building. Images are in colour where possible except for line drawings. This combination of images provides a reasonable overview of the buildings, but does rely heavily upon the skills of plan and section reading to provide a coherent presentation of the building.

9.2.3 Bibliography

The bibliographic part of the project provides listings of a range of papers, articles and books relating primarily to the buildings. More general titles are also included and these are cross referenced to the buildings.

9.3 Technical Issues

9.3.1 Development environment

The project has been developed using IBM PC compatible machines with Intel 80486 processors running Microsoft Windows. The software used to develop the programs is the ToolBook authoring software produced by Asymetrix Corporation which provides an object based and event driven environment. The package takes the metaphor of the book as its basis and information may be ordered into pages and books. Graphics and screen controls are easily created and manipulated and may be placed on pages or backgrounds which are used for multiple pages with common features. Each of these ToolBook objects may send or receive messages which are generated in response to events such as mouse button clicks or turning a page. These messages are trapped by objects and interpreted by scripts which need to be written in the programming language OpenScript, an integral part of the software.

This language is English-like and very flexible; however for complex programming tasks it becomes necessary to return to the traditional programming skills of trapping errors and evaluating returned values. To some extent ToolBook is object-oriented: graphics, screen controls, text etc. are all objects with properties which may be manipulated or created. It does not implement the key concept of inheritance, found in true object-oriented systems. However, objects consist of a hierarchy of books, backgrounds, pages, and then the various objects on a page. Messages are automatically passed up the object hierarchy until a script is found which can interpret the message. In this way the properties and scripts of an object further up the hierarchy may be exploited by an object lower in the hierarchy, thus producing some semblance of inheritance (for a review see Perkins 1993).

Images were obtained from 35mm slides using a Nikon LS-3500 slide scanner in conjunction with either Adobe Photoshop running on a Macintosh Quadra 800 or Aldus Photostyler on a Viglen 486 for image capture and processing. Images on paper were captured with a Microtek A4 flat-bed scanner connected to the Quadra. All images were scanned in 24-bit colour and then reduced in size to less than 640 x 480 pixels and the colour depth was reduced to 8-bit (either 256 colours or grey scales). As a rule of thumb image file sizes were limited to under 100k by manipulation of resolution and image size since larger images take too long to display in ToolBook. Using such low resolution images causes problems with complex images such as maps and plans but yields perfectly adequate results for other images to be displayed on high resolution SVGA monitors

Bibliographical data was stored in a dBase format file since ToolBook provides a Dynamic Link Library containing functions to directly access .dbf files without the need to use any other database management software. The data structure is a simple flat file with a field for each value. A more complex relational structure would have been desirable but would have caused programming complexities and performance penalties which outweighed the benefits.

9.3.2 Structuring

The structure of the project was determined by a compromise between the structure of the data and the capabilities of ToolBook which does not support the Multiple Document Interface standard, so cannot display child windows except when using MCI commands to display multi-media files. Fortunately multiple instances of ToolBook can run concurrently allowing more than one window to be used. This possibility was exploited to enable a window to be used for presenting map data, another for bibliographic data and others for information about individual buildings. Importantly for the buildings this structuring allows the display of more than one building at a time, essential for comparisons. The only limitation on the number of windows, and hence buildings which can be displayed at one time, is the amount of available RAM and system resources.
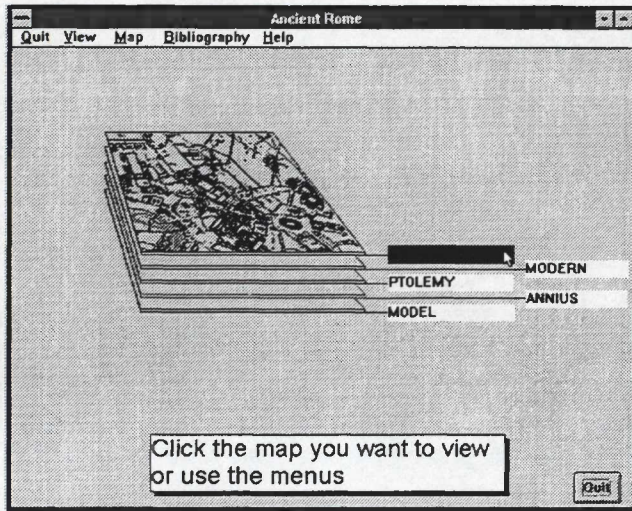
Figure 9.1: Clicking the Map menu produces this screen providing navigation to different maps; either the map sheet or the title may be clicked to go to that map.
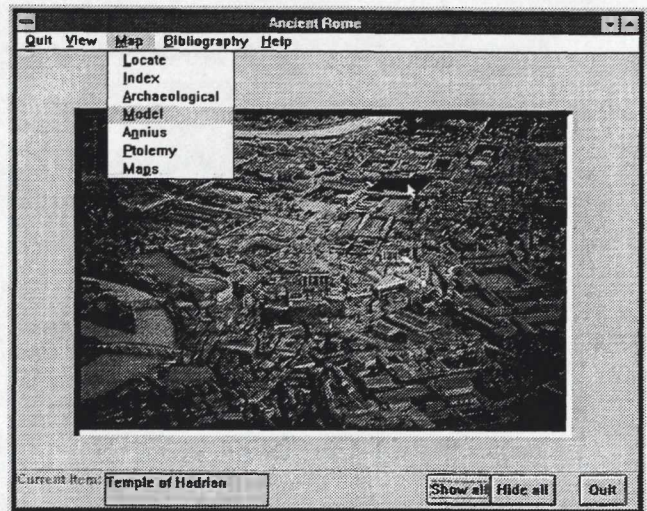

Figure 9.2: The Map menu with a view of the model of Rome. Note the mouse pointer over a highlighted monument which is identified at the lower left of the screen.
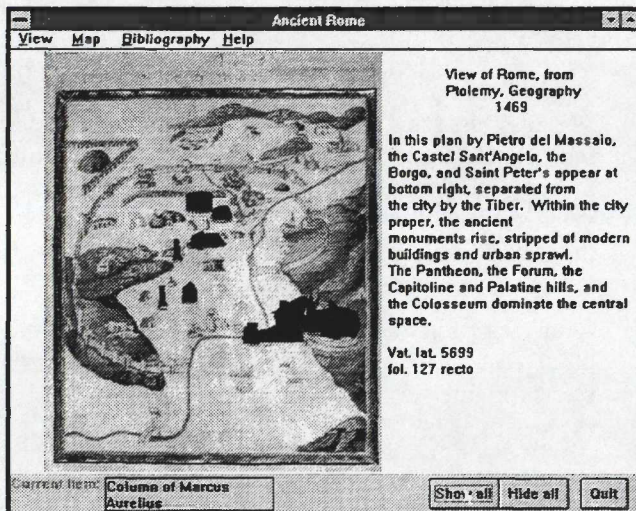

Figure 9.3: Rennaissance map of Rome with all monuments highlighted with the 'Show All' button.
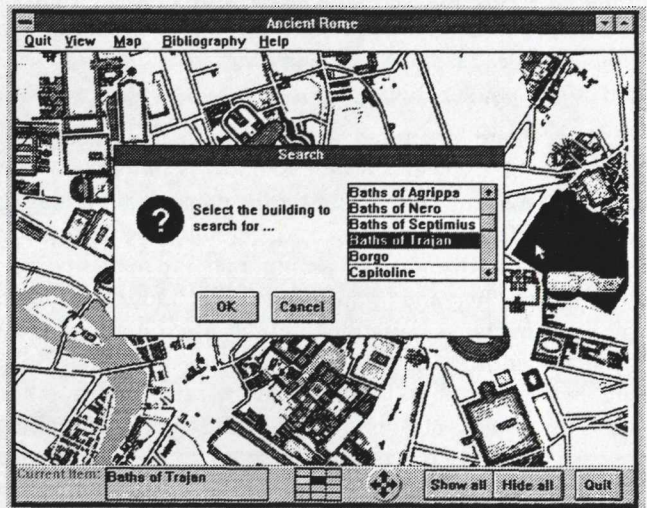

Figure 9.4: The Search dialog. Selecting the monument and clicking OK activates the search. If the search is sucessful the correct map is displayed, the monument highlighted and the mouse pointer is positioned over the monument as shown on the right of the screen

9.3.2.1 The maps

Following the discussion of maps above and the use of low resolution images, two forms of maps were used:

- maps which could be displayed on a single ToolBook page i.e. the entire map could be displayed in sufficient detail on a single screen

- maps which contained too much detail and consequently required to be displayed at a larger scale on several screens.

The maps as a group may be accessed from the opening screen, or from the 'Maps' choice on the *Map* menu. This presents a graphic of a stack overlaid map sheets, each of which is labelled. Clicking on a map sheet or its label will move to that map page (Figure 9.1).

Each map screen displays an image of the map as a bitmap and the individual buildings represented on the maps are further defined as vector polygons overlaid upon the bitmap. As the mouse pointer is moved over the map and enters a polygon the plan of the building is highlighted in red or green and the name of the building appears in a box at the bottom left hand corner of the screen (Figure 9.2). This mechanism is maintained for all of the various maps and provides a means of browsing the maps or the model and identifying buildings marked by
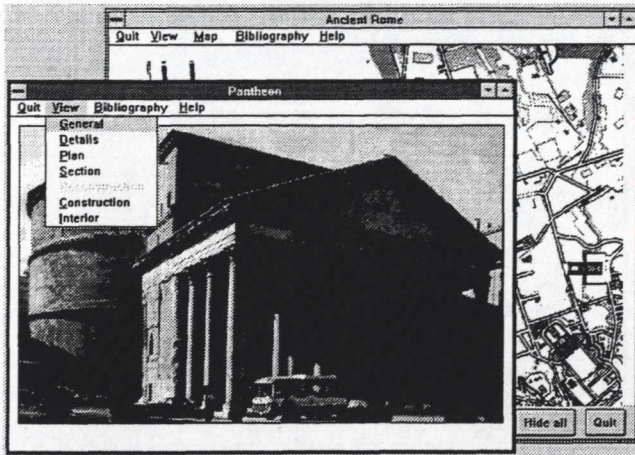
Figure 9.5: The result of clicking on the Pantheon on a plan. A window with details of the building is displayed. The menu shows the standard variety of information available.
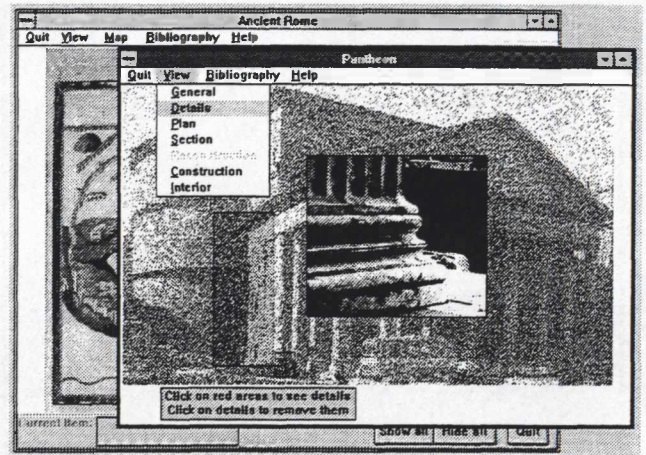

Figure 9.6: Screen showing details of the building. Clicking on a highlighted area of the overall view displays a detailed view of that part of the building.

simply moving the mouse pointer. On the lower right of the screen are buttons which will highlight all of the buildings identified, providing a context for browsing with the mouse pointer (Figure 9.3).

Other more structured forms of geographic query are also possible. The 'Locate' option on the *Map* menu produces a dialog box asking for the name of a building to find and, if the search is successful, automatically moves to the map showing that building, puts the mouse pointer over the building and highlights it. The 'Index' option on the same menu is similar but presents a scrolling list of all of the identified buildings allowing a building to be highlighted and then located with the same results as the 'Locate' command (Figure 9.4). Other options on the *Map* menu provide a means of moving directly from one historical map to another. On multiple page maps a further control is available at the bottom of the screen (Figure 9.4) to move from one map sheet to another. Clicking on one of the arrows moves to an adjacent map sheet, and a key to the maps on the left of the control indicates the relation of the current map sheet to others and also identifies other sheets previously viewed. It is possible to magnify the view of a map using a right mouse button click; however the results are not graphically pleasing because the pixelation of the low resolution images becomes apparent. Thus the digitised maps are unable to provide detailed plans of individual buildings as a good quality printed map can. Detailed plans are held separately along with other details of the building.

9.3.2.2 The buildings

Details of each building are maintained in separate files. Windows containing details of buildings each have a standard interface and as far as possible contain comparable material on each building. The window opens with a general view of the building, usually the main facade. Further information is obtained using the *View*

menu which contains choices to view other pages. The options are:

- 'General': the general view (Figure 9.5)

- 'Details': the same general view but with colour depth reduced and faded. Areas of the view are highlighted in red and clicking on one of these areas reveals a detailed view of that part of the building. A click on the picture will remove it. Several details may be viewed at any time (Figure 9.6).

- 'Plan': a plan of the building. If the building is multi-phase each phase may be viewed using buttons on the screen (Figure 9.7)

- 'Section': a section or multiple sections of the building (Figure 9.8)

- 'Reconstruction': a view of a reconstruction model or drawing

- 'Construction': views or diagrams of constructional details

- 'Interior': view of the interior with areas highlighted as in the 'Details' above.

These categories of information were refined during development; any idiosyncrasies of a building not catered for under these headings are dealt with using buttons on any of these screens. However, deviations from the standard scheme are kept to a minimum to maintain the familiarity of the standardised interface.

Digital video is also implemented in a limited number of buildings. A menu choice 'Video' appears on the *View* menu. Selecting this choice plays a short Microsoft Video for Windows file. Scenes are currently limited to simple panning views of the buildings: more complex video sequences would require purpose shot video sequences highlighting salient features.
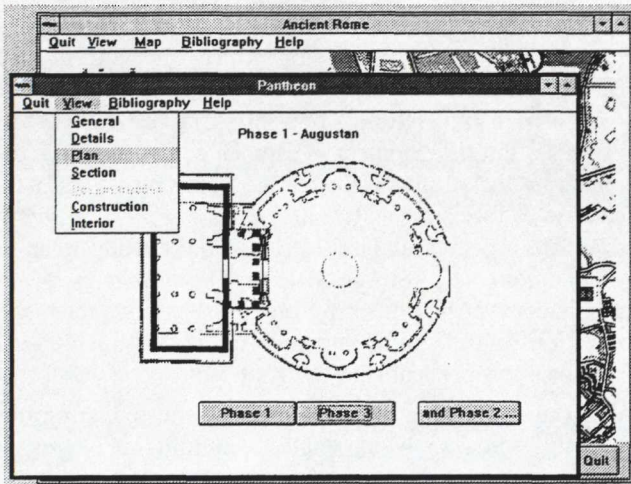
Figure 9.7: Screen showing a plan of the building, the result of clicking 'Plan' on the menu.
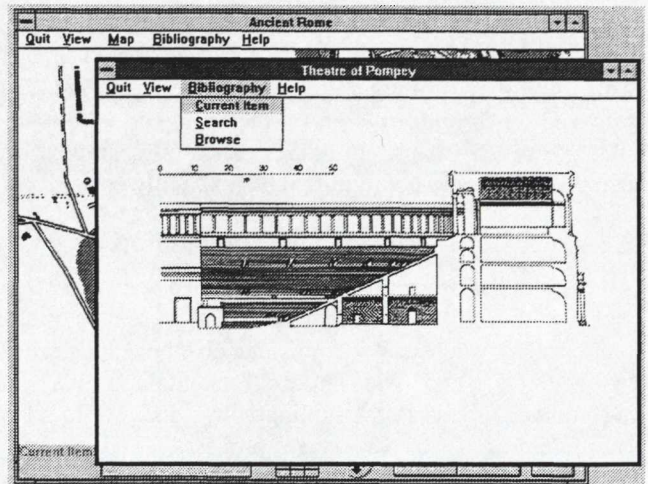

Figure 9.8: Screen showing a section of the building with the bibliography menu displayed.

9.3.2.3 The bibliography

At the top of the bibliography viewing window is a box titled 'Current Item' giving the name of the building to which the current database record relates. Beneath this are standard bibliographical details (Figure 9.9). Towards the lower part of the screen are boxes for keywords to enable searches independent of the buildings themselves (not yet implemented). Below this is a box titled 'Arrange by...' allowing indexes for the data file to be changed. Clicking the button below labelled 'Item' (Figure 9.9) produces a dialog box asking for a search string using the item (i.e. building) index. When the author index is in use the search criterion is the author's name. To the right of this are buttons for the management of data file records – the current record may be edited directly on screen. At the bottom of the screen are buttons to navigate through the data records sequentially.

9.3.3 Linking the parts

Windows of details of buildings are primarily accessed from the map sheets. On a map sheet if a building highlight is red this indicates that no further details are available, however when the highlight is green a mouse click will open the window presenting details of that building which may then be accessed via the *View* menu. The window opens leaving the map window visible behind. The maps may be returned to by clicking on the map window, which leaves the building window open, or by selecting 'Quit' from the menu bar which will close the building window and return to the maps.

The bibliography is accessible from the *Bibliography* menu which appears in both the map and the buildings windows. Three choices are available:

- 'Current Item' locates and presents the bibliography for the currently highlighted building in the bibliography window;

- 'Search' presents a dialog box to enter the name of a building or author to search for, and if the search is successful displays the bibliography, otherwise a notification of failure is given;

- 'Browse' opens the bibliography window at the current record, which is either the first record, or the last visited.

From the bibliography window the 'Building' button at the lower right opens a building window relating to the building in the 'Current Item' box, enabling direct navigation from bibliography to building, and closes the bibliography window. The quit button in the lower right corner closes the bibliography and activates the most recently visited window, either a map or a building.

In this way each part is accessible from any of the others via screen controls or menu choices as well as by
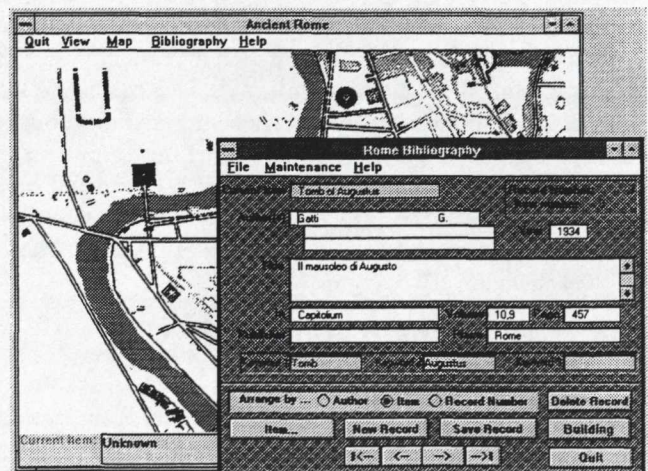

Figure 9.9: The window displaying the bibliographic data.

the standard Windows mechanisms of clicking the window to activate or using the Windows Task Manager. This multiple linking allows flexible querying and browsing of the information on the buildings. All of the links between maps, buildings and bibliography are dynamic and so do not require to be explicitly created.

9.3.4   Extensibility and modularisation

All parts of the project have been designed to be extensible by an author. The only exception at present is in the bibliography where new records can also be readily added by students, and the indexes maintained via the *Maintenance* menu in the bibliography window. To add a new building is a two stage process. First, a new ToolBook file must be created and the various images scanned and imported into their correct places. A blank template file containing the necessary pages and menu commands has been created to speed this process. The second step is to draw a vector polygon locating the building on a map and to set its 'name' property to the name of the building. Once this is done the program itself completes the integration of the building into the overall structure at run-time; for example the colour of a highlight is determined automatically as is the availability of options on the *View* menu. Adding new maps is straightforward: the scanned image is first imported and then named vector polygons drawn over it to locate the various buildings represented. To complete the process a new menu choice must be added to the *Map* menu a providing link to the new map.

Extending the system does not require additional programming unless any idiosyncrasies of the building need to be coped with. All of the programming scripts are centralised and modularised to enable efficient maintenance of the program. Thus there is only one script to handle a mouse button click, and the program itself determines what has been clicked and acts accordingly. Similarly there is only one script to handle the message generated when the mouse pointer enters an object. This generalisation of the event handlers does incur a performance penalty but it keeps the program code to a minimum and avoids duplication. Adopting this principle allows rapid and reliable modification and maintenance of the program. If for example it was decided to change the highlighting colour to blue when the mouse pointer entered the vector polygon of a building only one term in one line of code would require changing - the word blue would be substituted for red. If the script was not centralised it would be necessary to alter code associated with each and every polygon.

9.4   Discussion and Future Development

Although still at an early stage in development the project already provides a novel form of access to information about the buildings of ancient Rome. The intention has been to provide a relatively unstructured guide with the emphasis upon exploration and browsing. No structured tour is provided and no detailed exegesis of any monument is given. This choice has been deliberate and results from the purpose for which the project was designed. It would be perfectly feasible to design a computer based tutorial presenting a lesson in, for example, the development of Roman sculpture using the reliefs on the Arch of Constantine. However, within the context of this project it is not necessary since perfectly adequate accounts and scholarly works already exist in printed form (e.g. Strong 1911). The aim is rather to supplement such sources by providing a comprehensive selection of graphical images to both support and stimulate independent study by a student.

Some structure is provided through the searching and indexing functions which enable a building of interest to be viewed and located, but at present this is limited to enquiry by the name of a building. These functions will be augmented in future development by utilising the keywords in the bibliography file. These will be accessible from the map pages and will allow generic searches for broad subjects such as 'Temple' or 'Augustus' with graphical results in the form of what amounts to a distribution map and a choice of moving to more details about any of the buildings meeting the search criteria. Increasing the complexity of the search and linking facilities raises further issues concerning the structure of the project. At present viewing details of an individual building is something of a cul-de-sac: the options are to move to bibliography or return to the maps and there is currently no ability to move on to other related or contemporary buildings. Again, utilising the keywords and topographical locations, it is intended to provide a new option when viewing a building to move directly to an associated building. This will present lists of buildings differentiated by criteria of similarity offering a variety of moves through the system.

Currently there is no integrated facility for student note taking, although the experienced Windows user may utilise the Notepad or Write accessories for this purpose. Automating access to these utilities can be readily implemented from within the current structure, but will complicate student access to the system as a logging in routine will be required if individual files of personal notes are to be maintained.

At present using the system depends upon a knowledge of the Windows interface since much of the navigation depends upon using the drop down menus. Indeed initial testing has shown that students with a knowledge of the interface gain competence in using the structure much faster than those who do not. Therefore it is likely that further graphical controls will be developed to reproduce the functionality of the menus. However, certain difficulties can be foreseen in the creation of multiple buttons and meaningful and memorable icons to represent concepts such as interior, exterior or reconstruction for example. In addition a proliferation of controls will crowd and confuse the interface. An alternative is to use a reduced number of buttons to invoke dialog boxes, yet this too could potentially cause confusion. A solution adopted by packages such as the Perseus hypermedia guide to

ancient Greece is to provide a floating palette of navigation tools which are always available (Crane 1992). This approach has advantages in that it does not cause a cluttering of the interface, but at the same time it also creates a series of custom controls which need to be individually mastered and so looses the benefits of using a standard interface such as Windows or the Macintosh System.

Future development will include the addition of more text to the presentations of the buildings, not to increase the didactic direction but to present primary sources consisting of contemporary accounts and inscriptions relating to the buildings. Printed anthologies of such material are already available (e.g. Dudley 1967) but computerising the texts will enable the use of multiple indexes and automated linkages to bibliography and related buildings which the traditional printed medium cannot provide.

At present there is no intention to develop the project beyond its conception as an internal student resource, but if the scope and depth were increased it could become a powerful tool for accessing data. However this would require the gathering of detailed and accurate visual representations and perhaps also the commissioning of scholarly studies of individual buildings. The natural choice for the dissemination of such material would be CD-ROM. A further possible development would be the replacement of the bibliography with an interface to on-line public access catalogues of academic libraries. However, at present, such a linkage is not feasible for technological and performance reasons; furthermore it is not particularly useful for an undergraduate to discover that a key text is only available in Hawaii, when they are based in Birkbeck College!

This project, although overtly a piece of computer assisted learning software, brings together a number of techniques for the presentation of topographical and visual data along with a structured data set. Some of these are borrowed from Geographical Information Systems. The primary referent is a map, although here because of the time depth involved the concept of map layers is more applicable. However, the utilisation of maps from different periods to represent the shifting perceptions of the city through time disallows the precise geographic correlation of different map layers and absolute georeferenced locations for the building are not useful. The contemporary identification of a building and the cultural assignment of meaning to that interpretation becomes paramount in this context, rather than the cartographers' need to accurately measure location. The purpose of the mapping component of the Geographical Information System has been shifted from measurement to the cultural representation of space. Other aspects of GIS remain in a more familiar form. The spatial query is present in various forms: 'what can be found at point x,y?' is implemented by the interactive reporting of the location

of the mouse pointer as it is moved between vector polygons; 'where is x?' is achieved with the 'Locate' and 'Index' commands of the *Map* menu, and the results are presented graphically. Related information – the bibliography – held in data files and linked to the geography is also accessible via geographical as well as textual query providing further GIS style functionality.

The distance from a GIS increases when a building is queried and the results are visualised in a form which nears a multimedia presentation. The term multimedia is used cautiously, but here implies interactive access to cross-referenced graphics, photographs, text and in some cases moving video. There is currently limited implementation of hypertext simply because the project contains minimal text. Labelling the details about the buildings 'multimedia' is perhaps overstating the case since they are simply a complex, open ended response to a geographical query. The response to the query 'what is at point x,y?' comes not as a single answer but rather as a set of pieces of structured information and the tools to explore them. Commercial GIS software does not at present provide the means to obtain this style of response to a query; at best, responses come in the form of a pre-defined combination or a list of variables associated with a geometrically specified geographic location.

This interface between Geographical Information Systems and multimedia has yet to be explored by archaeologists. Projects such as this and the Perseus project begin to survey the territory but the means of representing a geographical location on some form of temporally referenced map and then realising the complexity of the data relevant to archaeological enquiries about that place remains to be prospected.

Postscript

Since this paper was written a new version of ToolBook (v.3.0) has been released and parts of the project have been re-written to take advantage of new features.

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