Archeologia e Calcolatori
7, 1996, 939-950

DIGITAL IMAGING OF STANDING BUILDINGS IN INSULA VI,1 AT POMPEII

This paper discusses the application of technological solutions to problems posed by the demands of archaeological and architectural research. Our research aim is to contribute to understanding the urbanization of ancient Pompeii through the changing patterns of buildings and land-use within one of its insulae. We are committed to a comprehensive study of the standing remains and sub-surface archaeology in the whole insula. The problem is how to record and analyze the standing remains practically and in sufficient detail for stratigraphic interpretation. Our solution is to use digital imaging instead of conventional drawing. It is allowing us to create a record of our buildings with unprecedented detail and flexibility.

This work is a central part of the program of the Anglo-American Research Project in Pompeii. This paper presents the results of the efforts of a large team who have worked to develop this approach in the field*. Our project is one of a number of newly established programs at Pompeii which are concerned with the diachronic development of the city. Fundamental to the ideas behind these projects is the view that the city of A.D. 79 cannot be properly understood without studying the processes of change which created that city. Enjoying the strong encouragement of the Soprintendenza Archeologica di Pompei in this approach, these projects have originated in a number of countries, notably Italy, the USA and the UK (BON, JONES forthcoming).

Our own work concerns the development of Insula 1 in Regio VI of Pompeii (BON *et al.* 1995). It provides an excellent opportunity to consider diachronic change at Pompeii. The block has a long ancient history, and contains the Casa del Chirurgo which has often been considered one of the oldest structures still standing at Pompeii. The insula also has a long modern history because it was one of the first parts of the ancient city to be exposed in the later eighteenth century, although only rudimentary records exist of its original unearthing to the A.D. 79 level.

Insula VI, 1 also shows how interpretations of its structural history have been made based on only partial records of the actual buildings, inevitably generating flawed conclusions. The commitment of our project to a comprehensive understanding of how the urban space was used essentially requires that we have a comprehensive record of the surviving evidence.

*During the 1995 field season of the Anglo-American Project, the methods described here were used by teams of students led by Jessica Davies and Mark Berrett (University of Bradford), who deserve the credit for applying and refining this approach, and making it work.

1. Insula VI, 1: the research problem

An introduction of the insula should demonstrate the nature of the problems we face. Insula VI, 1 is situated in the north-west corner of the city immediately inside the Porta di Ercolano, on the Via Consolare, one of the city's main thoroughfares (Fig. 1). As well as two large houses, the Casa del Chirurgo and the Casa delle Vestali, there are bars and workshops, some of unclear purpose. The structures remain in a generally good state of preservation, although the painted walls are badly degraded. The Casa del Chirurgo is often cited as an early example of Italic (or more specifically, Samnite) domestic architecture because of the use of very large blocks of Sarno stone in its construction, an old architectural style at Pompeii (Fig. 2).

The first modern excavations were conducted by Amedeo Maiuri who completed ten trenches in the Casa del Chirurgo in 1926 (Maiuri 1930). He dates the construction of the house to the fourth century B.C. and describes periods of modification, including work done on the entry chambers and rooms to either side, the construction of the impluvium (in tufa) post-dating the atrium (in Sarno stone), the pavement of the entry-way and the construction of the sidewalk in front of the house. He says that by the Roman period the house had achieved its final form. Maiuri's conclusions are re-considered by Cristina Chiaramonte Treré in her 1990 discussion of Samnite domestic architecture (Chiaramonte Treré 1990). Re-assessing the dates assigned by Maiuri on the basis of his excavations, she claims that his research was poorly documented, and that his conclusions were sometimes based on less than sound evidence. She suggests an original date for the house in the third century B.C., with minor modifications continuing until A.D. 79.

However the discussions by both Maiuri and Chiaramonte Treré concentrate mainly on the atrium area of the house. Both pay scant attention to some substantial later changes that are readily visible. A garden dining room was added. Service rooms including an upper story were constructed on the south and east of the original house, as well as separate properties which were entered directly from the Via Consolare. Chiaramonte Treré has shown how essential it is to re-examine accepted conclusions and to consider very rigorously the evidence upon which our own conclusions are drawn. Our project is designed to use explicit archaeological evidence to investigate carefully the full sequence of all different phases in VI, 1.

Our team made a preliminary examination of most of the block in 1994. In addition to the two larger houses, the Casa delle Vestali and the Casa del Chirurgo, to the north and south are a number of smaller properties (Fig. 1). At the southern end there is what seems to have formed a planned set of three properties. These three properties at an earlier stage may have been separated from the Casa del Chirurgo by an outdoor space that was later filled in by newer buildings. It appears that the Casa del Chirurgo itself was

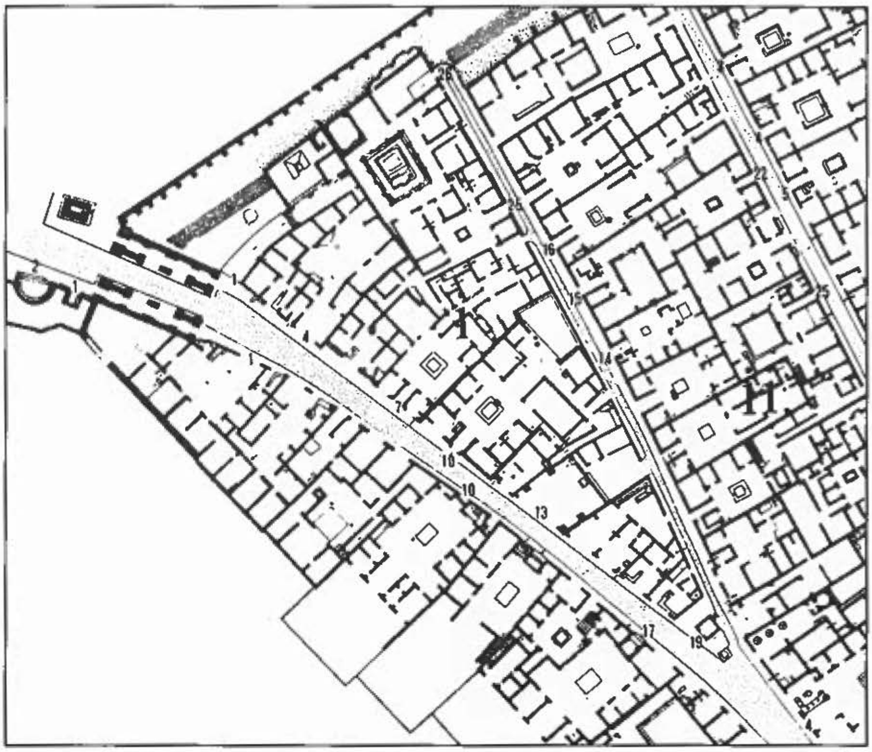
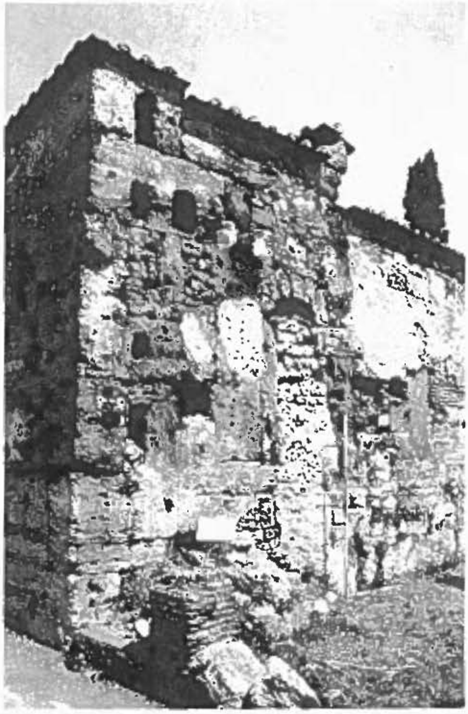


Fig. 1 – Insula VI, 1 at Pompeii (after VAN DER POEL 1984).

Fig. 2 – Insula VI, 1 at Pompeii: the façade of the Casa del Chirurgo.



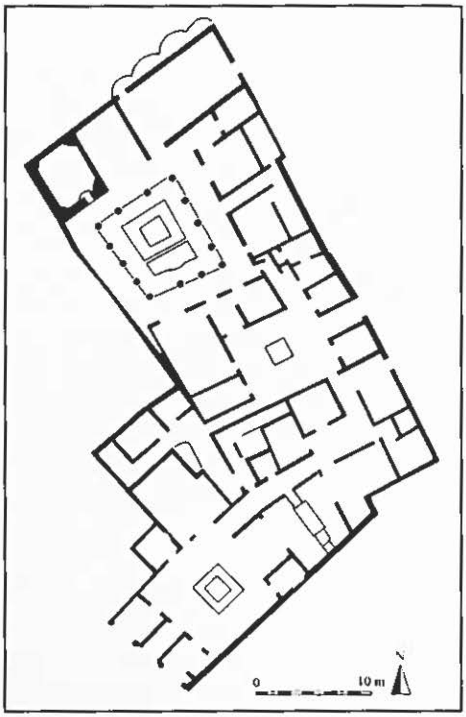


Fig. 3 – Insula VI, at Pompeii: the south wall of the Casa del Chirurgo, showing alterations for the added properties.

Fig. 4 – Insula VI, at Pompeii: Casa delle Vestali – final phase.

extended from a simple atrium plan by the addition of service rooms in an upper storey on the south side of the rear of the house (Fig. 3). Another property was created on the main street frontage immediately next to the south side of the Casa del Chirurgo, with a separate stair up from the street to another property.

The Casa delle Vestali evidently developed in a number of stages. In its final form it was a sprawling property that appears to have been architecturally inconsistent (Fig. 4). In its final phase, it had one elaborate entrance from the Via Consolare, opening into a wide atrium. At the back of that lay a small ornamental garden, but then passages led through a labyrinth of small rooms which connected to another atrium, opening from the Vicolo di Narciso. On the north side of that lay an impressive peristyle with a modified pool in the center. Some smaller rooms lay to the east of the peristyle, but there were on the north side a set of three imposing and elegant rooms decorated with Third Style wall paintings. Comparisons with the building line at the north end of the insulae to the east, VI, 2 and beyond, suggest that these rooms may all have been an extension of the house into the space behind the city wall (Fig. 1).

The main conclusion of our preliminary assessment was that the history of the insula was complex. Furthermore, even though its early history had been the subject of excavation and analysis, the existing knowledge of the insula was thoroughly inadequate. Many changes had clearly been made in antiquity to the visible fabrics of the buildings, complicated further by attempts at restoration made over the two centuries since the structures were first unearthed. No simplistic analysis of the insula could do justice to this complexity. It was relatively easy to make general interpretations of the main outlines of development from initial observations. However the validity of those interpretations could only be tested by systematic recording of the details of the standing remains. There was no other way of establishing whether observed changes were minor modifications within a major phase, or the key to a substantial remodeling of a building.

Our research strategy also sought to carry out selective excavation within the insula to recover as much as possible of the evidence for the pre A.D. 79 occupation. We were obviously committed to fully stratigraphic recording of the excavated below-ground archaeology. It was equally obvious that we should apply the same approach to the above-ground archaeology.

2. Possible solutions

It is of course one thing to decide what kind of results are needed, it is another to decide how to get them. A number of methods were experimented with in the course of our 1994 season.

Firstly, the traditional way to achieve detailed records of a wall is by conventional measured drawings. This method has the advantage of a precise record of the wall details, easily linked with an interpretation of the sequence of building activities. Despite the quality of the output achieved, this method would be prohibitively slow to produce the comprehensive record of the whole insula which our research aims demand. Photography presented a possible way forward. In 1994 we created a thorough photographic record of most of the structures on 35 mm color slides. This has proved invaluable as an easily available source of reference, but is in no way specific enough for our main purposes.

More promising were our experiments with detailed photographs of walls using measured control points to allow later rectification. We used black and white and color print 120 film in a medium format camera. This method provided results that brought us close to images that could be printed and rectified to represent the vertical plane of a wall, showing an acceptable level of detail in the actual masonry. The approach would have allowed us to avoid the time-consuming measuring of every stone in a wall. The rectified images would then be suitable to use as the base for overlays on which the stratigraphic interpretation of the wall's phases could have been drawn. However there were some significant practical problems in processing the photographic film. Ideally we would need the photographs to be printed and available to the teams working on wall interpretation during the same season. Yet to establish a dedicated dark-room facility for the field project would have been at best awkward and probably financially beyond our means. The alternative of taking photographs during one season for working with in the field in the following year was cumbersome and would have made for inflexible working.

3. Solution adopted – principles

What we have done is to use a still-video camera to produce digital images of walls. These images can be easily transferred to computer, where they can be rectified or otherwise processed as required. They are printed to provide a speedy hard copy image of the details of the wall, over which interpretations can be recorded as overlay drawings. This method creates detailed images which can be quickly provided for field use.

The principle is thus very simple. It provides a digital image from the start, avoiding having to transfer a conventional photographic image into digital form. This is easy to store and is then available for whatever processing may later be appropriate. For example, as we build our information base, it will be possible to create more sophisticated three-dimensional models of the structural history of the insula. This will be facilitated by our new total station survey of the ground plan of the insula. The method has significant benefits in that it uses easily available technology in cameras, computers and software. In that sense the principles are more widely applicable than the details of the equipment we are using. The principles can be applied and adapted according to the resources available for particular projects, but the basic requirements are readily available.

4. Solution adopted – practice

The core of our system is a Sharp VL-H410 Hi8 Viewcam video camera, with processing done on a standard IBM compatible 486 PC, running at 66mHz, fitted with an appropriate video card. Image editing has been done using Aldus Photostyler version 2. Drawings were digitized and rectified using AutoCAD (version 12).

The actual process involves the following stages:

Wall preparation. A grid of control points must be set up across the wall to be recorded. These should be marking areas of 1 x 1m. or 0.50 x 0.50m., according to circumstances. The points must be clearly observable. Brightly colored plastic photogrammetry targets are obviously ideal.

Taking the image. The framing of the image has very much depended on the available space around the wall. It is sometimes feasible to include a complete wall in a single shot. However there may be problems of the resolution of the image with this method, since the camera gives a maximum resolution of 470,000 pixels for each image. It has often proved satisfactory to take a whole wall in one image. The alternative is to create a composite image of the wall by taking a number of images which then have to be added together. The compositing method can give improved resolution, but requires considerably more time spent on processing. Of course a combination of the methods can be used as necessary. Each project must balance the quality of the image needed against the pressures on time.

The Sharp VL-H410 Viewcam has been mounted on a tripod for stability. Care is taken to line it up perpendicular to the wall in order to minimize the levels of distortion in the image. We have found it most effective for minimizing distortion to keep the lens of the camera at a fixed zoom setting. The images are taken as 4 second stills. Each image can be given a spoken identification integrated into the primary record by using the camera's sound facility.

We have used Fuji Hi8 ES-90 video film which allows about 1300 full color images to be taken on each tape. This provides a very economical and compact storage medium for the images.

Image capture. The video images can then be played back from the camera through the video card and captured as a computer image file. We have used the Creative Technologies Videoblaster card and Windows-based software to save images in a number of file formats.

Image editing. We have transferred images to Aldus Photostyler version 2 for editing in various ways, such as the cutting out of superfluous information in the background or foreground, or expanses of sky.

Printing. The images can be printed as taken. We have used in the field a Hewlett Packard HP520 printer with satisfactory results (Fig. 5). Clearly a higher resolution laser printer would improve the quality of the printed image, but again each project must assess acceptable quality against cost and maneuverability.

Wall analysis. Once an acceptable paper image has been produced, it is taken to the wall itself for stratigraphic interpretation. We have organized this with teams of students working usually in pairs on a given wall, under close supervision. Their task is to identify individual construction events in a wall, on the basis of variations in the stonework and mortar. These are defined and recorded in a system of forms which follow the design of the stratigraphic record forms for excavation. Each construction event must be explicitly described, just as a stratigraphic unit in an excavation, with the stratigraphic relationships identified with other construction events. The method is simply an extension of stratigraphic excavation processes to stand-

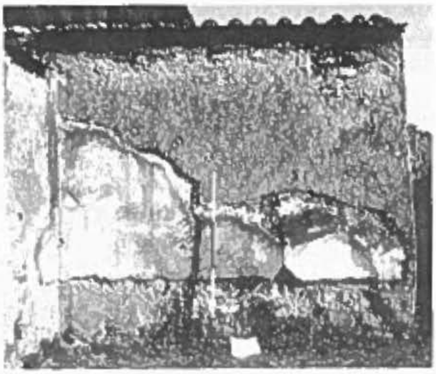


Fig. 5 – Unrectified still-video image of wall elevation in the Casa delle Vestali, Insula VI, 1 at Pompeii.

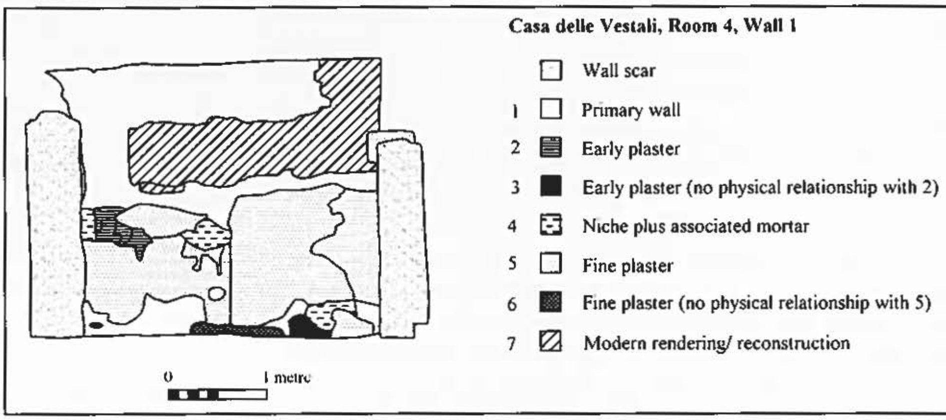


Fig. 6 – Rectified and interpreted drawing of a wall elevation – south wall of atrium of Casa delle Vestali, Insula VI, 1 at Pompeii.

ing remains. Essential to it is the drawn record on which the construction events are defined. This takes the form of a tracing film overlay on the printed image, on which the construction events are plotted.

Rectification. We have chosen to rectify into the vertical plane the interpretation drawing made as an overlay, rather than the original computer image (Fig. 6). The overlays are digitized using AutoCAD v.12, which takes into account the distortion between the control points on the image and in the true vertical plane, to produce a corrected drawing. Each construction phase is digitized as a single layer in the system. The rectification could be done earlier, before the printed image is passed over for wall analysis. However we have found that careful positioning of the camera has kept distortion levels very low, so that the raw image is usually accurate enough to work with in the field. We have therefore been able to leave the rectification to a time outside the pressures of our field season.

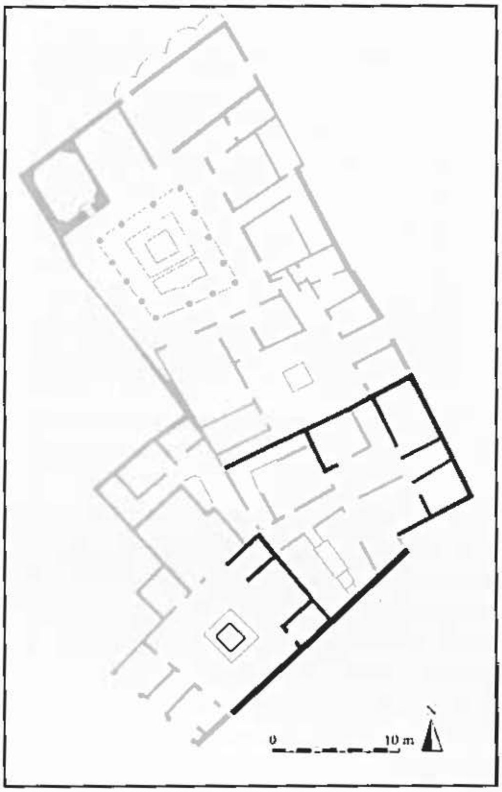
5. Review and prospects

We look forward to developing this system further as our project progresses. We will be using our record for interpreting and documenting the structural sequence in the insula, including three-dimensional modeling. The images can also be linked to relational databases of the wall contexts, and if appropriate to relevant excavation data. It is already clear that we will be able to archive images very efficiently, since the video tape format holds so many images. This is important for our continuing investigations. It is also likely that the quantity of digital images will raise new questions and possibilities for the publication and dissemination of our results and our archival data. Given the developments that can be envisaged in the storage and publication of images in various media it is not yet possible to say what will prove to be the most effective format in which to publish these images, but there is the exciting prospect that we will be able to publish our buildings in unprecedented detail.

We are still in the process of learning how to exploit the possibilities of the technology fully. Our experiences so far have taught us some of the problems and the potential. It is clear that implementing such new methods for the first time requires the working team to adapt. It is necessary to try out the techniques before being faced with the real situation in the field. This has to be done in terms of the needs of the particular project. The experimentation needs to address particularly the issue of when in the recording process to rectify the images.

We also found that many of our team took some time to get used to the idea of analyzing walls stratigraphically, even before familiarizing themselves with the new technology. Our team was made up mostly of inexperienced student members of our Field School. They needed close supervision at first, but soon became confident with the techniques. The methods are quite labor intensive, but not nearly so demanding of labor as conventional drawing. In fact the methods have proved remarkably cheap and efficient. Our experiences of work rate are that in 1995 the photographic team worked with an average of three students at a time, for five weeks. They achieved the recording of virtually the whole insula. The wall analysis teams worked in groups of five to six for four weeks, and completed the interpretation of about 20% of the insula. Both calculations include learning time because of frequent rotation of the students between these and other tasks in the project. The great advantage of our approach is that the time is mostly spent on working out the interpretation of the structures, rather than the laborious measuring-in of thousands of individual stones.

The results achieved in the Project so far demonstrate the strength of combining excavation and interpreting structures (Bon *et al.* 1995). We can show the outline of the development of the parts of the insula examined. In



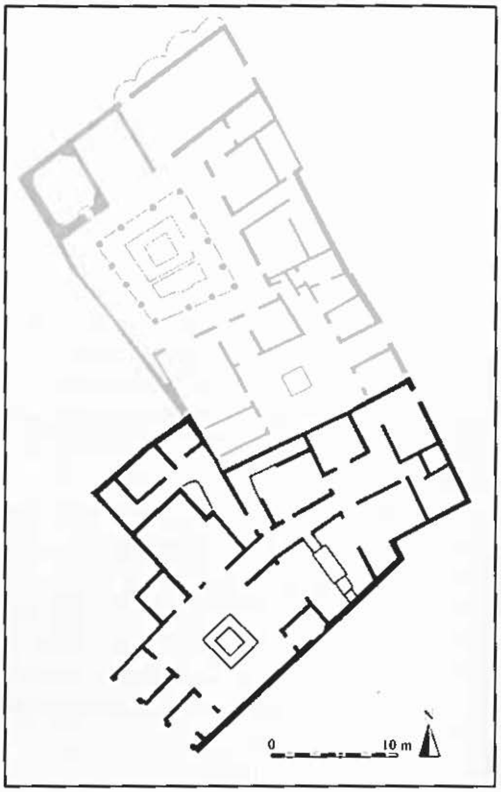


Fig. 7 – Insula VI, 1 at Pompeii: Casa delle Vestali – two atrium houses.
Fig. 8 – Insula VI, 1 at Pompeii: Casa delle Vestali – a single house.

the Casa delle Vestali, the early plan comprised a number of small atrium houses, the plans of two of which we can now present (Fig. 7). These two were later combined into a single unified house, with their different alignments linked by a small garden (Fig. 8). Later still this house was linked with another adjacent house to create a very large complex with a grand peristyle (Fig. 4). Such developments raise numbers of questions about changes in the use of urban space at Pompeii, and changes of social organization, over the centuries before the eruption of Vesuvius (Bon *et al.* forthcoming).

These results show how the application of new technologies can be used to create research evidence of unprecedented quality and detail. Our interpretations of the structural sequence depend on a full analysis of the buildings. That could not be practically achieved by conventional means. In a research context wherever standing remains are important, this method of documentation may prove useful. Pompeii is not the only major archaeological site where extensive standing remains were excavated many years ago and where the condition of much of the site continues to be effectively undocumented. In such cases, a full program of analysis and interpretation may not be immediately necessary.

However in many cases there is simply no record of the current condition of the remains as they survive today, artifacts of ancient construction and modern restoration. The technique outlined here can quickly document the state of survival of the extant remains. It is a very valuable tool for the conservation and management of the cultural heritage. It offers rapid, accurate imaging and compact archiving, through technology that is readily available world-wide. We hope that our work will prove helpful in these areas, as well as in understanding the urbanization of Pompeii.

SARA E. BON
Department of Anthropology,
University of North Carolina at Chapel Hill

RICK JONES
DAMIAN J. ROBINSON
Department of Archaeological Sciences,
University of Bradford

BERNICE KURCHIN
Department of Anthropology,
Hunter College,
City University of New York

BIBLIOGRAPHY

BON S.E., JONES R. (eds.) forthcoming, *Sequence and Space at Pompeii*, Oxford, Oxbow Book.

BON S.E., JONES R., KURCHIN B., ROBINSON D.J. 1995, *Anglo-American Research at Pompeii 1995. Preliminary Report*, Bradford Archaeological Sciences Research 1, Bradford.

BON S.E., JONES R., KURCHIN B., ROBINSON D.J. forthcoming, *The context of the Casa del Chirurgo: investigations in Insula VI,1 at Pompeii*, in BON, JONES forthcoming.

CHIARAMONTE TRERÉ C. 1990, *Sull'origine e lo sviluppo dell'architettura residenziale di Pompei sannitica*, «Acme», 43,3, 5-34.

MAIURI A. 1930, *Saggi nella 'Casa del Chirurgo'*, «Notizie degli Scavi di Antichità», 381-395 (reprinted in A. MAIURI, *Alla ricerca di Pompei Preromana*, Napoli 1973).

VAN DER POEL H. 1984, *Corpus Topographicum Pompeianum, III the RICA Maps of Pompeii*, Austin, University of Texas.

ABSTRACT

The large-scale recording and investigation of standing archaeological monuments by conventional methods presents considerable problems of labour and expense. Modern techniques provide cost-effective methods applied in Pompeii, using widely available technology in digital imaging, computer hardware and software. These approaches provide

important benefits both for research and for conservation policies. They facilitate the analysis of the structural history of the buildings, which forms a crucial part of the research programme of the Anglo-American Pompeii Project. However their advantages for the speedy documentation of the current condition of extensive areas of standing monuments are of more general application.