

22 The excavation archive: an integrated system for the management of cartographic and alphanumeric data

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22.1 INTRODUCTION

This paper illustrates the computing section of a strategic project for the development of research methods applied to the study and safeguarding of the archaeological heritage of southern Italy. The project has been launched by the Italian National Research Centre (CNR) at the University of Lecce.

Geographically, the principal area of interest is the Adriatic zone, with particular emphasis on the Salentine peninsula.

Recent archaeological research has highlighted the role of the area for studying phenomena of interaction and exchange between the various populations around the Adriatic. This may be summarised in the proceedings of two conferences held at an interval of over ten years from each other (*Adriatico* 1973; *Salento Porta d'Italia* 1986). Work over the last few years has revealed a phase of Hellenic presence that pre-dates the colonisation of southern Italy. This opened up a new research direction intended to analyse precocious Greek influence in the processes of cultural development of the indigenous societies. These problems have been debated in the Conference on Magna Graecia held at Taranto in 1990, and summarised in an article by D'Andria (1988). In this work, particular emphasis has been given to the reconstruction of settlement evolution. Indeed, present research within the strategic project is designed to understand the passage from primitive village structures, through a phase of "proto-urbanisation", to complex towns, in the context of the pre-Roman settlement patterns of the southern Adriatic zone. A phenomenon of autonomous and early settlement development may be contrasted with other areas.

From a methodological point of view, clearly such research requires an integration of data concerning settlement plans, construction techniques and transportable artefacts. Of particular importance is the analysis of the spatial distribution of artefacts as an aid in the definition of functional areas within settlements. The use of automatic data processing arises from the wish to try to identify and fully exploit the innumerable relationships existing between the various entities under study.

22.2 CHARACTERISTICS OF THE PROJECT

22.2.1 Types of data

A careful analysis of our archaeological objectives has permitted the identification of a technical solution held to be particularly suitable for developing research on settlement patterns. This consists of a data management system that guarantees the integration of three different types of information:

- alphanumeric
- cartographic
- photographic

These contain data deriving from field work. This comprises two different interacting research systems — field survey and excavation — directed towards the study and safeguard of the territory but with substantial differences as far as techniques and objectives are concerned.

Since the purpose of this project is to study a settlement in its entirety, it has been necessary to include data that has not been systematically or scientifically collected but may still provide useful information to complete the general picture.

This includes artefacts in collections, usually without background data, or surface material that has not been collected systematically.

The project proposes to integrate all information within a single system that permits interactive use of the different types of data: descriptions of excavations and of find analyses, plans, drawings and photographs. The problem of safeguarding archaeological sites is linked to the scientific objectives of the strategic project, especially regarding the preparation of maps and plans that can be updated in real-time.

22.2.2 The descriptive data

The interest expressed over the last fifteen years by Italian archaeology in the problem of the analytical description of excavation data represents just one aspect of a larger debate or revolution in stratigraphic and topographic methodology (for a recent synthesis see Manacorda 1990). The introduction of standardised forms for the registration of archaeological data reflects the search for systems that are able to describe, in an appropriate fashion, the increasingly complex realities of archaeology (Carandini 1977; Hudson 1979; Francovich 1990). At virtually the same time, the Italian experience in automatic data management has posed the question of finding instruments capable of handling the enormous mass of information produced by the ever more sophisticated analytical methods developed in archaeology (Gualandi, Ricci & Aloia 1987; Semeraro & Mangia 1987; Guermanni 1990).

I don't intend to illustrate the rich period of experimentation by the Italian National Cataloguing Institute (ICCD) and university departments that led to the development of a national recording system (see Medri & Polese 1991). Suffice it to say that, only a few years ago, collaboration between the ICCD and IBM led to the establishment of the SAXA data entry system for the acquisition of descriptive data. The original group of recording forms produced for SAXA, which dealt with *objects d'art* (Papaldo *et al.* 1988; Parise Badoni & Ruggeri 1988) was followed by a whole series of archaeological recording forms prepared by Project Eubea, also in collaboration with the ICCD, during the analysis of one of the richest archaeological areas of Italy, Naples and the Phlegrean Fields (Medri & Polese 1990).

The SAXA layouts reflect the intent to find the best possible answer to all the requirements of cultural heritage classification. In our project constant reference was made to this experience while analysing the alphanumeric data for processing, but at the same time the criteria for choosing and

the form in which to express each item of information was oriented towards 4 functions:

- 1) The field in which it would be used (scientific research or administration)
- 2) correlation between alphanumeric data
- 3) correlation with cartographic data and photographs
- 4) statistical processing of alphanumeric data

22.2.3 The graphic archive

The characteristics of the graphic and cartographic documentation were defined contextually, as were the predicted results of processing.

The composition of the archive to be processed is very varied. It includes large scale maps, area and site plans (1:5000 to 1:500), detailed plans of individual monuments or buildings (1:100 to 1:20) and both stratigraphic sections and feature and layer plans (1:20 to 1:10). The methods of planning and mapping used are also varied (aerial survey, survey with topographic instruments providing polar co-ordinates and triangulation) and consequently so are the topographical reference systems and graphic characteristics employed.

Such differences strongly influence the way in which the excavation data for the study of settlement patterns is analysed. For example, carrying out one of the most frequent operations — the updating of the general site plan and the insertion of new detailed plans — is a lengthy process. This is because of the need to turn to photomechanical reductions and enlargements and then to get specialised personnel to recompose the material graphically.

We foresee the possibilities of handling graphic data by computer by assigning not only complex phases of updating and modification of new data but also the drafting of thematic plans for the study of the settlement in its various phases selected on the basis of the user's requirements.

Right from the start research has been directed towards the software most suited to the field of digitised mapping. The acquisition of this data by vector processing is planned, guaranteeing various possibilities for programming. The alternative format for graphic acquisition is through raster scanning, and is best suited to graphics to be displayed purely for documentary purposes. These include single artefacts, photographs of material and structures or any sketches and plans of excavations to be consulted simply as documents.

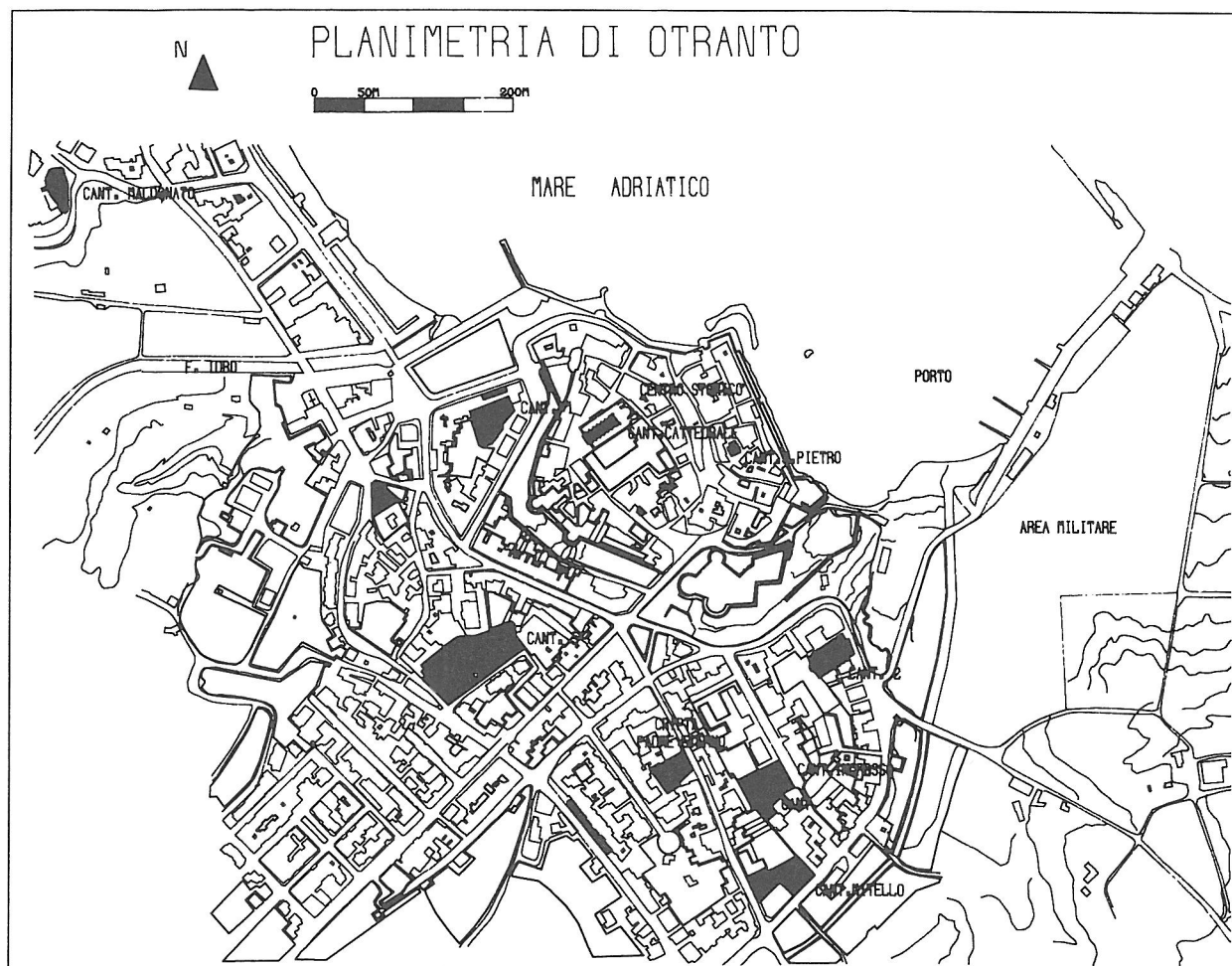


Figure 22.1: Otranto (Lecce, Italy). Site plan with excavation areas highlighted in black.

22.3 THE SYSTEM COMPONENTS

This preliminary analysis of data and predicted results has enabled us to define the *conceptual level* and the association between the classes of data to be treated. The software best suited to the implementation of the system planned have also been singled out. They are a relational database for the management of the alphanumeric data and a territorially managed software system for cartographic data.

The fundamental hardware component is the RISC 6000 system, an instrument noted for its flexibility and manageability, and marketed by IBM in answer to the increasingly popular UNIX environment. The RISC6000 operating system is AIX, the IBM version of UNIX. The relational database used is ORACLE with SQL as query language. These two, of course, constitute a standard in the field of database management.

The choice of the cartographic software was partly conditioned by the hardware components

mentioned above. The product chosen, the GEODIS programme, is one of the few implemented in the AIX system just now. One of the aspects that heavily influenced our final choice of system is that the GEODIS6000 (distributed by Automap, Rome, Italy) is a package of programmes for the management of the territory, able to manage both digitised mapping and an associated database that can be queried through SQL. It is based on the concept of "level" that corresponds to a homogeneous group of cartographic objects such as a particular type of building, contour lines, etc. Photographs or other graphics acquired through a scanner can be linked to each object, as can alphanumeric information, according to single or multiple associations between alphanumeric records and cartographic objects (= a series of relations: one to one, one to many, many to one).

Cartographic data is acquired through a digitiser. It is also possible to import data from printouts from an analytical photogrammetry system.

Vocabolari **DELETTI** Personaliz

SCHEDA DI SAGGIO STRATIGRAFICO			
Sigla SAS <input type="text"/>		Catalogo generale	
Date schedatore		Date competente	
LOCALIZZAZIONE GEOGRAFICA			
Stato	Regione	Frazione	Provincia
Comune	Localita'	Istit.	N. foglio
Tavoletta		Coord. foglio	Quadr.
AREA DI SCAVO			
Area	Particella	Anno aggiorn. catasto	
N. foglio catasto			
Fogli di confine			
Proprietari			
Indirizzi			
Utilizzo			
Settore/quadrato	Pos. saggio	Ambiente	
Saggio trincea			
Quota relativa			

Contatore: *0 (Elena(Sest.))

Vocabolari **DELETTI** Personaliz

Geomorfologia	<input type="text"/>
Geologia	Carta Geologica
Pedologia	Carta pedologica
Situazione agraria	
Uso attuale del terreno	
Inlagini precedenti	
Motivazioni scavo	
Precisazioni sul metodo	
Interpretazione e notizie storico critiche	
Sequenza culturale	
Limiti cronologici	
Condizioni a scavo ultimato	
Restauri da effettuare	
Proposte scavi da effettuare	
Collocazione materiali	
Bibliografia	

Contatore: *0 (Sest.)

Vocabolari **DELETTI** Personaliz

Ente responsab.	<input type="text"/>
Enti finanziat.	
Direttore scavo	Responsabile/i scavo
Funzionario responsabile	
Documentazione grafica	Documentazione fotografica
Compilatore scheda	Data compilazione

Contatore: *0 (Sest.)

Figure 22.2: SAS record sheet. Data entry maps 1-3.

22.4 APPLICATIONS

22.4.1 The procedures

The definition of the hardware and software components of the system have permitted the conceptual scheme to be transformed into a logical one, programmed according to the characteristics of the application packages.

We predict reaching a level of integration between alphanumeric data and maps that will meet the demands of simultaneous consultation of the two types of data in all phases of work. By this we mean the possibility of getting both graphic and the relative alphanumeric information on-line. At present, the project team is preparing a user-friendly interface that will greatly simplify access and enquiry. The user will thus be able to make use of a series of menus through which he can choose the path most suited to his needs. In particular we foresee the possibility of selecting graphic objects, based on data contained in the alphanumeric database and vice versa, from maps to descriptive documents.

The work carried out to date has concerned the adaptation of packages to the program's objectives, the implementation of a data entry system, as well as the digital acquisition of maps relating to some archaeological sites chosen as sample areas for the application of the project. Since we need to manage cartographic data pertinent to different levels within the same programme (regional maps, urban plans and detailed archaeological plans), we had to adapt the territorial management package that we acquired. Therefore, a series of procedures has been drawn up which, through the relational database, enable us to link the detailed site plans and individual reference sheets to the general site plans. To give an idea of the results we describe the following figures.

22.4.1.1 Examples of queries on-line

Figure 22.1 shows a plotter drawn map of Otranto, originally mapped at a scale of 1:2000, with the excavation areas within the town highlighted in black (on the graphic screen these shadings are in colour). When working on the graphic screen, the highlighting may be removed to show schematic reproductions of the structures unearthed.

The shading option can also be used to show the distribution on the general plan, of the excavation areas that have yielded archaeological remains pertaining to a given chronological phase.

Clicking on an area with the mouse provides a menu through which it is possible to obtain both excavation records (Scheda di Saggio Stratigrafico, SAS record sheet: see Figure 22.2) and graphic and photographic information. As far as the graphic data is concerned, a specific menu provides a list of all available plans and sections, including interpretative phase plans, permitting the user to select his requirements.

Figure 22.3 shows the phase plan of a particular area, acquired at a scale of 1:50, where early

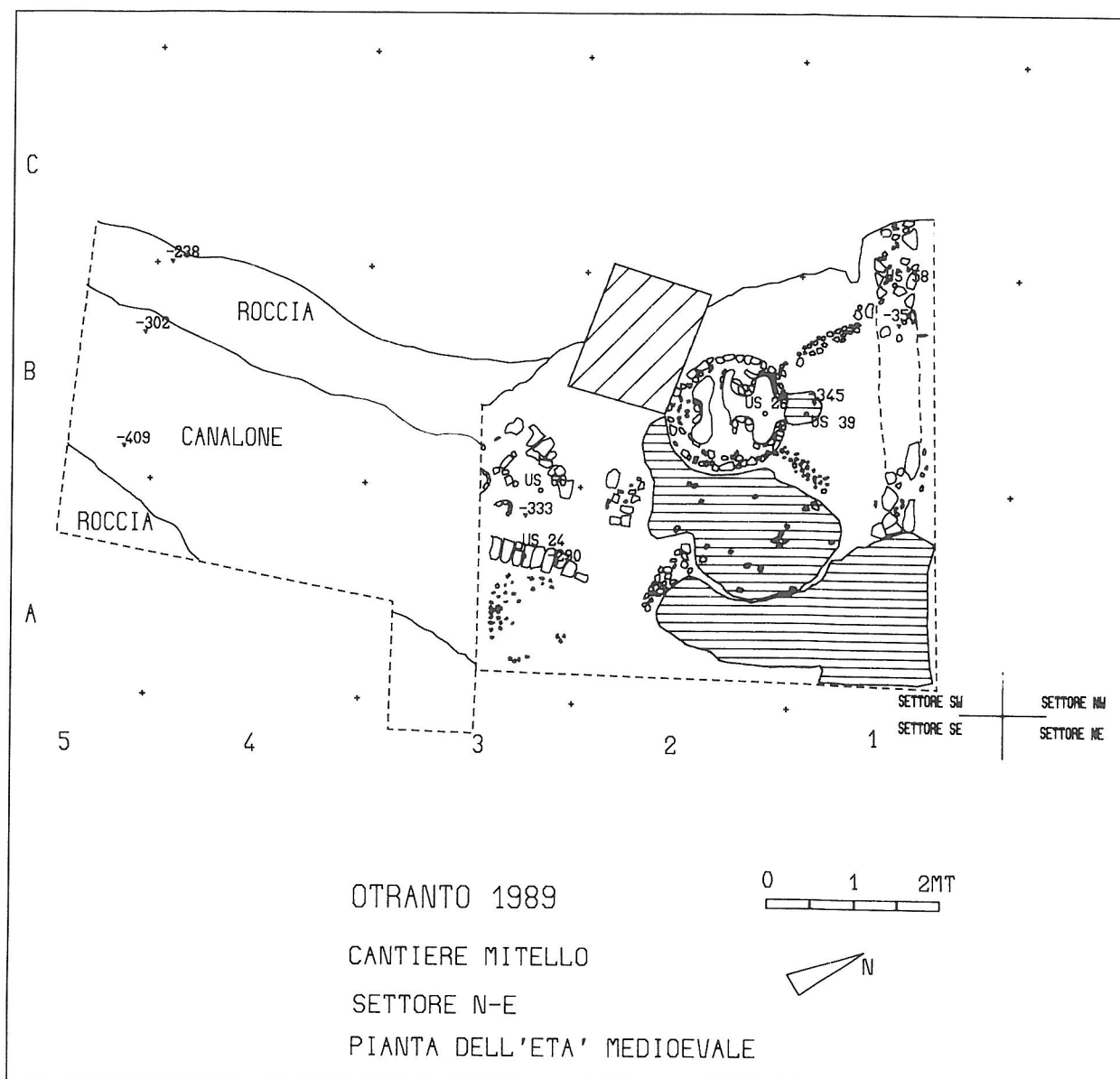


Figure 22.3: Otranto (Lecce, Italy). Interpretative phase plan of an excavation area with early medieval structures.

medieval kilns for the production of amphorae have been discovered. Clicking on the stratigraphic unit number (US) with the mouse will provide the relevant descriptive data of both the context and its associated material (Scheda di Unità stratigrafica, see Figure 22.4; Tabelle Materiali = Finds tables, see Figure 22.5). These record sheets are shown in a window in the bottom right-hand corner. With GEODIS menus it is possible to select other phase plans of the same area, or to come back to the general plan and select other excavation sites.

The alternative solution is to get phase plans produced automatically by the system. In this case, the operation takes place through the selec-

tion of the GEODIS level codes. The phase identification is activated through the colours supplied during acquisition. To be able to do this, the vocabulary in GEODIS has been appropriately organised, singling out a series of codes directed towards the description of the archaeological structures and making the various phases of objects on plan correspond to separate levels. It is important to point out that the phases in GEODIS vocabulary correspond to large chronological ranges. Any requests made to extract maps and plans with more restricted chronological ranges will be carried out through the database by selecting the period/phase entry on the stratigraphic record sheets (US).

Vocabolari **DEFINIZIONE** Personaliz

SCHEDE DI UNITA' STRATIGRAFICA			
Sigla US UF 88 125	Localita' VASTE	Data scavo	
Area FONDO VIA POLA	Settore Quadrato	Saggio/trincea	Ambiente
Quote: Orientamento da	a	Quota relativa	
Document. grafica: Piane	Sezioni	Prospetti	
Document. Fotografica: Stampe		Diapositive	
DATI DESCRITTIVI			
Definizione	US Naturale/Artificiale		
Posizione			
Criteria di distinzione: Colore	Consistenza	Composizione	
Altri			
Modo di formazione: Azione	Agenti		Tempi
Carat.			
Componenti inorganici			
Componenti organici			
Consistenza	Colore		
Misure: tipo	Valore	St. di conserv.	
Descrizione			

Contatore: *0 <Sost.>

Vocabolari **DEFINIZIONE** Personaliz

Relazioni stratigrafiche			
Sequenza fisica: Tipo		Sigla US	
Sequenza stratigrafica: tipo		Sigla US	
Osservazioni			
Interpretazione			
Elementi datanti			
Datazione			
Periodo	Fase		
Affidabilita' stratigrafica			
Campioni: Tipo	Setacciatura	Flottazione	
	Numero		
Direttore			
Responsabile			
Revisione scheda: Data	Revisore		
Data registrazione			
Aggiornamento: Data	Nome		

Contatore: *0 <Elenc<Sost.>

Figure 22.4: US record sheet. Data entry maps 1-2.

22.4.2 Finds classification system

It is appropriate to briefly explain the classification system used for the finds. Summarising the results of a rather long phase of experimentation on data management relating to the classification of finds from excavations (Semeraro 1984; Semeraro & Mangia 1987), we may say that our finds' classification system is divided into two distinct levels, depending upon the purpose for which the data is to be used. The first corresponds to a preliminary classification necessary to site and context interpretation. The system is intended to group the finds coming from a single context, such as a stratified unit or a site revealed in field survey.

This helps historical interpretation and the articulation of the sequence. The information mainly concerns typology and stratigraphic associations. It is also during this phase that the material that is more important from the typological point of view is identified to become the object of the second level of classification.

From a theoretical point of view, the find's tables prepared by the ICCD and adapted for com-

Vocabolari **DEFINIZIONE** Personaliz

TABELLE MATERIALI - CERAMICA			
Classe Cer. a fasce (IV-III a.C.)	Totale 91	% su Materiali 100	
	Totale 25	% su Ceramica 27.47	
Forma Unguento	Totale 2	% su Classe 8	Peso
Produzione Locale o regionale			
Dati epigrafici: Lingua	Tecnica		
Datazione			
Forma Coppetta	Totale 1	% su Classe 4	Peso
Produzione Locale o regionale			
Dati epigrafici: Lingua	Tecnica		
Datazione			
Forma Hydria	Totale 6	% su Classe 24	Peso
Produzione Locale o regionale			
Dati epigrafici: Lingua	Tecnica		
Datazione			

Contatore: 3 v <Elenc<Sost.>

Vocabolari **DEFINIZIONE** Personaliz

TABELLE MATERIALI - CERAMICA			
Classe Cer. a fasce (IV-III a.C.)	Totale 91	% su Materiali 100	
	Totale 25	% su Ceramica 27.47	
Esemplari interi	N.	% su Forma	Note
Esemplari ricomp.			Inventari
Frammenti: orlo	2	100	200
beccuccio			200
parete			200
fondo			200
ansa			200
Forma Hydria	Totale 6	% su Classe 24	Peso
Produzione Locale o regionale			
Dati epigrafici: Lingua	Tecnica		
Datazione			

Contatore: *0 ^ 4 <Sost.>

Figure 22.5: TMA record sheet. Data entry maps with principal datafields for ceramics classification (above) and quantitative data (below).

puter processing to the TMA (Tabelle materiali = Finds Tables) format of SAXA, corresponds to our data recording system. We have adopted a more simplified structure in our programme, with fewer data fields (Figure 22.5), for speeding up the preliminary phases of classification and the use of the database. Consequently certain fields were omitted if it was not considered possible to supply the required data without further study, such as the identification of the precise type of pottery forms (or corresponding entries for other material), the description of decoration and precise dates. Similarly, descriptions of technical characteristic have been omitted, such as clay fabric, slip, methods of manufacture and finish. Much time is usually spent on preliminary classification of this sort that is not relevant to our objectives.

The second level concerns the finds from a given context that have been selected for analytical study. Criteria for selection often include the state of conservation and categories of information, such as epigraphy and particular artistic and

technological traits, where further study is felt to be particularly appropriate.

The type of record sheet for this level of classification is directed towards in-depth artefact analysis and leads the way to computer management as a medium for typological study.

The alphanumeric archive has been conceived in such a way as to further allow the management of data acquired through the SAXA data entry system.

22.4.2 Further developments

The present module will be further developed through the integration of a statistical processing package. On the basis of our experience, we foresee the principal fields of application of the system to be the study of spatial distributions of artefacts for the analysis of settlement functions. In a broader, territorial, perspective the system may also be used as an instrument for the description and analysis of the phenomena of interaction and exchange reflected by the material evidence.

Acknowledgements

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