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PROPOSAL FOR SYSTEMATIC RECORDING OF ARCHAEOLOGICAL EXCAVATIONS

1. Introduction

The management and conservation of the archaeological patrimony needs to establish the conceptual and operative bases that permit the homologation, the storage and the management of information that provides the archaeological record. In Andalusia, the quantity and variety of existing archaeological elements has induced the design and development of an Archaeologic Information System (SIA) focused on the following objectives:

1) to establish the necessary methodological concepts that permit us to obtain an exhaustive information in the excavations.
2) to design a system of archaeological record that standardize the information obtained in the Andalusian excavations, obtaining a complete homologation in the archaeological information.
3) to incorporate into the system a procedure that permits to locate geographically (at level of the Earth) each archaeological element.
4) to develop a computer system that provides reliability, and a quick and flexible management of the archaeological information obtained through the previous methodology.

In this work is exposed the Archaeologic Information System that includes the archaeological system and the computer structure that has been designed and used in the Andalusian excavations to accomplish the previous requirements. This system is the result of an Investigation Project (during almost three years) accomplished by the authors, and encouraged and financed by the Consejería of Education of the Junta of Andalusia (Spain).

2. The bases of the system

The system is designed as a series of basic concepts that constitute the bases to obtain the locational, contextual and analytical information reached in the own archaeological record and from the analytical procedures applied to each one of the parts of the material culture that integrates it.

These basic concepts include the following aspects:

I. Geographical reference.
II. Structural organization.
III. Sequential organization.
IV. Computer system.

2.1 *Geographical reference: location and identification of the deposits*

The identification system of archaeological record is developed to include:

1) The denomination of the settlement and the archaeological elements located in it.
2) The spatial reference of these elements.
3) The connection between the identification digits and the UTM coordinates to obtain the spatial location from the archaeological elements.

The identification system is established according to the Fig. 1:

Section A establishes the codification key for each settlement according to:

- *Digits 1 and 2*: provide the key of the province where is located the settlement (GR=Granada, AL=Almería, JA=Jaén, MA=Málaga, SE=Sevilla, CA=Cádiz and HU=Huelva).
- *Digits 3 and 4*: provide the key of the municipality where is located the settlement (TA=Tabernas, GE=Gérgal, GA=Gádor).
- *Digits 5, 6 and 7*: establish the number of the settlement in the municipality (is possible to record 1000 settlement in each municipality).

In option, this section can be organized through a codes system already established in other areas (the transformation between both codifications will be carried out through a simple computer procedure):

- *Paragraph 1*: International telephonic code of country and of province.
- *Paragraph 2*: Postal municipality code.
- *Paragraph 3*: Number of settlement in the municipality.

Section B is focused on the denomination of archaeological elements and is constituted by 6 digits that indicate the spatial reference with respect to the UTM coordinates, moreover 4 digits for denote the specific numeration of the element. In the Andalusian excavations has been established this minimum format, that locates each element with 10 meters of precision; however, is possible to accomplish a more accurate location adding groups of two

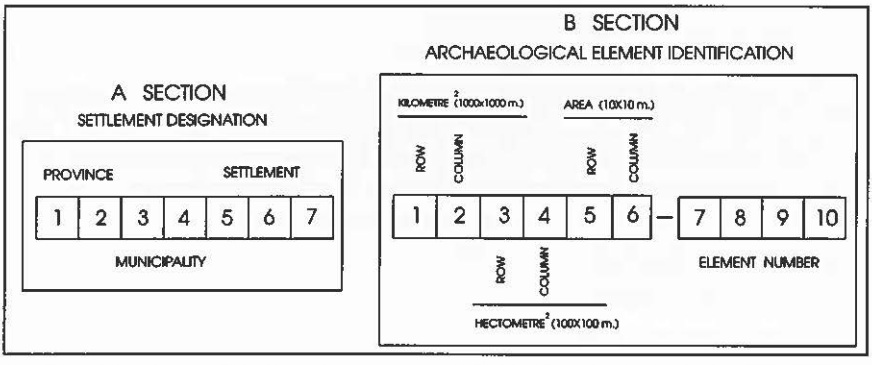

Fig. 1 – Identification and designation system of the archaeological record.

digits to the spatial reference, obtaining thus meters precision, centimeters precision, and so).

The detailed format is the following:

1) *Urban settlement*. From the square of 10x10 km. located in the UTM map (in a scale map 1:50000) and containing the settlement (in urban zones an only deposit occupies all the city) are determined the coordinates in the left corner point (SW) of this square. These coordinates will be indicated including the *number of zone* and the detailed x,y coordinates. Thus, the expression:

30 444 4114

corresponds to a point to SW of Granada city, that appears in the UTM square of 10x10 km. with coordinates (444,4114), in the zone 30. This square (oriented to the UTM North) is split into 10 rows and 10 columns to obtain 100 squares of 1000x1000 m., and each row and each column is numbered from 0 to 9. In this form we obtain 100 squares numbered (00-99) with a surface from a squared kilometer each one.

This process is reiterated splitting the square of 1 km^2 (containing the excavation) in 10 rows and 10 columns of 100 m. side each one, obtaining 100 squares of 100x100 m. numbered from 00 to 99. The square of 100x100 m., that contains the work zone, is chosen and is subdivided in 10 works and 10 columns, with numeration from 00 to 99, being each a new square of 10x10 m. (area).

The squares thus obtained constitute the basic unit for the identification of elements that form the archaeological record in a excavation. Is possible that a few of the elements in an excavation must be referred to several squares (Fig. 2).

In this way (in a **urban zone**) the first group of section B consists of 6 alphanumeric digits:

- *Digits 1 and 2*: indicate, respectively, the row and column in the 1000x1000 m. square (squared kilometer) in which is located the element within 10x10 km. square.
- *Digits 3 and 4*: denote, respectively, the row and column in the 100x100 m. square in which it is located the element within 1000x1000 m. square (squared kilometer).
- *Digits 5 and 6*: indicate, respectively, the row and column in the 10x10 m. square (area) where the element is located into 100x100 m. square.

2) *Rural settlement*. Each rural settlement is delimited by means of a 1000x1000 m. or 100x100 m. square (the selected square depends on the size of archaeological settlement that must be included in this square at all) containing the settlement and oriented to the UTM North. The left corner point of this square is located obtaining the UTM coordinates with as much precision as will be possible. This square is split into 10 rows and 10 columns and the obtained squares are numbered from 00 to 99. This procedure is repeated in

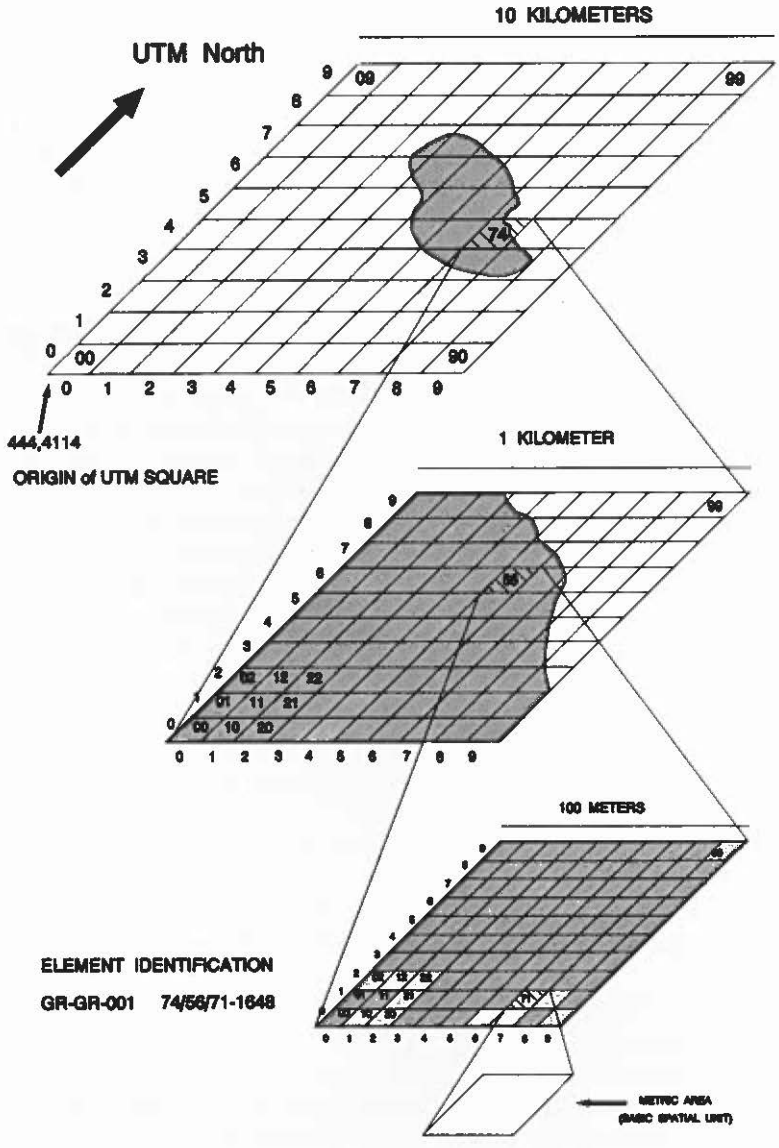

Fig. 2 – Identification of an archaeological element in an urban excavation.

function of the size of squares, splitting and numbering it as in the previous form until reaching the square of area (10x10 m.). If the basic square is a 100x100 m. square then the digits 1 and 2 will be 00 (Fig. 3).

These six digits section can be enlarged to reach greater precision by

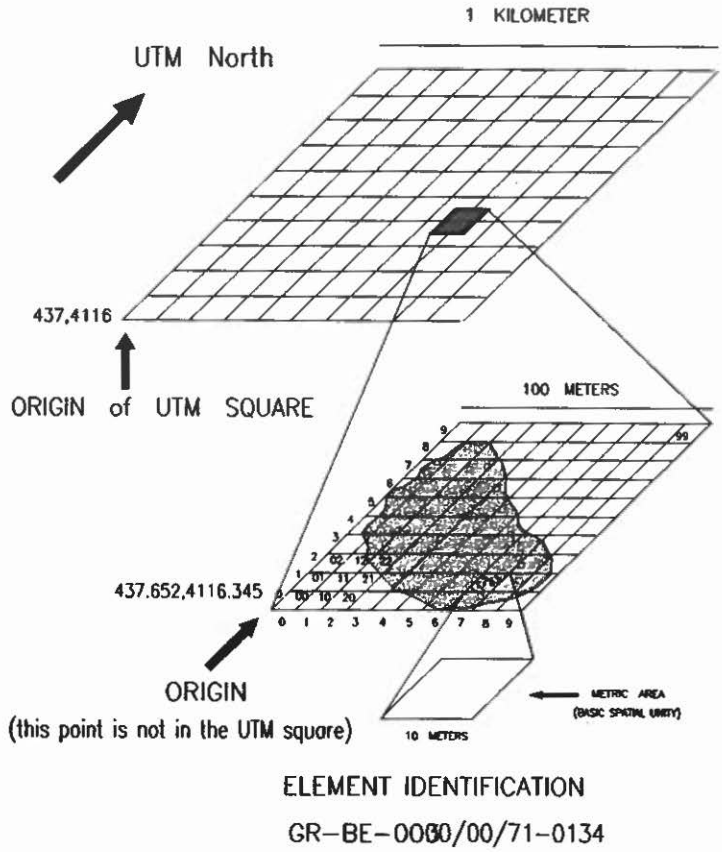

Fig. 3 – Identification of an archaeological element in a rural exacavation.

means of consecutive applications of the previously described procedure. The limit is determined by the scale of map and the width of outline; thus, using a scale 1:500 map accomplished with an 0.02 mm. outline pen width, the obtained maximum precision is 10 cm.

The identification data should be completed with the specific number of the element (4 numbered digits from 0 to 9999), constituting a unique identification system for each one of the archaeological elements recovered in a excavation.

The denomination previously proposed has the advantage of the simplicity and automatically furnishes the exact geographical location of the archaeological elements in UTM coordinates from coordinates of an only point in each excavation. In Fig. 2, the UTM coordinates for the elements example will be:

coordinates x $444 + 7 + 0.5 + 0.07 = 451.57$
coordinates y $4114 + 4 + 0.6 + 0.01 = 4118.61$

(in a rural settlement this process is reduced to follow the steps of case 2) that affects it, in function of the size of the initial square choosen.

3. Structural organization

The recovery of the archaeological record is carried out through the organization of the space in analytical categories that are hierarchically structured:

– *Stratigraphical Units* (built and unbuilt). Constitute the minimal units of archaeologic stratification that are distinguished and characterized in a settlement. Then, they are the basic elements of analysis upon which is organized the archaeological record system (grave foundation, wall foundation, wall rendering, etc.).

– *Structures*. A structure is composed of one, or several, stratigraphical units and, therefore, it is a spatial entity that is characterized by means of its morphology and the sedimentary deposits (stratigraphical unbuilt units) that contains, or that are associated functionally with the structure (grave, household, kiln, floor, wall, etc.).

– *Structural complex*. It is established as the organized and delimited archaeological space in which are integrated structures and deposits, related through a specific activities pattern (room, etc.). In some instances the structural complex can be divided in several substructural complexes; thus, in a room (complex) are distingueshed different areas (subcomplexes) of domestic character and specific functionality (kitchen, storage, etc.).

– *Structural group*. It is constituted by a set of connected structural complexes mutually related through functional and similar spatial relationships (a housing composed by several rooms; a fortification line that contains towers, face of a wall, associated constructions, etc.).

– *Structural zone*. It is delimited by several structural groups associated by means of spatial or functional criteria (a set of topographically or urbanizationally delimited housings, a cemetery, a small fort, etc.).

4. Sequential organization

The temporary organization of the archaeological record is carried out through a sequential system that is composed of the following analytical categories hierarchically structured:

– *Stratigraphical Units* (built and unbuilt). As well as the structural organization, the stratigraphical units constitute the fundamental and minimal base of the stratigraphical analysis.

– *Stratigraphical phases*. They are characterized by integration of several stratigraphical units using criteria of structural and functional character. The beginning of a new phase in an excavation is accomplished when there is a general reorganization of the analyzed space, either due to a global architec-

tural reconstruction or to a meaningful change in the space functionality.
– *Stratigraphical periods*. Each stratigraphical period is integrated by one or several stratigraphical phases and possess cultural and chronological similar characteristics.

5. Computer design

The set of the information that provides the archaeological record is composed of three sections defined in function of its own characteristic: alphanumeric information, map (vector) information and images information. These data should be integrated and managed by the system at all, linking the archaeological categories mutually (Fig. 4).

The data processing structure of the system is constituted, for each settlement, by a set of database files organized in directories that encompass the following categories:

Material:
- Materials inventory.
- Samplings inventory.
- Materials classification.
- Sifted and flotation samplings.

Structural entities:
- Structures.
- Structural complexes.
- Funerary structural complexes.
- Human Remains.
- Materials quantification by structures.

Stratigraphical units:
- Stratigraphical unbuilt unit.
- Stratigraphical built unit.
- Aedilicius sampling.

Drawings (graphics CAD):
- Simple plants.
- Phase plants.
- Area graphs.
- Sections.

Photos

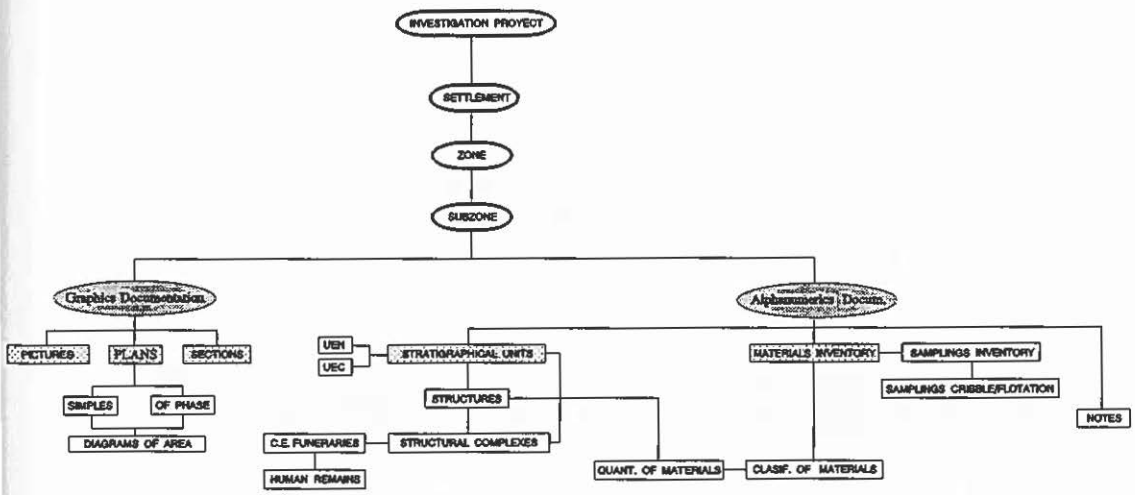

Fig. 4 – Archaeological categories used in the archaeological system.

The data processing structure that implements this design is organized upon a basic idea: the basic entity is the settlement as the place where there are human activity remains. For so much, the city is considered as an only deposit with great or smaller extension.

The settlement is divided in *zones* or spatial entities determined by topographic, functional, chronocultural, and so criteria. Each zone is divided in *subzones* (excavations) through similar criteria.

The computer design structures the information in this form:
from root directory *projects* (level 0), each project has its own level 1 subdirectory that contains the different *settlements* in subdirectories with their own name. Each subdirectory *settlement* contains five subdirectories (level 2) that correspond to the information categories previously established. In this way, the fundamental database files of data (level 3) include the complete information of each excavation split into the corresponding paragraphs of the different categories. These files maintain linkages of relational type between them, not only to link the corresponding information to each subzone (material, structures, etc.) but also to establish the existing relationships between the different categories (Fig. 5).

Furthermore a set of database files store the necessary archaeological information to make easier the introduction of information and to obtain a total compatibility in the data (materials classification, geometry of the stratigraphical units, surfaces texture, and so).

This design has been fulfilled by means of the development of a specific software that stores, manages and joints the information that origines

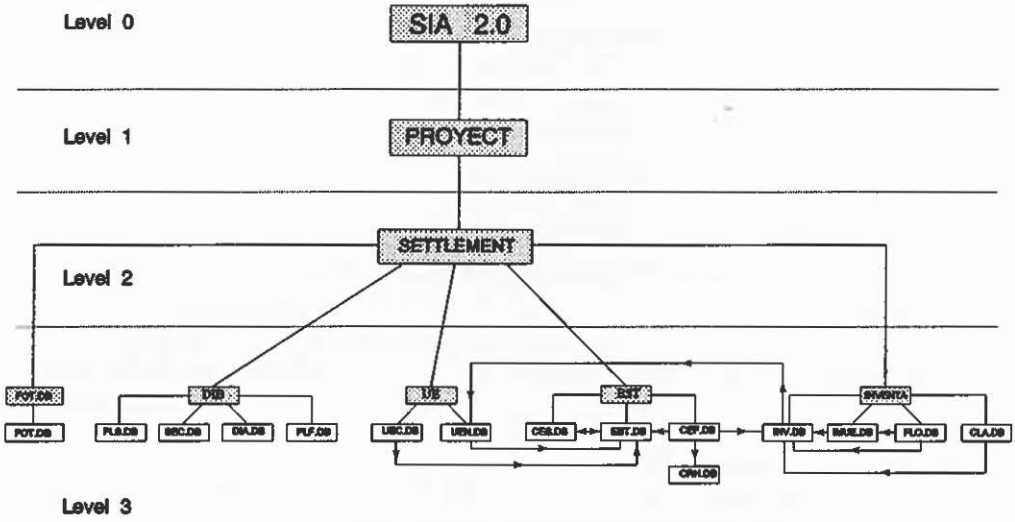

Fig. 5 — Directories and files computer structure.

the archaeological record. The computer program is configured as several multiple election menus with sixteen forms and its respective database files, and accomplishes the integration of the information according to:

– *Alphanumeric Information.* The alphanumeric data do not demand specific software to be imported or exported in the system; however, it is possible to introduce and recover them through standard software: wordprocessors and text publishers (exchange in ASCII format), database files (exchange in ASCII and DBF formats) and statistical analysis (export to commercial programs and own elaboration programs also, and in DBF and ASCII formats).

– *Graph Information (CAD).* The data of graphic type include the vectorial information of plans, maps, level curves, topographic maps, excavation plans, etc. This data is incorporated into system in DXF format and included in the corresponding database file.

– *Images Information.* Include the photographs, drawings of materials, etc. stored in bitmap (pixel) format and it demands a specific and differentiated treatment of the vectorial format: images acquisition software from different physical formats (paper, video, etc.), image analysis software that obtains new information from the original image (enhancement, contrast, equalization, saturation, hue, filters, etc.) and programs that analyze the images obtained by remote sensors. The incorporation of the information is accomplished in the most usual formats: TIF, PCX, EPS, GIF, etc.

The hardware integration of the system is carried out by means of a set of computers (PC and workstations) devoted to accomplish the different tasks and connected mutually and linked to the structure Andalusian data processing through INTERNET network (see Fig. 6).

The system of archaeological record will be integrated in a based GIS system that allows to carry out a complete management of the data set that provides the archaeological information (see Fig. 7).

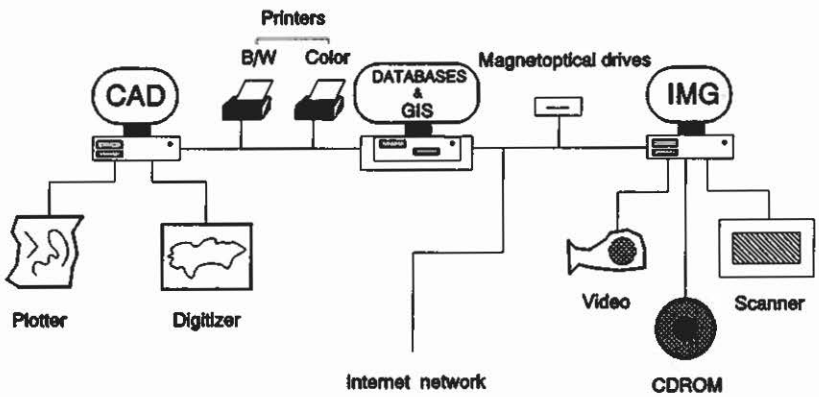

Fig. 6 – Hardware organization: workstations, personal computers and peripherals.

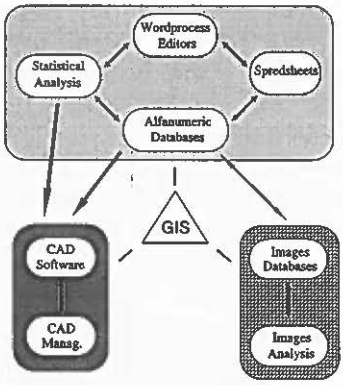

Fig. 7 – General sofware scheme.

6. Conclusions

Management and storage of the archaeological information does not consist in the creation of a database more or less sophisticated. If the objective is to obtain a compatible and suitable information it is necessary to accomplish a complete methodological system that includes the systematizing:
– the digging methodology;
– the geographical reference specific of archaeological material;
– the homogeneity in the description of materials;
– a software that integrates the data;
– the different hardware platforms integration.

The system developed by the authors of this work is not a simple computer database application but is focused towards a global management of the information obtained through a specific digging methodology and digging recording of the archaeological elements that permit to order, standardize and use the data set that provides the excavations carried out in Andalusia (Spain), and located geographically with a minimal mistake.

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BIBLIOGRAPHY

D'Andria F., Semeraro G. 1993, *Un sistema integrato per la gestione della cartografia e dei dati di scavo*, «Archeologia e Calcolatori», 4, 159-180.

Arroyo-Bishop D. 1989, *The Archéodata Project*, in S. Rahtz, J. Richards (edd.), *Computer Applications and Quantitative Methods in Archaeology*, BAR International Series 548, 69-86.

Benelli M.V. 1992, *Le collezioni archeologiche dell'Opera della Primaziale pisana*, «Archeologia e Calcolatori», 3, 139-155.

Burillo F., Gimeno A., Ibañez E., Polo C. 1993, *Un modelo de gestión integral del patrimonio arqueológico*, en *Aplicaciones Informáticas en Arqueología: Teorías y sistemas*, Bilbao, 23-39.

Filippi G. 1992, *Scheda computerizzata per il materiale laterizio bollato*, «Archeologia e Calcolatori», 3, 219-252.

Guimier-Sorbets A.-M. 1990, *Les bases de données en Archéologie*, Paris, Editions du CNRS.

Molina F., Esquivel J.A., Contreras F. 1991, *Sistema integrado de catalogación y análisis de la información arqueológica*, «Complutum», 1, 243-246.

Molina F., Rodríguez I., Contreras F., Esquivel J.A., Peña J.A. 1995, *Un sistema de información arqueológica para Andalucía*, en *Jornadas Andaluzas de Patrimonio* (in press).

Santis F., Peduto P., Sessa M.I., Ursuleo M. 1990, *Informatica e beni culturali*, Roma, Edizioni Scientifiche Italiane.

Santis F., Sessa M. 1990, *Programmi*, in *Informatica e beni culturali*, Roma, Edizione Scientifiche Italiane, 87-105.

Wijngaarden-Bakker L. (ed.) 1986, *Database Management and Zooarchaeology*, «PACT», 14, Strasbourg.

ABSTRACT

In this work we use an archaeological information system to record and manage data coming from an excavation. The system includes the digging methodology, the geographic reference of archaeological elements, the settlements and elements denomination, the directories and files structure and the computer organization.

The authors develop a computer software based on PARADOX to record the archaeological information including textual documentation, CAD maps and images.