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The ArchéoDATA Project

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10.1 Introduction

The evolution of theory and practice bring to light, in the long run, the limits of systems until then thought of as adequate. In archaeology, the problem of the archaeological archive now stands out, everyday augmented by surveys and excavations, generators of great quantities of materials, data and studies that increase the immensity of that already stored. The fundamental problems of conception, creation, management and conservation of the archives, will need in the future to be rethought to guarantee an efficient development of tomorrow's archaeological research.

The problem is aggravated if we take into account that the transfer of the knowledge generated is rarely undertaken in a satisfactory manner, being the subject of material, financial and temporal influences. Even in cases where they are effectively published and where specialists can consult them, the latter find themselves faced with a potential volume of information that they can neither read nor assimilate. Equally, one of the worst resolved problems in archaeology is reserved to the material recovered from the ground: how to organize its storage and classification, how to facilitate its accessibility and consultation, how to create a larger source of information.

The publication of the future must be a research tool in itself, a dynamic document, comprising a synthesis of the archaeological team's reflections and all the information necessary to allow, in the future, to go from the stratigraphical unit to the comprehensive intra-site or inter-site studies. The volume and the diversity of the data should, through a more rigorous selection and a more efficient management, be a windfall for investigation. If the publication of the synthesis on paper is at this moment the solution for communication, it will be necessary to add in the future an electronic variant, completed by the excavation's archive; we believe that this is the way to answer the needs of research, each day more searching and complex.

It is therefore essential to elaborate a system, scientifically and economically viable, that will permit archaeological data to be organized in a coherent way and to progressively implement it to guarantee that researchers will dispose of archives, ready to be employed by future methodology. The object is to find a way to present the recordings and the material, now or in the future, in a detailed way so that those, who may want to check the results exposed in a synthesis can go back to the excavation or survey data and to the facts on which it is based. To resume, find an efficient way to manage, from the start and with a comprehensive approach, the archaeological document and this on local, regional, national and international levels.

The archive problem, for it to be resolved in the best way, will need in the future, a reasoned and structured computerization from the start. The advantages of this approach are universally recognized, but little used, for diverse reasons, by the archaeological community in France. In many cases this should not only be for

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reasons of efficiency, but of scientific responsibility; when, for example, an urban archaeological team finishes an excavation and disperses, it leaves behind a huge amount of documentation consisting of thousands of records and it is practically impossible for a researcher, who has not participated in the original excavation, to retrieve and assimilate the information distributed, in static form, among hundreds of classifiers. Equally the evolution of computer technology has been such that there are many files which are now unusable, lost inside computers, programs and media of the first generations of computerization. The responsibility of the archaeologist, as a researcher of our cultural heritage, is not only to ensure the conservation of material remains, but also of the intellectual archive. This presents us with necessity to reason, from the beginning, in structuring and protecting computerized data and to assure its conservation and perpetuation.

To this end it is very important that the data be independent of specific material constraints and that it should be able to evolve as we are unable to project the evolution of computer technology towards the end of the century and beyond. The archaeological archive is destined to be conserved for an indeterminate period and we have to be prepared for the transfer of the data towards forms of storage, consultation and media, that will be substituted in the future for the best systems that we have at present been able to develop.

10.2 The ArchéoDATA Project

This paper presents different reflections and experiences that are being developed within the the ArchéoDATA project, trying to achieve adequate answers to the aforementioned problems. Even though it will be some time before they become reality, it is hoped that the foundation implemented will contribute towards the work undertaken each day by the archaeologist. Everything developed and proposed, be it material, programs, etc., must be readily available, easy to implement by the archaeologist himself and of reasonable cost. Past experience has shown that large scale centralized projects have usually failed because they have been imposed from the top down, with little or no consultation, used specialized personnel and made excessively high or unreasonable demands.

The ArchéoDATA project is the fruition of the tripartite collaboration between the university, the administration and field archaeologists. It forms part of the research group 'Méthodologie de la micro/mini archéo-informatique' of the GDR 880 (ex. GS 72) of the Centre National de la Recherche Scientifique which unites it with the University of Paris I and also the Laboratoire d'Analyse et d'Application de Méthodes Archéologiques of the University of Paris VIII. The administration is represented by the Sous-Direction de l'Archéologie of the Ministry of Culture and the Association pour les Fouilles Archéologiques Nationales which depends on the former. The project is principally funded by the CNRS through it's Action Thématique Programée.

10.2.1 The organization of the system

The following are the initial stages of a study which covers the phases of surveying, excavation, publication, and the deposit of the accumulated archaeological record. It is impossible to arrive at a satisfactory end without apprehending the problem, in a global way, from the beginning and it is necessary to have unity from the outset and continuity in its application.

The fundamental factor of a structured system is for it to be articulated around a common element that will allow it to be clearly and efficiently identified when needed. The archaeological site is the starting point. Two systems have been retained so that both administrative and territorial options can be used, a four point UTM

geographical plot and what we will refer to as a Universal Code, the combination of which give a great amount of flexibility. In this way we may bring together all the data from a province, a county, analyze a particular area or fifty kilometres in the round. The Universal Code (Fig. 10.1) is based on a thirteen digit number composed of three significant parts, that have been selected in that they combine clarity with efficiency and that they integrate existing universal norms in use for more than 25 years. The first three numbers identify the country and are based on the code originally developed for international telecommunications and today utilized in many other sectors to designate a particular country. The following seven numbers are the postal code that localize the site on a national level. The last three pinpoint the site out of 999 possibilities per locality.¹ Naturally, if an existing national code already exists, it is automatically included for reference. A Spanish example:

034 0034131 017

The first group identifies Spain internationally '34', the second group the township of Villoldo in the province of Palencia '34131', and the third, the site of the deserted medieval village of Somalcantes '17' (34-34131-17).

The ten digit code used for the excavation is also of a hierarchical nature and divided into three significant groups. The system here is based on the experience and methods developed over the last twenty years and their effects on archaeological recording. The first three numbers identify the zone excavated within the site, the second three, the stratigraphical unit of the zone, and a little under one million units can thus be recorded in this manner. This number is then completed, for the inventory of the material, by four digits, offering almost ten thousand possibilities per unit. The same ten digit organization is used for prehistoric excavations, although here the stratigraphical unit number is substituted by the square meter as the reference point. The excavation grids should be aligned with UTM points. An excavation example:

023 047 0022

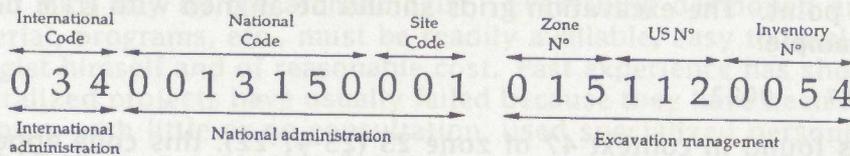
Object 22 was found in context 47 of zone 23 (23-47-22); this code appears to us to be a basis for the ArchéoDATA system in that it has the logical and lineal nature needed.

10.2.2 The imperatives

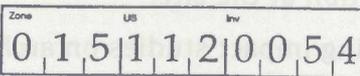
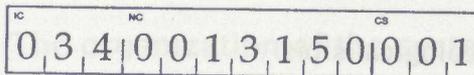
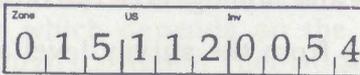
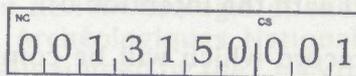
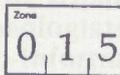
The objective has not been to radically change the present recording system with which the archaeological community has been in accord for many years, but rather to restructure and homogenize the record with the intention of:

- Preparing from the survey level a record which will be compatible with later intervention at the site.
- Facilitating impact studies on archaeological sites.
- Accelerating the processing of data and information, so that they can have a direct influence on the excavation strategy.
- Help to control the quality and the accuracy of the information recorded during and after the excavation.
- Permit in depth studies that exploit further the data.

¹Provision has been taken to eventually expand this number to more than 10,000, if this should prove necessary in the future.



ArchéoDATA
Universal Code
for the recording of
archaeological sites and finds



Bar Code



Equivalent

Figure 10.1: Two Spanish examples of the Universal Code.

- Encouraging the communication of data to other researchers and the possibility to group it with that from other excavations.
- Assuring the survival of the data recorded.
- Improving the accessibility and consultation of material remains.

Certain options have been taken for the recording system:

- Graphical information recorded during and after fieldwork must be an exploitable element of the data base (Fig. 10.2).
- Set up a unique data management unit, from where all recorded information can be recalled. All information must be available at all times.
- A clear separation must be made between what can be said to be scientific observation in the field and the interpretive study stages that follow.

10.2.3 The recording sheets

A study has been made of different recording systems and the sheets used. It was decided to prepare four series of record sheets for the project covering the phases of surveying, excavation, study and conservation. The excavation sheets are specific for urban or rural sites and a separate set is to be used for prehistory. At present eight are being tested and with the experience gained and the suggestions and critiques offered it is expected that they will evolve into a homogeneous recording format.

The survey and site sheets: These sheets are used to gather all the necessary geographical, historic, administrative information needed to identify and document the site as well as to give an initial interpretation of the occupation present.

The excavation recording sheets² must be usable in three basic application types: the highly computerized excavation, where the computer is used on a daily basis during the excavation and where its interaction contributes to the elaboration of the strategy to follow; the excavation that will process its data, for interpretation and publication, only at the end of the field stage; and, the last case where no computerization is expected or desired, but where the use of the sheets will have permitted us to structure the information sufficiently to enable it to be incorporated later into data banks.

For the organization of the record sheets we have also followed a lineal approach.

The context record sheet: (Fig. 10.2) Records all the individual context units as they are excavated.

The context file: (Fig. 10.3) Brings together all the context record sheets that make up a feature so as to study their interrelationship.

The structure file: Brings together all the context files that make up a single structure.

The photograph sheet: Records the photographs in relation to the contexts and zones. The numbering of the photograph is in direct relation to the film (253.17 represents the 17 photograph of the 253th film used).

The inventory record: (Fig. 10.5) The basic principle for the management of the excavation finds is that of having them grouped in one inventory. This assures the availability, in an homogeneous and structured way, of the totality of the data, for those analyses that make extensive use of relations. Ceramics of all types, metals and coins, human and animal remains, construction materials, and including all samples

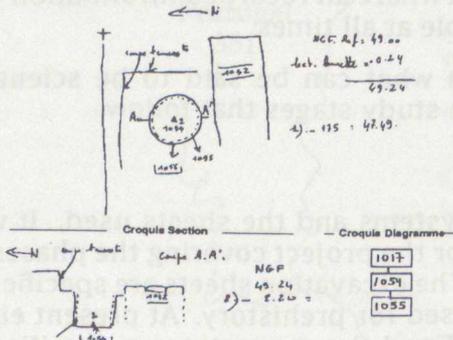
²The urban excavation recording sheets and their manual were put together along with M.T. Lantada Zarzosa and P. Van Ossel, and can be obtained, along with the other sheets, by writing to: care of the author, GDR 880 du CNRS, Université de Paris I, Institut d'Art et Archéologie, 3 rue Michelet, 75006 - Paris, France.



Listage - unités stratigraphiques 12 Septembre 1988 - Page 1

1 054 Zone N°: 1 US N°: 54 Fait N°: 8

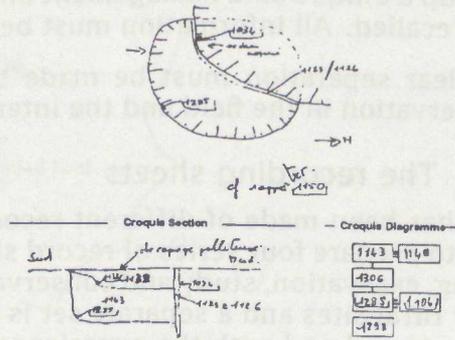
Nature US: Remplissage, Occupation / utilisation Nature activit : Occupation
 Matr / Inol / org / out: Sable tr s fin: fer, marbre 7 (tessels type opus sectile), c ramique (tr s peu), os, bronze (sculpture 7 cl. verso), fragments pl tre.
 Coull / asp / struo / morph: Cr me - jaune, plat.
 DataUSD: 1600 Croquis plan Baucheron
 DataUSF: 1700 Croquis plan 30.05.88



Observations:

1 285 Zone N°: 1 US N°: 285 Fait N°: 14

Nature US: Creusement Nature activit : Ind termin e
 Matr / Inol / org / out:
 Coull / asp / struo / morph: Creusement circulaire, bords verticaux.
 DataUSD: 1300 Croquis plan Speller
 DataUSF: 1450 Croquis plan 26.07.88

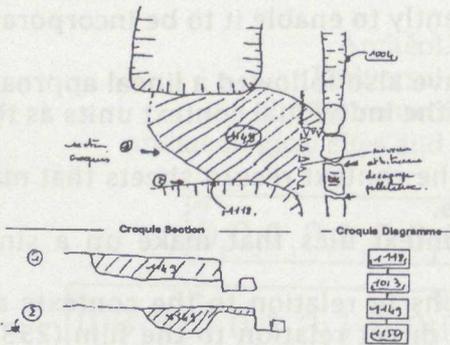


Observations:

Il s'agit peut- tre d'un m me et unique creusement avec 1133; 1133 ne serait que le niveau sup. de 1143 et le niveau inf. de 1132. Cf. le mat riel. Interpr tation tardive. Cf diagramme au doc. Il s'agit du creusement construction du puitsard P3. Datation m di vale.

1 149 Zone N°: 1 US N°: 149 Fait N°:

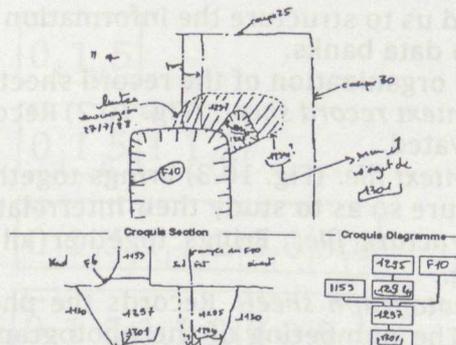
Nature US: Remblai Nature activit : Ind termin e
 Matr / Inol / org / out: Terre brune cassante, nodule de pl tre, fragments pl tras, poche sable jaune compacte.
 Coull / asp / struo / morph: Brun, tach s blanc, h t rog ne, jaune, compact.
 DataUSD: 1300 Croquis plan Speller
 DataUSF: 1450 Croquis plan 29.06.88



Observations:
 Peut- tre  galit  avec 001143.

1 297 Zone N°: 1 US N°: 297 Fait N°: 34

Nature US: Remblai Nature activit : Ind termin e
 Matr / Inol / org / out: Argile presque pure, s les, alt rations certainement li es   l'occupation du F10.
 Coull / asp / struo / morph: Orange rouille, extremement argileux, tr s homog ne.
 DataUSD: 100 Croquis plan Speller
 DataUSF: 200 Croquis plan 27.07.88



Observations:

Remplissage d'un creusement rep r  tout d'abord en coupe sur la paroi Est du F10 - limite entre 001297 et les gravillons 001295 pas nets, il peut donc s'agir d'une m me s quence de remplissage. Absence de mat riel II si les limites en coupe sont nettes entre le remplissage argileux et le terrain naturel (sable vireux avec lamelles rouille), s les sont difficilement per ues en plan. Cf croquis. 28.07.88 le remplissage argileux, semble contourner la fosse 001301 et largement d bord    l'est sur une  paisseur de 0,40 (base m canique 001147 et 001241).

Figure 10.2: Part of the excavation context record sheet data, including the field sketches (Fouilles de l'Îlot d'Arras, Paris, France).

ArchéoDATA Système stratigraphique v. 2.0	Cachet de la fouille	Fiche d'Unité Stratigraphique		Zone N°	US N°					
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Secteur N°</td> <td style="width: 33%;">Fait N°</td> <td style="width: 33%;">Structure N°</td> </tr> <tr> <td>Mur N°</td> <td>Sépulture N°</td> <td>Autre N°</td> </tr> </table>		Secteur N°	Fait N°	Structure N°	Mur N°	Sépulture N°	Autre N°		
Secteur N°	Fait N°	Structure N°								
Mur N°	Sépulture N°	Autre N°								
Nature US		Nature activité		Mode de fouille:						
Matrice géologique										
Couleur / morphologie (aspect de surfaces) / structure										
Inclusions organiques (écofactis)			Inclusions culturelles (artefacts)							
Observations						Datation estimée D				
						Datation estimée F				
Long (max)	Larg (max)	Epais (max)	Diam (max)	Haut (max)	X1	Y1	Z / NGF (sue)			
Long (min)	Larg (min)	Epais (min)	Diam (min)	Haut (min)	X2	Y2	Z / NGF (tr)			
Sous	Rempli par		Recoupli par		Sert d'appui					
Sur	Remplit		Coupe		S'appuie contre					
Egal	Equiv		Sync		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Interférences / contamination			Collages		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Plan			Section		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Elevation			Echantillon <input type="checkbox"/> Matériel <input type="checkbox"/> Autre <input type="checkbox"/> Prélèvement <input type="checkbox"/> Photo <input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Date	Nom		Ent Int	Démonté	Révision date		Ent Int			
				F.Terminé						

Archéo-DATA - IMAAT / ICRH 889 © CNRS

Figure 10.3: The context record sheet.

ArchéoDATA
Système stratigraphique v. 2.0

Cachet de la fouille

Dossier de Fait US

Zone N° Fait N°

Secteur N°

Structure N°

Séquence N°

N° de Mur (avec zones inversées)

Autre N°

Interprétation

Description

Fondation

Datation D	Séquence
Datation F	Phase
Critères de datation	
Comprend les US N°	
Plans	
Sections	
Élévations	
Photos	

Diagramme interne					

taken for analysis, should be found. From this database we will obtain the sub-categories necessary for specific studies, it being much more efficient to separate something homogeneous than to try to unite heterogeneous files. It is only with this type of structure that in the future we may unify and exploit the inventories of different excavations together. The classification of the finds is of a hierarchical type based on a 'material', 'family', 'category', etc. type of system.

To be able to query effectively the future database, certain unity must be present in the record, certain words and expressions must be present to guide the interrogator. In order to help establish equivalents and formalize the terminology used in contemporary archaeology, a glossary will accompany each record book in the field. The glossary does not pretend, nor does it try to cover all possibilities, as this would have an eventual negative effect on the progress of research, however the descriptions should cover 80 or 90% of the cases, leaving thus the possibility for specific descriptions. This is particularly important for this project as it has voluntarily wanted to be open to descriptive language and not reduced to multiple options.

The inventory glossary is much more complex. To structure present-day knowledge of material culture sufficiently to permit the setting-up of a universal querying system with sufficient flexibility to adjust to present divergences, and in the future, to assimilate their evolution, will take time and the collaboration of many specialists. This glossary is generated from a specialized database that permits the selection of the essential for each excavation, taking into account the geographical area, chronological periods, equivalents in terminology (with in the future, the equivalents between the principal European languages), etc...; in this way the glossary is adjusted to the needs of each excavation, although they will dispose of a summary volume of all the terminology, as the unforeseen is quite common. This database will be regularly maintained though studies and experiences.

A digitised image of the object can be included and it will complement the other information in the database (Fig. 10.6).

The study sheets: Structure the information generated by the study of the material.

The graphic document sheet: Is used to itemize all the drawings of the excavation.

10.3 Preparing the archive

An electronic archive for archaeological research has to meet a set of basic criteria: large storage capacity, the ability to handle both text and graphics, ease and rapidity of consultation. The purchase price, installation, exploitation and diffusion should also be proportional to the end sought. The system must be based on a technology which is established and its maintenance and development assured. The optical disk, in its various forms, seems at this time to be very promising and we are working, not only on the creation of disks with new excavation data, but also on ways of making old archaeological reports available in this format. These would use technology based on the document storage type developed for administrative and business purposes.

While the optical disk is still in an evolutionary stage three basic types are now being offered: the read only CD-ROM, the write once/read many WORM and the erasable optical cartridges. Feasibility studies that the project has undertaken have shown CD-ROM's to be economical, even small quantities,³ for the huge storage capacity they offer. The main problem appears to be the constant evolution of the hardware and the lack of accompanying software. A waiting period, to see which standards are finally adopted, has meant that no exact type has been chosen for the present.

³Prices, for small quantities, can range from as low as \$ 0.03 a megabit from a commercial house, to \$ 0.10 if one uses one's own computer and a WORM drive.

Archéodata
Système d'inventaire v. 2.0

Cachet de la fouille

Page N°

Nombre de pages

Fiche d'inventaire

Secteur N°	Fait N°	Structure N°
Mur N°	Sépulture N°	Autre N°
Datation US D		Datation US F

Matière	Famille	Catégorie
Identification		Décor / Trait. surface
Description / Observations		Type
		Culture
		Datation M D
		Datation M F
Exp A	Exp B	Quantité
		Longueur
		Largeur
		Haut / Ep
		Diamètre
		Poids
Type de Quantif	Nombre	X
		Y
		Z NGF
		Renvo vers les US N°
		Dessin N°
		Photo N°
Etat traitement	Stockage / Dépôt	Restauration
		Date
		Nom
		Enr <input type="checkbox"/>

Zone/Aire N°	US/Carré N°	Inv N°
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Matière	Famille	Catégorie
Identification		Décor / Trait. surface
Description / Observations		Type
		Culture
		Datation M D
		Datation M F
Exp A	Exp B	Quantité
		Longueur
		Largeur
		Haut / Ep
		Diamètre
		Poids
Type de Quantif	Nombre	X
		Y
		Z NGF
		Renvo vers les US N°
		Dessin N°
		Photo N°
Etat traitement	Stockage / Dépôt	Restauration
		Date
		Nom
		Enr <input type="checkbox"/>

Zone/Aire N°	US/Carré N°	Inv N°
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Matière	Famille	Catégorie
Identification		Décor / Trait. surface
Description / Observations		Type
		Culture
		Datation M D
		Datation M F
Exp A	Exp B	Quantité
		Longueur
		Largeur
		Haut / Ep
		Diamètre
		Poids
Type de Quantif	Nombre	X
		Y
		Z NGF
		Renvo vers les US N°
		Dessin N°
		Photo N°
Etat traitement	Stockage / Dépôt	Restauration
		Date
		Nom
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Zone/Aire N°	US/Carré N°	Inv N°
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Archéodata - BSMN / OBR 100 du OBR

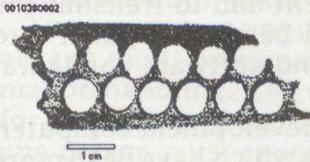
Figure 10.5: The inventory record sheet.



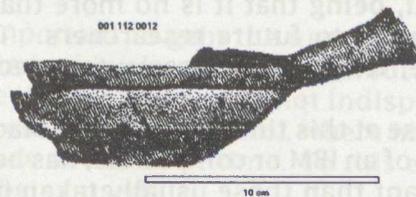
Listage de l'inventaire

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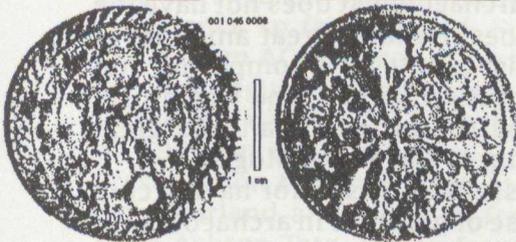
10380002 Zone N°: 1 US N°: 38
 Matière: Org Famille: Tabletterie Catégorie: Indéterminé
 Ident: Décor: Quantité: 1
 DescripObserv: Os plat percé de trous
 DataMD: _____
 DataMF: _____ Digitalisation _____ O



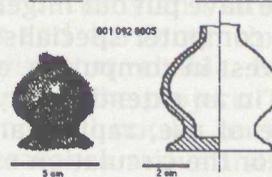
11120012 Zone N°: 1 US N°: 112
 Matière: Cer Famille: Commune Catégorie: Claire sableuse
 Ident: Poëllon Décor: Quantité: 1
 DescripObserv: Glaçure jaune interieure
 DataMD: 1300 _____
 DataMF: 1400 _____ Digitalisation _____ O



10460001 Zone N°: 1 US N°: 46
 Matière: Met Famille: Cuivre Catégorie: Numismatique
 Ident: Jeton Décor: Quantité: 1
 DescripObserv: De mariage
 DataMD: 1570 _____
 DataMF: 1650 _____ Digitalisation _____ O



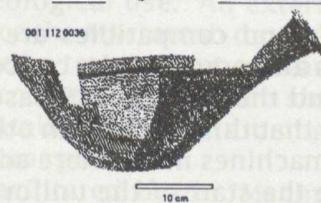
10920005 Zone N°: 1 US N°: 82
 Matière: Cer Famille: Commune Catégorie: Claire sableuse
 Ident: Flacon Décor: Quantité: 1
 DescripObserv: Glaçure jaune
 DataMD: 1300 _____
 DataMF: 1400 _____ Digitalisation _____ O



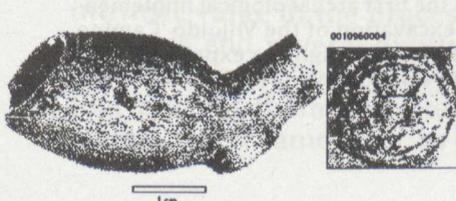
10880001 Zone N°: 1 US N°: 88
 Matière: Org Famille: Tabletterie Catégorie: Objet
 Ident: Epingle? Décor: Quantité: 1
 DescripObserv: Tourné
 DataMD: 1200 _____
 DataMF: 1900 _____ Digitalisation _____ O



11120036 Zone N°: 1 US N°: 112
 Matière: Cer Famille: Commune Catégorie: Claire sableuse
 Ident: Poëllon Décor: Quantité: 1
 DescripObserv: Glaçure Interieure
 DataMD: 1300 _____
 DataMF: 1400 _____ Digitalisation _____ O



10960004 Zone N°: 1 US N°: 96
 Matière: Cer Famille: Fine Catégorie: Blanche;
 Ident: Pipe Décor: Estampille Quantité: 1
 DescripObserv: Fourneau
 DataMD: 1600 _____
 DataMF: 1800 _____ Digitalisation _____ O



11460004 Zone N°: 1 US N°: 146
 Matière: Cer Famille: Fine Catégorie: Sigillée
 Ident: Bol Décor: Moulé Quantité: 1
 DescripObserv: Drag 37 signé "BUTRIO" dans décor libre.
 DataMD: 0100 _____
 DataMF: 0200 _____ Digitalisation _____ O

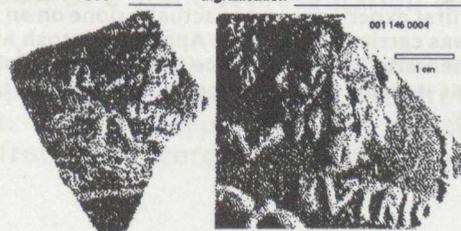


Figure 10.6: Low density video digised images (75 dpi) accompanying part of the inventory data (Fouilles de l'îlot d'Arras, Paris, France).

The 'hypertext' concept of information management will no doubt be an interesting addition. Much work has yet to be done in perfecting the concept, but we can already see advantages for the archaeological community in such an analytical product.

10.4 The material implementation

The ArchéoDATA system of recording, analysis and conservation of archaeological data has been thought out in a way as to make it independent of specific computer material, being that it is no more than a medium to implement and to transmit the information to future researchers. This notwithstanding, to be able to put it into practice, it is still necessary to select particular hardware and software configurations.

The use at this time of the Apple Macintosh as the principal development computer, instead of an IBM or compatible, has been due to several factors which have been more significant than those usually taken into consideration in a computer decision. The reality is that the MS-DOS/IBM compatible world makes up about 75% of the installed equipment, and that the extensive software library, the large number of accessories, the quality of construction of certain manufacturers (Compaq, Hewlett-Packard,...) is better. The reality of the situation is that whatever a Macintosh can do an IBM can do better and in many cases things that it cannot, that is if one is disposed to invest substantial quantities of money and support numerous incompatibilities. With this last factor we have put our finger on the problem: the archaeologist does not have the time to be a computer specialist, nor should he, he does not have great amounts of money to invest in computing, and for the archaeologist to integrate computing into his research in an extended way, he must use it in a routine manner. The Macintosh, with its ease of use, rapid learning, similarity among the programs and its great integration for the circulation of data, opens computing to the archaeologist.⁴

Even though the aforementioned is important, the essential reason for having chosen the Macintosh at this time has been the extensive use of graphics in archaeological recording and analysis and the capacity for this computer to use them,⁵ as well as the existence of several good databases to treat the information and the ease with which this type of information may be manipulated between programs. The only economical alternative with these characteristics is the Atari ST series; although this suffers from a lack of extensive software, it can be effectively used for archaeological recording.

The IBM's and compatibles are not being ignored, but adapting to their present limitations and preparing by concentrating along two principle lines, the autonomous portable and the top-end 386 based computers like the IBM 8580-111 running OS/2. We believe that this, along with other recent and forthcoming developments, will render these machines much more adequate for standardisation in our project. 1989/90 should see the start of the uniformisation among programs and the introduction of several graphic databases are but the start of a renouveau.

⁴A study by one of largest accounting firms, Peat Marwick, has shown that a given task taking 160 hours on an IBM-PC takes 104 hours on a Macintosh and that with 122 hours on the Macintosh you can output a superior version of the given task. The Macintosh accounts for only 10 percent of personal computer sales, but it accounts for 30 percent of computer software sales. This confirms another study which says that Macintosh owners master an average of seven programs, while MS-DOS users master about 1.5 programs. These figures come from MACazine and are based on the United States market.

⁵The first experiences were actually done on an Apple Lisa in 1983 and the first archaeological implementation was carried out with an Apple Macintosh at the Roman-Medieval excavation of the Villoldo 'Camino del Cementerio' in the province of Palencia in Spain, at the end of 1984. Even though the experience was a success it could not be deemed to be practical to implement at the time due to limited hard disk storage capacity.

The NeXT computer, although not directly compatible with the aforementioned, presents a state of the art alternative that embodies in its basic configuration some excellent features for the archaeologist: a large format monitor using Display Postscript for excellent graphics, a fast 25Mhz 68030 processor with 8Mb of RAM, the MACH Unix based OS and a removable/erasable 256 Mb optical disk for data storage, etc. This is a top-end product, but it also has probably the best performance/price/quality ratio of any computer marketed and is sure to influence others in the near future. The Unix operating system appears increasingly to be a route to follow if sufficient standardization takes place.

The computers are networked as it is very important to gain the necessary experience in multi-user and multi-task environments and in shared and distributed information handling. The multi-user aspect is especially important, if not indispensable, for large excavations, archaeological services, research centres, etc., where more than one person must consult and work on a database at the same time. To this end both local (LAN) and wide area (WAN) networks are being used.

For data processing we have elected to develop on a tiered basis so as to reconcile the different stages present. The first level permits the archaeologist and researcher to work with programs without any specialized help and to be able to register and analyse their own data. With regard to databases for the Macintosh, we have naturally chosen those which can record not only text data but also data of a graphical nature such as bitmap, vectorized, digitised and data with flexible in their formats. We have also checked for speed, selection, classification, data security and integrity. By the experience so far amassed, FileMaker II from Claris and 4th Dimension versions 3 and 4 from ACI, appear to be the best adapted and the most reliable. Both products are very regularly maintained, a very important factor for the project. The selection in the PC/MS-DOS/OS-2 world is much less clear and will not be until the middle of 1989 or 1990, when the next generation of databases arrive using Windows, Presentation Manager, GEM, etc. For the present R: Base from Microrim, Paradox 3.0 from Borland and dBase IV from Ashton-Tate, and on a minimalist level: RapidFile from Ashton-Tate, Reflex from Borland and Works from Microsoft, have all proved to be good products, although without graphic capabilities. For the development of the vertical, SQL micro-mini-mainframe connection, we have selected Oracle from Oracle International, as it provides a practically universal working structure. Oracle should, by the end of 1989 introduce direct graphic (bitmap, vectorizes, etc.) storage capabilities making it even more suited for archaeological use. An external routine for ACI's 4th Dimension makes it possible to interface the Macintosh database directly with Oracle SQL Link, thus opening the possibility of a transparent exchange of data between systems. New programs such as Lotus Corporation's Magellan should prove very helpful and now the new object-oriented database concepts being prepared could help transform our future outlook on data management.

The use of drawing software has been highly facilitated by the Macintosh. The quality obtained (Figs. 10.7 and 10.8) is far above anything that can be obtained with an IBM compatible computer at reasonable cost and ease of use. Aldus Freehand 2.0, Adobe Illustrator 88, Deneba Canvas 2.0 are but a few of the excellent programs we have used.

One of principal options in the ArchéoDATA system was the incorporation of graphics as a dynamic element in the management of excavation data. Until now this type of information could only be considered at best as a static representation with no intrinsic value in the processing of data.

To this end several digitising systems have been used to serve as interfaces with the computer as no one system is able to cope with the diversity of the problems that present themselves to the archaeologist. The first type is to process signals from a video camera, or as now is frequent, from a camcorder, to obtain images of

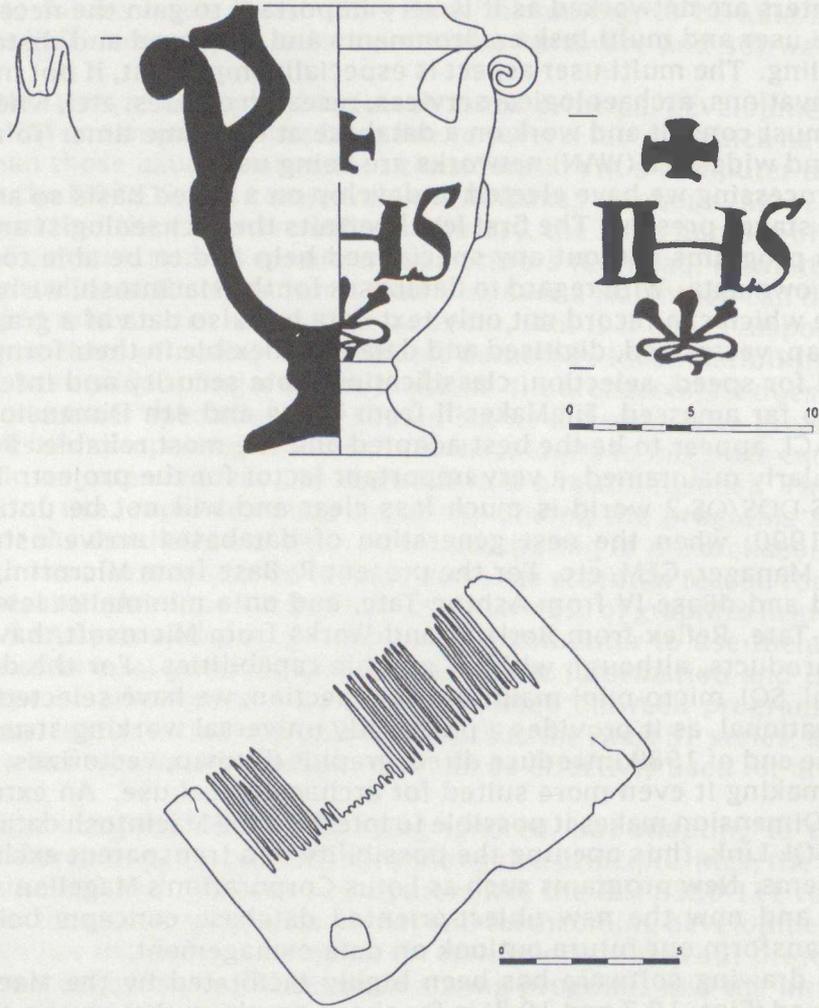


Figure 10.7: Material entirely drawn by computer and printed on a 300 dpi laser printer (Fouilles de la Cour Napoleon, Projet Grand Louvre, Paris).

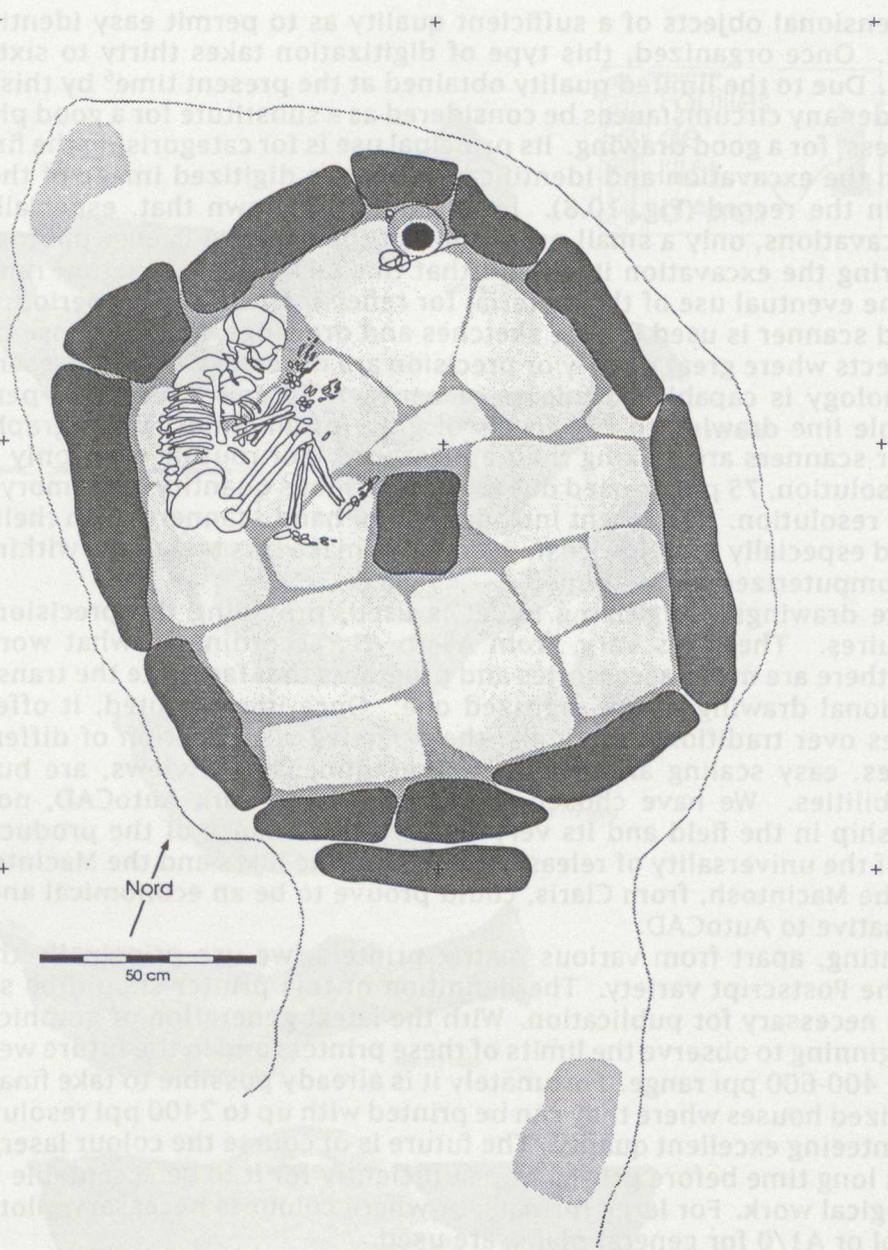


Figure 10.8: Schematic representation of a megalithic tomb (Spain).

three dimensional objects of a sufficient quality as to permit easy identification of the object. Once organized, this type of digitization takes thirty to sixty seconds per object. Due to the limited quality obtained at the present time⁶ by this process it cannot under any circumstances be considered as a substitute for a good photograph, and even less, for a good drawing. Its principal use is for categorising the finds, where apart from the excavation and identification data, a digitized image of the object is included in the record (Fig. 10.8). Experience has shown that, especially in large rescue excavations, only a small proportion of the material is ever photographed or drawn during the excavation itself and that this lack of visualization renders more difficult the eventual use of the material for reflection during this period.

A flatbed scanner is used for the sketches and drawings, and for those two dimensional objects where great quality or precision are necessary. At the present moment this technology is capable on micros of between 75 and 800 points per inch and from simple line drawing to 256 levels of grey for an almost photographic quality and colour scanners are making their appearance. For routine work only the lowest level of resolution, 75 ppi, is used due to the enormous quantity of memory necessary for higher resolution. The recent introduction of hand scanners, with their adequate output and especially their low cost, promise to make this technique within the reach of most computerized excavations.

For large drawings a digitizing tablet is used, providing the precision that this work requires. The sizes vary, from A4 to A1, according to what work is to be done and there are many accessories and programs that facilitate the transition from the traditional drawing to the digitized one. Once implemented, it offers several advantages over traditional methods; the selective visualization of different levels and phases, easy scaling and eventual three dimensional views, are but some of the possibilities. We have chosen for the high end work AutoCAD, not only for its leadership in the field and its very steady maintenance of the product, but also because of the universality of release 10 between the IBM's and the Macintosh. Claris CAD for the Macintosh, from Claris, could prove to be an economical and easier to use alternative to AutoCAD.

For printing, apart from various matrix printers, we use principally the 300 ppi laser of the Postscript variety. The definition of this printer should be seen as the minimum necessary for publication. With the latest generation of graphics software we are beginning to observe the limits of these printers and in the future we shall have to use the 400-600 ppi range. Fortunately it is already possible to take final drawings to specialized houses where they can be printed with up to 2400 ppi resolution in DIN A3, guaranteeing excellent quality. The future is of course the colour laser, but it will be quite a long time before prices drop sufficiently for it to be acceptable for regular archaeological work. For large formats, or where colour is necessary, plotters, of A3 for control or A1/0 for general plans, are used.

Diverse experiments are being carried out to incorporate methods which can help with the recording of data and that facilitate the rigours with which it is to be carried out, now and in the future. An example of this is the development of the bar code for archaeological purposes (Fig. 10.10). Today the bar code reader is an inexpensive and easy to use peripheral, which in most cases interfaces the computer and the keyboard. The first use was as a complement to the label information, combining a numeric code readable by man and the graphical bar code readable by the computer. The principal reason for its use is the automation, with precision, of the management of finds, helping initially with the excavation inventory and later at the museum or other storage depot. Several other uses have been implemented such as the filling out and identification of records.

⁶Their is no doubt that in the future this technology will develop to a high degree and that direct photography of this type could well replace traditional methods to a great extent.

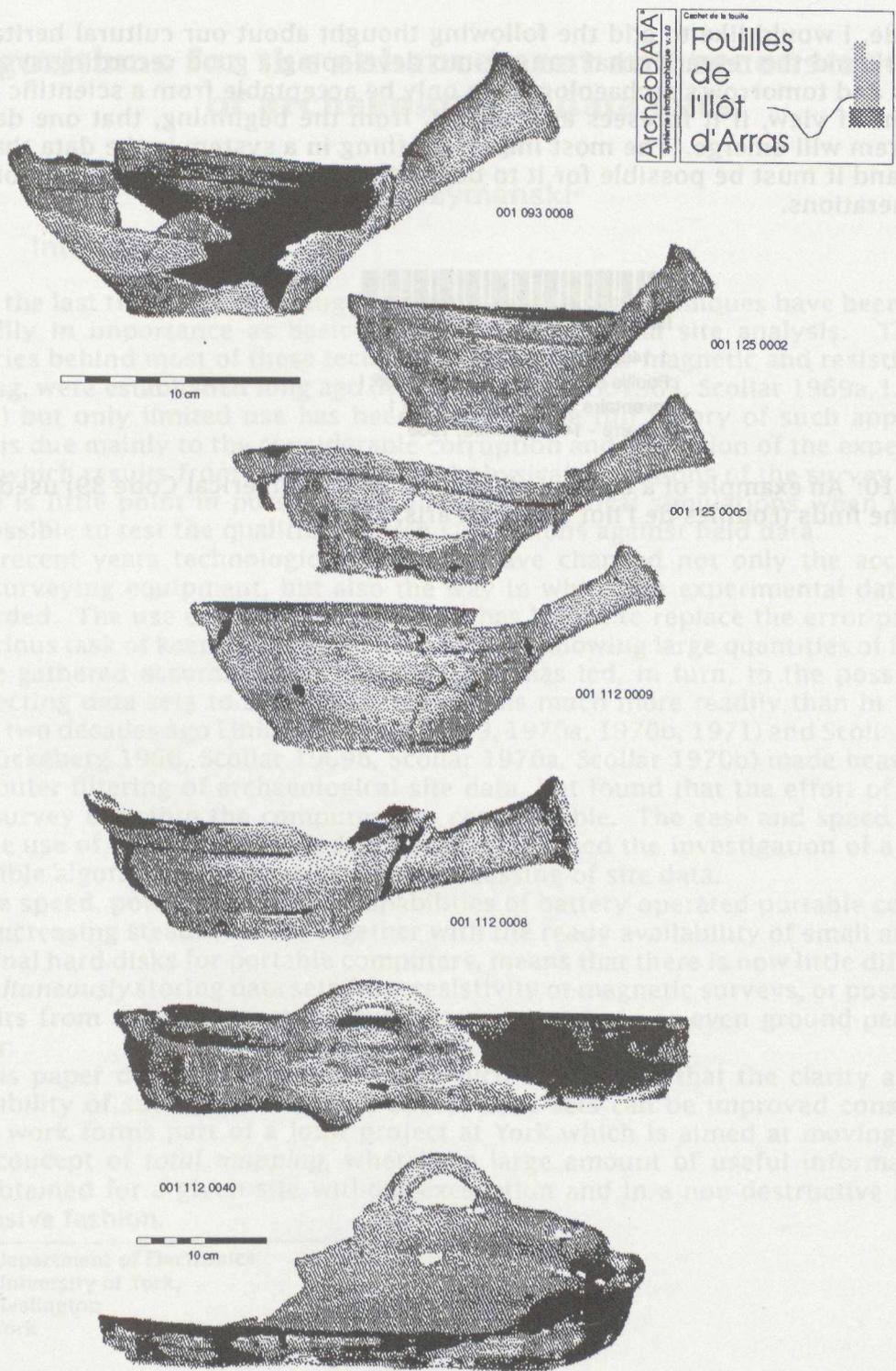


Figure 10.9: A page for an intermediary report made up from video digitised images taken directly from the inventory database and pasted into a page layout program (Fouilles de l'îlot d'Arras, Paris, France).

10.5 Conclusion

To conclude, I would like to add the following thought about our cultural heritage. All the work and the research that can go into developing a good recording system for today's and tomorrow's archaeology, can only be acceptable from a scientific and social point of view, if it foresees and admits, from the beginning, that one day a better system will emerge. The most important thing in a system is the data that it contains, and it must be possible for it to be, easily and economically, passed on to future generations.



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Fouille de l'ilot d'Arras - 33.75005.1
Inventaire materiel de la zone 1
Labarre - 14 septembre, 1988

Figure 10.10: An example of a bar code label (the alpha-numerical Code 39) used for marking the finds (Fouilles de l'ilot d'Arras, Paris, France).