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RELATING TIME WITHIN THE GENERAL METHODOLOGICAL STRUCTURE OF ARCHAEOLOGICAL INTERPRETATION

1. Introduction

We have presented and published these past few years a series of papers on the development work that we have been undertaking in the GDR 880 of the CNRS, in our quest for a methodological structure for the recording and analysis of archaeological data and the creation of a European Archaeological Information System.

This project, under the name ArchéoDATA, has been assumed with the varied collaborations essential to be able and test, ameliorate and refine the different components of a system designed to formalise and to structure archaeological document in general.

2. Object, space and time

The three basic components of archaeological recording and analysis are the factors of object, space and time. It is through the interaction of these three components, or what we could call the three "S"s of archaeological recording: something somewhere at sometime, that the archaeologist must employ to forge his interpretation and argument his thesis.

During the course of excavation finds are discovered, walls and floors are unearthed, and buildings take shape. These are all objects that at one moment, due to human activity, made up part of one or more areas occupation, and it is through the study of stratigraphic relationships and the associations that are derived, that it becomes possible for the archaeologist to reconstruct individual or multiple spatial complexes. These individual complexes will in turn mirror the occupation at one or more instances of time. Even though many of the particular constituents used to process any one part of the object-space-time trilogy can be said to be important, it is nevertheless these three fundamental relationships, as a whole, which are essential to archaeological interpretation and to all the studies derived from them. It is to further this objective that considerable reflection and experimentation has been undertaken.

Despite the methodological strides that have been undertaken in archaeology this century, and in particular since World War II, we are very far away from the possibilities that could be ours in the present computer aided age. Our profession continues to be dominated by the self centred characteristic that has been ours since the beginning and that continues to extend its

pervasive effect on us and we take refuge in the reasoning that as scientists we cannot but do good work, and, that the methods that we each use, are without doubt, the best.

To compound the problem, if we do find some literature on field archaeology and the techniques of archaeological evaluation and excavation, there is in general a dearth of archaeological literature pertaining to methodological practice and the effectiveness of particular methodologies on archaeological strategy as a whole. Though works from Wheeler, Barker, and others have urged archaeologists, through their writings, for them to be as careful and precise as possible in recording and analysing archaeological phenomena in the field and in the laboratory, there is little debate on how to structure the intellectual process in itself.

The fact is that today the elementary structuring of archaeological interpretation can only lead to, or play into the hands of, those who are only fundamentally interested in "justification" archaeology. Today we find that a frequent result of this policy is that the excavations schemes that are implemented in rescue archaeology have little relevance to cultural heritage and research, and much more to the cost effectiveness seen from a developer's budget-based point of view. The introduction of competitive tendering has undoubtedly raised some of the standards of rescue archaeology, but it has also probably noticeably changed its priorities. Inversely, how many research studies have never been undertaken because of the lack of the methodological means to assure the manipulation of data and maintain the flow of information.

3. Structuring information

We will overview the fundamental components of the system but we will omit going into excessive detail, as the basic structural concepts and the development work that has already gone into it, has been published elsewhere. We will though present in detail new work that has been undertaken on structuring time.

3.1 *Geographical and administrative space*

Geographic space is recorded directly on the Universal Transversal Mercator (UTM) projection of latitude and longitude. Each grid block comprises of one hundred squares numbered from zero to ninety-nine and related in three stages to the hundreds, tens and units of the UTM coordinates, and correspond directly with the metric system's own structure of kilometre, hectare, are and metre. The resulting number locates the exact unit directly on the surface of the earth. When an excavation grid is set up, the number of each square is determined directly by its X and Y coordinates. Since no two

places can have the same absolute coordinates, all excavation or site data is unique and it can be related to other data recorded in the same way. This is very important for intra and inter-site analysis, and especially for those who will work with Geographic Information Systems.

To manage administrative space, common national and international denominators have been found, as it should be possible for the archaeologist to process data at all spatial scales. The code derived is based on a fourteen digit number structured in three significant parts. The first three numbers identify the country, and are based on the code originally developed for international telecommunications, the following seven numbers are the Postal Union Code, that localise the site on a national level, and the last four position the site and survey data.

It is not only administrators who will find themselves at home with being able to manage their data according to administrative limits and boundaries, but also researchers who will adapt them to their work through the use of Spatial Entities, as will be presented below. For research purposes, most administrative boundaries are either very similar, or are easily adaptable, to those of historic periods, thus reflecting periods of historical space, occupation, culture, influence, etc.

4. Recording the site

Everything that has been developed has been done with the relational model in mind and the efficient functioning of these relationships on a computer-based system. That is not to say that it cannot be done manually on a small excavation, it is just that it would be unreasonable on a large or complex excavation and that the long term goal of multi-site analysis would be unattainable.

The management of data pertaining to each one of the components of object, space and time, should be undertaken, if possible with the same common elementary structure. Due to the diversity of recording methods, and in particular the inconsistent terminology used to express what in essence were similar things, a designation based on the word "Entity" was initiated so as not to be handicapped by ambiguity in meaning.

4.1 *Archaeological Entities*

The Archaeological Entities (AE) assign a precise archaeological identity to one or more related stratigraphic units that have been interpreted as being a specific archaeological manifestation (Fig. 1). If they are identified as being a wall, they are identified by a name in the form of a three letter abbreviation (WAL) and numbered uniquely (WAL 1, WAL 2, ...). Once identification has been achieved, it is no longer necessary to continue to reason, in the

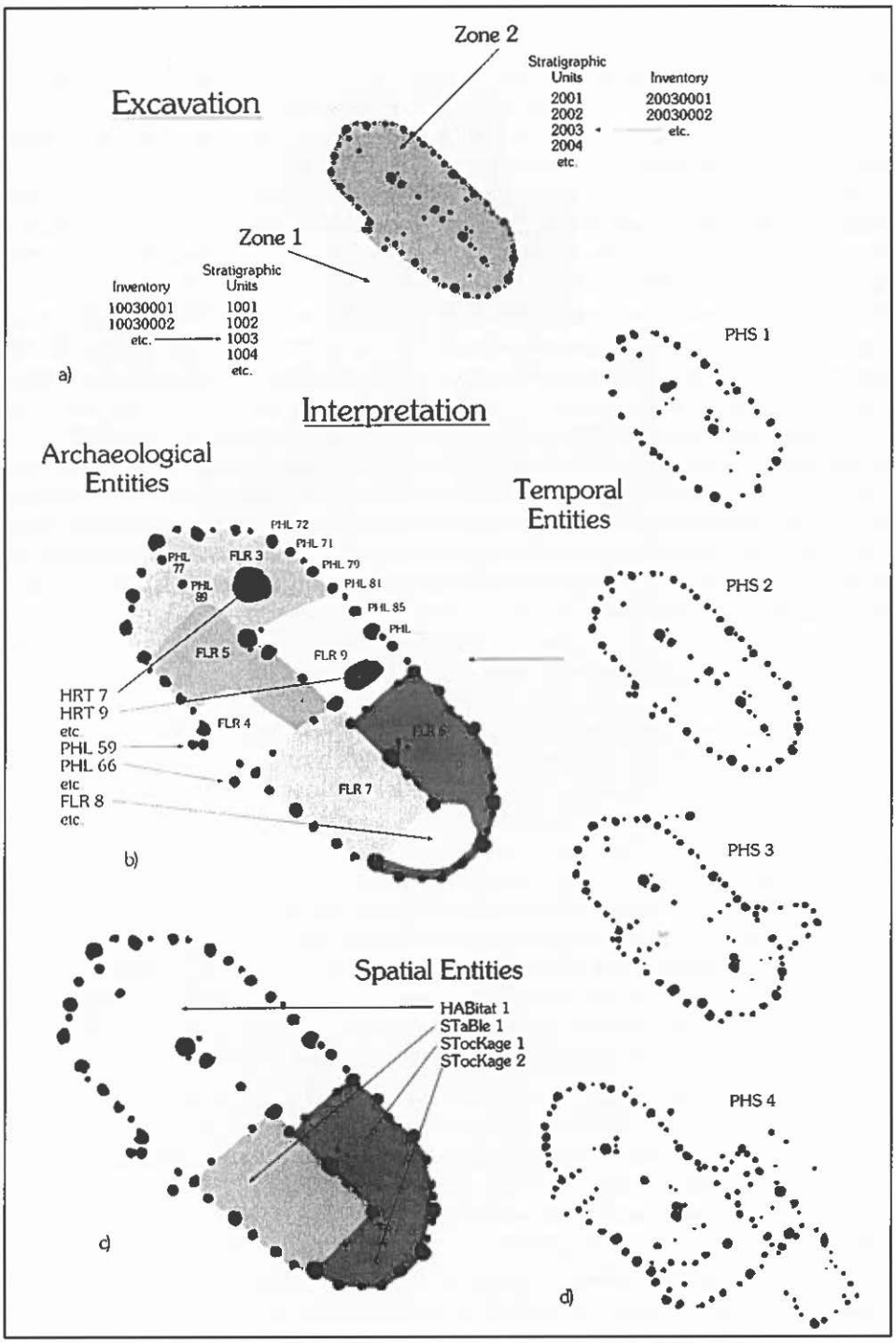
Excavation
Zone 2
Stratigraphic Units
Inventory
2001
2002
2003
2004
etc.
20030001
20030002
etc.
Zone 1
Stratigraphic Units
Inventory
10030001
10030002
etc.
1001
1002
1003
1004
etc.
a)
Interpretation
Archaeological Entities
Temporal Entities
PHS 1
PHS 2
PHS 3
PHS 4
PHL 72
PHL 71
PHL 77
FLR 3
PHL 79
PHL 89
PHL 81
PHL 85
PHL
FLR 5
FLR 9
HRT 7
HRT 9
etc.
FLR 4
PHL 59
PHL 66
etc.
FLR 8
etc.
FLR 7
b)
Spatial Entities
HABitat 1
STaBle 1
STocKage 1
STocKage 2
c)
d)

Fig. 1

following stages of interpretation, in stratigraphic units, but instead in the building blocks created by man at the time: walls, floors (FLR), silos (SIL), etc.. By identifying them clearly it becomes possible to readily select, group and compare; to quantify the components and contents of a series of AEs, to determine their origin, their use and their chronology. Nothing impedes the archaeologist from going back at a later moment to details of the stratigraphic units that make up the AE to check on composition, content or a particular relation.

Archaeological Entities, as the other Entities, exist in a second variant, the Structured Entity. This follows along a hierarchical logic, were it is accepted that there are successive levels of integration, both physical and interpretational, in describing the archaeological record. In the case of the Structured Archaeological Entity, it can be easily illustrated by the example of a house (HSE), which is composed of numerous Archaeological Entities of many different types. HSE 17 can be composed of 24 WALs, 6 FLRs, 2 FRP, a WEL, and surrounded by 3 PITs and as many SILs.

While these two types of Entities correspond to "feature" and "structure" in contemporary excavation terminology, their usage is considerably more flexible. Using the relational model, it is very easy to organise, though the Structured Entities, different levels of data in an unconstrained manner.

A derived type of entity are the Architectural Entities and they exists for recording and analysing standing structures and they vary only in name from their archaeological homologue, as it is simply the passage of time that converts one to the other. In practice it has been found that it is better to use two names to characterise each specific area of use, as would, for example, an architectural study consider a refuse pit as being an architectural structure.

4.2 *Spatial Entities*

The Spatial Entities (SE) are elements of interpretation determined to be those which make up the natural environment, the human modification of this environment, and lastly, the spaces created, in and around places of human activity. It is from these elementary notions that we have formalised the elements necessary to manage the data that is to be spatially studied.

The concept of the Spatial Entity is set forward as the spatial element for managing a collection of spatially related data so as to determine and compare content and usage of a given space. The space is characterised by material remains present and through them it is possible to contrast different spatial elements that make up a structure. Spatial Entities can be configured to cover practically any space. Some are logical and their configuration is dictated by the physical shape of a room, a corridor or a courtyard, while others, the surroundings of a house, for example, can stay indeterminate as

to their use, until later stages of interpretation when they might be characterised and then designated as areas of storage or disposal. The interior areas of a longhouse can be chemically analysed, its sherds quantified and spaces of occupation determined and structurally compared to other houses. Spaces can be designated as work areas, where specific actions have taken place. A room where a hearth and certain types of ceramics are found can be designated a kitchen, and a room near it, a storage area because of its content.

Two levels of Spatial Entities are available, the first, as we have said can be a room, a corridor, etc., they are the basic components used to identify elemental spaces, the second is composite. Several associated spaces can be said to be a HABitat, is the Structures Spatial Entity which brings together several Spatial Entities. Even though they are essentially a means for spatially structuring intra-site data, SEs are not necessarily limited to this scale of analysis, and they can be adapted to intra-site work and defined by the archaeologist to cover larger units of space depending on research needs.

4.3 *Temporal Entities*

Archaeology as an object-space-time relationship, needs to manage all three of these factors in order to arrive at valid conclusions, but in particular the temporal aspect. To effectively model evolution, it is necessary to efficiently access spatio-temporal data, that is, to process the dimensions of both space and time in relation to one another. If we in archaeology are to effectively analyse human chronological / historical evolution through the study of material remains and of the traces left through time, it is fundamental that a spatio-temporal component be structured to analyse the data in this dimension. The Temporal Entities again use the three letter abbreviation: PHaSe, PeRioD, etc.

At their basic level, Temporal Entities mimic the contemporary use of "phase" and "period" to structure the passage of time. But to assemble chronologically contemporary data, they have the inherent capacity to integrate one or more Archaeological Entities and/or Spatial Entities, into coherent manifestations of human presence at a given moment.

Where there is an enhancement to the basic traditional methods is at the site, inter-site, period, etc., levels of analysis. Structured Temporal Entities can be used to manage any level of chronology and to associate related data to them; for example ROMan 3, MEDieval 6, etc.

4.4 *Interpretative and Analytical Entities*

Throughout the ArchéoDATA projects development process, the obligation to utilise uniformly structured environments has led to the efficient flow of information within the system. But, as it is only possible to structure what is known, it became apparent that to efficiently carry out certain stages

of research, it was frequently required, to be able to assemble data in a heterogeneous and piecemeal manner. It was, therefore, necessary to develop of a procedure for grouping data and data structures in an independent manner, and at the same time, to benefit from previous structuring. Interpretative and Analytical Entities (IAE) permit data to be assembled for a particular study.

They permit the selection and integration of homogeneous and heterogeneous data, isolating subject matter clearly for a specific analyse or to build a particular synthesis or model. Interpretative and Analytical Entities can be used in many different ways, they can globalise the final stage of a hierarchically structured system, or inversely the potential for grouping data independently of previous types of structuring. Equally they can be used, from the beginning, to structure studies on specific subjects such as NUMismatics, CERamics, etc.

To illustrate this, a farm may be comprised of only one building, although usually there are also barns, stables, enclosures, etc., every one of them structures or SAEs, as well as fields, grasslands, or Spatial Entities, etc. Together these make up a farm (FRM), or in other words, an analytical unit (IAG) if we were to study rural life at a given moment. To these we could add inventory from survey, excavation, or even from a city museum.

An Interpretational and Analytical Entities can also include other IAGs as is the case where several farms (FRM 1, FRM 2, FRM 3 ...) and a church (CRH 1) make up a village (VLG 1), to be studied with other villages (VLG 2, VLG 4, VLG 5 ...), which make up a geographical feature such as a valley (VAL 3), a natural or user defined region (REG 1), etc.

5. The problem with time

If in our work to structure data, we had reached an acceptable level for conceptually identifying the passage of time through the Temporal Entities, it was still far from what was necessary to manage it. What was missing were the basic elements which a computer could readily use to base its calculations and structure the data. Created, this key component should also encourage flexibility in analysis and interpretation.

One of the advances towards a structured management of the passage of time was the matrix system developed at the Winchester archaeological excavations in the mid-sixties and published by Edward Harris in the middle and late 1970's. Later, in the early nineties, he published a book containing several papers on the adaptations of the matrix system to various types of excavations and projects. Ever since the Winchester matrix system started to generalise, there has been substantial interest to find ways of automating the process. Although many tried in the late seventies and the early nineties, to computerise the process, most have met with only limited success, and by consequence, with limited value for interpretational stage.

The fundamental problem seems to have been the lack of an appropriate data structure on which to set up and manage the analytical process. The whole process had been exclusively based on the immediate "before" and "after" stratigraphic relationship, while leaving other associations and correlation's, to be carried out manually by the archaeologist. Contemporary archaeological methodology thus uses this couple to found the basic chronology of an excavation. While this procedure is fundamental for interpretation and important for detecting and correcting errors in the basic stratigraphic relationships, it offers very little in the way of extensively structuring analysis in any useful and meaningful way. This is particularly true, as we have pointed out before, if computerisation is to play an important role in the interpretation to be carried out at the various stages of excavation and post-excavation work, but, there was no questioning the basic stratigraphic relation of "before" and "after" as the point of departure for structuring time.

As we have seen the Temporal Entities are a combination of a three letter abbreviation, which in most cases function quite acceptably to present instances of time, but they are not adequate for basing the primary needs of calculation. Nevertheless, computation is naturally best done mathematically, so it became necessary, if time was to be efficiently managed, that we have a fully mathematical element on which to base calculation. Furthermore, for this new element to be practically acceptable, it should readily relate to the Archaeological Entities structure already incorporated into the system, and if possible, further enhance their flexibility.

Urban archaeologists in France have been using, for quite some time, the following structure on which to base chronology:

"Unité Stratigraphique" > "Séquence" > "Phase" > "Période"

However quite efficient, this structure is of course different from the aforementioned definition of the stratigraphic sequence. There seems to have been an error some twenty-five years ago, but that has been totally assimilated by contemporary French archaeologists. Nonetheless, even though sequence is the same as stratigraphic unit as the departure point, there is a definite need for the intermediary methodical step to help structure chronology.

We decided to keep the Winchester definition of stratigraphic sequence as the parting point of chronology, and as being the same as Stratigraphic Unit, but it was evident that the now missing structural element had to be replaced. The word "events" has been retained as the expression suitable to express this second ordering of chronological data. The structure is then represented by:

Sequence > Event > Phase > Period

In our continuing quest to systematise the structural process, it was calculated that each stage in the chronological process should have an inter-

nal hierarchical framework of 99 steps (Fig. 2). This 99 unit systemisation has already proven itself in several other of our data structuring needs, it is mathematically efficient without sacrificing the possibility of accessing directly a stratigraphic sequence, a particular event or a whole phase or period. Nonetheless, to render this mathematically compatible, the components have rearranged in an ascending order, giving the following representation:

Period < Phase < Event < Sequence
99 99 . 99 99
1209.0515 =
Period 12 < Phase 9 < Event 5 < Sequence 15

Even though this structure has the appearance and feeling of potential complexity, at the moment of putting it into practice, it has been designed in a way that most of the work is done progressively and transparently. At each stage of excavation and interpretation, the archaeologist adds to the structure, and the computer calculates, or recalculates, as need be the new chronology. When the archaeologist records a stratigraphic sequence, as in the case of a wall, the computer will automatically create the first level sub-sequence. As he advances in interpretation he will create the subsequent levels of chronology and associate events to one another, and then, to phases and periods. An advantage to having a potentially automated system is that stratigraphic data need not await for the advanced stages of analysis to take form, this information can, if processing is carried out more directly, be more readily used during the actual excavation in the field.

Even though the stratigraphic sequence is unique in time, conceptually, one or more events can take place at the same time (Fig. 3). Four walls that make up the construction of a house need not necessarily be numbered as four distinct chronological events, if it is deemed they were laid out simultaneously and reflect common logic, whereas the floor, which could be said to be installed after the walls, is a new event. The walls are however, in the recording process, considered as four distinct Archaeological Entities. This system also favours visualising chronology in the form of different Entities, and at different levels, as they are always present.

Flexibility is apparent when there are numerous changes to be made as new elements of interpretation are incorporated though progress in analysis or extension of the excavation. It should not be underestimated the burden that changes in stratigraphic interpretation can be on the workload of an excavation team.

6. Conclusion

All that has been said is of course applicable at various levels of interpretation and analysis. Until now we have privileged the micro level of ar-

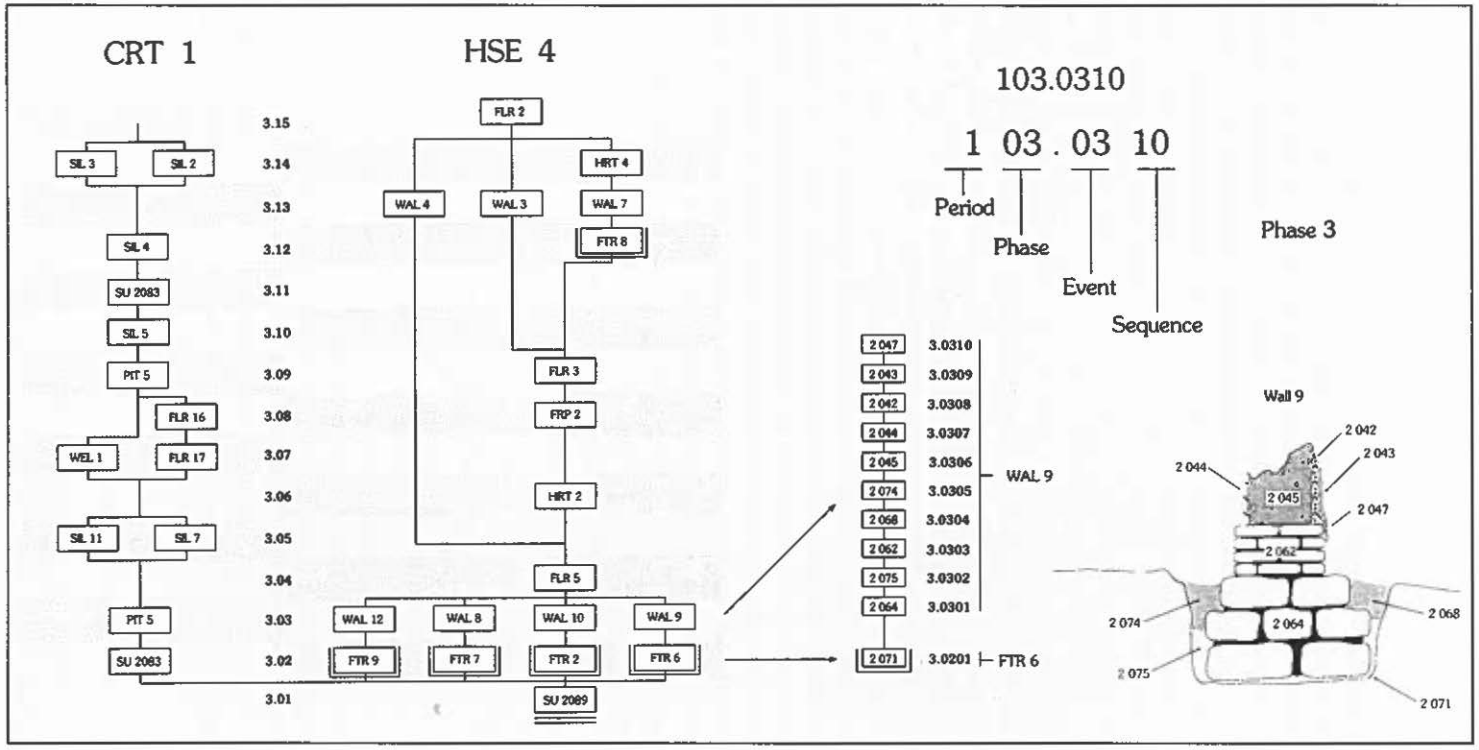
CRT 1
HSE 4
103.0310
1 03 . 03 10
Period
Phase
Event
Sequence
Phase 3
SIL 3
SIL 2
SIL 4
SU 2083
SIL 5
PIT 5
FLR 16
WEL 1
FLR 17
SIL 11
SIL 7
PIT 5
SU 2083
3.15
3.14
3.13
3.12
3.11
3.10
3.09
3.08
3.07
3.06
3.05
3.04
3.03
3.02
3.01
FLR 2
HRT 4
WAL 4
WAL 3
WAL 7
FTR 8
FLR 3
FRP 2
HRT 2
FLR 5
WAL 12
WAL 8
WAL 10
WAL 9
FTR 9
FTR 7
FTR 2
FTR 6
SU 2089
2 047
2 043
2 042
2 044
2 045
2 074
2 068
2 062
2 075
2 064
2 071
3.0310
3.0309
3.0308
3.0307
3.0306
3.0305
3.0304
3.0303
3.0302
3.0301
3.0201
WAL 9
FTR 6
Wall 9
2 042
2 043
2 044
2 045
2 047
2 062
2 074
2 064
2 068
2 075
2 071

Fig. 2

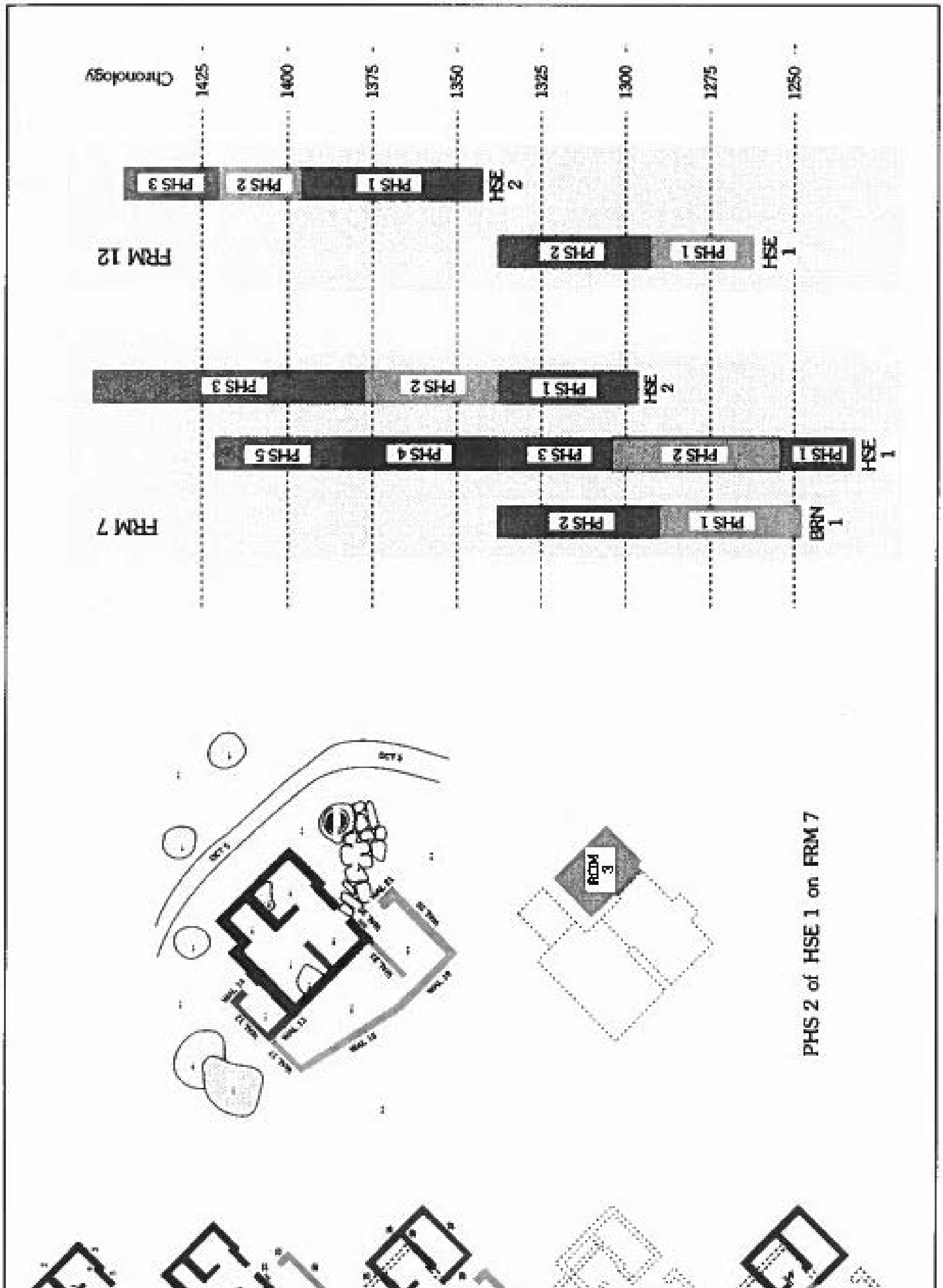
Chronology
1425
1400
1375
1350
1325
1300
1275
1250
FRM 12
HSE 2
PHS 1
PHS 2
PHS 3
HSE 1
PHS 1
PHS 2
FRM 7
HSE 2
PHS 1
PHS 2
PHS 3
HSE 1
PHS 1
PHS 2
PHS 3
PHS 4
PHS 5
BRN 1
PHS 1
PHS 2
RCM 3
PHS 2 of HSE 1 on FRM 7

Fig. 3

chaeological excavation, but what we have discussed becomes even more important to long term research as the quantity of information grows and becomes more complex and difficult to manage. It is because these techniques are applicable at different levels, local, regional, etc., and that they can ensure the basis for an automated analytical process, that advances can be expected.

In the future we must be able to draw great swaths through data to find the information that we need, we must be able to slice though a particular moment in time and be able to retrieve collections of structured data and associate them to specific places, finds and actions. For archaeological analysis to continue to develop and to attain new levels of interpretation it must be able to efficiently make use of accumulated knowledge.

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ABSTRACT

During the past few years we have presented and published a series of papers on the project ArchéoDATA that we have been developing in the GDR 880 of the CNRS, in our quest for a methodological structure for the recording and analysis of archaeological data and the creation of a European Archaeological Information System, designed to formalise and to structure archaeological documents.

The three basic components of archaeological recording and analysis are the factors "objects", "space" and "time". Through their interaction the archaeologist must attempt to forge his interpretation and argue his thesis. The management of data pertaining to each one of the components of "object", "space" and "time" should be undertaken with the same elementary structure. Due to the diversity of recording methods, and to inconsistent terminology used to express what in essence were similar things, a designation based on the word "Entity" was initiated and the "Archaeological, Spatial, Temporal, Interpretative and Analytical Entities" were consequently defined. This paper presents in detail new work that has been undertaken on structuring the basic component "time".