Archeologia e Calcolatori
10, 1999, 7-16

FROM EARTH TO CYBERSPACE: THE UNFORESEEN EVOLUTION

1. Introduction

When asked to do a paper on the research work that we had undertaken in the last ten or so years on the development of an Archaeological Information System for the general management of this part of our Cultural Heritage, several detailed approaches were considered. Actually two different papers were nearly finished in succession before it became altogether apparent that one particular element had evolved in this span of time and that it would be the key factor that would fundamentally influence the prospect of being able to feasibly implement an AIS concept, at all.

2. The stated objectives

Over the years we have worked with many different groups and individuals, field archaeologists, research teams, scholars, administrators, and many others, to develop and test the many modules that would be needed to manage the envisaged system. Over this period we were also to develop, through the use of analytical entities, several methodological approaches to help analyse and interpret the object/space/time trilogy, or what we have called the three "S" of archaeology, *something, somewhere, at sometime*.

The overall philosophy of the project and its objectives were probably best presented in an old paper given at the National Archaeological Records Conference held in Copenhagen in May 1991 (Arroyo-Bishop, Lantada Zarzosa 1992). We will quote part of the introductory text as we consider it to be of enduring value for helping to illustrate our proposals.

«At the end of the twentieth century, we are very far from the self sufficient research which prevailed for a long time in archaeology and which is being replaced through collaboration and by multidisciplinary studies. Since the last world war, archaeology has evolved into a science in its own right and as such, it must now accept, as many other professions have found necessary, and to their own benefit, that it is essential to adopt, in this new phase of maturity, certain structuring and homogeneity in the data produced if research is to be favoured and conservation efficiently carried out into the next century.

Isolated examples of structured archaeological data do exist, and excavation records and museum inventories, are but two where it has been applied. Some countries can count on regional and even national databases to help research specific areas. But, even in these cases, it is not conceivable that the archaeological record continue to be divided up into small units, barely able to communicate and

interrelate with one another and that in the future it must evolve into a common research unit.

If archaeology is to reap some of the benefits from the Information Age it must prepare now, as sufficient difficulties already exist. It cannot allow a myriad of databases to develop independently, each with their own themes, structures, indexes and vocabularies, as it becomes rapidly impossible for anyone to effectively research and master more than a few of them.

If there is to be in Europe's future an integration of archaeological research it must of course be computer based, and for computerisation to work, it is an intrinsic necessity that we structure and formalise the fundamental way we record and store data.

It is imprudent, to say the least, to continue to ignore these basic facts. To face up to reality is not to consent to a grandiose scheme, but to support a scientific and administrative necessity of which goes far beyond individual or group preferences and interests. Archaeology cannot expect to continue to evolve scientifically if it sniffled in its quest to dispose of the required data needed for research. It is no longer possible to continue to prepare good isolated systems, a good integrated system must now be accomplished.

Information must be able to circulate widely and it must be possible to select, group and compare on a wide scale without the limitations imposed on data by the regional and national boundaries. It is no longer sufficient to decry the state of the archaeological record, it is time to establish the future framework for it to evolve.

There is no question of imposing immediate and radical change on the archaeological sector by, for example, a set of European Community regulations. This would certainly not work for many reasons and would certainly interfere with many projects and development work at present underway. Implementation though must not fall prey to either of two extremes, neither *laisser-faire*, nor imposition, but rather it must count on convincing the archaeological community of the scientific and administrative necessity for a system's progressive introduction.

The adoption of a general system has to be based on reasoned and well founded arguments that present the archaeologist, the curator, the administrator, etc., with motives to adopt it.

A few examples:

– The possibility of selecting, grouping and analysing data independently of thematic, geographical or administrative constraints.
– The possibility of rapidly accessing vast amounts of data from surveys, excavations, collections, etc.
– The potential for analysis of being able to interface with other types of data such as geological, climatological, population, etc.
– Being able to efficiently relate site data to the administration and evolution of land use.
– Guarantee the future conservation of archaeological data through global hardware and software conversion and renovation.
– Favour the transfer and exchange of data.
– Permit the generalisation of new methods of communication and publication.

The underlying system must be founded on basic archaeological methods and concepts, and the data registered, strait forward. The system must be logically implemented, enabling it to be easily integrated into existing administrative and research structures. Its implementation must be planned for well in advance and then progressively introduced, built from the ground up, little by little, to make up the whole, and not as has been attempted in other occasions, from the top, down. It is by the common usage of the system by surveys and excavations that its base is built up.

Some will take up the system immediately, others will need time to adapt as many possible obstacles, material and formal, do exist. This could of course take a new generation of archaeologists to put into generalised use, not to say completed, but this can only be seen as to further guarantee its perennity.

Fundamentally the system established must be maintained so that it can evolve as new developments take place in the profession. It must not be a rigid system, established once and for all, which could only hinder research, but rather open to evolution and ready to accept it».

It will be quite apparent to the reader of this old text that what would make the system work would be a collectively adopted universal methodology, but what would sustain the system in the future and give it its undeniable value, would be in networking the data thus organised. Even though the ArchéoDATA Project had been developed along methodological lines, it had also been continually tested and confronted with computing reality. All through the varied development stages computer modelling has been used to test the data structure and efficiency of the processes used. At each one of our test sites, database and other software were utilised in the field to verify the capacity of the system to correctly manage the archaeological tasks at hand.

Nonetheless, it would be essential in the future to demonstrate that the project was being set up on a sound financial base and that maintenance would be reasonable. In no manner could we expect to convince those who had the responsibilities for managing national and international budgets if our needs were perceived as being expensive academic schemes, albeit for preserving our Cultural Heritage, if they were not within socially acceptable financial limits. It would not be possible to ignore these basic realities in an international project where the proposals would be critically evaluated from many standpoints and judged on its benefits to the collective in general.

The project has therefore always had self-imposed limits on what could be reasonable to implement, and therefore probable to achieve, rather than farfetched in its aspirations and later inadequate in its results. As networking archaeological data could never expect priority treatment due to the high costs that it would entail, and the low return value this was perceived to have, expectations for networking our data were in consequence limited in scope.

Although wide area networking was present in our planning since the beginning, it became progressively more apparent that it was becoming an

improbable final feature as full implementation was estimated to be much too expensive and complex to put into everyday use. The models that could be found at a number of American university campuses could not be reasonably emulated in Europe and other parts of the world, as these computing networks are supported by their enormous budgets, unavailable, and probably unreasonable, elsewhere.

Nothing more extensive than what was habitually in practice a decade ago in academic circles was expected to be workable. This limited environment would naturally curtail the extent of system's implementation as well as the potential diversity and quality of the documents to be exchanged.

3. Something evolved

The mutation in the early 1990's of the global NSF administered Internet network from a text and code driven data exchange communications medium to a graphically interfaced multimedia environment was probably the greatest single, and unexpected, development to our AIS strategy. The advent of the HTTP World Wide Web protocol to the Internet fundamentally changed the way we were to perceive the possibilities of data flow and networking. Many words were to lose their dreaded overtones; cost, number, availability, maintenance, distance, rapidity; networking and communications would never be the same again.

The impact of the Web on our work and its future potential were simply immense. It has already demonstrated many possibilities for present and future development and has presented archaeology with an opportunity to diversify and accelerate the general circulation of knowledge at all levels. On-line libraries, bibliographies, publications, databases, video-conferencing and on-line round tables are but a few of what is to seen at present.

If anyone doubts how universal Internet is to become, one has but to look into the Motorola initiated global *Iridium* 66 satellite based telephone network to illustrate what can be expected in the future. Even though this system would be quite expensive to use at present for long computer usage, it has nevertheless demonstrated the possibility of universal Internet connections without any exceptional equipment or any particular network dependence. As for cost and capacity, they can be expected to evolve favourably in the coming years, making this kind of system widely available, even for archaeology.

4. Implementation

After gaining some needed exposure to the continually evolving WWW and testing different ideas with on-line experiences, we proceeded to engage

discussion on porting ArchéoDATA to the Internet. The UMR 5608 of the CNRS is located within the campus of the University of Toulouse II "Paul Sabatier", and as such, we have been working for the last year with the Centre Interuniversitaire de Calcule de Toulouse (CICT). We have been preparing the groundwork to initiate, in 1999, a field and laboratory implementation of the system. With their assistance we have been able to solicit the support of the regional Conseil Générale de Midi-Pyrenées administration, in order that a computer engineer be sent to the UMR to help us with this phase of our project.

Through this partnership, at the beginning of the year, a further step has been taken in the development of the system using Oracle Corporation's software. The choice of this particular company, beyond its proven reliability and continual development, has been Oracle's networking experience and its commitment to the implementation of Internet solutions. The specific software to be used in this phase of development will be the recently released Oracle8i, which incorporates extensive use of Java and the implementation of XML. These two features are considered essential to creating a convivial and ergonomic environment, which we have seen through experience, will considerably encourage users at all levels to accept a computerised system.

Over the years our studies on system implementation had evolved through three successive networking strategies:

1a) Our original idea was to have individual archaeologists working on isolated computers and installing on each computer a complete and compatible database.
   – A non-networked microcomputer.
   – A local database.
   – Application software for managing data.

1b) Once back at the research laboratory, the data recorded in the field was then analysed and afterwards transferred to a traditional local client-server network. At the beginning of our program no other solution could be realistically considered, although over the years, this configuration could have been expected to evolve into a distributed system.
   – A multi-site database.
   – A database server in charge of maintaining the data.
   – Client stations with the appropriate software to manage the data.
   – A local network to permit communication between clients and server.

2) With the advent of the WWW we reviewed our data management structure into a global network strategy.
   – A multi-site database.
   – A database server for database management.
   – A Web server for accessing the database from the Web.

– Client posts with Internet navigators for accessing the Web server.
– A global network (Internet) for exchanges between clients and server.

3) The final solution, and the solution being installed at present, is the Universal Client-Server. In this solution we have taken the decision of implementing the previous solution, but without implementing the local network.

Server side:
– Deployment of an Oracle database server.
– Networking the database through the use of Oracle Web Server.
– Programming the necessary software to permit the generating of dynamic HTML pages.

Client side:
– Only a TCP-IP Internet connection and a Web navigator are necessary. The Universal Client-Server solution offers the greatest accessibility and flexibility along with the least development time and at the lowest cost.
– Data access on the client side is independent of any specific application software or computer hardware. Any PC, Macintosh, Unix station or future Internet interface will do.
– No need then for the development of specific application software.
– The possibility of using standard office applications to enhance and rework extracted data. This aspect will probably become very interesting with the advent of fully Web oriented software packages such as Office 2000 from Microsoft.

Finally this solution remains compatible with the traditional Client-Server solution in as much as it will always be possible in the future to develop the necessary Client software to interface directly with the database on the Server.

The first full-scale field test (Fig. 1) of the system will be in September 1999 at the Saint-Bertrand-de-Comminges Roman period excavations in the South of France. This excavation and other associated research projects have been using the ArchéoDATA system over the years and they have been contributing substantially to developing case studies. All computerised recording will be done directly on-line with the CICT and all queries and database management will be handled in the same manner. The CICT has confirmed its support for maintaining the installed applications at least over the next several years, decision which is essential to the overall success for implementing and testing this phase of the project.

5. Conclusion

As the ArchéoDATA Project has developed over the years, many new decisions have had to be made and new directions taken, but that is the daily

Fig. 1 – Early interface phototyping using standard HTML 4.0 code.

lot of experimental work and research in general. The systematic structuring of archaeological recording, and the methodology developed for analysing the data thus collected, have initially been complex for the archaeologist to apprehend and apply, but acceptance has been forthcoming because of the intrinsic long-term benefits of the System for research and conservation.

At this stage of development, we are fully committed to investigating the potentiality of Web development for all the components that are comprised in an AIS. Can complete immersion of the archaeologist in the Web be made to work, and will universal usage of the Internet network live up to its promise and potential? If in a future paper we will overview our Internet activities and experiences, it will also be possible to follow our work by connecting to our CNRS site: http://www.univ-tlse2.fr/rech-utah.html.

Much has already been said and written on archaeology and the Internet, and undoubtedly archaeologists will continue to seek new ways to use this distinct medium. We, at least, have already found the WWW to be a fundamental evolution for our Archaeological Information System strategy.

DANIEL ARROYO-BISHOP
Université de Paris
UMR 5608 du CNRS
Unité Toulousaine d'Archéologie et d'Histoire

BIBLIOGRAPHY

ARROYO BISHOP D. 1988, *Los archivos arqueológicos, realidades, perspectivas y evolución*, «Boletin de Arqueología Medieval», 2, 49-73.

ARROYO BISHOP D. 1989, *The ArchéoDATA Project*, in S. RAHTZ, J. RICHARDS (eds.), *Computer and Quantitative Methods in Archaeology 1989*, BAR International Series, n. 548, Oxford, 69-86.

ARROYO BISHOP D. 1991a, *The ArchéoDATA System: Towards a European archaeological document*, in K. LOCKYEAR, S. RAHTZ, *Computer and Quantitative Methods in Archaeology 1990*, BAR International Series, n. 565, Oxford, 61-70.

ARROYO BISHOP D. 1991b, *El sistema ArchéoDATA: Hacia la creación de un Sistema de Información Arqueológico (SIA)*, in V.M. FERNÁNDEZ MARTINEZ, G. FERNÁNDEZ LÓPEZ (eds.), *Aplicaciones Informáticas en Arqueología - Madrid 1990*, «Complutum», 1, 167-174.

ARROYO BISHOP D. 1992a, *El "Sistema ArchéoDATA". Registro en Prehistoria*, Seminario de Arqueología y Ethnología Turolense, «Kalathos», 9-10, 31-46.

ARROYO BISHOP D. 1992b, *Further structuring of the ArchéoDATA System*, in G. LOCK, J. MOFFETT (eds.), *Computer and Quantitative Methods in Archaeology 1991*, BAR International Series, n. 577, Oxford, 89-94.

ARROYO BISHOP D. 1992c, *El tratamiento de los datos obtenidos en las intervenciones arqueológicas y su inclusión en los archivos arqueológicos*, in *Jornadas Internacionales Arqueología de Intervención (San Sebastien, December 1991)*, San Sebastien, 287-318.

ARROYO BISHOP D. 1994, *Advances in archaeological recording and analysis: The ArchéoDATA groups and entities*, «Archeologia e Calcolatori», 5, 237-255.

ARROYO BISHOP D. 1995a, *ArchéoDATA: Enregistrement, analyse et conservation du document archéologique européen*, Paris.

ARROYO BISHOP D. 1995b, *Une méthodologie pour la création et la conservation du document archéologique*, in L. VALDÉS, I. ARENAL, I. PUJANA (eds.), *Aplicaciones Informáticas en Arqueología: Teorías y Systemas, Colloque Européen d'Archéologie et Informatique (Saint-Germain-en Laye, 1991)*, Bilbao, 23-53.

ARROYO BISHOP D. 1995c, *Organisation de l'analyse et de l'interprétation en archéologie*, in L. VALDÉS, I. ARENAL, I. PUJANA (eds.), *Aplicaciones Informáticas en Arqueología: Teorías y Systemas, II Colloque International d'Archéologie et Informatique (Bilbao, 1993)*, Bilbao, 11-22.

ARROYO BISHOP D. 1996, *Relating time within the general methodological structure of archaeological interpretation*, in P. MOSCATI (ed.), *III Convegno Internazionale di Archeologia e Informatica (Roma, 22-25 novembre 1995)*, «Archeologia e Calcolatori», 7, 15-26.

ARROYO BISHOP D. 1998a, *GIS and archaeology in France*, «Archeologia e Calcolatori», 9, 31-45.

ARROYO BISHOP D. 1998b, *Archaeological Information System methodology applied to Landscape Archaeology*, in F. BURILLO *et al.*, *Arqueología del paisaje, V Coloquio Internacional de Arqueología Espacial*, Teruel.

ARROYO BISHOP D. 1998c, *MEDAIS*: The potential contribution of GIS to the identification, study and conservation of the Cultural Heritage of the Mediterranean Basin I (*MEDiterranean Archaeological Information System)*, in *1st International Congress on Science and Technology for the Safeguard of Cultural Heritage in the Mediterranean Basin (Catania-Siracusa, November 27-December 2 1995)*, Palermo, 207-216.

ARROYO BISHOP D. 1998d, *MEDAIS*: The potential contribution of GIS to the identification, study and conservation of the Cultural Heritage of the Mediterranean Basin II (*MEDiterranean Archaeological Information System)*, *ibid.*, 443-465.

ARROYO BISHOP D. in print, *El registro de estructuras arquitectónicas,* in *I Congreso de Castellología Ibérica (Aguilar de Campo, Palencia, Septiembre 1994)*.

ARROYO BISHOP D., LANTADA ZARZOSA M.T. 1992, *The ArchéoDATA System: A method for structuring a European Archaeological Information System (AIS)*, in C.U. LARSEN (ed.), *Sites & Monuments, National Archaeological Records, National Archaeological Records Conference (Copenhagen, May 1991)*, Copenhagen, 133-156.

ARROYO BISHOP D., LANTADA ZARZOSA M.T. 1993a, *Planning for site and intra-site data management interpretation*, in J. ANDRESEN, T. MADSEN, I. SCOLLAR (eds.), *Computing the Past, Computer and Quantitative Methods in Archaeology 1992*, Aarhus, Aarhus University Press, 195-204.

ARROYO BISHOP D., LANTADA ZARZOSA M.T. 1993b, *ArchéoDATA: Quelques pas dans l'enregistrement et l'analyse architecturale*, in C. ARNAUD, J. BURNOUF, *Dossier: L'archéologie du bâti médiéval urbain*, «Nouvelles de l'archéologie», 53-54, 23-28.

ARROYO BISHOP D., LANTADA ZARZOSA M.T. 1995, *To be or not to be: Will an object-space-time GIS/AIS become a scientific reality or end up an Archaeological Entity*, in G. LOCK, Z. STANÈIÈ (eds.), *Archaeology and Geographic Information Systems: A European Perspective*, London, Taylor & Francis, 43-54.

ARROYO BISHOP D., LANTADA ZARZOSA M.T., MARTY M.T. in print, *Pour une réelle valorisation des dépôts et des archives: un Système d'Information Archéologique,* in *Colloque national sur la conservation du patrimoine (Bourges, novembre 1998)*.

ABSTRACT

The ArchéoDATA Archaeological Information System has been under development for some ten years now and during this time considerable experience has been gained in the field of archaeological information management.

At the outset, a methodological philosophy was set out and based on the premise that archaeology was in essence something, somewhere, at sometime. This provided the foundamental platform for data recording and has also given rise to, through the development of the "Entities", a singular framework for archaeological analysis. The structures necessary to achieve an efficent balance between research, administration and conservation have been worked out and then tested under the actual conditions that will prevail under normal working conditions.

The problem has been that at the heart of an AIS there is communication, and that the practical means of achieving this finality are not simple. Not only do we need to efficiently structure the theoretical model, there also has to be the physical means of achieving it. This has been for many years the Achilles heal of implementation, as cost has been seen as being of an order not commensurate with archaeological budgets. The unforeseen evolution of the Internet network into the World Wide multimedia Web has provided information based systems with vast possibilities, and in the case of archaeology, with its first opportunity towards implementing universal communication.

This paper describes some of the steps being undertaken to transfer the ArchéoDATA AIS to the Internet.