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Analecta Praehistorica Leidensia 28 / Interfacing the past : computer applications and quantitative methods in archaeology CAA95 Vol. II

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Citation

Kamermans, H., & Fennema, K. (1996). *Analecta Praehistorica Leidensia 28 / Interfacing the past : computer applications and quantitative methods in archaeology CAA95 Vol. II*. Retrieved from <https://hdl.handle.net/1887/32944>

Version: Not Applicable (or Unknown)

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Note: To cite this publication please use the final published version (if applicable).

ANALECTA PRAEHISTORICA LEIDENSIA

28

PUBLICATIONS OF THE INSTITUTE OF PREHISTORY
UNIVERSITY OF LEIDEN

INTERFACING THE PAST

COMPUTER APPLICATIONS AND QUANTITATIVE
METHODS IN ARCHAEOLOGY CAA95 VOL. II

EDITED BY
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UNIVERSITY OF LEIDEN 1996

Graphic design: Henk de Lorm

Computer graphics: Peter Heavens

Copy editor: Marianne Wanders

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ISSN 0169-7447

ISBN 90-73368-10-3

Subscriptions to the series *Analecta Praehistorica Leidensia* and single volumes can be ordered from:

Institute of Prehistory
P.O. Box 9515
2300 RA Leiden
The Netherlands

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1 Introduction

The study of archaeology, like the cultures we attempt to describe, is evolutionary in nature. As new data are collected, methods, techniques, theories, and interpretations undergo change. Archaeologists are increasing in number, their research interests are diverse, and their study areas overlap both in a geographical and a chronological sense. Traditional techniques of data sharing and communication between archaeologists, such as print media and organised conferences, can no longer keep up with the quickening pace of this evolution. They are slow, prohibitively expensive, and often do not allow for the presentation of complete data sets which would be useful for research purposes.

As the discipline of archaeology continues to expand and evolve, we should exploit new technologies which allow for a cost-effective means of pooling information, and foster international collaboration in a timely manner. Scholars in a variety of disciplines have found that resources offered by the Internet provide a means of sharing and distributing information of many different kinds (sound, video, graphics, and text) in many different ways. In this paper we outline some of the shortcomings of traditional techniques for the sharing and presentation of data and ideas, describe current Internet resources being developed by archaeologists, and conclude with a proposal for the establishment of a European network of archaeological information services accessible via the Internet.

1.1 EVOLVING COMMUNICATIONS CHANNELS

In view of the delays and costs inherent in traditional communications (phone, fax, letters, meetings, conferences, books, journals, exhibitions), it is perhaps surprising that archaeologists have not been faster to take up the possibilities offered by the world wide computer communication structure called the *Internet*. Many, especially in northern and western Europe, Australia, Japan and North America already have this facility at their disposal. The Internet allows for both communication and reference services to take place, using a variety of techniques and protocols of which the user (luckily) need not be aware.

Communication via the computer, using facilities ranging from e-mail via news and discussion lists to video conferencing and electronic publications, enables researchers and archaeological resource managers to profit from the knowledge and experience of others, without incurring the costs of traditional conferences or the delays of traditional publication. Many archaeologists already communicate by e-mail on a regular basis, and their messages arrive at their destinations all over the world within the hour. Recipients are warned of the arrival of electronic mail on login and a reply function facilitates prompt answering of questions. Mailing lists act as electronic bulletin boards in that correspondence is directed to a central list address which redirects mail to a group of 'subscribers'. This is the easiest way to make contact with a world wide audience and peer group, to discuss research and debate current topics. Newsgroups are similar to list servers, but the correspondence is held at a central archive which is accessed by the subscribers.

Reference services by computer are also being used by many archaeologists who, if they are connected to the Internet, may regularly use a file transfer protocol (FTP) to swap documents, software and images. Instead of asking around in their office or going down to the library when they need a bibliographic reference, they telnet to the on-line searchable library catalogue and get full details immediately. Archive materials from field surveys, excavations, and museum collections to legal documents on heritage management are being made available through FTP and related services such as the Gopher browser developed at the University of Minnesota. On-line searches of world wide bibliographic databases, including grey literature and journals, radiocarbon dating archives, and national archaeological databases have been made possible through the use of telnet and related services.

1.2 INTEGRATING INTERNET SERVICES

Although list servers, FTP, and Gopher have been available for years, they require a certain amount of technical skill and knowledge of the structure of the different protocols used. This has tended to scare off many potential users. In addition, the absence of specialist guides for the

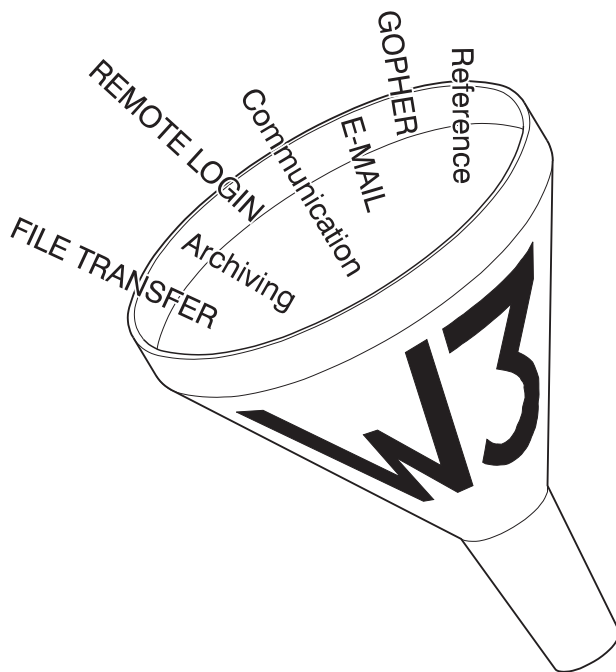


Figure 1. World Wide Web architecture serves as a funnel, integrating a plethora of network services and protocols. It presents the user with an easy-to-use 'browsing' interface to a wide range of multimedia information resources on the Internet.

inexperienced user has meant that a lot of persistence was required to find one's way to contacts or information. Several ways of dealing with these technical problems, all now rapidly converging on the World Wide Web (WWW or W3) architecture developed by the European Centre for Nuclear Research (CERN) in the late 80s, have emerged (fig. 1).²

Browsers and search engines are two methods for navigating the Internet that present the user with a) an easy-to-understand interface to the technical side of Internet, and b) a keyword-based way of automatically finding resources of potential interest. Browsers such as Gopher, providing a text menu based interface to Internet resources, have evolved into the current generation of WWW hypermedia browsers, which use hyperlinks to access material from *all older Internet protocols* and in addition allow for the viewing of multiple media documents. These now have become the global standard for navigating the Internet. The development of search engines has shown a similar evolution from relatively simple engines such as *Veronica* (searching titles in Gopher space) and *Archie* (searching FTP archives) through *WAIS* to the *WWW Worm* (key word search of indexed Web space) and the *Web Crawler* (document search). These are all based on string searches and conform to the WWW standard.

Internet Resource Guides are documents produced by professionals working in the field, that locate and summarise the available resources. Guides such as Peter Stott's (1994) *Internet Resources for Heritage Conservation, Historic Preservation, and Archaeology*, Allen H. Lutins' (1994) *Network Resources of Interest to Anthropologists*, Simon Holledge's (1994) *Archaeology on the Net*, and Sara Champion's (1995) *Internet Resources for Archaeologists* have generally become available either in print or as Internet documents only since early 1994, and they provide guidance and links to Internet resources of interest to archaeologists.

What if it were possible to combine browser, search engine, and resource guide into one application? The WWW protocol can do this, and is therefore radically changing the way people use the Internet as data providers and consumers. Search engines, because they follow the WWW protocol, can be accessed through Web browser interfaces such as Mosaic and Netscape. Resource guides written in hypertext format and accessed through these Web browsers allow readers to 'jump' instantly to information of particular interest. *ArchNet*, maintained by Thomas Plunkett and Jonathan Lizée at the University of Connecticut Department of Anthropology, sets out to do exactly that and has been available on the Internet since November 1993.³ One of its goals is to facilitate international data exchange — it 'provides a road map to the information superhighway' (Plunkett/Lizée 1995). *ArchNet* is a collaborative effort which provides links to all known archaeological data on the Internet and serves as the World Wide Web *Virtual Library* (resources list) address for archaeology. Since its inception, *ArchNet* has been accessed over one million times by users in 50 countries. Research and teaching archaeologists, cultural resource managers and museum staff are all now starting to see the potential of the Web to provide attractive means of communication, data exchange, and presentation.

Is there enough useful information available on Internet? With user-friendly access insured by World Wide Web technology, we quickly arrive at an information bottleneck: the limited number of information providers that serve the fast growing legion of information consumers. Current archaeological communication services often restrict themselves to providing basic (names, addresses) and/or general information (exhibits, 'tours', brief project descriptions) aimed at a large rather than a professional public. Current reference services are largely restricted to bibliographic catalogues and a limited number of survey and site reports. Archaeologists might well be justified in not bothering to explore the Internet if the available resources are few and of low quality. In order for the Internet to fulfil its potential in both of these areas, a lot of



Figure 2a. ArchWEB-NL. (downloaded 23.2.96)

effort must be put into opening up the many resources that are as yet only available through traditional means of communication and reference (fig. 2).

So what IS available in the way of resources for European archaeology? Overviews, admittedly skewed heavily in favour of hypermedia resources, are being maintained in the *Europe* page of ArchNet⁴ and in a page especially compiled by the authors for the 1995 CAA conference (*ArchNet - Europe*).⁵ The latter page provides some idea of how a European Archaeological Heritage Web might look. It contains links to all the archaeological resources relating to or originating in Europe, that the authors have been able to locate so far. The majority of resources



Figure 2b. WWW 'Home pages' of ArchNet. (downloaded 23.2.96)

consists of academic departmental information, museum exhibits, and project descriptions. These are all localised initiatives, and little attempt seems to have been made to construct nationwide or international access to archaeological resources. Examples of such localised Web services are the University of Southampton's Archaeology server⁶, the Cagliari National Archaeological Museum exhibit⁷, and the French Ministry of Culture archaeology pages.⁸

The only example of a nationally organised archaeology server at present appears to be *ArchWEB Netherlands*.⁹ Set up in late 1994, this server for Dutch archaeology, involving most of the professional and amateur archaeological community, museum and heritage management staff, etc., has received funding for an initial period of 1.5 years by the company that maintains the Dutch academic network infrastructure, after which responsibility for its upkeep reverts to the ArchWEB-NL members. No transnational archaeological information services other than ArchNet, the global discussion lists, newsgroups, and some electronic journals could be identified.

Yet interest in such services appears to be large and growing rapidly. For example, in 1992 an attempt was made

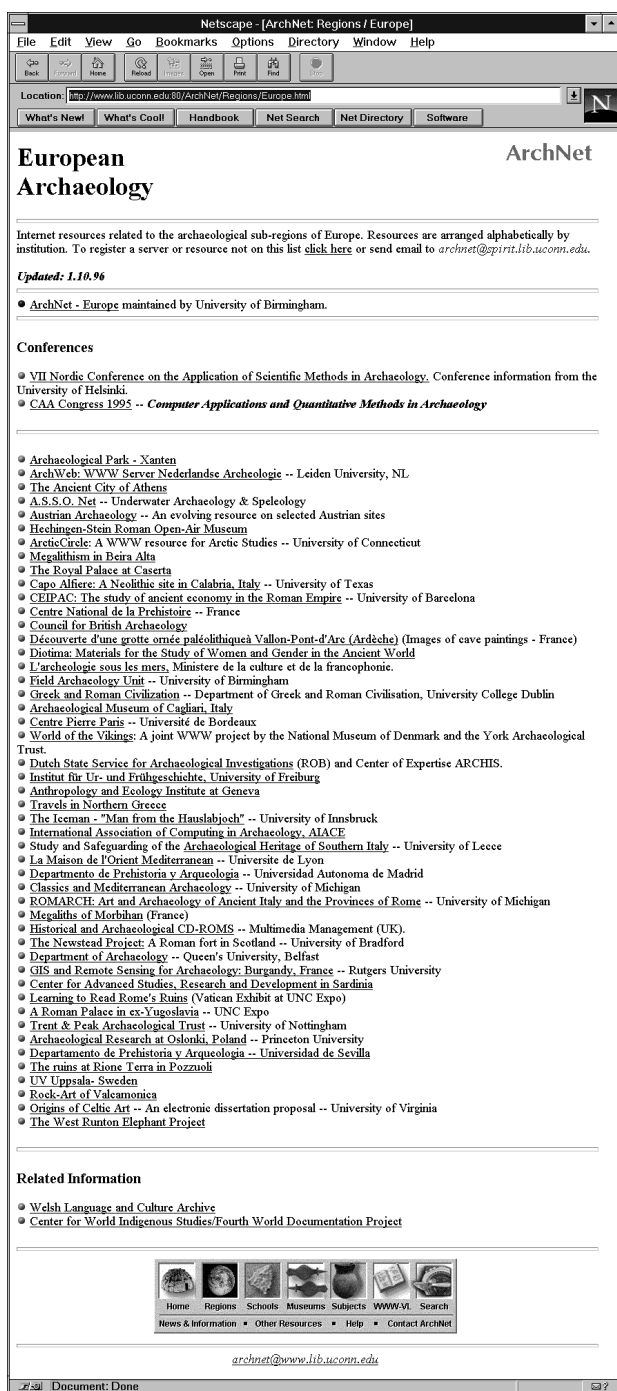


Figure 2c. ArchNet 'European resources' page. (downloaded 23.2.96)

to start the process of setting up a European Archaeological Database (EUARCH). The initiative for this was taken in late 1991 by Uwe Schoenfelder (Essen, DE); it was discussed at the 1992 CAA conference in Aarhus (DK), and

a preliminary plan was produced by Anne Vikkula (Department of Archaeology, University of Helsinki, FI) and mailed to the ARCH-L discussion list in July 1992 (Hansen 1993). Two of EUARCH's aims were to:

- preserve the common European Archaeological Heritage;
- facilitate the access and exchange of archaeological data within Europe.

Again in 1992, the European Association of Archaeologists (EAA) was formed, which aims to:

- promote the development of archaeological research and the exchange of archaeological information;
- promote the management and interpretation of the European archaeological heritage;
- promote proper ethical and scientific standards for archaeological work;
- promote the interests of professional archaeologists in Europe;
- promote co-operation with other organisations with similar aims.

Clearly both EUARCH and EAA aims would be well served by the establishment of an appropriate internationally networked communication structure, which would also tie in well with the 1992 Convention of Malta (Council of Europe 1992), which aims to:

- form inventories and databanks for cultural resource managers to use in preparation for development projects;
- educate the public in the value of the archaeological heritage as a major element of the European cultural identity.

The latter point introduces yet another important area of traditional interest for archaeologists which should be pursued using Web technology, that of public outreach and education.

2 Toward a European Archaeological Heritage Web

We propose that access to, and use of, archaeological information resources in Europe be facilitated through the establishment of a *European Archaeological Heritage Web* (fig. 3) service building on and extending the ways archaeological information is accessed by ArchNet and ArchWEB-NL. This service should cater to both providers and consumers of archaeological information at all levels. It should provide a forum for professional discussion and publication, promote public interest in and access to European Archaeological Heritage resources, and actively extend itself into regions and sectors that are currently poorly connected.

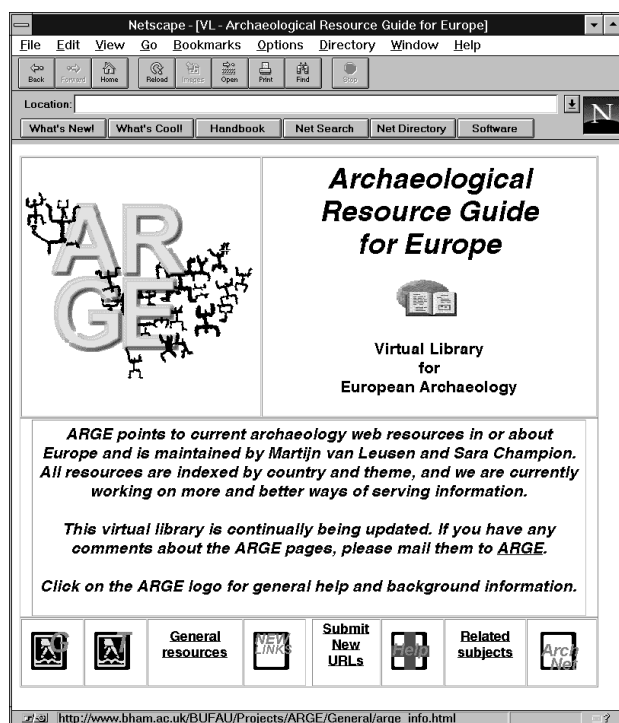


Figure 3. WWW home page of the Archaeological Resource Guide for Europe (ARGE), which the authors hope will become the nucleus for a European Archaeological Heritage Web.

Although this proposed service could be set up using minimal resources (just pointing to locations on other servers), that would not be satisfactory in view of the fact that many sites do not have server capacity. We therefore envisage establishing one or more Web servers either dedicated entirely to archaeology or piggybacking on existing servers.

We are fully aware that many aspects of our proposal will need to be more fully explored, and our discussion of its problems and potential in the next two sections accordingly is not meant to be exhaustive.

3 Problems to overcome

The establishment of the proposed service will to some extent have to overcome a range of problems. These relate to access (connectivity to the Internet and legal access to information), costs (of establishing and maintaining the service), and the language barrier, and will be discussed in some detail below.

3.1 ACCESS

The main technological problem will be to ensure that a high-capacity infrastructure to support large data streams (the Information Superhighway) is in place. Obviously

archaeologists will need to have access to this infrastructure both in the sense of being connected and of knowing how to use it. At present practical access to the Internet is largely restricted to academic networks in western Europe. E-mail connectivity exists over most of the remainder of Europe, but has not been discovered yet by many archaeologists there. Luckily, we need not worry about such technological hurdles. Given the speed of current developments, within a few years access to the Internet will have been extended to many more archaeologists all over Europe. For the moment, institutional connections by modem are quite affordable, the cost being comparable to that of an ordinary telephone connection. Public Domain software is available for both client and server sites and for most computer platforms.

One of the major benefits provided by the establishment of a European Archaeological Heritage Web would be to enable access to filespace by European countries, institutions and individuals whose IT infrastructure is not currently able to support the development and maintenance of on-line information services for archaeology. Museum catalogues, Sites and Monuments Records, excavation records, special exhibitions, research papers etc. could be stored on or linked with the European server and be available for consultation and use as the owners/generators of those data wished. It would thus be possible for 'owners' to restrict access to certain data sets, such as sensitive information on the exact location of sites, by the use of a password only given out to suitable people who wished to register with the 'owner' of that data set. We would see this as an enabling device, allowing excavation units, local authority planning departments, museums and individual researchers to deposit and share their work.

It should be remembered that copyright issues currently play an important role in restricting the types of information that may be distributed over the Internet; the question of 'ownership' of information and knowledge is one which will have to be the subject of considerable debate, and may require radical new attitudes in the context of the wider potential access to material.

3.2 COSTS

In addition to the costs involved in the purchase of a server or in the rental of space on an existing server, the work of setting up and maintaining information services will take a certain amount of technician's and specialist's time. However, the benefits, compared with traditional print media, outweigh such costs. Exhibits can be mounted or 'published' by their authors and submitted electronically. High resolution colour images can be made available at little or no cost, which would enhance archaeological research and education.

The development of archaeological Internet resources, and the provision of access to these, have up till now been the work of dedicated individuals, who have neither been told nor paid to do this. Some have managed to acquire grants from various sources. It is to a large extent one of the strengths of the Internet that it allows and encourages this kind of initiative, and we think most of the work on European Archaeological resources should be done this way in future. It is only where the purchase of hardware and technical maintenance is concerned, that more permanent facilities should be set up. The cheapest alternative is to piggyback on an existing WWW server; costs might then be restricted to buying or renting filespace and a certain level of maintenance. Any work on the design and upkeep of the information access structure could be done by a small group of interested archaeologists and librarians.

3.3 LANGUAGE

The language barrier, which is effectively keeping, for instance, the large anglophone archaeological research community apart from other language communities on the Web, is surely the most important problem that any truly European resource must deal with. There are three main areas where an appreciable language barrier would be fatal: a) in the Web navigation structure or 'road map'; b) in the documents themselves (e.g. papers); and c) in discussion lists.

Any inability or difficulty in understanding the first of these will effectively bar one from using the Internet; the second, bars one from following news and developments in one's field; the third, bars one from understanding and taking part in discussions with colleagues in other language communities. Although it is the user's own responsibility to learn any language that she may need, the EAHW should in no way add to her problems. The Web navigation structure, with its main function of providing pointers to archaeological resources elsewhere on the Net, could be made multilingual with a relatively minor effort by volunteer translators. Texts and e-mail would be much more resistant to such translation because of the effort involved. Here perhaps the path taken by traditional publications — abstracts in other languages — points the way forward.

Any translations must also deal with the restrictions inherent in the standard ASCII character set -ISO-Latin is the current standard for Web documents, but this will not provide for Greek or Cyrillic character sets, a problem currently under research.¹⁰

4 Potential for new developments

Problems apart, we see in the WWW a way to change radically the way in which archaeologists communicate the results of their work, both for the benefit of their fellow professionals and for the wider public. Although it will not

replace traditional means of communication, it will certainly enhance communication itself by removing many traditional obstacles to inter-institutional and international information sharing and collaboration.

4.1 RESEARCH

For ongoing fieldwork projects, the annual or interim report has become a standard method of publication, with its associated time and financial burdens. In many cases such interim reports take up considerable space in august journals, take more than a year to appear, and are required to conform to standards more suitable for a final report — indeed, often the material thus published has to be repeated in the final report anyway. In other cases, an archaeological organisation may produce a more popular document of its own, which can cost a considerable amount to print in any numbers.

In both cases, we see the WWW and a European server as an obvious way to present ongoing fieldwork, as the examples on the Southampton server demonstrate. Here a normal descriptive text is illustrated by plans, coloured contour plots and colour photographs, the last two of which would be difficult to justify on cost grounds in a standard interim report and which would be expensive to produce in a self-published format. Access to both types of publication is limited, while any number of people, both professional and members of the public, can access the material on the WWW. The amount of material included is quite enough and of a perfectly acceptable standard for an interim report.

Similarly, the interim results of ongoing research work, and the presentation of kite-flying new ideas, find an obvious home on the WWW, where they can be commented on and discussed, and replaced with further versions as they develop. Again, examples can be found on the Southampton server; it seems to us that this is an economic and accessible way in which to try out new ideas and to keep new research under review. Moderated electronic journals, with articles subject to peer review and simultaneous comment, are already beginning to appear (e.g. *On-line Archaeology*¹¹ and *Electronic Antiquity*¹²). Such journals have been developed in other scientific disciplines since 1990 (Harnad 1990, 1995; see also Harnad's Web pages¹³).

Until now, many in Europe would be prevented from taking part in such contact except when they could get to conferences. Even if they themselves do not have access to the WWW, they could file things on the European server, reach a much wider audience, and receive e-mailed or 'snail-mailed' comments. While some of these research ideas might find their home in moderated electronic journals, others could quite happily be presented as individual contributions — the WWW is infinitely more flexible than hard copy.

Another development with a considerable research potential concerns the creation of Web browser interfaces to existing softwares. Current work includes research into interactive access to visual databases and catalogues (Jakobs/Kleefeld 1995) and to major software packages (GIS, RDBMS).

4.2 EDUCATION

We also see great possibilities in the area of public education, and in the presentation of the heritage. Quite apart from public access to the above, the graphic and interactive potential of the WWW will allow the development of a wide range of resources associated with particular sites, localities and countries which can be linked to or placed on the server for the purpose of information and education. Already a small number of such resources exist, both in the form of museum exhibits, and as 'virtual tours' round sites of interest (e.g. a 'field trip to Salisbury Plain'¹⁴ or a 'tour of the Pompeii Forum'¹⁵).

A further way to engage the European public would be the development of distance learning materials, which could be located on the server and whose introductory levels could be made available for public browsing. Access to more detailed course materials could be by password after registration with whichever institution had developed the course, and credit could presumably be obtained on completing assignments and the payment of assessment and other fees. At a more junior level, the opportunity to develop an interest in and an understanding of the European heritage in children could perhaps be provided by the setting up of a European Archaeology Club, where not only basic educational materials could be produced by the Education Officers related to national heritage bodies, but where communication between children along the lines of the global *Kidlink* project¹⁶ could be facilitated. Clearly, problems of language may be involved (see section 3.3), but these have not prevented tremendous success in this particular project.

Finally, all the above resources have the potential to also draw in people who would otherwise have difficulty in experiencing the European heritage at first hand — the disabled, elderly, sick, housebound and geographically isolated.

5 Conclusions

The intention of our proposal as outlined above is to use the power, speed and trans-national attributes of the World Wide Web to facilitate increased and more productive communication between archaeologists; and to allow improved access to the results of archaeological research by the development of on-line publication, and the creation of electronic links between researchers and computerised databases, whether these be excavation records, sites and

monuments records, or museum, heritage and conservation resources.

In addition, the intention is to improve access to such resources and information by non-specialists, through the construction of user-friendly interfaces to the data in order to enhance leisure-based experiences, and through the development of more formal educational packages for both children and adult learners.

The decentralised and co-operative structure of the Web (a network of networks) contrasts with the centralised and often hierarchical structure of professional archaeology, and in seeking these improvements in communication, we are aware that we tread a potentially difficult middle path. We do not wish to exercise any central control over sources of archaeological information, nor their content; but we would like to encourage specialists to provide more open access to their material by assisting with the construction of links from such resources to the European Archaeological Heritage Web.

We also wish to encourage the use of such a central distribution point by thousands of potential users, many of them currently unfamiliar with modern information technology, or navigation procedures on the World Wide Web, by constructing attractive and easily negotiable pathways to the information available.

We thus see the role of the European Archaeological Heritage Web as a facilitator for communication between archaeologists and heritage professionals, the archaeological data which they generate, and the wider community of Europe.

An informal glossary

FTP	File Transfer Protocol, a set of rules that all software used to transport files over the Internet should adhere to.
Gopher	The predecessor of today's Internet browsers, this software allowed full browsing of the Internet but had no hypermedia capability. Gophers, being burrowing animals, represented the software's role of digging for information, besides punning on the word 'gofer' and on the fact that this animal symbolises the state of Minnesota, the home of the software developers.
HTML	HyperText Mark-up Language, the protocol for writing hypermedia documents.
HTTP	HyperText Transfer Protocol
Hypermedia	Software that accesses multimedia information through hypertext links in the documents themselves.

Hypertext	Text that contains 'active sites' — words or images — which, when clicked upon with the mouse, link the user to a new document. The actual process by which such documents, which may be located anywhere on the Internet, are accessed is hidden from the user.
Internet	The network of networks consisting of computers linked all over the world. Also known as the Web. Originally grown from the US Defence ArpaNet, it now consists of many publicly and some privately owned networks in most of the world's countries. It has no 'centre' and no hierarchy.
Multimedia	Software that allows presentation of more than one type of medium. Commonly taken to include at a minimum text and images, this may also include sound, movies, and interactive access to various services.
TCP/IP	Transfer Control Protocol / Internet Protocol, a set of rules to govern the movement of data over the Internet.
Telnet	Software that gives users login access to remote computers. A common application of Telnet is accessing library catalogues.
URL	Universal Resource Locator, the protocol for defining both the document type (plain text, image, hypertext), the location (server name, path and filename) and the server type (FTP, gopher, http, file, news) for a resource.
WAIS	Wide Area Information Server. Searches the indexed contents of Internet documents.
WWW	World Wide Web, a protocol developed at CERN to access the Internet.
WWW browser	Any of a range of programs that provides a hypermedia interface to the Internet (e.g. Lynx, Mosaic, Netscape).

Acknowledgements

We would like to express our gratitude to the following people, who have kindly helped us in assessing European

archaeology connectivity and resources: Kai Jakobs, Zoran Stančič, and Joachim Rehm. Thanks are also due to the British Academy and CAA, who provided funding toward the CAA95 conference for one of us (Van Leusen).

notes

1 As this paper is published in traditional manner in the CAA proceedings, and will not be available until April 1996, most if not all of our description of the current state of Internet resources for archaeology will be out of date by then. We feel that this will not affect the thrust of the paper, and may add a note of historic interest to it.

2 The World Wide Web protocol allows for the transmission of large data sets of multiple media which include images, text, sound, and video in a seamless presentation. Hypermedia presentations, constructed using the HyperText Mark-up Language (HTML), also allow for the construction of collaborative data sets using interactive forms for data input and querying.

3 <http://spirit.lib.uconn.edu/ArchNet>

4 <http://spirit.lib.uconn.edu/ArchNet/Regions/Europe.html>

5 <http://www.bham.ac.uk/BUFAU/Projects/EAW/>

6 <http://avebury.arch.soton.ac.uk/index/>

7 http://www.crs4.it/HTML/RUGGIERO/MUSEO/mus_ind.html

8 <http://www.culture.fr/gvpda.html>

9 http://prehist.leidenuniv.nl/archweb_nl.html

10 <http://www.free.net/Docs/cyrillic/notes.en.html>

11 <http://avebury.arch.soton.ac.uk/Journal/journal.html>

12 [gopher://info.utas.edu.au/70/11/Publications/Electronic%20Antiquity%20%3A%20Communicating%20The%20Classics](http://info.utas.edu.au/70/11/Publications/Electronic%20Antiquity%20%3A%20Communicating%20The%20Classics)

13 <http://cogsci.ecs.soton.ac.uk/~hamad/>

14 <http://avebury.arch.soton.ac.uk/LocalStuff/Stonehenge/salisburymap.html>

15 <http://jefferson.village.virginia.edu/pompeii/page-1.html>

16 <http://www.kidlink.org/>

references

- Champion, S.T. 1995 Guide to Internet Resources for Archaeologists, *British Archaeology Yearbook 1994-1995*. York: Council for British Archaeology.
- Council of Europe 1992 *European Convention on the Protection of the Archaeological Heritage* (revised). Explanatory report, 3rd European Conference of Ministers responsible for the cultural heritage, Malta, 16-7 January 1992.
- Hansen, H.J. 1993 European Archaeological databases: problems and prospects. In: J. Andresen/T. Madsen/I. Scollar (eds), *Computing the Past, Computer Applications and Quatitative Methods CAA92*, 229-237, Aarhus: Aarhus University Press.
- Harnad, S. 1990 Scholarly Skywriting and the Prepublication Continuum of Scientific Inquiry, *Psychological Science* 1, 342-343. Reprinted in *Current Contents* 45, 9-13 (November 11, 1991).
- 1995 The PostGutenberg Galaxy: how to get there from here, *Times Higher Education Supplement* 12.5.95.
- Holledge, S. 1994 *Archaeology on the Net: an Internet resource list*. Cambridge: Wessex International Archaeology.
- Jakobs, H.
H. Kleefeld 1995 Multimedia Communication in Archaeology — Why and How. In: J. Huggett/N. Ryan (eds), *Computer Applications and Quantitative Methods in Archaeology CAA94*, 43-45, BAR International Series 600, Oxford: Tempus Reparatum.
- Lutins, A.H. 1994 *Network Resources of Interest to Anthropologists*. URL: <http://lucy.ukc.ac.uk/afaq.html>.
- Plunkett, T.
J. Lizée 1995 ArchNet and Archaeological Cyberspace, *Cultural Resource Management* 18 (3): 5-7. US Department of the Interior/National Park Service.
- Stott, P. 1994 *Internet Resources for Heritage Conservation, Historic Preservation, and Archaeology*. URL: http://hpb1.hwc.ca:10002/Internet_Resource_Guide.html.

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