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Digging into data: Open Access and Open Data

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Since its foundation in 1995, the e-journal *Internet Archaeology* has been exploring imaginative and novel methods of publishing online, but also of providing seamless access to underlying data archives. All its content is archived by the UK's Archaeology Data Service (ADS), and articles and data are all freely available. This paper will discuss exemplars of integrated publications and archives, ranging from the award-winning LEAP (Linked E-Archives and Publications) project, to the more recent development of data papers. It provides some ground-breaking examples of new forms of archaeological dissemination and demonstrates the transformative impact of *Internet Archaeology* on the publication of archaeological research.

Keywords: e-publishing, e-journals, Open Access, Open Data, data papers

La rivista Internet Archaeology, fin dalla sua fondazione nel 1995, si occupa di esplorare nuovi metodi di pubblicazione online, fornendo inoltre ininterrotto accesso agli archivi di dati alla base delle ricerche. I contenuti sono archiviati presso l'Archaeology Data Service (ADS) in Inghilterra, e gli articoli e i dati sono liberamente fruibili. Questo articolo discute esempi di integrazione tra pubblicazioni e archivi, a partire dal progetto LEAP (Linked E-Archives and Publications), fino ai più recenti sviluppi. Fornisce inoltre innovativi esempi di diffusione dei dati archeologici e dimostra l'impatto notevole che Internet Archaeology ha avuto sulle modalità di pubblicazione delle ricerche.

Parole chiave: e-publishing, e-journals, Open Access, Open Data, data papers

1. Introduction

Archaeological research depends upon the interpretation of patterning observed in incomplete and ambiguous data. If our confidence in an interpretation is to depend upon more than the reputation of its proponent, it is essential that we are able to access the primary data upon which the interpretation rests, and are able to test the relationship be-

tween theory and observation. Since the origin of the discipline, therefore, there has been an acknowledgement that any publication of primary fieldwork must be supported by a structured archive and, given that archaeological research often involves the destruction of primary evidence, there is a professional ethical principle which demands both publication, and the deposition of an archive which can be used to test and refine published interpretations (Richards 2008).

The advent of the Internet as a means of online dissemination of both publications and data has greatly facilitated these primary objectives. Electronic publication overcomes the constraints of space that limit traditional publication, allowing access to full archive and specialist reports, as well as unlimited numbers of images, in full colour if required. It also gives more versatility than the printed word, allowing presentation of the rich variety of media that increasingly comprise the record of archaeological fieldwork, including spreadsheets and databases, CAD and GIS, and sound and video. Indeed, archaeology and the cultural heritage disciplines provide an ideal test-bed for such explorations. The use of ICT is relatively advanced and there is a richer variety of data formats, than in almost any other discipline. Furthermore, data usually exist in such quantities that printing is prohibitively expensive and only a subset can be published (Richards 2006).

For the majority of publishers, however, the move towards electronic publication has simply meant a shift to an electronic means of dissemination, and most e-journals are simply the PDF equivalent of the traditional printed journal article. Many archaeological publishers have been driven by spiraling printing and distribution costs, as well as the demand from libraries to cut down shelving costs and to meet expectations of users for instant access to articles from their desktops. They have followed cross-discipline trends and embraced simultaneous publication of online editions, and many now encourage electronic-only subscriptions. A few archaeological publishers are beginning to experiment with online-only journals, such as Maney's *Science and Technology of Archaeological Research*. Some, such as *Antiquity*, or the *Journal of Archaeological Science* have also responded to the demand from authors to provide longer articles, or to give access to some of the underpinning data, by providing the facility to publish supplementary materials, usually on the publisher's web site, but occasionally in a secure data archive. Nonetheless, this is generally limited to a few spreadsheets or some images, and it is rarely linked to the text in any integrated way. One of the key driving forces towards electronic publication, however, has come from the Open Access movement and has been led not by the desire to change the publication format but rather the campaign to change the publishing business model (e.g. Suber 2013 and links at <http://bit.ly/suber-oa-writings>).

2. Open Access

For the more radical proponents of electronic communication, such as Stevan Harnad, the move by traditional publishers to disseminate their journals as PDFs but to continue to charge subscriptions did not go far enough. They asked why the *status quo* in paper journals should simply duplicate itself in the new medium (Harnad, Hemus 1997; Harnad 2001). They saw self-publishing (sometimes called self-archiving) through the Internet as “a means of returning the responsibility of ownership and distribution of scholarship to its creators” (Day 1999).

One of Harnad’s basic assumptions was that when scholars and scientists publish in peer-reviewed journals they are not primarily interested in monetary reward – which would, in any case, be unlikely – but in having their work read, used, and referenced (Harnad, Hemus 1997). In the “Gutenberg era”, authors had to maintain what Harnad called a “Faustian bargain” with commercial publishers, whereby they handed over their copyright in return for having their research published (Harnad, Hey 1995). Harnad argued that this made sense when publishing remained an exclusive and expensive domain, but that it had no relevance in the electronic era when scholars can publish their own papers at little or no personal cost. He argued that authors should make the texts of their papers freely available on the Internet and that readers would then access the free electronic version of a paper rather than a more expensive paper version published much later (Harnad, Hey 1995, pp. 114-115). One of the first exemplars of the “subversive-proposal” in action was the “e-print archive” for high-energy physics set up by Paul Ginsparg at the Los Alamos National Laboratory in 1991 (Ginsparg 1994). It very quickly became the primary means of scholarly communication in its subject area and has since expanded to cover the whole of physics, mathematics and computer science.

As institutions – often driven by the Research Excellent Framework (REF) in the UK – have sought to promote the research undertaken by their own scientists and researchers, and to increase its impact, many have developed their own institutional e-print repositories, creating a fragmented hybrid publication landscape, split between discipline-based data centres, generic institutional e-repositories, and traditional publishers. The suggestion that e-prints should be made freely available prior to formal publication has evolved into what is now often referred to as “Green” open access (OA), whereby authors publish in any journal and then self-archive their pre-publication text in their institutional repository or on some other open access website. By contrast, “Gold” open access is provided by authors publishing in an open access journal that provides

immediate OA to all of its articles on the publisher's website (Harnad 2005; Suber 2008). In order to be free at the point of use these journals are generally funded by subventions drawn from authors, and ultimately research funding bodies, known as Author Processing Fees (or Author Processing Charges – APCs; Solomon, Björk 2012). In addition, in this transitional era, there are also what are known as “hybrid” open access journals which provide Gold OA only for those individual articles for which their authors (or their author's institution or funder) pay an OA publishing fee (Prosser 2003).

In 2012 the report from the National Working Group on Expanding Access to Published Research Findings (the “Finch Group”) was published (Finch 2012). The report recognised the need for different channels to communicate research results, but recommended support for the “gold” route, in particular. UK Research Councils have used the findings of the group to further develop their own policies and the four UK HE funding bodies have introduced a new policy for open access in relation to research assessments after the 2014 REF. The policy states that, to be eligible for submission to the post-2014 REF, authors' final peer-reviewed manuscripts must have been deposited in an institutional or subject repository on acceptance for publication (HEFCE 2014). Deposited material should be discoverable, and free to read and download, for anyone with an Internet connection. The requirement currently applies only to journal articles and conference proceedings with an International Standard Serial Number, however, and not to monographs (but see Crossick 2015).

The concept of Open Access publication has gained considerable momentum in archaeology, but concern has also been expressed for the future of learned societies and their journals (see Darley *et al.* 2014). Publication still carries a cost, even if it can continue to depend on the goodwill of editors and reviewers, or their employers, who are willing to contribute their time for free. The publication infrastructure, whether it is a traditional journal, an e-journal, or an e-print repository, still costs money to staff and maintain. The Open Archiving movement simply transfers the cost from the publisher onto the university libraries that maintain the repositories.

3. Open Data

Within archaeology the debate on openness has typically focused on “open access” publication, and has been particularly focused on its impacts on the “traditional” outputs of research and grey literature (Lake

2012). Yet, as the benefits of openness within archaeological publication have been recognised, its expansion to the structured data produced during archaeological research and fieldwork seems logical. The development of so-called “open data” has, and will continue to have a significant impact on the development of the profession.

For many Open Data is often equated with Linked Open Data and attempts to develop a linked data cloud of open data sets, in which key concepts are each linked to other online sources, in fulfilment of Berners Lee’s original vision of a semantic web of machine-readable data (Binding 2010; Tudhope *et al.* 2011a; Tudhope *et al.* 2011b). However, this paper is concerned with providing access to data more broadly. In fact the concept of Open Access to scientific data is not a new one, and long pre-dates the Internet. Indeed, it was first institutionally established in preparation for the International Geophysical Year of 1957-8. The International Council of Scientific Unions established several World Data Centres to minimize the risk of data loss and to maximize data accessibility, further recommending in 1955 that data be made available in machine-readable form. In 2004, the OECD (Organisation for Economic Co-operation and Development) Science Ministers ruled that all publicly funded archive data should be made publicly available.

The European Commission (2012) has outlined a “digital agenda for Europe” which seeks to promote open data for publicly-funded research. Similarly the UK Government has advocated “a culture of openness” which contends that “access to data is fundamental if researchers are to reproduce and thereby verify results that are reported in the literature” (House of Commons Science and Technology Committee 2011). Endorsing the findings of the Finch report (2012), the UK Government has promoted greater accessibility for research data and grey literature through subject and institutional repositories (House of Commons, Department for Business Innovation and Skills 2012, p. 4). The Government’s Open Data White Paper: “sets out clearly how the UK will continue to unlock and seize the benefits of data sharing” by enhancing access to data and safeguarding it from potential misuse (Cabinet Office 2012). In the light of these developments research councils, funding agencies and higher education institutions have outlined commitments to open data (Research Councils UK 2013). The implications of these statements are currently being worked out through the policies and procedures of individual councils, with the Engineering and Physical Sciences Research Council (EPSRC) taking one of the strongest positions to date, namely that research organisations are expected to publish online appropriately structured metadata describing the research data they hold, normally within 12 months of the data being generated, and

for the data themselves to be made available without restriction for a minimum of 10 years. Although no additional funding has been made available to support data archives or institutional repositories, research organisations in receipt of EPSRC funding are expected to have a roadmap in place for compliance with the EPSRC policy framework on research data by May 2015.

The Arts and Humanities Research Council (AHRC) – the funding body which funds most university-based archaeological research in the UK – has adopted a similar, but slightly more conservative position. Under AHRC rules publications “should be made available as rapidly and effectively as possible via deposit in an appropriate repository at or around the time of publication”, and “electronic resources must remain accessible for a minimum of three years after the end of the award”. For archaeological research the AHRC specifies that the ADS must be consulted within three months of the start of the proposed research and data must be offered for deposit within three months of project completion (AHRC 2014).

English Heritage, the lead state agency for heritage protection in England has adopted a robust position to make sure that the digital outputs from the work it funds are adequately archived. Under their funding guidance: “it is a contractual requirement for projects funded through the National Heritage Protection Programme that digital archives be deposited with the Archaeology Data Service (ADS, <http://archaeology-dataservice.ac.uk/>) or similar digital archiving organisations acceptable to English Heritage” and furthermore that: “all projects creating primary digital data must archive that data” (English Heritage 2014).

The international Open Data Movement has recently received two further boosts. On 13 June 2013 the European Parliament ratified new rules on Open Data, and specifically included cultural heritage data held by public archives museums and galleries. Less than a week later, on 18 June 2013, the Open Data Charter was unveiled at the G8 Summit at Loch Erne, in Northern Ireland. It recognises “a new era in which people can use open data to generate insights, ideas, and services to create a better world for all” (Cabinet Office 2013). The G8 Charter establishes 5 principles: (1) that data should be open by default; (2) that steps should be taken to increase the quality, quantity and reuse of data that is released; (3) that it should be usable by all; (4) that releasing data should improve governance; and (5) that releasing data should increase innovation.

As a profession archaeologists have sometimes been reluctant to share their primary research data with others. For some this is attributed to the technical barriers associated with providing access to data

(Condrón *et al.* 1999; Kansa, Whitcher Kansa 2013) or more practical restrictions on the dissemination of data imposed by publishers or data providers. Yet by far the greatest hurdle to overcome is conceptual; while Pratt has observed that “archaeologists are eager to find ways to publish these data sets” (2013, p. 101), some remain unconvinced about the benefits that open data promotes. Others may be reluctant to expose perceived deficiencies in primary data recording to the critical scrutiny of their peers, or may believe that there is a risk that their data will be published by others before they have the opportunity to do it themselves. An awareness of the academic, symbolic and economic “capital” of archaeological data streams has hindered the sharing of data (Porter 2013); whilst potential misuse and misappropriation of data have always been concerns. For Kansa “the discipline should not continue to tolerate the personal, self-aggrandizing appropriation of cultural heritage that comes with data hoarding”, indeed data withholding “represents a clear threat to preserving the archaeological record” (2012, p. 507).

Such cultural reluctance is not new to archaeology; these issues have not precluded the sharing of data in the past, but have simply constrained the scale of dissemination. Within the current climate with disparate groups and communities conducting related research; where the scale of research and the data produced has increased exponentially, such an approach is unsustainable. Open data offers researchers a mechanism to improve disciplinary interaction and, as a consequence, enhance research. Increased accessibility has the potential to allow others to test the validity of our interpretations; allowing them to examine and reanalyse the original data. As Lake contends, these “approaches to knowledge have the potential to bolster scientific rigour by increasing transparency” (2012, p. 473). At the same time this transparency can serve to illustrate the professionalism of data creators by highlighting good research practice (Kansa 2012).

While increased accessibility and reuse has done much to raise awareness of the intrinsic value of research data, official recognition of its importance has served to encourage data creators to share these outcomes. The UK Government, for example, has stated that: “the work of researchers who expend time and effort adding value to their data, to make it usable by others, should be acknowledged as a valuable part of their role. Research funders and publishers should explore how researchers could be encouraged to add this value” (UK Government 2011).

Despite this change in mind-set the data outputs of archaeological research can still be treated with some diffidence; an incongruent outcome of less significance than the final interpretation or synthesis. Costa *et al.*

propose that in order to overcome this perception, archaeological data needs to be treated as “a more relevant part of the archaeological publication, research, management, curation and policy process, and not merely an afterthought” (Costa *et al.* 2013; Atici *et al.* 2012; Pratt 2013). The solution advocated by many is to treat the dissemination of data as a form of publication; one which should employ established practice found within text-based publishing, including citation and editorial control (Kansa *et al.* 2010; Kansa, Witcher Kansa 2011). This it is believed will instill a sense of familiarity to the process of disseminating and citing digital resources. This movement towards, what is termed “data sharing as publication”, is intended to make the dissemination of data “a more regular and integral part of professional practice” (Atici *et al.* 2012, p. 161).

4. *Internet Archaeology*: digging into data

Internet Archaeology (<http://intarch.ac.uk>) was established in 1995 with initial funding from the Joint Information Systems Committee (JISC) eLib programme (Rusbridge 2001). Its first paper – a searchable visual catalogue of Roman amphorae in Britain by Paul Tyers (1996) – was published in September 1996, just 3 years after the release of Mosaic, the first windows-based web browser, and the Internet itself was in its infancy. *Internet Archaeology* was the first refereed online e-journal in archaeology and has been very successful in gaining international recognition as a high-quality academic journal. The journal has had a transformative effect on scholarly communication in archaeology, and a significant impact on the humanities more broadly.

Reviewing issue one, Costis Dallas (1997) described it as: “an intriguing glimpse of the potential of electronic media for scholarly publication”. The *New Scientist* noted that “for anyone studying or working (or wishing to publish) in the subject, this is an important online resource”. Writing in the *Times Higher Educational Supplement* in November 2000, Professor Steve Mithen described *Internet Archaeology* as “a flagship e-journal ... providing a fine balance between the more creative use of new technologies and traditional publishing formats. The editors of *Internet Archaeology* are making an invaluable contribution to the discipline, one that goes far beyond the provision of their journal alone”.

The journal is published by the Council for British Archaeology but hosted by the University of York, where it sits within the family of online services managed by the UK’s national digital data archive for archaeology, the Archaeology Data Service (ADS). All journal content is archived by the ADS, and the journal is also able to link directly from papers to sup-

plementary archives held by the ADS. Several papers in early volumes of *Internet Archaeology* discussed the potential for changing publication models by providing access to unlimited data as part of the publication strategy for a site (e.g. Hodder 1999; Gaffney, Exon 1999).

Internet Archaeology has gone through several changes in business model as the publication climate has changed. With initial funding from JISC, access was initially free but the journal was encouraged to become self-sustaining, partly, at that stage, to test if an e-journal could survive under a subscription model. Institutional and individual subscriptions were introduced, as well as pay-per-view, whereby readers could purchase access to specific articles (Winters 2000; 2001). However, with the growing momentum of the Open Access movement, *Internet Archaeology* was able to transition back to becoming free at the point of use by levying Author Processing Charges (APCs). As the first step it became a hybrid journal with a mixture of open access papers and closed content and switched to a default CC-BY licence, but in September 2014, it was able to make the final step to becoming a Gold Open Access journal (Winters 2014).

Internet Archaeology is still unique in that it is a multi-media journal available exclusively on the Web; it has no print equivalent. It includes elements that would be impossible in a paper publication, such as searchable database and map interfaces to analyse online; full-colour, interactive multimedia; video footage; virtual reality models and access to related digital archive material. The idea from the outset was that articles would enable readers to drill down into the data, to test interpretations and to put forward rival hypotheses (Heyworth *et al.* 1996; Heyworth *et al.* 1997). Our approach is influenced by the fact that in the electronic era the division between the archive and the publication has become less meaningful, and both need to be seen as part of the publication strategy for an archaeological project (Richards 2004). This has further implications for the archaeological process. The deposition of archives was previously often seen as an afterthought, with boxes dispatched to the museum after the publication had appeared. As a consequence, creating a structured, consistent and accessible archive was rarely given the attention that it warranted and, since archives were rarely consulted, flaws in the archive were infrequently exposed. Furthermore, since access was so difficult, re-use of archives was discouraged, and published interpretations were rarely challenged.

Since its inception *Internet Archaeology* has sought to publish a range of exemplars of publications linked to supporting data sets. One of the first papers to take advantage of this opportunity is a report on field-walking in the Ave Valley in northern Portugal (Millett *et al.* 2000). The

supporting archive (Millett 2001) provides the raw GIS files and the pottery database, allowing readers to assess the interpretation of the pottery scatters made by the fieldwork team for themselves. In the same year I (JDR) republished the traditional journal article on the excavations of the Anglo-Scandinavian site at Cottam as a linked electronic publication (Richards 2001a) and archive (Richards 2001b). A similar model was also adopted by the Silchester project team as an experimental publication for their excavation of Insula IX of the Roman town (Clarke *et al.* 2003). In 2005 the opportunity arose to take these experiments further when the ADS and *Internet Archaeology* were granted £73,196 under the AHRC ICT Strategy programme to undertake the *Making the LEAP* (Linking Electronic Archives and Publications) project (ADS/*Internet Archaeology* 2005). The aim of the project was to provide a series of four exemplars of linked publications in *Internet Archaeology* with archives held by the ADS, covering the projects of Merv, Silchester, Troodos, and Whittlewood (Richards *et al.* 2011). The project attracted much interest and won the British Archaeological Award for 2008 for Best Archaeological Innovation, followed in 2009 by being Highly Commended in The Association of Learned and Professional Society Publishers Awards in the Publishing Innovation category. In order to stimulate similar debate in the United States the Andrew W. Mellon Foundation funded a follow-on project, *LEAP II: A Transatlantic LEAP*, which allowed us to publish a further four exemplars from North American authors (*Internet Archaeology* 2013), in some cases linked to the American-based repository, tDAR, hosted at Arizona State University (e.g. Holmberg 2010). LEAP II also included an online mechanism to facilitate comment and debate.

A more open archaeology and the dissemination of increasing quantities of data necessitates the development of new techniques and tools to deal with the proper referencing and citation of digital resources; indeed without this there is a very real possibility of becoming “lost in information” (Huggett 2012). At the same time a common concern amongst data creators is the lack of accreditation for data. Both concerns could be addressed through improved citation. Traditionally digital resources have utilised the URL to reference digital resources, however, the durability of this method of citation has begun to be questioned (Jeffrey 2012). A number of schemes have attempted to address this issue; one of these is the DOI system which “allows collections of data or individual data files to be allocated a URL that will not change irrespective of changes to the physical location of the files in question” (Jeffrey 2012, p. 564). The “minting” and subsequent management of DOI’s is handled by a conglomerate of organisations, working as part of the Inter-

national DOI Foundation, who guarantee the sustainability of the citation system (www.datacite.org). As an adopter of the DOI system the ADS creates persistent identifiers that consistently and accurately reference digital objects and collections. This serves to address one of the principal concerns of the PUNS report (Jones *et al.* 2001) by formalising associations between digital resources and printed outputs. An important outcome of the DOI system is that it also allows citations to be tracked, meaning that data creators, users and repositories can track the use and impact of specific data sets or publications (Hole 2012).

In 2013 *Internet Archaeology* introduced another publication model to encourage researchers to provide access to their data sets: the data paper (Internet Archaeology 2014). The concept of the data paper was developed in the physical sciences, and first extended to archaeology via the *Journal of Open Archaeological Data*, established at University College London under the auspices of Ubiquity Press. A data paper is generally a short paper which simply describes and summarises a research data set, and which outlines how it might be re-used. It is generally a condition of publication that the dataset must have been deposited in an archive and have been allocated a Digital Object Identifier. Thus, for example, a paper by Bevan and Conolly on the Antikythera survey project (2012) references a dataset held by the ADS (2014). *Internet Archaeology* has developed the concept of the data paper further, adding a published review of the dataset, by a named external reviewer (e.g. Williams *et al.* 2014). In conjunction with the ADS, *Internet Archaeology* has also introduced an annual digital data re-use award, to encourage archaeologists to undertake their research in the digital archive, rather than expensively destroying more primary data in the field or laboratory (ADS 2014).

In conclusion, the Internet allows us to move away from traditional publication models and facilitates greater and more flexible access to a whole variety of supporting data. This has the potential to transform the way in which archaeology is done, but it demands new ways of thinking about publication and archiving. *Internet Archaeology* and the Archaeology Data Service have embraced the Open Access and Open Data movements. By working together we are uniquely placed to explore the interface between journal and archive, and between interpretation and data. This needs archaeologists to think creatively about their dissemination strategies, but should allow us to reach out to new audiences, and to demonstrate that whilst rooted in study of the past our discipline is very much looking to the future.

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