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OPENNESS AND ARCHAEOLOGY'S INFORMATION ECOSYSTEM

ABSTRACT

The rise of the World Wide Web represents one of the most significant transitions in communications since the printing press or even since the origins of writing. To Open Access and Open Data advocates, the Web offers great opportunity for expanding the accessibility, scale, diversity, and quality of archaeological communications. Nevertheless, Open Access and Open Data face steep adoption barriers. Critics wrongfully see Open Access as a threat to peer review. Others see data transparency as naively technocratic, and lacking in an appreciation of archaeology's social and professional incentive structure. However, as argued in this paper, the Open Access and Open Data movements do not gloss over sustainability, quality and professional incentive concerns. Rather, these reform movements offer much needed and trenchant critiques of the Academy's many dysfunctions. These dysfunctions, ranging from the expectations of tenure and review committees to the structure of the academic publishing industry, go largely unknown and unremarked by most archaeologists. At a time of cutting fiscal austerity, Open Access and Open Data offer desperately needed ways to expand research opportunities, reduce costs and expand the equity and effectiveness of archaeological communication.

KEYWORDS

Open Access; Open Data; scholarly communications; data sharing; data preservation; information architectures; ethics; career path

INTRODUCTION

The late 1990s saw wild speculation about how the Internet fundamentally changed the economy, which helped fuel the NASDAQ's unsustainable inflation of dot-com stock prices. Two financial crises later, the global economy is still reeling from tremendous dislocations fueled in large part by technology changes. Academia, in general, and archaeology in particular, are not isolated from these dislocations. Mergers and consolidation of academic presses, changing copyright laws, the rise of electronic journal distribution, and experimentation with social media all help shape contemporary scholarship. Questions about the access, use, and preservation of digital data feature prominently in national research policy debates. Archaeology now sees rapid transformations in its financial, institutional, and information contexts. The discipline faces multiple challenges in managing digital data while public support rapidly erodes through fiscal austerity.

Though changes in archaeology's information landscape impact the discipline globally, this paper has a primary focus on developments in the United States. In the U.S., competing legislation proposals, the Obama administration's "open government" directives, and policy shifts by private and public granting bodies reflect shifting perspectives on the information outputs of research. The U.S. National Science

Foundation's recently introduced "Data Management Plan" requirements underscore the policy significance of digital data. The evolution of Open Context (<http://opencontext.org>), a U.S.-based Open Access digital data publishing system, illustrates some of these transitions in archaeology. While aiming to serve some of the data needs of archaeology, Open Context takes cues from the larger "Open Access" and "Open Data" movements to guide its access and intellectual property policies, technologies, and outlook and orientation toward the public World Wide Web. The author's experiences developing Open Context in these new areas of scholarly communication inform discussions presented in this paper. Other programs such as Digital Antiquity's tDAR service, the Archaeological Data Service (ADS), and many others are progressing in somewhat different directions. Discussion of these different approaches and models will highlight some of the issues explored in this paper.

In the U.S., both the National Science Foundation (NSF) and the National Endowment for the Humanities (NEH) specifically reference Open Context for research data management. These granting agencies now require researchers to describe how they will manage research data. Grant reviewers must review the merit of data handling, dissemination and preservation measures presented in funding proposals¹. These changes represent a major attempt to include "data" in the mainstream professional evaluation of research. While this is a sign of progress, Open Access (free-of-charge Internet distribution of peer-reviewed publications) and Open Data (free-of-charge analytic data, released from standard intellectual property restriction) still largely remain at the margins of archaeological practice. New forms of scholarly communication face steep and well-known adoption barriers. Fortunately, these barriers show growing cracks as current norms of closed access and data withholding research in archaeology become increasingly untenable and new modes of understanding and communicating the past take root.

*Information Wants To Be Free. Information also wants to be expensive.
...That tension will not go away.
-Stewart Brand (1985, according to Wikipedia²)*

WHAT IS OPEN ACCESS?

Peter Suber, one of the leaders of the Open Access movement, defines Open Access literature is "...digital, online, free of charge, and free of most copyright and licensing restrictions."³ In other words, Open Access scholarly literature has no subscription or price barrier to block retrieval. The "Open Access movement" seeks to implement policy changes that lead to the removal of "toll barriers" to scholarly literature. The movement spans many disciplines in the sciences and humanities and involves universities, granting agencies, libraries, non-profit advocacy groups, and prominent scholars seeking to reform scholarly communications.

In his recent book describing Open Access, Suber (2012: Chapter 2) identifies fifteen major motivations for shifting scholarly communications to Open Access models. Costs figure centrally in these motivations for Open Access. Consolidation in academia's commercial publishers has helped fuel dramatic price increases, averaging 7.6% per year for the past two decades and amounting to 302% cost increases between 1985 and 2005 (McGuigan and Russell 2008). Escalating subscription costs maintain consistently high profit margins for publishers— 35% in the case of Elsevier (Mobbio 2011). These price increases hit libraries seeing declining budgets, as higher-education institutions struggle in a climate of

¹ For NSF see: <http://www.nsf.gov/sbe/bcs/arch/senior.jsp> for NEH see:

http://www.neh.gov/files/grants/data_management_plans_2012.pdf

² http://en.wikipedia.org/wiki/Information_wants_to_be_free

³ <http://www.earlham.edu/~peters/fos/overview.htm>

fiscal austerity. Inevitably, academic institutions absorb these costs through tuition hikes, salary cuts, fewer hires, decreased services, and reduced research budgets.

Beyond costs, current publishing norms introduce equity and preservation problems. University-paid researchers write, edit, and review articles without compensation. Once accepted, researchers sign over their copyright to the publisher. Finally, university libraries rent (via temporary licensing agreements) that same content back from the publisher (Smith et al. 2011). Libraries typically do not maintain local copies of e-journals; rather they authenticate institutional users into external repositories controlled by publishers. When libraries stop paying institutional subscriptions, they often lose access to works they previously purchased (Yokoi 2010)⁴. A recent report from Cornell and Columbia libraries estimated that only 15% of e-journal titles see any digital archiving (Rieger and Wolven 2011). Subscription-based electronic journals therefore make it more difficult for libraries to fulfill their preservation missions (Kidd 2010; Kelley 2012), including preservation of the published archaeological record.

The Web's dramatically reduced dissemination costs make Open Access feasible. While sharing information is now very cheap, creating high quality content remains expensive. Most archaeologists have great familiarity with these costs, which at times pose significant challenges to their work: extensive and expensive training; equipment and salaries; access to remote and hazardous locations; insurance, storage and artifact curation costs; and specialized software, to name a few. Following field research, archaeological publication must also be financed. Preparing publications, reviewing papers, editing, and type-setting all have labor costs. Open Access advocates highlight how publishers rely upon largely uncompensated scholars for essential editing and peer review functions. Substantive improvements to publications come through uncompensated co-production and collaboration of authors, editors, and peer reviewers. Only at the copyediting and layout stage do most publishers invest in a publication. While publication has its costs, these costs are a small part of the larger picture, a picture largely financed directly or indirectly through public sources.

Opponents of Open Access claim that it is not sustainable and diminishes the quality of scholarly outputs, particularly with respect to peer-review. This is the picture painted by the Archaeological Institute of America's President, Elizabeth Bartman (2012)⁵. However, she presents a highly distorted picture that ignores a large body of literature including several blue-ribbon reports and peer-review publications highlighting how Open Access does *not* undermine peer-review (see Bailey's 2010a, 2010b bibliography of over 1300 sources; Suber 2012: Chapter 1.2). Worse, Bartman's blanket rejection of Open Access undermines Open Access efforts in other disciplines, especially medicine and public health, where broader access to peer reviewed medical knowledge can quite literally save lives. Instead of undermining quality, Open Access is simply an alternative model for distributing publication, and is fully consistent with traditional practices of peer-review (Davis et al 2010)⁶. The intensely competitive and selective Open Access journal *PloS-Biology* boasts impact factors on par with *Nature* or *Science*, showing that peer-review and prestige can thrive in Open Access settings.

⁴ Smith et al. 2011 note that even if libraries keep their own local copies of content, licensing restrictions, metadata ownership questions, and lack of supporting software make preservation and access of such content difficult and expensive.

⁵ Bartman authored a follow-up editorial as a "clarification" of the AIA's position, see: <http://www.archaeological.org/news/aianews/10349>. This later editorial has a less confrontation tone, though it still communicates a belief that open access is not financially feasible for AIA publications.

⁶ Like all forms of scholarly communication, Open Access is not immune to abuse. Some archaeologists receive email "spam" soliciting articles for Open Access publication paid by hefty processing fees. Other, "closed access" presses make similar solicitations as do organizers of some high-commercialized conferences. As in all publication decisions, archaeologists should be judicious in selecting an Open Access venue.

WHY OPEN ACCESS? EFFICIENCY AND TEXT-MINING OPPORTUNITIES

Open Access advocates believe publication costs should be financed just like other research costs—through public support. Indeed, some leading science funders, particularly the U.S. government’s National Institutes of Health (NIH), have instituted Open Access mandates for grant funded research outcomes. Within a year of publication, NIH-funded research must be accessible via PubMed Central, the NIH’s Open Access repository. The Research Councils UK (RCUK) and the European Research Council (ERC) have similar mandates. The Wellcome Trust, one of the largest private science-funding foundations recently announced Open Access and Open Data (see discussion below) mandates (Jha 2012). Members of the public genuinely seem to seek such access. The major (restricted access) journal repository JSTOR turns away 150 million login attempts every year by people without access seeking to read papers (Madrigal 2012).

Open Access advocates often say that lowering access barriers reduces “friction” and transaction costs associated with obtaining relevant literature. Reduced barriers can mean greater uptake and impact, as measured through citation counts (Eysenbach 2006). Open Access advocates also point to how barrier-free bulk access to literature can be used with new computational methods, especially text mining and Natural Language Processing (NLP) techniques. Valuable information that can fuel new search and discovery services and new analytic capabilities can be extracted from large corpora of scholarly literature. The Archaeology Data Service’s ArchaeoTools Project (Jeffrey et al. 2009; Richards et al 2011) represents a high profile example of text mining and NLP analysis to better discover, use, and manage archaeological grey-literature. Similarly, the Google Ancient Places (GAP) project⁷ uses text-mining techniques to identify ancient places in digitized literature (Isaksen et al. 2012). Researchers can use text-mining for many research goals ranging from enhancing discovery and search of texts, investigating important relationships between concepts and analyzing how language, terminology and research interests evolve. These research programs and many others help illustrate how text-mining can be an important tool in helping to shape understanding of the past.

Most commercial academic publishers specifically prohibit outsiders from text mining their collections, under the theory that such text mining represents a threat to copyright owned by the publisher. For the GAP project, we limited our analysis to public domain books digitized by Google. It is much more difficult for the GAP project to obtain bulk access to in-copyright works from Google, because such a release would present additional legal risks to the project and to Google. Google already faced a high-profile lawsuit from publishers, and settlement negotiations specifically discussed ownership of the information outcomes of text mining. Like Google, many academic publishers control large bodies of texts and often see potential markets in text mining-based services. Publishers resist allowing researcher-led text mining efforts that may compete or undermine services for enhanced search and article summarization they themselves plan to market. Publishers may also want to impose highly restrictive intellectual property constraints on the data outputs from text mining of their corpora. A recent JISC-sponsored (2012) report highlighted these and other barriers to research applications of text mining⁸.

Control over text mining opportunities will directly impact the interpretive possibilities of archaeological literature. Such control raises new stakes in the ongoing question of who owns the past. Much of the literature about ownership of the past (e.g. Hollowell and Nicholas 2008; Nicholas and Bannister 2004) has not looked at the role of academic publishers. These organizations routinely require transfer of copyright from authors, but this transfer of ownership sees surprisingly little comment, even among archaeological ethicists. In essence, academic publishers not only “own the past” (as presented in

⁷ <http://googleancientplaces.wordpress.com/>

⁸ <http://www.jisc.ac.uk/publications/reports/2012/value-and-benefits-of-text-mining.aspx>

copyright-protected scholarship), they own much of the scholarly conversation *about* who owns the past⁹! The past, as constructed through algorithmic processes, seems likely also to fall into the hands of commercial or semi-commercial interests.

OPEN ACCESS AND THE EXPANDING SCOPE OF COPYRIGHT

The legal scope of copyright and the penalties for violating copyright have grown dramatically with the rise of digital technologies. Traditional media organizations, faced with uncontrolled file sharing, have pressured legislative bodies across the world for ever more draconian copyright restrictions and penalties (steep fines and even imprisonment). Since most scholarly works fall under copyright, copyright's growing scope directly impacts scholarship. Recently, Cambridge University Press filed a lawsuit against Georgia State University over alleged copyright violations associated with putting texts on electronic reserve. This case is important because many scholars feel that making course texts available via e-reserves clearly falls under the tradition of "fair-use" that, thus far, exempted educators and researchers from many of copyright's limitations (The Chronicle of Higher Education 2011). Many routine scholarly activities require annotation, commenting, critique and excerpting copyrighted works, activities traditionally allowed as fair use.

Fair use, though part of U.S. copyright law, has an ambiguous legal scope making fair-use justified practices legally risky. Elsevier, the largest academic publisher, lobbied heavily for the Stop Online Piracy Act (SOPA) (see Flood 2012) that caused wide public backlash, including the Wikipedia "going dark" for a day in protest against SOPA. SOPA would have further eroded fair use while expanding copyright's scope and penalties. The changing landscape of copyright risks can provide additional rationale for many universities to adopt Open Access mandates. Open Access mandates, such as those now in place at Harvard, MIT, University College London, ETH Zürich, and the University of Southampton, require the deposition of scholarly works into an institutional repository for free-of-charge access, a practice called "Green Open Access." Green Open Access contrasts with "Gold Open Access" in that Green model articles are typically originally published in closed, toll-access journals, while Gold model articles are originally published in Open Access journals (Suber 2012: Chapter 1). Proponents of Open Access often feel Green models can see more rapid uptake and participation, since faculty can publish in familiar conventional journals and still freely share their scholarship via institutional repositories. Open Access mandates and the Scholarly Publishing and Academic Resources Coalition (SPARC) copyright transfer addendum help researchers retain certain rights to participate in archiving with institutional repositories. Unfortunately, Taylor & Francis rejected the SPARC copyright addendum to allow institutional archiving of the definitive final version of this particular article.

Some universities use archiving mandates to better highlight and showcase their scholarly outputs. They also attempt to collect author-level metrics on the use of these repositories to help motivate and reward scholarly excellence. Such mandates can also help build, in house, valuable corpora of publications that can be used without legal risk. Because Green Open Access can work with conventional and familiar closed access journals, it is easier to motivate faculty participation and more rapidly build up larger collections of literature available for text-mining and other applications. In other words, Open Access mandates are ways research institutions retain more control over copyright and help mitigate legal risks associated with the flow of intellectual property outside the doors of universities and into the hands of publishers. Ironically, the media industry's continued push to expand the scope of copyright has helped motivate some research institutions to retain more copyright control for themselves through Open Access mandates.

⁹ A search for "ethics copyright archaeology" in Google Scholar quickly snippets of articles about archaeological ethics, but those snippets are publisher copyright assertions.

LOOKING TO THE FUTURE OF OPEN ACCESS

Without much thought or debate, the archaeological community has largely ceded control of its intellectual outputs to publishers. As text mining matures, this lack of foresight may come to haunt the discipline. However, researchers have a growing awareness of Open Access issues. The recent battle over the Research Works Act (RWA) starkly illuminated the divergence between scholarly and publishing interests. This legislation, backed by major academic publishers aimed to prohibit U.S. government granting bodies from requiring Open Access to outcomes of grant funded research. The RWA earned so much ire from scholars that some 8,000 researchers pledged not to contribute, edit, or review in any Elsevier (a leading proponent of the RWA) owned journals (Howard 2012). The large public outcry of the research community, well documented in the *Chronicle of Higher Education*, the *New York Times*, the *Economist*, and other leading news sources, motivated the publishing industry to back down, and the RWA stalled in Congress. The battle over the RWA helped to place Open Access models at the center of public debate. In fact, competing legislation, the Federal Research Public Access Act (FRPAA) is now making its way through the U.S. Congress, despite the opposition of over 80 learned societies and publishers, including Taylor and Francis, the publisher of this particular journal¹⁰. If enacted, FRPAA would require all federal granting programs to mandate Open Access to research outcomes. This would alter dramatically the landscape of archaeological publication in the U.S., opening new research and public engagement opportunities. Cultural Resource Management (CRM) archaeology especially stands to gain, since contract archaeologists, usually lacking academic affiliations, are often locked outside of journal paywalls paid by university libraries. While academic archaeologists lament the creation of CRM gray literature, the flipside is also true. To researchers outside of a paywall, journal publications are like gray literature.

Not all archaeologists are waiting for legislation. Besides participating in Green Open Access (institutional repositories), some archaeologists participate in Gold Open Access with free-of-charge e-journals. Charles Jones, the head librarian of the Institute for the Study of the Ancient World at New York University, lists some 1221 Open Access titles in “ancient studies” as of July 1, 2012¹¹. Not all of these titles are peer-reviewed, but all are oriented toward the scholarly community in archaeology, philology, ancient history, art history, and beyond. Most of these titles seem oriented toward specific regional and chronological subject niches, and none of these Open Access venues rank highly in terms of overall impact factors¹². In that sense, archaeology does not yet have a flagship Open Access journal like *PLoS Biology* or *PLoS Medicine* with impact factors rivaling lead closed access titles. Nevertheless, they all reflect widespread experimentation with Open Access publishing models in archaeology and related disciplines.

OPEN ACCESS AT THE MARGINS OF THE PROFESSION

The above discussion of Open Access largely focused on policy and institutional issues, not on individual motives for adopting Open Access. In looking at individual incentives, context matters greatly. Archaeology in much of the developed world faces tremendous financial pressures. Traditional career paths that lead to positions on university faculties or government heritage ministries are in steep decline. In the U.S., the price of a university education has sky-rocketed while government financial assistance has declined. The impacts are dramatic. Student debt associated with U.S. higher education has increased by

¹⁰ Taylor and Francis, the publisher of this particular journal, opposes FRPAA, see:

<http://www.publishers.org/attachments/docs/library/aap%20-%20dc%20principles%20letter%20frpaa%20senate.pdf>

¹¹ See: <http://ancientworldonline.blogspot.com/2009/10/alphabetical-list-of-open-access.html>

¹² See Thomson Reuters rankings for archaeology: http://www.sciencewatch.com/dr/sci/11/jun12-11_1D/

some 511% in the past ten years (Indiviglio 2011). Rising student debt, combined with declining job prospects and pay (inside and outside the Academy), makes a degree in archaeology an ever riskier gamble.

Archaeology faces the task of understanding and preserving the record of the past with comparatively fewer resources and people than enjoyed in previous decades. To meet this challenge, archaeology needs to enhance its productivity and efficiency. Unfortunately, this means overcoming a disciplinary “brain drain.” Many newly-minted PhDs quickly tire of low pay, low status, and dismal job prospects of adjunct positions and leave the Academy. Nevertheless, these individuals already invested greatly in doctoral training. A loss of such expertise, developed at such expense, diminishes the discipline and has great emotional and community costs. Open Access scholarship can help minimize the emotional damage and human-resource losses caused by archaeology’s poor job market. Many would continue to productively contribute to archaeological scholarship in their spare time if they had access to the resources and channels of scholarly communications.

Fortunately, while some career paths face relative decline, others see expanding opportunities, especially in areas that emphasize technology and data management. Many recent graduates find “Alt-ac” (alternative academic¹³) positions to be desirable, with flexible prospects for advancement both inside and outside of academia. Alt-ac hires play an increasing role in digital humanities, scholarly communications, digital library, and other areas that blend humanities (or social sciences) domain expertise with information technology skills (Scheinfeldt 2011). The work of many Alt-acs often requires great sophistication in data modeling, advanced data analysis techniques (including text mining), and user experience and design skills (Cayless 2011). Expertise and experience in these areas is in high demand both inside and outside of the Academy, leading to more job and grant opportunities, wider collaborative ties, and well-paying consulting engagements.

In these cases, Open Access publishing and participation in Open Data projects can play very pragmatic career advancement roles for technologically-oriented archaeologists on Alt-ac trajectories. Harley et al. (2010) noted how professional incentives and rewards deter many faculty from participating in digital publishing. Faculty often feel wary of committing effort toward digital projects when mainstream publication offers much more clear and certain rewards. In contrast, Alt-acs without permanent faculty positions have less to gain through publication in closed access journals. Instead, they have more incentive to build an online reputation accessible to wider audiences. At the “margins” of professional archaeology, one is more likely to find participation in Open Access (see the excellent discussion by Murray-John 2011). There is also a stronger incentive to publish in multidisciplinary venues that cover topics in the digital humanities, scholarly communications, and data management. In such emerging areas of research, many leading publication venues are Open Access. Elliot and Gillies’ (2009) vision for digital data represents an excellent example of Open Access Alt-Ac contributions to ancient studies.

OPEN DATA

Access and intellectual property concerns around data have evolved differently than texts. “Data” usually refers to content that has some formal and logical structure needed to meet the requirements of software processing. Distinctions between structured versus unstructured data represent more of a continuum or spectrum than a sharp line. Transactional rather than narrative applications set data apart from texts.

Archaeology has long managed data, including electronic formats. For decades, museums, heritage organizations and government offices developed electronic databases of archaeological content, but these

¹³ See Bethany Nowinskie’s definition of “alternative academics” (<http://nowiskie.org/2010/alt-ac/>).

databases primarily served needs inside their home organizations. Individual researchers in archaeology have also prepared electronic databases of survey data, artifact inventories, zooarchaeological observations, etc. While some researchers have long sought to disseminate such data, paper reproduction often proved unwieldy for comprehensive sharing (Schiff 2012). To control printing costs, publishers discouraged researchers from putting too many tables, plans, drawings, and images into print. With increasing use of digital media, this lack of dissemination raises important data preservation concerns. Given the volatility of digital media, these resources face grave preservation threats unless professionally archived. In the 1990s the Archaeology Data Service (ADS) became the first major and successful effort to professionally archive archaeological data, and it continues to lead in this field.

In the 2000s, scholarly-communications researchers focused greater attention on policy requirements for the dissemination of structured data. Using data sources stemming from different research designs, traditions, and sampling strategies poses important interpretive and methodological challenges; however, many see vast research potential in sampling, aggregating, and integrating shared data (for archaeology see Kintigh 2006; Snow et al 2006). Such activities can open new research opportunities for larger scale and analytically rigorous studies.

DEFINING CHARACTERISTICS OF OPEN DATA

Creative Commons, the nonprofit organization that successfully promoted a suite of permissive copyright licenses, launched Science Commons in 2005 to explore the public and research community's needs vis-à-vis research data. Science Commons¹⁴ and the allied Open Knowledge Foundation¹⁵ came to broadly similar conclusions about key requirements for Open Data:

1. *Technical Openness*: Data must be available in widely used, nonproprietary file formats that can work across multiple computing and software platforms.
2. *Legal Openness*: Data must be free of encumbering intellectual property restrictions (copyright or contractual obligations).
3. *Access*: Datasets must be made available freely and, unless there are overriding privacy or security needs, data releases need to be both comprehensive and sufficiently documented to enable reuse.

Both Science Commons and the Open Knowledge Foundation took cues from the Free Software (open source) movement, especially on the question of commercial use. One of the biggest misconceptions of Open Source (or Open Access or Open Data) is that “open” means anti-commercial. In fact, open source software licenses expressly allow commercial uses and applications of source code. Such uses however cannot exclude others, meaning that open source is free for commercial use but such uses cannot monopolistically exclude others from benefiting from the same source-code. Similarly, commercial interests can make non-exclusive, non-monopolistic use of Open Data. For example, commercial services can make use of U.S. mapping and census data, made available as Open Data by the U.S. Government, but these same services do not control access or rights over these same public data. This allows researchers and new commercial entrants to make their own alternate uses of data.

¹⁴ See <http://sciencecommons.org/projects/publishing/open-access-data-protocol/>

¹⁵ See <http://opendefinition.org/okd/>

In U.S. archaeology, both Open Context and tDAR recommend or require use of the most permissive of the Creative Commons licenses, namely the Attribution license (“CC-By”). This license choice conforms to the Open Knowledge Foundation’s requirements for Open Data. The UK-based Archaeology Data Service (ADS) launched well before Open Data’s definition and many of its policies and resources do not meet Open Data’s newer requirements. By default, the ADS imposes terms of use limited to “valid not-for-profit teaching and research purposes.”¹⁶ Such restrictions lie outside the normative definitions of Open Data. However, the ADS is evolving. Some content now archived by the ADS carries Open Data compliant Creative Commons licenses. For example, the Antikythera Survey Project (Bevan and Connolly 2012) archived in the ADS uses a Creative Commons Attribution license.

Licensing and copyright concerns have real implications on the use of archaeological data. Already, Pelagios¹⁷, a JISC-funded effort to apply “Linked Open Data” to integrate multiple archaeological and historical collections directly confronted such licensing concerns. Linked Open Data centers on the use of Web identifiers to link and relate data according to shared concepts. Pelagios makes use of linking relations across several different collections, each with different and sometimes incompatible copyright licensing requirements. Since reconciling these different licenses created great difficulties, the Pelagios team asked participants to release linking metadata as Open Data and into the public domain.

OPEN DATA AND PROFESSIONAL ETHICS

One would be hard-pressed to overstate the ethical and policy case for greater data transparency in archaeology (with a notable exception, detailed below). Now that technologies make Open Data feasible, the discipline should not continue to tolerate the personal, self-aggrandizing appropriation of cultural heritage that comes with data-hoarding. Archeological methods are often destructive and many sites see outside threats from looting and development. At the same time, digital media rapidly decay without active and continual preservation. Thus, data withholding represents a clear threat to preserving the archaeological record. Moreover, withholding key documentation and evidence closes off research opportunities, makes it harder to contest interpretations, and weakens the foundation of archaeological knowledge claims (Champe et al. 1961). Withholding data also represents a tremendous waste of public money. Datasets whose creation may require many thousands or millions of dollars, must be available for open discovery and reuse. After all, why should the public continue to finance research that largely languishes on a researcher’s hard drive, only to go see very limited and highly selective exposure in obscure journals locked behind cost-prohibitive paywalls? Finally, withholding such data also weakens archaeology’s case against the antiquities trade. If archaeologists themselves routinely neglect and withhold irreplaceable contextual data, how can they condemn others for their mistreatment of such information?

Given that academic tenure can mean over \$2 million in salary over the course of a career and its alternative can mean total ejection from the field, archaeologists face high stakes in their work. Failure to incentivize greater data transparency would demonstrate an egregious failure of leadership and utter dysfunction in a discipline supposedly devoted toward building and preserving knowledge of the past. Even so, changing the discipline’s professional norms and ethical expectations will likely take years or even decades. Archaeologists must adjust their own internal evaluations of the costs, benefits, and risks of data sharing. One strategy in influencing this calculus centers on changing ideas about what constitutes good professional practice. Archaeologists rightfully care about their professional reputations. No one wants to earn a reputation for using sloppy field methods, or abusing and exploiting one’s colleagues! Instead, excellence in research methodologies, coupled with excellent collaborative and project

¹⁶ See <http://archaeologydataservice.ac.uk/advice/termsOfUseAndAccess>

¹⁷ See <http://pelagios-project.blogspot.com/>

management skills helps lead to professional rewards. Similarly, good data management and Open Data transparency can provide clear and very public evidence of professionalism and good practice.

Perception of professional benefits also needs to outweigh perceived risks of exploitation by “free-riders” who use shared data without providing adequate credit. Thus, the ethical and social norms relating to the use of Open Data need to co-evolve along with norms for disseminating these data. For these reasons, many Open Data projects in archaeology promote familiar practices of scholarly citation. Open Context, Pleiades, the Archaeology Data Service, tDAR and others provide suggested citations to help ease incorporation of data into established norms of citation and credit.

OPEN DATA AND COMMERCIAL USES

While most archaeologists acknowledge that data hoarding should be discouraged, many scholars worry about potential commercial exploitation of archaeological data (despite the fact that archaeologists routinely participate in academic publishing practices that are arguably highly exploitative and commercialized). Fears of aiding looting, vandalism and commercial abuse present strong motivations to impose legal limits on data allowing only purposes favored by archaeologists, namely noncommercial research and teaching. Unfortunately, such limitations have surprising ambiguities and difficulties, especially with respect to commerce. For example, much archaeology takes place in the commercial sector through cultural resource management contracting. Indeed some commercial firms contribute greatly to archaeology’s open resources. L-P Archaeology, a for-profit consulting firm, has released ARK, a powerful data management tool, as open-source software¹⁸. Non-commercial restrictions may exclude this key and valued constituency. Even in teaching and research settings, it is surprisingly difficult to define “noncommercial” activities. Is teaching a class to students paying tuition really noncommercial? Would developing a free-of-charge online course supported by advertising be any more commercial? Are fee-for-access nonprofit publishers (many scholarly societies) or digital repositories like JSTOR really noncommercial?

Creative Commons itself has had to grapple with these questions with regard to the “non-commercial” restriction in some of its licenses. The non-commercial term has sparked confusion, long lasting Web debates, and a great deal of painstaking explanation and discussion by Creative Commons. Given the ambiguities and difficulties with defining acceptable and non-acceptable forms of non-commercial use, Creative Commons recommends *against* using non-commercial license variants for instructional and research content.

APPROPRIATE USES OF DATA

Creative Commons’ difficulties with the noncommercial licensing term help illustrate some of the challenges inherent in encoding visions of ethics into digital data that flows on public networks. Despite years of effort, privacy-invasive surveillance, lawsuits, legislative lobbying and the “best laws money can buy,” (Samuelson 2004) even the music recording industry has failed to control the flow of digital music. Archaeologists face even dimmer prospects for controlling data once released. In some ways, the simplicity and highly relaxed permissions of Open Data represent an honest recognition of digital data’s mercurial nature. The imposition of complex licensing, access, and permission controls may mainly burden legitimate applications, while illegitimate actors would ignore or bypass such controls. After all, a

¹⁸ See: <http://ark.lparchaeology.com/>

person intent on looting would likely feel little deterrence from violating “click-through” agreements. Any release of data, whether open or not, requires a careful determination that rewards and public benefits will exceed likely risks. Once data are released, it is very difficult to insure that they will be used as one would wish.

While archaeologists may struggle with Open Data’s permissiveness with regard to commercial uses, the ethical issues relating to indigenous claims to the archaeological record are even more problematic. Archaeologists in many parts of the world work in contexts with colonial and even genocidal histories. Indigenous stakeholders in archaeology, many of whom have had difficult histories and conflicts with archaeology, may regard Open Data as a form of cultural appropriation (see Christen 2009). Concepts about the public domain are culturally situated, and while often useful in certain communities, these concepts are not universally applicable (Chander and Sunder 2004; Kansa 2009). While adopting Open Data may be highly ethical in some circumstances, imposing Open Data arbitrarily must be avoided. Navigating these ethical issues, especially when trying to bridge multiple communities with radically different world views and often tragic histories, represents a difficult area for Open Data in archaeology.

Nevertheless, exploring and understanding these issues can help put archaeology and archaeology’s relationship with indigenous communities on a much stronger ethical foundation. Clearly, not all archaeological data should be cast as Open Data. One-size-fits-all solutions will fail. Information systems, including those run for and by indigenous communities, need cultural contextualization (see Kansa 2009; Christen 2009). Open Context addresses this in part by asking contributing researchers to work in collaboration with stakeholder communities, from their project’s inception, to help align data management and dissemination practices to community needs, including needs *not* to publish data in Open Context¹⁹. Experience with cultural property issues, including the challenges associated with implementing the Native American Graves Protection and Repatriation Act (NAGPRA) highlight how understanding community needs and data sensitivities, while absolutely necessary, will never be easy. Stakeholders can be difficult to identify and no community has monolithic or homogenous perspectives. As digital archaeology matures, there will be increasing need for developing processes to identify and resolve conflicts over the disposition of data. The institutional structures and cross-community networks developed by professional societies, particularly ethics committees, will likely need to play a sustained role in archaeological cyberinfrastructure. In advocating for appropriate, as opposed to arbitrary, use of Open Data, we hope to encourage stronger and better ties between archaeologists and all stakeholders. In some ways, this widening of perspectives and consideration of data needs in larger communities represents one of Open Data’s key contributions to archaeological method and theory.

PROMOTING OPEN DATA IN PRACTICE

To reach the point where researcher data can be used by a wider community, datasets must have sufficient quality and documentation. To give context, data also need to be related and linked with shared concepts and with other datasets available on the Web. This requires effort. New skills, professional roles, and scholarly communication channels need to be created to meet the specific requirements of meaningful data sharing. To meet these needs, Open Context is developing a model of “data sharing as publication” with editorial processes and persistent citation, guaranteed by the California Digital Library (CDL), a leading digital repository (Kansa 2010; Kansa and Kansa 2011). By adapting existing workflows and norms of scholarly communication to the dissemination of structured data, we hope to increase professional acceptance of Open Data.

¹⁹ <http://opencontext.org/about/intellectual-property>

Scholars are familiar with editorial workflows that transform manuscripts into completed publications. Researchers submit text files to journal editors, who then circulate manuscripts for review. When a paper is accepted, a researcher works with a journal editor through multiple revisions before the manuscript is ready for publication. Email, versioning, and edit-tracking help coordinate the work.

Similarly, appropriate workflows and technology can facilitate data publishing. Datasets, however, have several important qualities that differ from manuscripts. Datasets can often be quite large and full of complex interrelationships between various tables and multimedia files (images, videos, GIS, etc.). This is especially the case in archaeology where projects can involve large teams, including specialists who create their own datasets. Complex dependencies commonly span various data components of an archaeological project. For example, the datasets of different specialists (zooarchaeology, pottery or lithic analysts) at an excavation typically need to be related through reference to archaeological contexts. Integrating, cleaning, and adequately documenting such large and complex datasets requires a great deal of effort and experience with data.

Data usually needs software mediation for human use to such an extent that data and software share many characteristics, especially in terms of logical structures. Editorial processes for improving data quality many have many of the same requirements as editorial processes for improving software. Specialized data editing tools, such as the open-source Google Refine application can be used in conjunction with software bug-tracking tools to facilitate collaborative editorial work on data. In the case of Open Context, we use such tools to identify, track, and resolve issues, clean data, and create documentation. Contributing researchers and data editors collaborate in the coproduction of higher quality, more intelligible and usable datasets.

Versioning and collaborative editing need not end upon public release. Recently, Open Context further built upon the parallels between data and software and began to deposit datasets into GitHub. GitHub, a popular open source code repository, provides powerful tools for transparent versioning and collaborative “issue tracking” (error detection and correction). GitHub also opens new use possibilities by making it easier to “fork” datasets (copy and modify) in ways that track provenance and provide credit to data creators. This highly experimental use of GitHub helps to illustrate how digital publication can take surprising new forms.

Open Context’s “data sharing as publication” approach can better meet critical professional incentive needs by providing a citable, professionally-edited publication venue backed by a leading digital repository. Nevertheless, publishing high-quality data aligned to standards requires effort and expertise. To distribute this effort, this model can and should be replicated and adapted by other research teams. Just as multiple print journals exist, so can multiple data publishers. Archaeology’s growing data challenges can only be surmounted through collaboration across the widest possible community.

Fortunately, Open Context is not the only effort exploring data publication models. The *Journal of Open Archaeology Data* recently launched in 2011²⁰. This journal has similar aims, but is a for-profit commercial effort. Nevertheless, the *Journal of Open Archaeology Data* is fully open access and has adopted the Creative Commons Attribution License, the most permissive of Creative Commons’ license options. The entry of a commercial journal in this niche is a welcome development, highlighting new possibilities for profitable (and hopefully sustainable) business practices that align with the public interest in open and reusable data.

²⁰ See <http://openarchaeologydata.metajnl.com/>

FINANCING OPEN ARCHAEOLOGY

Financial “sustainability” represents an obvious requirement for archaeology’s digital resources. While a paramount concern, the financial sustainability of “digital archaeology” cannot be divorced from financing the discipline in general. Archaeology, as a scholarly or heritage management practice, is manifestly not financially sustainable. It requires continued public support. Because archaeological knowledge dissemination and preservation are integral aspects of the practice of archeology, information dissemination and preservation should not be held out separately in terms of financing.

Questions about Open Access and Open Data raise issues of how different organizations and interests, including researchers, publishers, professional societies, funders, libraries, and the public interact. Each of these players have an interest in sustainability, and ideally their sustainability strategies should be complementary and not in conflict. Thus, the policy focus for sustainability should look beyond individual projects and organizations. Being too narrowly focused on select projects or organizations can motivate behaviors and orientations that put public interest in a distant second place to the parochial interests of a given organization. The recent battle over the Research Works Act (RWA) illustrates this danger. Some scholarly societies, including the American Anthropological Association and the Archaeological Institute of America actually supported the RWA, despite widespread opposition from researchers, universities, and libraries. These scholarly societies had a difficult time looking beyond the parochial interests of their fee-based publication arms²¹.

Scholarly communications stakeholders need to avoid pitting their interests against each other in RWA-style conflicts. After all, if publication costs and intellectual property barriers continue to escalate unchecked, these costs will be absorbed in ways that damage the profession. Research budgets will continue to fall, more archaeology students will be priced out of education, and professional societies will ultimately lose dues-paying members. Peter Suber (2012: Chapter 7) notes many different financial strategies to sustain Green and Gold Open Access, many of which involve the “redirection” of existing publication financing toward Open Access outcomes. For example, the SCOAP3²² consortium, a collaboration between laboratories, libraries, and funding agencies represents the highest profile attempt to redirect money currently allocated to subscriptions to directly pay for production, editing, and review costs associated with Open Access publications. Archaeological societies such as the Archeological Institute of America and the Society for American Archeology may be able to participate in Open Access publishing through a similar strategy of redirection, perhaps by joining with other scholarly societies, universities, and library groups to coordinate publication and digital archiving arrangements at a cost-effective scale²³.

²¹ See also the AIA and AAA responses to a recent White House “Request for Information” for public access to scholarly publications: the letters from AIA and AAA on the White House RFI (Public Comments submitted to RFI for Public Access to Scholarly Publications):

<http://www.whitehouse.gov/administration/eop/ostp/library/publicaccess>

²² See: <http://scoap3.org/>

²³ The SAA depends less on publication revenues and has lower publication costs, perhaps because it emphasizes serial publications rather than the monograph-heavy AIA. In that sense, the SAA is less heavily tied to the current toll-access *status quo*. The weblog “Doug’s Archaeology” has aggregated financial data for U.S. nonprofit scholarly societies, detailing publication finances; see links: <<http://dougsarchaeology.wordpress.com/2012/09/17/society-for-american-archaeology-990-form/>> , and <<http://dougsarchaeology.wordpress.com/2011/04/12/would-you-pay-4-84-per-page-to-read-a-journal/>>. Experiments with Open Access monographs have yielded mixed results in terms of financial sustainability, despite demonstrated positive impacts in terms of wider dissemination and longer-lasting scholarly attention, see (Hadro 2010). University presses in general face sustainability challenges with monograph publication, even without adopting Open Access models.

In exploring how the discipline can better increase the reach, effectiveness, and equity in its communications, we can help identify current inefficiencies and areas of under-investment. Currently, while fieldwork gets the bulk of direct public support, publication of any form, much less Open Access or Open Data, gets relatively little support²⁴. With the notable exception of Shelby White - Leon Levy Program for Archaeological Publications²⁵ (WLP), there are very few granting agencies that directly support archaeological publication. A recent report (co-authored by this author) noted that WLP grants generally led to completed publications, though often on a much longer time-scale than the actual period of grant funded activities. Thus, allocating financial resources specifically toward publication outcomes does help close the gap between data collection and dissemination efforts. This experience suggests that Open Access and Open Data outcomes can similarly result through dedicated funding. The new “Data Management Plan” requirement in NSF and NEH may help address this issue, since researchers can include costs associated with data publishing and / or archiving into their grant budgets.

In our experience with Open Context, data publishing and archiving with the California Digital Library need not bust the budget of research projects. For example, Open Context recently published data from nearly ten years of excavations at Kenan Tepe, a late Neolithic – Iron Age site in Anatolia (Parker and Cobb 2012). Bradley Parker, the project director, estimated that excavation and documentation required roughly \$800,000 in direct costs. Publication of this very large and complex dataset in Open Context cost between \$10,000 and \$15,000 (mostly labor). Though \$15,000 is a large number for archaeologists, it bought comprehensive dissemination of a large, openly licensed and wholly reusable body of data that would otherwise be lost to the larger community and represents only a few percent of the overall research budget. If we can find ways to finance costly excavations, we should be able to finance better stewardship and dissemination of the results of those excavations.

Archaeology’s digital repositories and data sharing efforts require continued financial support. The costs of using this infrastructure should be factored into ongoing research costs as budget line-items in grants. Researchers should be able to pick and choose which (qualified) digital repository to use that best matches their specific needs, and then spend their grant budgets accordingly. Such choice will encourage continued dynamism. Similarly, publication costs for more “value-added” research outcomes (those with high production values) need to be built into granting budgets. In that way, Open Access venues, including commercial enterprises, can sustainably publish high quality outputs. Paying for dissemination, quality improvement, and archiving services upfront rather than setting up paywalls and intellectual property barriers better aligns financial sustainability means toward public benefit ends (Carroll 2011).

OPEN ARCHITECTURES TO CULTIVATE A DYNAMIC INFORMATION ECOSYSTEM

A digital archive is not an end unto itself. It is a means to an end, even if that end means fostering new forms of digital archives that supersede the old. Such turnover without information loss would be a sure indicator of a healthy dynamism in digital archaeology. New entrants into digital archeology need to be encouraged, since these will bring new perspectives and innovations. Web data skills, familiarity with data curation and preservation requirements, programming, and data visualization, user experience,

²⁴ Elizabeth Bartman’s clarification of her editorial attacking open access (<http://www.archaeological.org/news/aianews/10349>) makes a similar point in that publication expenses rarely see direct support from granting agencies. However, most academic archaeologists do see less direct public support, either through employment at public universities or employment at nonprofit institutions that benefit from public subsidies and tax exemptions.

²⁵ The WLP report will be publically available at: <http://www.fas.harvard.edu/~semitic/wl/>

design, and other information skills need to be much more fully developed in archaeology. With such skills, the next generation of archaeologists will not be passive users of today's cyberinfrastructure, but will pioneer new and better information systems that surpass current capabilities. With such skills, this next generation will also be far better equipped to flourish in a radically transformed job market. Informatics intensive instructional programs, such as the MATRIX lab at Michigan State need to be replicated widely.

“System think and ecosystem think seem to be almost irreconcilable: suck everything in, or turn the inside out and expose all relevant parts.”

Erik Wilde, Web Architect, via *Twitter* (@dret), Jan. 21, 2012

Open archaeology needs go beyond licensing concerns but extend to systems designs and architectures. Some approaches are better than others at inviting wider participation and innovation. Over centralization in monolithic “one repository to rule them all” systems can put too many information eggs in one limiting basket. Rather, we should seek open architectures that “expose all relevant parts” for networking data and services across systems inside and outside of archaeology. In practice, this means orientating systems designs toward the public Web. Although archaeology has some unique informatics challenges, archaeology shares many needs faced by other domains. A Web orientation can help archaeology look and contribute beyond its provincial boundaries and use a host of tools and services (Heath 2010). For example, the website “Open Access Archaeology” aggregates open archaeological literature and data using a custom Google search interface²⁶. Web-oriented systems accommodate interactions not just with human users, but with machine software agents, permitting extensibility. Much of our work with Open Context has focused on Web-centric technical methods to promote such extensibility (Kansa and Bissell 2010; Kansa and Kansa 2011). Similarly, Linked Open Data (see Isaksen et al. 2009) methods have great potential to both promote interoperability and maintain the decentralization needed to welcome innovative new entrants to the ecosystem. Linked Open Data methods emphasize use of Web links to precisely identify shared concepts and common vocabulary terms. With Linked Open Data, different Web-based collections cross-reference each other, making this an inherently collaborative approach to data dissemination and data integration.

Recent experiments in scholarly communications point to ways that open information architectures may promote sustainable and high quality forms of digital publication. Looking to the future, we will likely see continued experimentation in the choreography of loosely-joined, complementary, archaeological information systems. Priem and Hemminger (2012) recently described this kind of publishing model, coining the phrase “the decoupled journal.” They argue that dissemination, archiving, indexing, peer-review, editing and promotional activities can take place across multiple loosely joined component services.

Open Context's place in a data publishing ecology illustrates this principle. Open Context does not need to solve all aspects of digital dissemination and archiving in-house. For example, data preservation and archiving processes are relatively difficult, requiring specialized expertise and infrastructure. Open Context draws upon data preservation and persistent identifier services provided as a service by the California Digital Library, one of the world leaders in data curation. Similarly, Open Context, being oriented toward publishing structured data and rich media, lacks interfaces and processes well-suited for narrative publication. Nevertheless, Open Context can collaborate with the *Journal of Open Archaeological Data* or other authoring venues like *Visible Past*. Authors and editors can use these other platforms to compose and edit narratives to help explain a dataset in Open Context. They may also use

²⁶ See: <http://www.openaccessarchaeology.org/>

these platforms to discuss data in other systems, like tDAR or the ADS. This example helps describe a “loosely coupled” information system, where component sub-systems can evolve independently and can be swapped in or out for other systems with greater ease (Pautasso and Wilde 2009; Matei, Kansa, and Rauh 2010). Tim Berners-Lee and colleagues originally built the Web to facilitate scholarly collaboration. It’s high time we used it for its original purpose.

CONCLUSIONS

Archaeologists work within highly stratified, professional hierarchies that allocate funding, rewards, and prestige. Open Access and Open Data need more champions at the highest levels of archaeology’s professional hierarchy. Such leaders can help set the tone and agenda to motivate changes in tenure and reward processes, grant reviewing, and other areas that allocate rewards. In the U.S., the current President of the Society for American Archaeology, as well as a number of former presidents, actively promotes data professionalism through his activities with Digital Antiquity (the organization managing tDAR).

At the same time, we see a groundswell of more grassroots interest and participation in archaeology on the Web. Innovations in this space are truly distributed, coming from established leaders like the Archaeology Data Service, Perseus, and Arachne, and major new efforts like tDAR. Just as significantly, a host of other initiatives especially Pelagios and its multiple collaborative partners (including Pleiades, Nomisma, and many others), highlight the creative power of decentralized and “bottom-up” innovation.

Many of these projects will come and go, but the growing acceptance of Open Access and Open Data models in archaeology will help ensure that the information contributions of these distributed efforts, because of their openness, can find new homes and applications in other digital systems. Thus, Open Access and Open Data help promote the resilience of archaeology and archaeology’s information resources, despite continued uncertainty in funding. Similarly, the outlooks and orientations of Open Data offer greater hope for the overall resilience of the profession and its practitioners. In the face of a rapidly changing, uncertain, and unfamiliar professional landscape, it looks as though the future of the past is increasingly open.

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