Chapter 8
Ktêma es aiei: Digital Permanence from an Ancient Perspective

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Introduction

The Greek historian Thucydides in the introduction to his work on the Peloponnesian War discussed his motivation for writing as he did:

> καὶ ἐς μὲν ἀκρόασιν ἴσως τὸ μὴ μυθῶδες αὐτῶν ἀτερπέστερον φανεῖται· ὅσοι δὲ βουλήσονται τῶν τε γενομένων τὸ σαφὲς σκοπεῖν καὶ τῶν μελλόντων ποτὲ αὖθις κατὰ τὸ ἀνθρώπινον τοιούτων καὶ παραπλησίων ἔσεσθαι, ὠφέλιμα κρίνειν αὐτὰ ἀρκούντως ἕξει. κτῆμά τε ἐς αἰεὶ μᾶλλον ἢ ἀγώνισμα ἐς τὸ παραχρῆμα ἀκούειν ξύγκειται.
>
> The absence of romance in my history will, I fear, detract somewhat from its interest; but if it be judged useful by those inquirers who desire an exact knowledge of the past as an aid to the interpretation of the future, which in the course of human things must resemble if it does not reflect it, I shall be content. In fine, I have written my work, not as an essay which is to win the applause of the moment, but as a possession for all time (*ktêma es aiei*).[1]

Thucydides' remark implying the permanence of his work is interesting in several ways. First, it is not simple bravado. Statements of the immortality of an author's work (and therefore of the author also) are not uncommon in poetry, and Thucydides is responding in his introduction to a poetic tradition, but this statement is different in its form. Thucydides is talking about the permanence of his history in terms of its design. It is not written as entertainment, but as a document meant to be useful to anyone interested in the conduct of human affairs.[2]

1 Thucydides 1.22, trans. Richard Crawley, *Thucydides' Peloponnesian War* (London, 1903), <http://www.gutenberg.org/dirs/etext04/plpwr10.txt>. (All URLs current at the time of writing.)

2 See W. Robert Connor, *Thucydides* (Princeton, 1984), pp. 20–32 on the 'Archaeology'. See also his introduction for a discussion of Thucydides' relevance to international affairs during the Cold War.

Second, it is evidently accurate. Thucydides set the standard for historical writing and is a central text both for Greek history and for historiography in general. So how do works like this survive, and can we derive any lessons from that survival that will help with the preservation and sustainability problems we face today?

Understanding new technologies takes time. Typically, we progress in gradual stages of understanding, beginning with a metaphorical stage, in which we compare new processes to others that we already understand and ending with a thorough knowledge of the technology in itself. We know in some detail how certain works have survived from ancient times to the present day, having crossed cultural and political boundaries in both space and time, and outlasted not only the cultures that created them, but also many of the societies that passed them on. It seems reasonable then to wonder whether there are examples we can apply to digital sustainability to help us begin to understand how digital works might be preserved indefinitely.

The sustainability and permanence of electronic materials are issues much on the mind of anyone concerned with the preservation of cultural heritage in the digital age. Many granting agencies emphasize sustainability as an important component of successful applications for funding to develop new online resources.[3] The typical response to this on the part of grant applicants is to include some sort of institutional affirmation that materials created in any given project will be preserved by the institution in question. While it is laudable that these concerns for digital materials are considered important, it must be noted that no real solutions to the problem are reflected in this requirement. I hope to shed some light on how solutions, or at least strategies, might be developed by considering how certain cultural heritage materials from the ancient world have survived to the present day.

Clearly, there are important differences in both the physical nature and the modes of transmission of digital and physical objects, but it is my contention that some of the same general rules apply to both, and that an examination of the transmission or survival of truly ancient materials may provide some implementable ideas for the design of digital materials which are intended to be permanent.[4] As a basis for discussion, I will focus principally on three examples of surviving material from the ancient Mediterranean world, the works of Vergil, Sappho and the *Res Gestae Divi Augusti*, all of which have survived to the present day for different reasons.

There are four principal ways in which an artefact or text can survive for such a long period of time:

3 See Kevin Guthrie, Rebecca Griffiths and Nancy Maron, *Sustainability and Revenue Models for Online Academic Resource* (Ithaka, 2008), <http://www.ithaka.org/publications/sustainability> for a discussion of the importance of sustainability.

4 See James M. O'Toole, 'On the Idea of Permanence', *American Archivist*, 52 (Winter 1989) for a discussion of the idea of permanence in archives – as near forever as possible.

1. Accident: the artefact or text survives because of a fortunate (or sometimes unfortunate) chain of events.
2. Reuse: i.e. incorporation into some other entity that itself survives.
3. Republication or replication: i.e. the copying and/or re-edition of the text or artefact.
4. Durability: i.e. construction from or inscription upon some material which was capable of surviving for millennia.

The first of these does not lend itself to any sort of planning, since accidents are by definition unpredictable. Though it may be possible to minimize the chances of destruction by accident, there really is no way to maximize the chances of accidental survival. Survival by reuse may easily be argued to be a type of accident, but as we will see, there are design strategies which limit or prevent the possibility of reuse. I have chosen to mention both replication and republication because, while both imply the copying of the content of a resource, that copying may involve a degree of alteration that serves the purposes of the editor, producing an essentially new work. Finally, durability may seem to offer the best hope of the four, but it is also the hardest to attain, and is not a guarantee, some degree of fortune still being necessary.

Vergil

Vergil was widely regarded as the preeminent poet of his day. Even before it was published, posthumously, his *Aeneid* was proclaimed by his fellow poet, Propertius, to be greater than the *Iliad* of Homer. Vergil instantly became part of the Latin canon, and knowledge of his poetry would have been a necessary prerequisite to be seen as culturally literate at all periods of the Roman Empire. Indeed, his works came to be regarded as a repository for all religious knowledge and were interpreted as religious allegory by his commentators.[5] Vergil was a central component of the Roman educational curriculum and students would be expected to memorize passages from his works. His importance was not seriously diminished after the rise of Christianity, both because of his works' centrality to Roman culture and because he was regarded as a sort of 'proto-Christian'.[6] The sheer quality and great appeal of his poetry must also be acknowledged, and Christians might well be drawn to it despite the fact that its author was a pagan.

5 Servius's (a late fourth/early fifth century grammarian) commentary on the *Aeneid* is a gold mine of information on Roman religion and ritual because of this (see <http://www.perseus.tufts.edu//.jsp?=Perseus:text:1999.02.0053>).

6 In Vergil's fourth *Eclogue*, the birth of a miraculous child is foretold (see <http://www.perseus.tufts.edu//.jsp?=Perseus:text:1999.02.0056:poem=4>). Many Christians naturally (but mistakenly) assumed this was a prophecy of the birth of Jesus.

Naturally enough, then, there were many copies of Vergil's poems in circulation for the whole of their existence. Indeed, Vergil is the best-attested Latin author, except possibly for Terence, the comic playwright (with over six hundred surviving manuscripts).[7] We must take careful note, however, of what is meant by 'survival' in this context. The earliest complete manuscripts of Vergil's poems date from the fourth and fifth centuries CE, some four hundred years after the poet's death in 19 BCE.[8] Thus, even the earliest manuscript available is itself the product of a chain of copies of indeterminate length. This copying too, was not a mechanical process. It was done by hand, and therefore subject to human error. Even with a text like Vergil's, in relation to which, for religious and cultural reasons, there would be pressure to make the copy as exact as possible (in the early centuries of its existence at least), variants would creep in over time. Indeed, since we do not know the precise details of how the initial publication proceeded, there might have been variant versions in existence from the beginning.[9]

The popularity of Vergil's works led to their continual adaptation and reuse over the centuries. The text was put to a number of different uses both in the original and in translation. Over time, the texts acquired both a cluster of attendant works around them and also an accretion of commentary and other types of annotation that would frequently accompany an individual text when it was copied. The Vergil available to a medieval or Renaissance scholar therefore looked very different from the Vergil we find in a modern text. The history of Vergilian transmission is well understood enough that it is possible to identify different interpretive strands in that history.[10]

Sappho

Sappho's situation is very different from that of Vergil. She wrote enough lyric poetry that Alexandrian scholars compiled those poems into nine books, the first

7 Ronald H. Martin (ed.), Terence, *Adelphoe* (Cambridge, 1976), p. 41.

8 R.A.B. Mynors, *P. Vergili Maronis Opera* (Oxford, 1969), p. v. The Greek Bible is the only text with a better manuscript tradition.

9 *The Amores* of Ovid begins with an epigram which notes that the current publication, containing three books of poems, supercedes a previous one that contained five. Ovid appears to have been successful in replacing his first publication of the book, but other authors were less so. Galen (K xix, 8–11) complains about spurious or inaccurate texts circulated under his name that he has frequently been asked to correct. See also L.D. Reynolds and N.G. Wilson, *Scribes and Scholars: A Guide to the Transmission of Greek and Latin Literature* (Oxford, 1968), 23.

10 Christopher Baswell, *Virgil in Medieval England* (Cambridge, 1995) notes three different streams of Vergilian interpretation in Medieval England, see also Colin Burrow, 'Virgils, from Dante to Milton', in Charles Martindale (ed.), *The Cambridge Companion to Virgil* (Cambridge, 1997).

1,320 lines long.[11] Her poetry enjoyed a reputation in antiquity as the height of poetic craft, but her work survives today only in fragments, some recovered from papyrus and others quoted by later authors. The point about cultural adoption and reuse is particularly telling for Sappho in our own culture. She is once again a beloved, and much-read, poet because her work (what remains of it) resonates so well with our own sensibilities. This clearly was not the case in later antiquity, however, as Sappho ceased to be copied at some point. There are papyrus fragments containing her poems from the seventh-century CE, but no surviving manuscripts.[12]

In Vergil's day, she was clearly still very popular. Vergil's contemporary, Catullus, published a free translation of one of her poems (Fragment 31) into Latin, and Horace employs meters used by Sappho in many of his poems. But her texts were not a part of the standard curriculum, as Vergil's were, and this probably accounts for their disappearance. What does survive comes largely via quotation. Fragment 31, for example, is quoted by Longinus (10.2), in his treatise on the 'high', or grand, style in literature, περὶ ὕψους.[13] Sappho's poem is quoted as a supreme example of skill in representing the emotions felt by a lover observing her beloved. Longinus' text itself only survived through a single tenth-century manuscript and did not become popular again until the eighteenth century. The poem is still available to us because an obscure literary critic found it a useful illustration of a method that makes for high style in poetry.

The *Res Gestae*

The Roman historian Suetonius notes that one of the documents the first Roman emperor, Augustus left with the Vestal Virgins at his death, along with his will, was a narrative of his deeds, which he wished to be inscribed on bronze tablets in front of his mausoleum. The bronze tablets mentioned by Suetonius do not survive, but three copies of this document inscribed on stone have been found in the area covered by the Roman province of Galatia. One, from Ankara, contains both Latin text and Greek paraphrase, and there are fragments of a Greek translation discovered at Apollonia, and fragments of the Latin version at Antioch. There is enough text remaining for scholars to supplement and correct the Latin text and so to produce a fairly complete reconstruction of the original.

11 David A. Campbell, *Greek Lyric Poetry* (Bristol, 1994), p. 261.

12 L.D. Reynolds and N.G. Wilson, *Scribes and Scholars*, pp. 43, 46.

13 This is typically translated as On the Sublime, but as Ernst Robert Curtius, *European Literature and the Latin Middle Ages* (repr. edn, Princeton, 1991), p. 398 notes, this is somewhat misleading. We do not know who 'Longinus' was nor when he lived.

This is a text that was clearly intended to be a permanent memorial of its author. The location of the original 'engraved on two bronze pillars set up at Rome'[14] is noted at the head of the inscription. The copies, then were intended as physical representations of Augustan, and therefore Roman power and prestige, and provided a concrete link back to Rome, where the originals could be found. The copies themselves were also intended as a permanent installation, with a readable translation of the Latin original, which would have been unintelligible to most of the literate population, but nevertheless authentic. And even though the choice of medium for the originals, text inscribed on metal, was the best available, it is the copies and translations that remain, perhaps because the metal was regarded as a valuable (and reusable) commodity itself.

The nature of texts and transmission

The process of restoring the 'correct' readings of a text is called textual criticism.[15] It relies initially on the construction of a genealogical tree of relationships between manuscripts, based on the patterns of errors and variant readings contained therein. Once this recension has been constructed, manuscripts which are derived from other existing manuscripts can be eliminated from consideration as sources for reconstructing the correct version, and the intellectual process of deciding upon the best reading may proceed. This method is rarely 100 per cent successful for a variety of reasons. There may not be a clear ancestor manuscript because the existing copies may derive from multiple traditions, for example when the author made multiple editions of the work. Moreover, where there are such parallel traditions, manuscripts from different traditions may have been used by editors in the past to correct new editions, thus crossing the lines and creating a situation in which it may not be possible to reconstruct the sources. It is clear after centuries of studying the processes by which manuscripts are transmitted that precise, mechanical copying was not typically the intent of those making new editions of classical works.[16] Vergil in particular was adopted and adapted by a number of cultures for their own purposes. A new edition of an ancient work must therefore

14 P.A. Brunt and J.M. Moore (eds), *Res Gestae Divi Augusti: The Achievements of the Divine Augustus* (Oxford, 1989).

15 See Notis Toufexis, 'One Era's Nonsense, Another's Norm: Diachronic study of Greek and the Computer', (Chapter 6), in this volume for some useful perspective on the practices of textual criticism: the reconstruction of a single edition throws out data that are useful to historical linguists, for example.

16 Textual criticism typically aims at the reconstruction of an original version of a work, which may be impossible. The Homeric epics, for example, began as an orally transmitted tradition before they were written down. See Casey Dué and Mary Ebbott, *The Homer Multitext Project*, <http://chs.harvard.edu/chs/homer_multitext> for an attempt to use technology to represent the full sweep of Homeric textual transmission.

be examined for its rhetorical intent as well as the quality of its reproduction of its sources. As we have noted however, one of the reasons for the Vergilian corpus' success at surviving the passage of time was the ability of his editors to make their own uses of the text. Despite its limitations, textual criticism is able to produce texts which are useful to modern scholars.

The collection of difficulties that textual criticism has been developed to address consists of various kinds of copying errors. It is arguable that these may largely be mitigated in a digital environment. But the existence and success of the discipline of textual criticism shows that it is possible to do useful work on a tradition whose copying methods inherently impose a considerable degree of uncertainty on the readings of texts. These methods will have to be refined to work with digital copies and derivatives.[17]

We must also consider the question of formatting. The format in which a text of, e.g. Vergil is published today is vastly different from that in which it was originally published. At that time, the standard format for published books was the papyrus scroll. Codices, bound leaves of parchment like our own books, did not become a standard vehicle for publishing pagan literature until the second century. It seems initially to have been regarded as a low-quality, cheap medium, despite its mechanical superiority.[18] Not only was the medium different from our own, the actual placement of text on a page would also seem very unfamiliar. Words were not separated by spaces, lower-case letters were not used, nor was there any punctuation that would be familiar to us. The differences become painfully obvious when we consider that changes of speaker in drama were indicated only by a horizontal slash at the beginning of the line, or by a colon-like symbol in the middle of a line. Copying mistakes were an inevitable result.

By contrast, there is much emphasis in the modern study of digital preservation on preserving the appearance of documents, that is features like pagination, font, font size, the placement of text and figures on the page, and the like. But an overemphasis on appearance pushes one in the direction of technologies that I will argue are not the ideal vehicles for digital preservation.

Digital permanence

As we noted in the introduction, it was not uncommon for ancient authors to contend that their works would be immortal, and even that they would confer a degree of immortality upon their authors. Thucydides adapted this claim to his own, new style of writing, and we find even more explicit versions in poets like

17 Tools like the Versioning Machine <http://www.v-machine.org/index.php>) are the beginning of this work.

18 Reynolds and Wilson, *Scribes and Scholars*, pp. 30–31, describe the process of converting text on scrolls to codices in terms that will be familiar to anyone experienced in data migration.

Horace and Ovid.[19] What made these authors confident of their works' survival in this way, and into what sort of climate were they sending these surrogates of themselves? One answer is that they could look upon a certain continuity of culture and see that authors like themselves were still being read. They were also in many ways setting these works free. There was at the time absolutely no notion of copyright or intellectual property (IP), and no hope of royalties from book sales. Writing was thus an activity reserved for the aristocracy or for those lucky enough to acquire a patron. There was a lively book trade, mainly in cheap copies, although higher-quality editions were produced also. But an author would neither expect, nor receive any income from sales of copies of his work.

The situation is quite different today. But while the cultural circumstances surrounding modern publication are different in terms of the expectation of control over IP, and IP as a source of revenue, in the digital realm the situation is less well defined. While copyright pertains to digital objects, there are no physical barriers to copying and reuse, and the effort to develop business models for the distribution of digital material is still ongoing, with no clear winners yet. The problems with creating a revenue stream stem from the ease with which digital files may be copied and redistributed by their users. The field of digital rights management (DRM) represents one attempt to cope with this model, but the solutions presented thus far tend to be easily defeatable and/or too restrictive. DRM is an attempt to maintain control of a digital object once it has left the possession of the copyright holder. Unfortunately, this sort of control seems likely to be incompatible with long-term preservation goals, which will necessitate actions like making and distributing copies and migrating from one format to another for an indefinite period of time.

There is a growing movement to deal with the problems of digital publication by going in the opposite direction, and explicitly relinquishing some or all copying rights to the general public. The Creative Commons, for example, provides a mechanism for authors to produce licences that allow varying degrees of freedom to the consumers of their works to recopy, edit, republish, mash up or otherwise repurpose published works.[20] One objection to such licences is that they may reduce the ability of creators to profit from their work. The relationship of commerce to preservation is an important consideration, though somewhat outside the scope of this chapter. It is interesting to note that a number of authors who publish simultaneously in print and online report no adverse impact on sales. Indeed, the opposite may be the case, since open digital copies make the works much easier to discover.[21] As I noted above, to the extent that efforts to profit from digital

19 See Horace, *Odes* 3.30 and Ovid, *Metamorphoses* 15.871ff. for example.

20 Creative Commons, <http://creativecommons.org>.

21 See Cory Doctorow, *Ebooks: Neither E, Nor Books; Paper for the O'Reilly Emerging Technologies Conference, 2004*, <http://www.craphound.com/ebooksneitherenorbooks.txt> (2004) and Bruce Eckel, 'Why Do You Put Your Books on the Web? How Can You Make Any Money That Way?' *FAQ*, <http://web.archive.org//20041204221726/http://mindview.net/FAQ/FAQ-010>.

works involve controlling them once they have left the publisher's grasp, they reduce those works' chances of surviving long term. Creative Commons licences depend upon copyright law, and do not prevent creators from profiting from their creations, but may at the same time permit uses that improve the odds for the works' long-term survival.

It seems therefore reasonable to argue that we have returned to a situation somewhat like the one that existed in the ancient world and furthermore that perhaps some of the processes that governed the survival of ancient works might pertain to digital media. As in ancient times, a work released into the electronic environment may be copied, quoted, reused or resold without the originator's having much control over what happens to it. There are legal frameworks for controlling what happens to copies of a work, but in practice they may be hard to apply or may not be worth the trouble. Some works may be licensed in such a way that there are no legal barriers to such treatment. What we have seen from the limited survey of ancient works above is that copying often provides the most promising avenue for long-term survival.[22] We have also seen that simple mechanical copying does not represent the norm. Copies are made for a variety of reasons, but in general they reflect at least to some extent the motivations of the surrounding culture, and the copies are shaped and sometimes altered by those motivations. Copying often takes the form of reuse, or quotation, and these types of copying are by definition influenced by the motivations of the copier. Yet it is only through reuse that we have much of the Sappho that we do.

Much of the anxiety over the preservation of digital materials (particularly texts) has to do with concern over the loss of some intrinsic qualities that have to do with 'user experience'.[23] For printed materials, this means the appearance of text on the page. This has led to an effort to repurpose Adobe's Portable Document Format (PDF) as an archival digital format (PDF/A).[24] But as we noted above, there have been huge changes in the last two millennia in the ways in which written language is recorded. Modern printing methods are completely unsuited to representing the appearance of ancient texts. It wouldn't be possible to print a scroll on a modern laser printer without destroying its form. But there is absolutely no guarantee that the current standard form will be the dominant one in a hundred years. Indeed, we may be back to something more scroll-like: an 8.5 x 11-inch page does not fit well on a laptop screen. This doesn't matter yet because people in general prefer to read on paper rather than on screen, but as the technology improves, the obstacles to reading on screen will gradually be removed. Will the page as we know it make sense any longer at that point?

22 This is the principle behind the LOCKSS (Lots Of Copies Keep Stuff Safe) initiative, which attempts to preserve electronic content such as journals by distributing copies throughout the LOCKSS community. See <http://www.lockss.org/lockss/Home>.

23 William G. LeFurgy, 'PDF/A: Developing a File Format for Long-Term Preservation,' *RLG DigiNews*, 7:6, RLG, <http://worldcat.org/arcviewer/1/OCC/2007/08/08/0000070519/viewer/file3170.html#feature1> (15 December 2003).

24 See LeFurgy, 'PDF/A', for a summary of these efforts.

What this implies is that perhaps emphasis on technology that faithfully replicates the printed appearance of documents is misplaced. Technologies like PDF do this very well, but do so at the expense of the document's flexibility. Text-based markup technologies, on the other hand, such as XML, allow for the presentation of documents to be abstracted out to a separate set of instructions. Instead of the document being embedded in the format, the format is applied to the document. In other words, the content becomes primary again, and the appearance secondary. This type of focus is very much in keeping with the ways in which ancient documents have reached us: none of their copyists would have argued that the text's appearance was as important as its content. The appearance will have changed every time the text was copied.

O'Toole, in his seminal article on ideas of archival permanence, notes the distinction between the preservation of information and the preservation of the original documents.[25] Here we have a similar, though not identical, question to answer: whether the preservation of the precise appearance and experience of the digital original is more important than the preservation of the information it contains. As with physical preservation efforts, over the (very) long run, permanence of information seems a far more attainable goal than permanence of the originals.

Moreover, as we have seen, copies of ancient materials typically gathered additional materials in the form of commentary, glosses, and marginal notes as they progressed through history. These accretions would essentially become part of the text in many cases, because their value was recognized by those handling the text. Texts were witnesses not only of their author's words, but also of the interpretations and difficulties of their subsequent readers. It seems important to ask whether there should not be mechanisms built in to digital texts that allow for this type of annotation. In many cases there are: word processors allow for annotations and keep multiple versions of documents embedded in the same document, and PDF has a facility for this type of annotation also. What is lacking, again, is flexibility. Both are constrained by an orientation towards printed text, and in both the annotation mechanism is built in as a secondary function. Markup technologies such as XML, on the other hand, are inherently adaptable to new types of information. They also add the ability to further define and augment texts with semantic information, such as the marking and disambiguation of personal and place names as such.

Print-replicating technologies are typically argued to be preferable to others because they replicate the page structure of works, and therefore permit relatively precise citations to be made of their content.[26] Pagination is a relatively fragile construct in the digital age, however. A word-processing document will probably not retain the same pagination on two different computers. Indeed, it may change from one calculation to the next in the same program, on the same computer.

25 O'Toole, 'On the Idea of Permanence', 16–17.

26 LeFurgy, 'PDF/A'.

Citations by page for digital materials are thus not as helpful as they appear to be for print.[27] With the advent of full-text-searching capabilities, the need to specify the precise location of a cited thought in a monograph or article has lessened. Moreover, the digital medium provides mechanisms for very precise linking. The advantage of print-replicating technologies therefore is one based only on familiarity, not on actual usefulness. Based on these reasons, I would argue that efforts like PDF/A, while useful, are fundamentally flawed because of the way they 'freeze' the digital content.

In sum, we can see that the examination of a subset of textual transmission from the ancient world has a number of useful lessons for digital archivists.

1. We cannot predict how future generations will view or use the works in our care. The things a culture values can change radically over the course of several generations, so there is no guarantee that the intrinsic value of a work will be estimated in the same way one hundred or one thousand years from now. Therefore, while due care must be taken in preserving digital resources in our archives, their long-term survival may best be ensured by releasing copies from our control.
2. There tend to be cycles of societal interest in any work. Any long-term preservation strategy must therefore rest upon preparing the work to survive the next interval of disinterest. There were editions of Sappho's poems in the Library of Alexandria, but because they ceased to be copied, nearly all of her output is lost. Preservation decisions will be driven, at least to some extent, by the interests of the culture at large. There are no clear solutions to this problem, but a digital archivist can at least seek to inspire interest in their materials by making them generally available. The modern situation is far better than the ancient in the sense that there are fewer communication barriers and a larger audience, and so there is a higher probability of attracting an interested community around your material.
3. Self-sustaining communities of interest provide the best insurance against the ravages of time. The survival of the Vergilian corpus is in large measure due to not one but several communities that made their own uses of his texts. This suggests another possible role for the digital archivist: facilitating communication between interested users and creating communities that care about our materials.
4. Original objects typically do not survive, but their intellectual content may be preserved nevertheless. Even if there have been errors introduced into derivatives of the original work during its transmission, it is likely that the original can be reconstructed, or at least a close enough approximation to be useful. We should therefore not be overly concerned about maintaining the

27 Even in print, they are sometimes of dubious value: pagination changes with each new edition of a printed work, and scholars frequently have the experience of finding citations that do not actually point at the right section of text.

integrity of copies of digital resources outside our control. We especially should not over-stress the importance of preserving the original appearance of such resources.

5. The likelihood of the success of long-term preservation is higher the more copies of the work there are in existence. Digital archivists should therefore consider trying to obtain rights to reproduce digital resources without limitation. The Creative Commons licensing schemes provide a useful framework for allowing rights holders to assert those rights without hindering the reproduction or use of their materials. The sources for any access component of a digital preservation project should be made publicly available, so that they can be republished or repurposed by other projects. Publications that reuse or make partial use of archived resources are to be encouraged, because these contribute to a cultural atmosphere that values these resources.

We may conclude by returning to Thucydides' definition of his history as a possession for eternity rather than an ephemeral entertainment. This binary division suggests a strategy for digital archivists wishing to preserve cultural material: objects encumbered by restrictions on copying and reuse cannot truly be called possessions (except of the rights holder) and are therefore *ipso facto* less likely to survive and perhaps do not deserve to have limited resources used on them unless there is hope of bringing them ultimately into the public domain. This is a pessimistic view, but to the extent that this is an engineering problem, Murphy's Law can be assumed to operate: over time, anything that can go wrong, probably will. The true solution to the long-term preservation problem is to change it, as much as possible, from a technical problem to a social one. Preservation, leaving aside accidents of history, is a human enterprise, and cannot succeed without human intervention. The rise in recent years of online communities with broad adoption, such as Facebook, may point to ways of enabling digital survival by generating community interest in them.