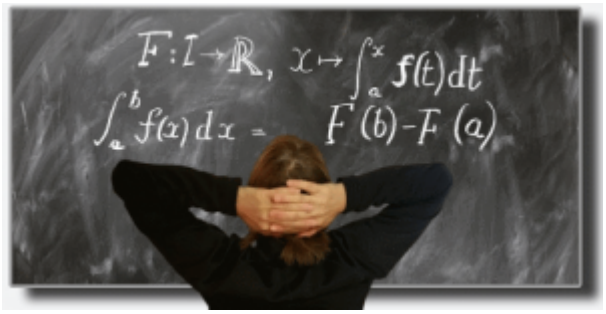
A Romantic Digital Archaeology

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Is everything in archaeology computable? Does digital archaeology reach to the furthest corners of archaeology, or are there limits to what can be addressed digitally or computationally? This was a question that came up at the CAA conference in Tübingen earlier this year: Juan Barceló argued that the term 'digital' was fundamentally associated with numbers and formal logics, and that this constituted an unrealised 'dark side' to digital archaeology which required us

> … to rebuild the way we think about the connection from the past to the present using a new language – mathematics, geometry – that should allow new explanations. The trouble is that most researchers do not know the language nor the tool, and they are still linked to a traditional way of doing things. (Barceló 2018).

Juan's proposal was met with a mixed response: while some (a few) recognised this and agreed that the future success of digital archaeology lay in this language of mathematics and associated analytical methods (see, for example, Iza Romanowska's (2018) abstract in the same conference session), others clearly felt that they did not recognise this view of digital archaeology. So why was the response so ambivalent?

A mathematical focus is not an entirely new characterisation of archaeology; for example, some time ago Ken Dark proposed that "… archaeology is, of necessity, a scientific discipline. Data are compared numerically, or in terms of numbers of shared traits, or patterns, all methods ultimately reducible to mathematical terms" (Dark 1992). More recently, Jim Doran wrote:

> Mathematical and computational models challenge unreliable, ambiguous, often merely fashionable, verbal theorising that is elegant but has little precision and little practical value. Not all scholars understand or welcome this challenge or can accept that at our disposal is important "white magic": "mechanical" structures and processes running within a digital computer such that their properties (mathematically provable or experimentally

> demonstrable) *can* reliably inform our real world choices (Doran 2015, v-vi)

The idea that everything is ultimately reducible to mathematics (or computation) is certainly not new – it underpins Isaac Newton's *Philosophiæ Naturalis Principia Mathematica*, for example, and (to throw in a Glasgow connection) Lord Kelvin argued that knowledge that cannot be expressed in numbers is unsatisfactory: "it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be." (Thomson 1889, 73). So in many respects this claim for the primacy of mathematics in (digital) archaeology could be seen as a reversion to Enlightenment perspectives on science and in conflict with the postmodern thinking that has characterised much of archaeological thought over the past twenty years or so. It's also part of a much larger debate which has been going on in other disciplines for many years. For example, Stephen Brush writes of the early days of Science and Technology Studies (STS) when, amongst other things, STS scholars argued that scientists did not discover objective facts, but constructed them in the light of social, political, and gender interests (Brush 2000, 115). This perspective sounds familiar in an archaeological context – for instance, I for one have argued that archaeological data are situated and contingent, that they are a consequence of cultural processes and consequently theory-laden, process-laden, and purpose-laden (e.g. Huggett 2018, 99).

The problem is that in the end, as Brush goes on to say, such postmodern positions can lead to a situation in which science is seen to have no more validity or authority than any other approach, be it creationism, alternative medicine, mysticism, or astrology, for example (Brush 2000, 115). Harry Dyer has recently written of this in relation to a Flat Earth conference and what it revealed about science and knowledge today (Dyer 2018). This certainly has an all-too familiar feel to it in a western political environment in which a UK justice minister can claim that people have had enough of experts and a US president can promote fake news at the same time as decrying it. On the other hand, as Tom Andrews puts it, "One can believe that concepts are constructed rather than discovered yet maintain that they correspond to something real in the world." (Andrews 2012). Indeed, postmodern constructivist perspectives are primarily epistemological: they concern the construction of knowledge and how we structure reality, rather than deal with reality itself.

One reaction to this supposed relativism is to re-promote scientism. For example, Stephen Shapin writes of the resurgence of scientific method and its extension to the solving of problems of morality, value, aesthetics, and social order:

> Science, it is now claimed, will show us what is good and how to live the good life—and if it does not now have the ability to do so fully and effectively, then we should rest assured that it soon will. Science will cure problems of moral relativism, and it will reveal the objective truth of some set of moral positions as opposed to fraudulent others. (Shapin 2015).

Digital computation as a subset of 'science' in this sense is equally culpable in this optimistic perspective as evidenced in the increasing availability of ever-expanding computer power and the growing ambitions of large multinational software development corporations to reach into the furthest corners of the human experience. One perspective of Barceló's call for a pre-eminently mathematical approach to digital archaeology that it represents a desire for just such a return to scientism. However, while there is little doubt that not all digital archaeologists are comfortable with

aspects of postmodernism within the discipline, it does not necessarily follow that they subscribe to a digital archaeology predicated on mathematics and statistics – as was the perception of archaeological computing in the 1960s and 1970s.

But is everything computable? The Department of Media, Culture, and Communication at New York University and the School for Poetic Computation are organising an event in June called 'Uncomputable', defining uncomputable thus:

> In the digital realm the uncomputable appears in logical paradoxes and rational incompleteness. In the analog realm the uncomputable consists of all those things that remain ungovernable, unspeakable, or unseeable.

Similarly, David Golumbia's blog, *Uncomputing*, which focusses on digital studies and theory, is so called because:

> … the word gets at a thought few people seem willing or able to entertain today: that the solution to many of our most pressing social problems might lie not only *not* in the proliferation of computing technologies, but even in the *retraction or limitation* of computing in some important parts of society. That does not mean getting rid of computers; it means asking carefully which parts of life computerization belongs in and which parts, and it what ways, it may not. (emphasis in the original)

Alan Turing famously demonstrated in his 1936 paper 'On Computable Numbers' that some problems were uncomputable. As Noson Yanofsky (2013) highlights, some problems are uncomputable because they require such a long time to run that they cannot be completed (but technical advances and faster computers will ultimately resolve such issues), whereas other problems are uncomputable because they can never be solved, however powerful the computer (although non-Turing types of computer, if/when they exist, might do so for all we know). The Halting Problem and the Tiling Problem are two such examples of uncomputable problems, but equally we may posit that computers will never cope satisfactorily with more subjective issues associated with human perception and cognition – frequently the stuff of archaeological interpretation. On the other hand, mathematical problems seem ultimately limited only by the power of the human mind – although, as Yanofsky observes, we can never prove this:

> … an absolutely unsolvable problem is a problem that we can never prove, and we can never know that we can never prove. This makes the question of their existence somewhat metaphysical since whether or not they exist is something we can never know. (Yanofsky 2013, 336)

Consequently, he concludes that there are absolute limitations to computable problems and, more than likely, to mathematical problems as well.

So where does this leave digital archaeology? There is no doubt that mathematics has a role to play

in archaeological analysis, but is it (or need it be) the be-all and end-all? Coincidentally, Isaac Ullah has just posted on the theme of 'Computational Archaeology' (Ullah 2018), in which – among other things – he defines computational archaeology in terms of a series of mathematical approaches (what he calls *analytical computations* such as statistics, GIS analysis etc., and *generative computations* such as simulation studies, agent-based modelling and the like). By his definition, Computational Archaeology is distinct from Digital Archaeology: while Digital Archaeology is concerned with data management, visualisation and qualitative analysis, Computational Archaeology concerns quantitative analysis and simulations. Such a distinction is reminiscent of the divide that used to exist within the CAA conference: originally called 'Computer Applications and Quantitative Methods in Archaeology', it was abbreviated to CAA and, despite strong a rear-guard action over the years, the 'Quantitative' part of the name has been dropped even if quantitative methods still figure in the conference proceedings. However, Ullah emphasises that he is not a 'splitter', and argues that essentially the two characterisations are simply different parts of each other. We are indeed all digital archaeologists now (as someone once said!).

What this suggests to me is that what is at issue is not a question of whether digital archaeology is fundamentally a post-modern, constructivist methodology, or a scientistic endeavour embedded in a mathematical and computational approach; the reality is that it is both, and both have their part to play. Indeed, Barceló et al. (2015, 3) acknowledge that not all phenomena can be expressed mathematically. We may naturally ally ourselves with the one or other approach (or more likely situate ourselves somewhere on a continuum between the two), but as archaeologists we essentially agree on our subject of study – the physical stuff of archaeology – and where we diverge is in how we arrive at an understanding of what we can say about it, our methodology for creating knowledge about the empirical remains of past worlds. While this may appear to be a very relativistic conclusion – no one approach is more correct than another – it's perhaps a more rational one than seeking to claim pre-eminence for one approach above another. It's a case of the most appropriate tools for the job: to argue that one approach is fundamental to the exclusion of others is to choose to die by the barricades of postmodernism or scientism (or name your preferred -ism) rather than embracing difference and capitalising on the opportunities so presented.

So my Romantic view of Digital Archaeology seeks to incorporate the multiple shades of opinion, argument, methodology and epistemology while at the same time celebrating inspiration, intuition, subjectivity, and the primacy of human cognition. As Ullah concludes: "I would be very surprised if there was anyone who did *only* 'Computational' archaeology and no 'Digital' archaeology, and vice versa. You really can't have one without the other."

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