Science, Data, and Case-Studies under the Third Science Revolution

Some Theoretical Considerations

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Abstract

The Third Science Revolution described by Kristian Kristiansen (2014) has been openly embraced and is currently underway in archaeology. It has brought considerable improvement in terms of scientific methods and approaches, but at the same time, it brings with it the risk of transforming archaeology into something that is methodologically uniform, inflexible, and oversimplified, or in other words, *a methodologically monistic discipline*. This is particularly evident when it comes to Big Data: the Third Science Revolution has inaugurated a new understanding of data, one that reduces archaeological reality exclusively to those elements that are quantifiable.

The aim of this paper is to demonstrate that archaeology needs to go beyond Big Data, and the Third Science Revolution in general, and embody *qualitative research*. This can be done by incorporating methods and theories from history and anthropology that contextualize the purposeful character of past human action. This requires (re)embracing case-study research, but also recognizing a meaning of 'case-study' that has been largely ignored: as a paradigmatic example of a *Zeitgeist* – a context where different institutions, power relations, and ideologies are all entwined.

Key words: Big Data, revolution, theory, case-study, quantitative, qualitative

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The rise of the Third Science Revolution

Some years ago, in this very journal, Kristian Kristiansen (2014) presented a remarkably in-depth and insightful commentary on what he, at the time, labelled the Third Science Revolution. This paper left an indelible mark in the archaeological community, with archaeologists across the world addressing both in print and during their coffee breaks what the Third Science Revolution meant to the discipline. In fact, in a very short amount of time, pretty much everyone was aware of the 'Third Science Revolution', with an entire theme of the 2017 EAA annual meeting at Maastricht dedicated to it. But what is the Third Science Revolution? In the last 10 to 15 years, archaeology has been conducting research that involves more scientific techniques and methodologies, with many archaeologists developing projects with explicitly scientific research questions and engaging in ventures alongside the natural sciences. Kristiansen (2014:17–19) boiled down this revolution to three main elements: 1) the introduction and employment of Big Data; 2) the widespread application of quantitative methods and modelling; and 3) the incorporation of information obtained from isotope and aDNA analysis. As Alexandra Ion (2017:185) has shown, it seems almost impossible for archaeological projects to obtain funding nowadays unless they incorporate hard science, whether it is in the form of aDNA analysis, isotope analysis, Bayesian modelling of radiocarbon dates, paleodiet reconstruction, or some combination of these. In the process, more and more papers engaging with archaeology are accepted into high-profile journals such as *Nature*, *Science*, *PNAS*, *PLOS-One*, and *Cell*. In general terms, the Third Science Revolution has been fully accepted by most archaeologists; there are ever more researchers applying scientific techniques and methods in archaeology. Several questions arise in light of this situation: where and under what circumstances can humanities and social science methodologies operate in conjunction with these more natural science techniques?

Several aspects of the Third Science Revolution have been critiqued (e.g. Cunningham & MacEachern 2016; Sørensen 2017) and this paper aims not towards that end. Rather, the main aim of this paper is to first understand the dialectic between more fast-paced scientific archeology (*sensu* Cunningham & MacEachern 2016), and the slower and more humanistic side of archaeology. To a certain extent, it is believed that part of this dialectic is based on the logical difference separating scientific causal explanations and human teleological explanations. On a more practical note, this paper will explore the advantages and disadvantages of engaging with Big Data, and from there argue that this type of research is best counterbalanced by a more small-scale case-study type of research.

The interface of two cultures in archaeology

As Kristiansen (2014:25) notes, archaeology requires a critical stance towards the interface of natural and human sciences, of biology vs culture, and genetic vs cultural evolution, yet despite several papers addressing this specific issue (e.g. Kristiansen 2017; Moro Abadía 2017), no one seems to be taking it very seriously (Gardner & Cochrane 2011:11–12). Rather than recognizing this as a problem of 'two cultures', the issue might be clearer if we think in terms of influences derived from New/processual archaeology and post-processual archaeology. When framed in this manner, I cannot but agree with Tim Flohr Sørensen's (2017:102) claim that the Third Science Revolution is nothing but a 'New Empiricism' or a 'New New Archaeology', because when it is boiled down, the Third Science Revolution is served primarily by natural science, and the human sciences are presented as a side dish. Now, as Kristiansen (2014:23, 2017:121) himself recognizes, the revolution reflects changes occurring outside the discipline, and to understand what is actually going on, it is important that we engage in some critical historicizing (see Chilton's (2014:35–40) comments on Kristiansen's paper for a more in-depth historical perspective).

There are many aspects of both New Archaeology (later known as processual archaeology) and post-processual archaeology that can be highlighted, however, there are certain aspects of both that have largely been ignored. For instance, an important facet of New Archaeology in the 1970s was its reliance on a neo-positivist methodology of science, namely that derived from the work of Carl Hempel and Karl Popper (Kelley & Hanen 1988). Despite the varied ways one can conduct archaeological practice under the neo-positivist banner, science was considered at its essence *methodologically monistic*. What does this mean? When it came to science, the positivists believed in three basic tenets: first, that despite the variety of subject matters, all sciences could operate under one single explanatory methodology; that among the empirical sciences, mathematical physics should serve as the model for all other sciences, including the human sciences; and that all explanations in the sciences have to be causal, or at least reducible to causes (Von Wright 1971:4). Although New Archaeologists did not necessarily support these tenets explicitly, nor did every New Archaeologist agree with them (e.g. Flannery 1973), many did support them via their programmes and methods – and this was only challenged with the rise of post-processual archaeology in the 1980's and 1990's.

One of the aspects of post-processual archaeology that is rarely addressed is how it broke away from methodological monism in favour of *methodological pluralism*, which can be recognized throughout the post-processual programmatic literature. Whereas New Archaeology tried to re-

duce everything to a single methodology, one based on the natural sciences, post-processual archaeology was open to the possibility that archaeology could operate with at least *two methodologies*. This is most evident in the work of the champion of post-processual archaeology, Ian Hodder, who embraced methods from the human sciences (e.g. the hermeneutic method) but also scientific practices – somewhat tacitly at first, but then very explicitly in his field project Çatalhöyük, and also through scientific modes of explanation (Vanpool & Vanpool 1999).

It is precisely this pluralist attitude that needs to be kept in mind because it is only by recognizing that *science has more than one methodology* that true multi-disciplinarity is possible (see Ion 2017; Stutz 2018). Unfortunately, this is not what we have in most research projects nor is it possible in the scientific regime promoted in the Third Science Revolution. This is not to say that archaeology does not engage with multiple disciplines; a cursory look into any average-sized archaeology department will show a mixture of researchers with backgrounds in history, ethnography, chemistry, physics, botany, anthropology, and more. But in the Third Science Revolution it seems that this cooperation between the natural sciences and human sciences heavily favours the former. This is quite concerning because it means that the human sciences are only important if they can further support what the natural sciences have 'objectively' established. A recurrent example of this type of 'interdisciplinary collaboration' is the use of historical documentation in support of arguments established by environmental data (e.g. Kaniewski et al. 2012), where history is reduced to 'proxies' that can be compared to environmental archives. Even more concerning is the academic imperialism implied in the Third Science Revolution, where richer countries (primarily Northern European countries and the US) monopolize funding for projects based almost exclusively on natural scientific methodologies, while the rest of the world has to content itself with small-scale human science research (Cunningham & MacEachern 2016; González-Ruibal 2014). Thus, in spite of Kristiansen's call for a critical archaeology that addresses the interface of natural and human science, what appears to be happening is a clear dominance of the natural over the human. While many projects involve natural science due to its questions and aims, others seem to involve science simply to attract large-scale funding. It appears that in a lot of cases science is being practised not because it is needed, but simply because it is available (Sørensen 2017, 2019). A paradigmatic case is that described by Ion where human remains are being analysed through DNA techniques, such as the remains of Richard III, but with no real intellectual enquiry in mind (Ion 2017). This, in turn, leads to a rather disheartening attitude: several archaeologists across the world have come to realize that the only way to keep their departments and institutions relevant and well-staffed is

to get with the programme, and find ways to somehow encroach into projects that involve aggressive natural scientific practices, even in cases where these are not needed.

The result of all this is the oversimplification of archaeological explanations (Ion 2019) At face value, archaeology might seem more complex today because of the scientific jargon, the cryptic graphs, and the overcomplicated distribution maps – but the most valued papers in archaeology right now are those that provide the simplest of explanations: 'people migrated from the steppe in the Neolithic' (Haak et al. 2015) or 'beaker was introduced through migration in the British Isles' (Olalde et al. 2018). These one-dimensional archaeological explanations are not only riddled with inaccuracies (see Furholt 2017 for comments on aDNA studies on migration, and Ion 2017 and Lidén & Eriksson 2013 for problems with aDNA in general), they are symptomatic of the dangers of methodological monism in archaeology.

The dismissal of nuance

Of all the breakthroughs that are part of the Third Science Revolution, aDNA is the one that has received most attention. There are several reasons for this, but the most obvious is the polemical nature of its results and the ethical implications of its use (e.g. Hakenbeck 2019). Big Data, on the other hand, has flown under the critical radar, even though it raises just as many questions, if not more than aDNA.

The expression 'Big Data' can be quite confusing at times because it is not exactly clear what makes data 'big'. If we are thinking in terms of sheer quantity, archaeology has always generated vast amounts of material suitable for analysis. If 'big' refers to the interpretation of vast amounts of data, then one should associate Big Data with Fernand Braudel's total histories, which were introduced into history in the 1950s, and influenced archaeological practice in the 80s and 90s. In addition to all this, it is also not entirely clear why Kristiansen singles out Big Data as one of the elements comprising the Third Science Revolution, considering that Big Data has no explicit connection to science at all (Levi 2013). In fact, most scientific methodologies operate with samples of limited size more often than Big Data. Overall, the expression 'Big Data' seems to be more about how data is accessed and what analytical methods are associated with data, rather than its actual size. For example, Gattiglia (2015:2) points out that most definitions of Big Data focus on volumes of data that can only be processed by *enhanced computing power.* On a similar note, Snijders et al. (2012) have pointed out that Big Data tends to be quite heterogenous,

which makes computing power crucial in its capacity to obtain, filter, and categorize it. Additionally, another key aspect of Big Data is its availability and accessibility: in Kristiansen's (2014:17) description, he refers to the fact that the collation of vast quantities of data is not necessarily new in archaeology; what is actually new is the universal demand to make this data readily available. In general, there is no clear definition of Big Data as this is determined by how and by whom this data is used. Nevertheless, from an archaeological standpoint, it makes sense to follow Boyd and Crawford's (2012) understanding of Big Data, where it is not so much about the data itself, but the capacity to search, aggregate, and cross-reference large datasets. Additionally, this capacity relies on technology, that is, the maximization of computing power towards search and comparing different datasets, and specific forms of analysis, which in turn allow the recognition of patterns within the data.

It is surely undeniable that the information obtained from Big Data is unequivocally new and interesting, and with advances in information processing technology and the continued funding of digital infrastructure, the knowledge obtained from Big Data will become even more impressive. But some concerns need to be raised. While in archaeology Big Data, as described by Kristiansen, is a relatively recent development, it has featured for longer in other disciplines and other areas of society, and there is apprehension about how easily Big Data can be abused for unethical reasons, or outright nefarious purposes. The most glaring case is that of Cambridge Analytica's involvement in the 2016 American elections, through the misuse of Big Data illegally collected from potential voters. There are also concerns about how Big Data has become so normalized in everyday western society, to the point that people forget that their cell phones are constantly tracking their life in multiple ways. This has led to the gradual abdication of previously acceptable levels of privacy and the fostering a new society of self-control (Kappler et al. 2018). Even more concerning is the blind trust in the knowledge produced from Big Data. Most proponents of Big Data assume that given the sheer amount of data processed, the results obtained are automatically objective and fair (Boyd & Crawford 2012:667–672). This seems logical since mathematical models generate results obtained from Big Data, which means that they should contain little to no human bias. But just because these inferences are mathematically sound and obtained from vast quantities of data, it does not follow that they are either correct or socially fair. An analysis of 'Big' crime data in the United States shows that crime is primarily committed by certain ethnicities, or in certain neighbourhoods. This type of information can be used by insurance companies, banks, or services, to justify discrimination against these ethnicities (O'Neil 2016). It appears that in a lot of cases Big Data is being

fetishized and valued because it is 'Big Data' (Gattiglia 2015:116) and not because it is actually generating knowledge that is necessarily useful. As a series of methods that identify patterns in heterogenous data, there is the methodological issue of how Big Data, primarily inductive, can be combined with the hypothetico-deductive method of other archaeological sciences. By transferring the decision of which hypotheses to test to the neutrality of computing power, it might seem that objectivity is enhanced, but this is largely illusory because behind the apparent objectivity of Big Data, there is the serendipity of political, economic, and technological trends (Leonelli 2014:7) – what data and variables are accrued are contingent on whatever is considered of 'relevance' at the time. This automatically leads to biases in what is kept and what is not.

Ultimately, it seems unavoidable that some missteps will happen as Big Data becomes more widespread in archaeology, since it has happened with other scientific archaeology techniques (Killick 2015). However, that is not perhaps the greatest problem; the problem is how Big Data pushes archaeology further towards the aforementioned methodological monism. Although it might sound paradoxical, *Big Data is reductionist*. This is because Big Data operates with models that contain very specific information that is carefully selected. In the human sciences, information that is often considered of relevance would have to be considered noise in the modelling of Big Data, that is to say, information that is too historically specific or epiphenomenal to the actual causes of phenomena. Take the example of Big Data research in the American Southwest concerning changing regional networks (Mills et al. 2013, 2015), recently highlighted by Cunningham and MacEachern (2016): the validity of these studies relies on the acceptance of networks defined primarily by ceramic attributes, that is to say, the study is based on the correlation of social groups with specific ceramic decorative styles. As Cunningham and MacEachern (2016:633) point out, this type of association can be spurious, since it is a result of the size of the data, but not the analysis of the data itself nor its context. As Calude and Longo (2017) have demonstrated, very large databases will always contain arbitrary correlations, and these can be found even in randomly generated databases. Similarly, this same problem is evident in large-scale aDNA studies where simple correlations are established between genetic affinity and cultural groups (Haak et al. 2015; Olalde et al. 2018). As has been pointed out by Furholt (2017), the many claims of geneticists require the acceptance of clearly bound entities such as Corded Ware culture and Beaker culture, however, in archaeology, these terms tend to be used for purposes of clarity and comprehension, rather than as actual designations of distinct and homogenous human collectives. Again in the field of aDNA, the recent study of the genomic history of the Iberian Peninsula is based on similar prem-

ises (Olalde et al. 2019): the study identifies the influx of Pontic-Caspian (Steppe) ancestry during the Bronze Age (from 2200 BCE onwards), with greater influx of males than females, and greater impact in the North than in the South. Scientifically, the study is sound and I believe few would challenge the fact that there was in fact admixture of local and Steppe ancestry during the Bronze Age in Iberia. However, the genetic evidence provides little to explain the transition of the Chalcolithic to the Bronze Age, especially in Southern Iberia, where the Chalcolithic trade networks and highly charged symbolic systems collapsed in a very short time period (Lull et al. 2015). In short, the influx of Steppe ancestry occurred in Iberia during the Bronze Age, but this can have had little effect on the new Bronze Age social and political systems that were established very rapidly around 2200 BCE.

The reduction to numbers

What connects all the elements comprising the Third Science Revolution, especially Big Data, is their reductionist character. It is this tendency to reduce that makes it also a tendency towards methodological monism. Reductionism can take many forms in the natural sciences, for instance, some sciences believe that explanations can be obtained by reducing reality to its molecular or quantum constitution, other sciences believe that explanations can be obtained by reducing phenomena to underlying mechanisms of nature.

What the Third Science Revolution in general, and Big Data specifically, seem to imply is that what is scientifically relevant to archaeology has to be reduced to quantifiable elements. The philosopher Cornelius Castoriadis (1984:209) has shown that in the natural sciences there is an automatic bias towards those objects that are fully distinct from one another, that is to say, objects that can be posited, chosen, spoken, and assembled. More recently, the philosopher Quentin Meillassoux (2008) has also argued that a proper understanding of reality beyond human experience is one that only considers the quantitative characteristics of the phenomenon under analysis.

Lost in this process of reduction are precisely those elements that allow the incorporation of human scientific methods – those vague and ambiguous elements that defy quantification yet nevertheless help us capture real human experience (Sørensen 2016). As Marko Marila (2017:80) explains, in the current scientific climate, vagueness is seen as a deficiency that can be eventually corrected with more empirical data or better scientific techniques, rather than as an actual aspect of the world. So for instance, in the Third Science Revolution we are limited when it comes to understanding the symbolic principles underlying certain prehistoric rituals; symbolic principles that can be better understood through anthropological approaches,

ethnographic analogy, semiotics, and historical methods – none of which seem to be of relevance to archaeology under the current scientific climate. For the scientific analyst, religious rituals would have to be studied in the same way that natural phenomena are usually studied: as incidental to biological/natural processes (Boyer 1994, 2001), or as data to be analysed by quantitative models. While this type of research would definitely qualify as scientific and satisfy the rigorous standards of objectivity demanded by the natural sciences (and some funding entities), it fails to provide an explanation as to why the rituals under analysis are practiced in the first place.

On top of all this, a rather disingenuous attitude has made its way into archaeology alongside the Third Science Revolution – that of simply pretending that none of these problems actually matter. According to this attitude, the problem of the 'two cultures' in academia is one perpetuated by archaeologists themselves and we can simply ignore it by claiming it is a red herring (Riede 2019), or that it has become a non-issue since the decline of post-processual archaeology (Kristiansen 2014:23). It is easy for the 'two cultures' problem to seem non-existent if one stands firmly entrenched in one of the cultures.

The 'two cultures' problem extends considerably beyond what C.P. Snow (1998[1959]) described – it concerns the generation of explanations under two completely different research regimes, explanations that are oftentimes not compatible, or outright contradictory. This does not necessarily have to do with the so-called 'cultures' themselves, but rather with differences in the *logic of explanation*. When it comes to these differences, for our current purposes we need only to recognize and understand some key ideas. First, the natural sciences tend to explain by identifying a necessary connection between causes and effects, unlike the human sciences, which tend to favour explanations via contextualization. This is because the human sciences also address *purpose*, something that the natural sciences rarely do. To explain purpose is to understand why someone acted in the way they did (Anscombe [2011]1957). Consequently, this entails understanding the *context* for those purposeful actions and contexts, and purposes are irreducible to causes and effects (Descombes 2001; Ribeiro 2018).

Why is purpose dependent on context? As argued by phenomenologists, purpose exists only in virtue of elements external to the subject: to act intentionally is an action that occurs outside of the subject (Ribeiro 2018:109) towards an object that exists in a certain time and place in the world. To understand how a subject connects to an object is to understand the historical and social context in which this is possible. So for instance, to understand why Romeo loved Juliet is to understand more than just brain chemicals, it is to understand how it is possible for people from different familial backgrounds to have fallen in love in Verona, Italy, during

the sixteenth century. If these premises are acceptable, it becomes clear in what respects the natural sciences are limited, and why they cannot replace the human sciences, as has been repeatedly pointed out by several scholars (e.g. Descombes 2001; Tallis 2014; Taylor 1964; Von Wright 1971; Winch 2008[1958]).

When intentionality is framed in this manner, the reaction by archaeologists is usually one of asking whether it is even possible to recover past intentionality in archaeology (e.g. Russell 2004). Ironically, the Third Science Revolution itself has provided several examples showing that this is indeed possible. For example, Kristiansen highlights an exceptionally interesting case of potential wife-stealing and revenge at the Corded Ware (c. 2800–2050 cal BC) site of Eulau, Germany (Kristiansen 2014:24; Meyer et al. 2009) as an example of short-term and micro-scale research. More interesting than its scale or duration, is the fact that the research features humans acting intentionally. Robbing and revenge are intentional acts: one cannot rob unconsciously because one needs to recognize the institutional agreement towards private property in order to rob. Thus, the case highlighted by Kristiansen is interesting because it describes actors in terms generally ascribed to the human sciences. And this is precisely what makes the human sciences relevant and fully compatible with the Third Science Revolution. The argument could be made that it is only at the micro-scale and short-term that intentionality is potentially recognizable in archaeological contexts. This argument, however, would be directly contradicted by one of the paradigmatic papers of the Third Science Revolution: *Massive Migration from the Steppe was a Source for Indo-European Languages in Europe* by Haak et al. (2015). Just like robbing or revenge, it seems fair to say that migration is an intentional act. Barring very particular circumstances, to migrate is something that can only be done purposefully.

A modern analogy can help us understand why intentionality is crucial: imagine that the aim is to explain why drivers in New York city stop at the red light (Descombes 2001:38). From the perspective of the Third Science Revolution, what matters is the establishment of a causal connection between the red light and the driver's response by pressing the breaks of the car. How is this causal connection established? This can be achieved by quantifying the amount of times drivers stop at a red light, as opposed to drivers' reaction to a green light. Once the correlation is established between the lights and the behaviour, it can be surmised that causal connection exists between red lights and the human behaviour of stopping a car. However, the establishment of this causal connection means little – *it provides no explanation as to why the cars are stopping*. This example serves to illustrate that establishing these causal connections can only be considered a very limited part of what archaeology can offer, that by itself, the causal con-

nections are not explanations at all. This is one of the many concerns that archaeologists have shared when it comes to the articles on aDNA which identify migrations across the vast expanses of Europe (Haak et al. 2015; Olalde et al. 2018) yet cannot provide explanations why those migrations happened. As Descombes (2001:39) and Anscombe (2011[1957]) explain, intentional behaviour purports not to cause and effects but to practical concerns and means to achieve certain ends, and in order to understand these purposes it is necessary to recognize the contexts in which it would have made sense to act in those ways, that is, to migrate.

Thus, when Kristiansen (2014:20) addresses the combination of methods and theories needed to produce a more 'holistic' archaeology, he mentions scale, duration, modelling, thing theory, complexity, and evolutionary theory, but leaves out those methods that could identify and enlighten the purpose of past human agency: contextualist methods and theories, which are quite prevalent in history and anthropology, such as object biography or ritual theory, and which have been used and applied quite successfully in archaeology (e.g. Bell 1992; Ginzburg 2012; Graeber 2001; Kopytoff 1986; Le Roy Ladurie 1980; Sahlins 1972)[1]. It is precisely the study of human as actual humans, as opposed to humans as genes (in aDNA), or numbers (in quantitative models), or animals (in evolutionary models), that is being pushed out of archaeology right now – otherwise known as 'the Indian behind the artefact (Braidwood 1959:79).

The return of the singular

The application of Big Data is, of course, of great importance in archaeology since it is only through large datasets that certain arguments about past human lives can be put forward with any degree of confidence (e.g. Shennan et al. 2013). The problem with Big Data is that it forces the reduction of data to those variables that are repeatable. Non-repeatable features have become less relevant in the Third Science Revolution – and can be dismissed as accidental, incidental, or epiphenomenal.

With the rise of Big Data research, we witness a gradual abandonment of case-study research. Whereas as the 1990s and 2000s were decades when countless case-studies were put forward as particular instances of general theories, for example agency theory (e.g. Dobres and Robb 2005), under the Third Science Revolution, the case-study seems to have simply become

1 Kristiansen & Larsson's (2005) *The Rise of Bronze Age Society* is a great example of the application of anthropological theory, namely the work of Mary Helms (1998) in order to contextualize the life of Bronze Age travellers.

a synonym of some empirical category: region, site, time period, a box of sherds, a box of bones, or a chemical compound. Part of why this has happened is that archaeologists felt the case-studies had little to no connection to the theories they were supposed to illustrate. In the words of Matthew Johnson (2006:119): '[t]he case studies offered in support of a particular theoretical position frequently do not match up to the claims made about them in the preceding theoretical excursus'.

It is fully understandable that when new and interesting perspectives on dealing with the archaeological past appear, archaeologists will naturally try to explore them. It is precisely in exploring what the Third Science Revolution has to offer that case-studies can provide so much more than assumed. In order to recognize their importance, it is crucial that we acknowledge the multiple understandings of what case-studies are and some of their shortcomings: one of the most familiar applications of the case-study is that described by Johnson (2006), in which it serves as a particular instance of a general theory or idea. This was particularly popular amongst agency theorists, who provided archaeological examples of 'practice', 'structuration', and 'agency'. There have been critiques of this type of theory and their case-studies (e.g. Boudon 1972) since, they often describe processes that are so general and abstract that anything and everything can be considered an example of 'practice' or 'agency'. Case-studies are also commonly understood as particular instances of general scientific hypotheses (Flyvbjerg 2006). There are several examples of natural scientific bias towards the use of case-studies, where it is assumed that a single case can illustrate a broader class of phenomena. For instance, a single case of migration, such as that of the Dust Bowl farmers' migration to California, was used by Carl Hempel (1942:40–45) to illustrate the universal tendency to migrate under dire conditions. What is problematic about this understanding is that it falls into the trap of assuming that a single case can corroborate universal tendencies. The only way a case-study is of any use in these situations is when a case directly contradicts a pre-established hypothesis of a universal kind (Flyvbjerg 2006:227; Popper 2002[1935]). Furthermore, case-studies are also regularly evoked as research that identifies elements that escape generalization. For instance, a thick description (Geertz 1973; Ryle 1949) of a social context, such as football match or a board meeting of a big company, can be quite revealing in terms of details that often go unrecognized in more generalizing research. While there is nothing inherently wrong in wanting to research that which is singular about the world (e.g. Mímisson & Magnússon 2014), when it is understood in this manner, with the meaning of 'case' as an instance of something is lost, case-study research simply becomes synonymous to field or empirical research.

Part of the problem surrounding how case-studies are conceived in archaeology derives precisely from the automatic bias that science has towards the quantitative, as Castoriadias (1984:209) has argued. A case-study is usually perceived as one instance of something quantitatively broader – but this is not the only way to recognize case-studies: case-studies can and should be *qualitative*. The most paradigmatic example of a qualitative case-study is Carlo Ginzburg's (1980) seminal *The Cheese and the Worms*. In this study, which is based on inquisitional records, Ginzburg (1980) re-constructs the sixteenth-century trial of a man who lived in rural northern Italy: a miller named Menocchio who was accused of heresy for having developed a personal religious worldview. This study became famous when it was published because at the time the predominant school of history in Europe was the *Annales* School, whose research was based primarily on quantification and positivist methods (Stone 1979), or in other words, remarkably similar to the approaches employed on Big Data that Kristiansen (2014) describes.

What made Ginzburg's (1980) *The Cheese and the Worms* such a compelling book, and a crucial element in dethroning the then dominant *Annales* School, was that it described humans as actual humans, that is to say, *as humans acting intentionally* and being able to explain those intentions. For Ginzburg, the quantitative methods employed by the *Annales* School meant paying a very high price in cognitive terms: they precluded the study of the ideational realm that operates in religious institutions, and in political history they reduced all past agents to their numerical value (Ginzburg 1993:21). What makes *The Cheese and the Worms* such a paradigmatic case-study is not its scale, which is what many scholars tend to overemphasize (e.g. Chartier 1982; Gregory 1999), nor how it represents sixteenth-century Italian popular culture, which it does not do very accurately (LaCapra 1985) – but because it truly represents ideological trends that were currently coursing through Europe at the time. To use Hegel's famous concept, the book is an accurate description of its *Zeitgeist*. The case described in *The Cheese and the Worms* is clearly singular: it cannot be compared to other cases nor can it be evoked as an example of everyday life in rural sixteenth-century Italy (Ginzburg 1980). However, being singular does not mean that the events described are completely accidental – Menocchio's trial in the *The Cheese and the Worms* could not have happened during the Palaeolithic nor would it make sense for it to happen today. *The Cheese and the Worms* makes sense as a case-study because it is a detailed insight into the general disillusionment of Christianity in Europe during the Reformation (Ginzburg 1980). It is in this sense that this study is qualitative – it highlights the connections between different actors, the relations of power, and pervading presence of ideology, and how this all affects agents and their intentional actions.

It is also in this sense that *less is more*. Whereas Big Data provides a wide-angle perspective into the archaeological past, it must be counter-balanced by close-up qualitative descriptions of human life. It is in these dialectical terms that perhaps Big Data and case-study research can be understood and produce higher quality research. Naturally, it is impossible to achieve the same level of detail as that of *The Cheese and the Worms* in archaeology, but it is not the detail that matters nor the scale, as Kristiansen (2014:19) assumes, but a matter of quantity vs. quality. In archaeology, quality is that vague and ambiguous aspect of life that Marila (2017) describes, and can be expressed by the *contextualist* theories that help us make sense of the *Zeitgeist* in which past agents were embroiled.

In conclusion, there seems no doubt that the Third Science Revolution has re-invigorated archaeological research, but at the same time, it carries the dangers of methodological monism with it. While these dangers might seem unimportant to those who have benefited from the Third Science Revolution, the dangers are very real to those who have dedicated their lives to understanding humans as the historically unique creatures that they are. This uniqueness is expressed most clearly in human teleology – in the unique things humans do and why they do it, from Romeo loving Juliet to challenging the ideology of the Church, or from re-distributing wealth in the form of feasting to sacrificing animals to ancestors to denote respect.

Methodological pluralism, at its most simple, holds that human reality is not reducible to the claims of the natural sciences. This does not imply an ontology that considers humans as exempt of causal connections; what it does imply is that *the understanding* of human social behaviour transcends the explanations that take the form of causes and effects (Von Wright 1971). In this sense, case-studies as representations of social behaviour are essential for understanding the trends and patterns evinced by research conducted according to the Third Science Revolution.

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