Whither Archaeology?

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Editor's note

As JJA has just passed its fifth-volume mark and is heading to the next five years of its existence as the official English language journal of the Japanese Archaeological Association, we are pleased to publish an article written by one of our editorial board members, Professor Sander van der Leeuw, one of the most prominent researchers and thinkers of the interface between archaeology and other scientific disciplines and between archaeological pasts and futures. In this paper, from the perspective of complexity science, Professor van der Leeuw shares with us his insights on the core nature and content of archaeology as a scientific discipline and his foresights as to how archaeology may or should develop for the future.

Introduction

After 25 years as an active archaeologist, in the Near East and in Europe, for the last twenty-odd years I have used my archaeological background to focus on the future of our planet and its societies, as an active member of the sustainability scholars community. When the editor of this Journal asked me to reflect on the future of archaeology as a discipline, I therefore first responded that I was no longer an archaeologist, and would have a hard time writing something useful about that topic. But after some discussion and reflection Prof. Misoguchi convinced me that a contribution along the lines he wished could be useful.

In particular, he argued that because I no longer was active as an archaeologist, I might be able to say something pertinent because the future of any field of study is not only determined by its practitioners, but also by other disciplines and fields of study to which it might contribute, and by society in a wider sense.

I will therefore try to present a view on the actual and potential roles of archaeology in a society that is increasingly rapidly changing and encountering novel, unheard of, challenges under the impact of such developments as climate change, the information technology revolution and a series of phenomena that increasingly point to the insufficiency of our current institutions and customs.

Much of that vision is not clearly based in specific experiences or observations that can be described in scientific terms, but is the cumulative sediment of personal experiences in different countries and as part of large trans-disciplinary teams. But it

is to an important extent influenced by my early years in archaeology, and may thus, I hope, contribute something useful to the readers of this Journal.

Some of archaeology's strengths and weaknesses

There has for a long time been a debate whether archaeology is actually a discipline in its own right. It is in so far as there is a community of archaeologists who identify themselves as such, but on the other hand it does not have a specific, unique, corpus of theories and hypotheses of the kind that characterizes other disciplines. Instead, it uses a wide range of ideas from other fields in its interpretations. I would argue that the *undisciplined intellectual nature of archaeology can also be one of its major strengths*. Archaeologists often have an education in the humanities and social sciences as well as in the natural and life sciences. The field uses ideas and techniques as well as instruments and metrics from all these groups of disciplines in original ways. It is one of the few fields of current intellectual endeavor that reaches as widely across the knowledge of mankind to interpret its findings, and, what is more, uses both quantitative and qualitative data. Archaeologists are thus as likely to understand the principles of atomic physics, as those of tectonics and genetics, mathematics and the humanities. That gives archaeologists often an advantage in working in trans-disciplinary teams. And it gives them huge freedom in the range of intellectual efforts they undertake. On the other hand, it imposes certain approaches and techniques that I have outlined in a recent paper (van der Leeuw 2017).

That freedom is further enhanced by the fact that archaeology has a very long verification/falsification cycle compared with many other disciplines. That begins with the fact that when excavating, archaeologists study the phenomena that they either recognize or, if they are novel, cognize. But many other phenomena that could be observed in the soil are simply destroyed because they remain uncognized. Then it takes a very long time to bring together all the data (glue the potsherds together, etc.), do the analyses and then come up with interpretations, so that scientifically contradicting the work of archaeologists often takes a very long time. Finally, no two archaeological sites are exactly the same, so that it is virtually impossible to compare results between excavations. Even with very thorough excavation and post-excavation work, there is therefore a degree of uncertainty about archaeological interpretations that is both a weakness and a strength, *as it accords more importance than other disciplines to the internal coherence of the explanations offered and gives more latitude to archaeologists in interpreting their results than is current in many other disciplines*. One of the strongest assets of archaeology is the fact that *it is the only approach that is able to go as far back in the history of human-environmental relations as several millions of years*.

There is often a debate about the usefulness of that perspective, as many people argue that the world has changed so much that knowing more about the distant past does not help us understand the present. I take issue with that point of view because, as I have argued with John Dearing and others (2010), it is based on a misunderstanding about how to draw lessons *from* the past *about* the present and *for* the future.

Most people use observations about the past as *analogues* to the present (or the future). That never works, as the present is indeed so different from the past that it is virtually impossible to project the one onto the other. However, an *evolutionary* approach that looks for the emergence of the trajectories that have ultimately led to the present, and may lead to the future, is indeed valid as it *studies how changes that have occurred throughout history have transformed the distant past into the present*. To achieve that goal we must complement our 'ex post' approach of looking at the origins in the past of things observed in the present with an 'ex ante' one that looks throughout the past, in the direction of the arrow of time, for the emergence of novelty and change.

Archaeology *contributes substantially to the satisfaction of the desire to have a vision about the past, about the origins of the present*. That desire is at the origins of the discipline, in the Renaissance and subsequent centuries, when the leisurely classes began excavating relics from 'classical' antiquity. In Europe the emergence of archaeology as a specialized field of study is part of a slow but important shift, from one in which most phenomena were explained by automatically invoking the past as in "… it has always been like that …," to one in which the novel category "nature" became increasingly important in explaining the present, and the focus of society shifted from the past to the future (Girard 1990).

It often seems to me that the *blossoming of archaeology is a compensation for the increased focus of our society on the future*, on rapid change, and novelty. One of the questions that we therefore need to consider concerning the future of the field is whether this trend will continue or not. Humans live a process of transforming the future into the past. *Can they conceive of and live a future without a past, or vice-versa?*

In the last 100 years, we have seen a major shift in the rationale for, and the role of, archaeology. In the first part of the 20th century interest in the archaeological past was predominantly scientific, and confined to a relatively small community. The goal of archaeology was *to know more* about the past. In the 1970's, that shifted. Because of the rapid expansion of cities, infrastructures and similar ventures that destroyed the subsoil, the preservation of archaeological remains themselves became increasingly important. Relatively rapidly that changed the nature of the funding of the discipline by linking it no longer to scientific priorities, but to the nature and extent of contemporary development. The activities the profession invested in changed as a result, often under the pressure of keeping archaeologists employed and active. Excavating and preserving

remains became more important, analysis, post-excavation work and scientific publication less so. But this trend also affected the kinds of objects that were being excavated, and the overall archaeological research strategy. *The field as a whole lost some of its early focus on understanding the past in favor of preserving it.* Is that a continuing trend, or will the future bring changes in this respect?

An incredibly striking characteristic of archaeology over my lifetime has been its increasing incorporation of techniques and ideas from other fields, in particular the natural, earth and life sciences. *The community of archaeologists has been very open-minded and quick to see the advantages of adopting novel inventions.* Will that trend continue? As our world is increasingly driven and enabled by "big data," what are the challenges and opportunities this development offers to archaeology? And how about machine learning, artificial intelligence and developments related to these innovations? Can some of archaeology be automated, or not?

There are major "tectonic" trends active under the surface of the wider scientific landscape. One of them is the *increasing loss of trust in science and scholarship.* Will that trend affect archaeology? Another trend is the *rapid explosion of novel ways to treat and communicate information.* How might that trend affect the nature and status of our discipline? As part of that trend, the conventional distinctions between "signal" and "noise" in information processing are disappearing, and this is likely to ultimately affect what is considered "scientific" or accepted as "true." It gives rise to what are currently called "alternative truths"—multiple simultaneous perspectives on our world, on the past and on the present that are competing for the attention of the wider public.

The context

My answers to most of these questions are closely tied to the vision that I have on societal and environmental developments over the next few decennia. Of course that vision is both partial and biased. It distinguishes three major trends for the remainder of this century.

One of these is the need to overcome the current, consumerist, resource-to-waste economy controlled by "the market," and in many ways even more narrowly by the world of finance. That transition will be forced upon us by climate change, resource depletion and major changes in the biochemical cycles of the Earth system such as ocean acidification. But the changes it will entail will require major transformations in our institutions, our governance and, more profoundly, our mindsets.

The second major trend is the rapid evolution in the way in which societies deal with information processing. We are in this domain, worldwide, at the beginning of changes that are so huge that at present we cannot even conceive them to their full extent. Their

impact will completely change our civilizations; it will be of an order of magnitude comparable to the discovery, for example, of fire, of agriculture and herding, of the use of fossil energy at other moments in the human past.

The third change that I postulate is dependent on the outcome of the field of tension between increased and decreased integration across societies and political entities. On the one hand we observe in current debates a drive towards increased integration of multiple societies into larger economic or political entities based on treaties and other measures to facilitate trade and exchange. But on the other hand we see in many places a strong reaction against this that is rooted in the need for local and regional societies to have their own identities, to determine their own futures. Part of this is a field of tension between 'top down' and 'bottom up,' between rich and poor, but it goes much deeper than that, touching on the fundamental values of people. For the moment we cannot see the outcome of this tussle, or how it might affect the future of our societies.

Archaeology in the Anthropocene

The easy part of looking into the future of archaeology is its relationship to the increasing concerns about the Anthropocene—the advent of an era in which human societies essentially control so many of the natural dynamics of the Earth system that we need to change our way of looking at the nature-society relationship. Redman and I argued already in 2002 that the growing interest in the long-term evolution of human-environmental relationships offered a major opportunity for archaeology to expand into a growing area of new research with direct and important relevance for our understanding of the present. Archaeology is, as mentioned, the only discipline that is focused on improving our understanding of the long-term evolution of human-environmental dynamics on the planet. Knowledge of those dynamics over the very long term contributes insights no other discipline or field of study can contribute.

It allows us to monitor and describe the very slow socio-environmental processes that can only be observed on millennial or longer timescales, such as micro-tectonics, long-term climate change or millennial cultural developments. It also allows us to monitor the interaction between societies and a much wider range of environmental conditions than we can possibly do by studying the present. It further enables us to study the evolution from a nature-dominated environment to a human-dominated one. And last but not least it allows us to study the second-order changes in socio-environmental dynamics—the changes in the ways dynamics change.

Modern archaeological techniques allow us to monitor so many aspects of environmental dynamics through time, including those of non-human living organisms, and in interaction with humans, that the archaeological record is proving a major asset in

our efforts to understand the emergence of technologies, institutions, societies and their environments in the pre-historic past.

As we are only at the beginning of studying the Anthropocene in an integrated way, it seems to me that archaeology has, in this domain, an important and productive future in front of it. In the process, our community will integrate yet more and different methods and techniques from physics, earth sciences, biology and related fields. But to be successful our community will also have to explore novel ways to build bridges, and create intellectual fusion, between the various disciplines involved, such as the humanities and the natural sciences. It will in that area hugely profit from further expanding and deepening a systemic, evolutionary perspective on the trajectories that have led different societies from the distant past to the present.

By combining the detailed measurement of environmental dynamics through time with the knowledge that is gained in archaeology, history and anthropology, our field of study can develop a unique vision on the long-term co-evolution of socio-environmental systems, but it can also present important insights in the societal dynamics that have, after two millennia, driven western society to its current unsustainable relationship with the environment. Other important insights it can provide concern the ways in which many societies on Earth, after a considerable period of blossoming, have disintegrated.

In this context it is of fundamental importance that sustainability in the Anthropocene be *viewed as a societal challenge rather than an environmental one*. After all, societies define what they consider their environments, what might be the things in those environments they see as challenges, and also what might be solutions to deal with them. They do not do so in interaction with their environment, but entirely among the members of society themselves. Until now, much of sustainability science is considering its issues as either environmental or as part of the relationship between society and the environment. They are not—the core of the sustainability conundrum concerns the ways in which our current societies have developed themselves, and transformed their environments in the process. The long-term perspective of archaeologists, as eminently trans-disciplinary scholars with credibility in the natural, life, and social sciences, can bring this point home and point in directions that can help the transition towards a sustainable Anthropocene.

Archaeology and the Information and Communication Technology (ICT) revolution

There are two aspects of the rapid evolution of digital technologies that I think will have a major impact on the future of archaeology. The first of these is the fact that numerous new methods and techniques have been—and will continue to be—developed

that can help archaeologists manage the huge quantities of data they gather, process and interpret. The other major impact of the ICT revolution, which is much more difficult to conceptualize except in the sketchiest of terms, is on our own societies and their internal and environmental dynamics. In this section, I will try to sketch my vision on some aspects of both.

Beginning with the development of innovative techniques of data processing that can be used in archaeology, allow me first to point to some relatively simple ones that have had a major impact on our data processing in excavations. My favorite example is the introduction of the barcode (and more recently the QR system), which has had major consequences for the processing of samples and artifacts during excavations. Coupled with the increased use of electronic data processing, from the use of total stations to ground-penetrating radar and CAD-CAM techniques, the last twenty-five years have seen a true revolution in archaeology. But I suspect that that is only the beginning. Archaeology will soon, if it is not already, hit the edge of the "big data" revolution that is in the process of transforming all domains of science by introducing ways in which literally everything can be measured. In the process, techniques are being developed to store and process the massive quantities of information that are thus gathered and studied.

Those techniques are in my opinion a major domain of development that can be of use to archaeology, but where archaeology can also help information technology by prompting it to contribute to solving some of its challenges. In the domain of data storage and treatment, archaeology is particular in that it involves data and information of many different kinds, both quantitative and qualitative, both narratives and images. As a result, in a society that is increasingly driven by "big data," and in which it is probable that more and more research will be based on data stored in databases, and less and less on new (and costly) field research, archaeology will for example in a major way be confronted by the need to improve understanding of the epistemologies, methods and techniques involved in the collection of different data-sets that originated in other disciplines.

The development of tools to more easily create, access and interpret huge databases containing many such different kinds of data is an ongoing challenge, which archaeologists are trying to meet in several places. In the USA, for example, the Digital Antiquity project at Arizona State University does so. But there is much more to be done in that domain. The introduction of 3-D imagery and 3-D modeling software, for example, will add new dimensions to this work by enabling virtual storage of 3-D objects in ways that are easily searchable, while 3-D printing will facilitate the production of complex physical models of anything from artifacts to sites.

Two other, related domains in which novel developments will hugely help and speed

up archaeological data processing are pattern recognition and machine learning. Recent years have seen a major turnaround in this domain. Rather than create systems in which expert knowledge was programmed to help recognize patterns, recent developments have enabled the acquisition of understanding from data by confronting complex, multi-layer network computers with raw data and 'training' them to recognize patterns in those data, thus transforming very large quantities of data into manageable quantities of information. Here again archaeology poses its own challenges, but these can be turned into advantages by stimulating new technologies.

As a last example in this domain I want to mention the development of a wide range of techniques to model various kinds of processes, relationships and interactions. These facilitate for us the use of "*in silico*" (computer) experiments in which we can construct complex dynamic relationships and study how they play out over time. This is a rapidly growing and very important field that in my opinion is not yet used to capacity. Recent developments in computer hardware and software have enabled us to go far beyond the very primitive models that were being advocated in the '80's and '90's of the last century. Currently, complex interactions between millions of networked agents can technically be modeled. Once archaeologists have developed better ideas of the many ways in which individuals in groups, societies and populations can interact, for example by building on developments in cognition and individual and collective decision-making, I do believe this is another area in which we will quickly see quantum jumps in our understanding.

But let us now turn to the other topic of this section—how the ICT revolution is likely to change our societies themselves. Seeing how much unanticipated change has occurred in the last twenty years, I do this with much hesitation and aware that two, three or five years from now all that I can say on this topic may be outdated. However, there is one major point that I think stands out, and will do so for some time: the loss of the clear distinction in societal information processing between signal and noise.

Until very recently (in terms of human evolution) individual societies had ways to distinguish between what they esteemed as 'signals' in communication and all those other impulses that they relegated to the status of 'noise.' The ICT revolution has changed that by enabling anyone to communicate with anyone and everyone in the world. That loss of control over information processing has changed the status of 'information' itself, which is of course dependent on that distinction between signal and noise.

In due course, this will result in changes in the relationship between data and observations on the one hand, and knowledge or understanding on the other. Knowledge or understanding enables someone to interpret patterned data and observations, relating them to ideas, but the fact that the data never completely fit the extant ideas exactly allows the person interpreting them to enhance his or her knowledge and understanding. Over time, this has enabled societies to develop, path-dependently, different relationships

between observations and knowledge or understanding.

But the reciprocity between the two can also facilitate the reverse: to use personal insights or opinions to elaborate presumed 'data' and 'observations.' In our societies (and our sciences) we have thus far generally adopted the first of these interactions, gaining knowledge and understanding by observing patterns in the realm of phenomena. Now, however, there are people and places on the Internet where the reverse is done, whether deliberately or by default. They present 'data' or 'factoids' that are constructed based on their worldview. In itself that is nothing new—the rumor mill has always, in every society, had this effect. But in the global information society it is often much more difficult, or even impossible, to find out how any piece of "information" has emerged, and what its relationship to the realm of phenomena is. In due course that could fundamentally undermine the existence of all social institutions, and of the societies that have created them.

History has in many societies played an important role in anchoring the distinction between 'signal' and 'noise' in the past, in the process shaping the identity and the values that distinguished different societies. In societies where there was no conscious and explicit concept of 'our past' the same role was fulfilled by beliefs reflected in narratives, myths or other means (such as the Australian Aborigines' "dreamtime" for example). Archaeology may therefore have a role to play in shaping one or more pasts for humanity that could help anchor our societies.

Archaeology, identity and globalization

Looking back over the past of our western societies, but also over the history of other political entities throughout history, one observes, at different spatial scales, a field of tension between the geographic growth of such entities, and their reduction into numerous smaller entities. To understand what is going on from an information-processing perspective it is interesting to look at the current interaction between 'globalization' and 'populist' or 'nationalist' trends. The former have, over the last century for example, on several occasions brought about some form of internationalization: intensification of interactions (trade, tourism, etc.) between different societies with different cultures. Part of that trend has been a growing (and often forced) adhesion to specific values that were being promoted by a dominant (part of a) society. In our present case, this has led to the predominance of wealth and money as the main value in terms of which differences between people, groups or whole societies are measured. The many other values of each of the societies involved were downgraded to lesser importance in the process. Essentially the same process has enabled the emergence of what we call "the Roman Empire" or any other major political entity: the alignment of different societies on a specific, reduced

set of (more or less) shared values, which are essentially those of the dominant socio-political entity. Following an approach first suggested by the economic anthropologist Polanyi (1944), I think that in each such situation there comes a time when this triggers a socio-cultural and political reaction among the people concerned.

In the simplest of terms, people have two major social needs: to be part of a group, and to be able to distinguish themselves within that group. Those two needs can only be satisfied simultaneously if (a) the society has a value system with which individuals can identify, and (b) that value system has so many dimensions that individuals can feel valued if they excel with respect to one or more of those values. All coherent social systems must therefore be rooted in a high-dimensional shared value system so that individuals can distinguish themselves differentially within that value system. Once a process such as globalization begins to reduce the dimensionality of value systems, this creates major tensions in the societies concerned. Rather than accept the (culturally impoverishing) changes imposed "top down" by the dominant society, class or culture, people will revive their own values and resist the "globalizing" trend. That is what we are currently seeing in many parts of the world, where societies are withdrawing from globalization.

How is this relevant for archaeology? Well, archaeology has emerged in many places as a discipline that contributes in major ways to the creation of an identity for socio-cultural groups or nations. In the 19th century, archaeology played a major role in the creation of identities for France, Germany, and Greece, for example, and currently it is playing the same role in such different nations as Egypt, Mexico, the indigenous nations of North America, etc. And in the 20th and 21st century in many places in Europe the shift from scientific archaeology to cultural resource management has subtly transformed the role of archaeology from enhancing and deepening a universalist scientific perspective on the world to one that is rooted in, and strives to preserve, different cultures by protecting and preserving their remains.

In an essay with profound implications for our community, Olivier (2011) has pointed out that because archaeology interacts both with the present and the past, it projects and anchors in the past certain values that are dominant in the present. Once thus anchored, these values are difficult to change, exactly because they are located in the past. Hence, archaeology will play a major role in the outcome of the tussle between globalization and localization, between larger and smaller socio-political units and value systems, by contibuting to the creation of identities for the individuals, groups and societies concerned.

Conclusion

In this short paper, I have tried to word some of my 30,000 feet (10 km.!) high perspective on the context in which I think archaeology will evolve in the next few decades. As in any exercise in thinking about the future, much is unclear. But one thing stands out: like our societies more widely, our archaeological community will have to integrate, even more than it is doing to date, the fact that everything we observe and do is subject to increasingly rapid change. I would argue that that entails another major change for us.

Thus far, generally, archaeology assumes stability and explains (or tries to) change. It has still very much a 'staircase' model of past evolutions. That stems from the wider Aristotelian assumptions to that effect in our culture and our science. In as far as I can see, one of the imperatives of future work is that we let go of those tenets and adopt Heraclitus of Ephesus' perspective: "Everything changes, nothing ever remains the same." Thus, we may need to assume change as ubiquitous and begin to explain why at certain times in the past stability dominated. That would require very different ways of designing and using theories in our work!

But as I have tried to outline in the first section of the paper, I think there are characteristics of archaeology as a field that make it eminently suited to play a major role in the kinds of intellectual and societal transitions that are going to be required: openness, trans-disciplinarity astride all disciplines, focus on internal cohesion of explanations, rapid adoption of new techniques and methods…

References

Dearing, J., A.K. Braimoh, A. Reenberg, B.L. Turner II, & S.E. van der Leeuw. 2010. Complex land systems: the need for long time perspectives to assess their future. *Ecology and Society* 15(4): 21. [online] URL: http://www.ecologyandsociety.org/vol15/iss4/art21/

Girard, R. 1990. Innovation and Repetition. *SubStance* 19(2/3): 7–20.

Olivier, L. 2011. *Le Sombre Abîme du Temps* (English edition: *The Dark Abyss of Time: Archaeology and Memory*, Lanham, MD: AltaMira Press)

Polanyi, K. 1944→2001. *The Great Transformation: The political and economic origins of our time* (2nd Edition). Boston: Beacon Press.

van der Leeuw, S.E. 2017. It is all a question of discipline…, in L. Manolakakis, N. Schlanger & A. Coudart (eds.) *Europe: Identités et migrations/Europe: Identities and migrations* 31–42. Leyden: Sidestone Press.