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Forty years and still growing: *Journal of Archaeological Science* looks to the future

Robin Torrence [a, *], Marcos Martinón-Torres [b, 1], Th. Rehren [c, 2]

[a] Geosciences and Archaeology, Australian Museum, 6 College Street, Sydney, NSW 2010, Australia
[b] UCL Institute of Archaeology, 31-34 Gordon Square, London WC1H 0PY, UK
[c] UCL Qatar, Education City, Doha, Qatar

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A B S T R A C T

This special issue honours Richard Klein's outstanding contributions to archaeology through his seminal role as a senior editor for the *Journal of Archaeological Science* (*JAS*). The papers presented here assess achievements in archaeological science during the 40 years of research since *JAS* began, and scope the future within evolutionary and social theory in archaeology and across the fields of dating, aDNA, environmental reconstruction, diet, subsistence, artefact technology and function, and provenancing. Science is shown to be integral to archaeology as a whole, but challenges are identified particularly in the continuing search for new methods to answer key questions and the maintenance of rigour, significance, sustainability and social responsibility.

1. Honouring achievements

For forty years the *Journal of Archaeological Science* (*JAS*) has played a major role in shaping the discipline of archaeology as a whole. Despite the important contributions of *Archaeometry* (founded in 1958), when *JAS* was initiated sixteen years later, scientific techniques were still often envisaged as something additional, practiced by specialists largely placed outside the field, and whose expertise was only called on when required – or as an entertainment for curious scientists towards the end of their career. In contrast, by 2015 what had previously been described as 'the application of scientific techniques to archaeology' has morphed into 'archaeological science', which comprises a large, diverse body of theory and method that has become essential for answering questions about the human past. What has made *JAS* unique throughout its history – so much so that a raft of newer journals are attempting to follow in its tracks – has been the focus on the use of science in addressing significant archaeological problems. In fact one could argue that 'archaeological science' is a key ingredient in current top-notch 'archaeology', to the extent that differentiating between the two fields is increasingly difficult and pointless (Killick, 2005; Martinón-Torres and Killick, in press). No longer is *JAS* a 'niche' journal. It has become the 'go to' venue for exciting new developments in the discipline of archaeology as a whole. *JAS* publishes papers that produce results central to major debates within archaeology as well as providing a venue for the introduction, development and discussion of a vast range of scientific approaches. This integration of science and archaeology, however, did not happen overnight and by itself. We have the past editors of *JAS* to thank for their efforts in recognising the need for and providing a place for the development of archaeology as a whole through the incorporation of scientific methods and theory.

Among the various editors of *JAS*, the most significant has been Richard Klein (Fig. 1). He joined the Editorial Board in 1978 and became a senior editor in 1981. He has therefore been a major force in the journal for 80 per cent of its history! His first edited volume (1982; vol. 9) comprised 4 issues with 28 articles (plus book reviews) filling 409 pages. The topics of the articles covered a broad spectrum that included dating, both zooarchaeology and archaeobotany, statistical approaches, geochemical analyses and characterisation, and a pioneering study that employed gas chromatography to detect organic residues in storage jars. In the same year, the proceedings of a landmark round table were published, where leading archaeologists and scientists tried to find ways to resolve their seemingly incompatible concerns, jargon, and lack of mutual awareness (Olin, 1982). But the early volumes

* Corresponding author. Tel.: +61 2 93191030.
E-mail addresses: robin.torrence@austmus.gov.au (R. Torrence), m.martinon-torres@ucl.ac.uk (M. Martinón-Torres), th.rehren@ucl.ac.uk (Th. Rehren).
[1] Tel.: +44 20 76797496.
[2] Tel.: +974 44 578683.

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Fig. 1. Richard Klein, 2014, with his favourite hat (Photo: Mark D. McCoy).

nurtured by Klein and the *JAS* editorial team were already well on track to establish archaeological science as an integrated field that produced results relevant to a very broad audience. Consequently, under the guidance of Richard Klein and his fellow editors *JAS* has grown considerably to become the leader in its field. The 2014 set of 12 volumes presented 480 articles over 5128 pages, representing a more than 10-fold increase in size. The range of studies has also vastly expanded to include an immense array of ideas and methods that are now firmly incorporated within the broader discipline of archaeology.

After 40 years, it is therefore highly fitting that this special issue of *JAS* brings together papers that traverse the entire range of archaeological science, to acknowledge the fundamental role of Richard Klein in the history of our discipline and to honour him on his retirement from his senior editorial role. *Scoping the Future of Archaeological Science* was put together by first inviting members of the current Editorial Board to write papers assessing the state of the art and looking to the future of their specialist field within archaeological science. Not everyone was able to meet the deadline set by our goal to have the issue ready soon after Richard stepped down, but many could bring their skills to the reviewing process. We then expanded the group to include active younger scholars in key research areas, a number of whom, not surprisingly, are Richard's students.

The authors were asked to address searching questions about their chosen speciality. What have been the major achievements? What are the major challenges for future research? What new research might overcome potential stumbling blocks? What are the likely advances for the next 40 years of archaeological science? The broad range of papers covers theory, method and two excellent case studies that are particularly relevant to Richard's own research: the spread of modern humans out of Africa (O'Connell and Allen, 2015) and extinctions of megafauna in North America (Grayson and Meltzer, 2015). Although the authors have concentrated on research within a particular subfield in archaeology, it is notable that all the papers refer to the necessity for continuing and expanding collaborations between archaeology and an impressively wide range of scientific disciplines. Perhaps the truly multidisciplinary nature of archaeological science helps explain its rapid growth and expansion into new areas.

Written in an engaging style, the essays comprise an invaluable introduction to specialist fields for students and practicing archaeologists alike because they raise fundamental issues and identify key areas for future research. While the volume is not fully comprehensive of archaeological science, the broader issues raised by the authors provide an excellent guide to the field as a whole.

2. Integrating theory

One of the themes underscoring the bulk of the contributions to this special issue is that the current prosperity (if not maturity) of archaeological science is in large part due to a closer integration between theory and data (Martinón-Torres and Killick, in press). In his review, Killick (2015) applauds the fact that the old reluctance, even suspicion, against archaeological science is now largely overcome, mainly because the purposes and results of scientific analyses are increasingly integrated into broader discussions about the human past. For decades, evolutionary archaeologists have been exemplarily explicit in their attempts to use formal modelling in their hypothesis-driven research. Codding and Bird (2015) highlight the benefits of employing human behavioral ecology (HBE) to structure research primarily focused on subsistence and settlement, although they also review models relevant for understanding social change. Their review goes substantially beyond the commonly employed Prey and Patch Choice models to discuss the potential of Ideal Distribution Models that take into account population and social dynamics including models of social hierarchies. The growing importance of studies employing faunal data that use HBE to better understand past subsistence and land use are also highlighted by case studies discussed in Thomas (2015b), Steele (2015) and Barton and Torrence (2015). In contrast, Lycett's (2015) phylogenetic approach to evolutionary theory is based on concepts of cultural change derived from social transmission theory. In this case the emphasis is on material culture and specifically stylistic change. He recognises that a potential difficulty with what he terms 'cultural evolution' is that the methods and theory have been derived from outside the discipline, primarily within cladistics, but he is positive that the trend to bring these into archaeology and modify them as needed will yield significant understandings of human behaviour.

Another body of theory widely shared among the papers centres on the life-history or social biography of materials (e.g., Kopytoff, 1986; Gosden and Marshall, 1999) as a framework for understanding innovation, selection, manufacture and exchange of goods. For example, independently, and irrespective of the material they focus on (i.e. copper, iron, glass), three papers (Bray et al., 2015; Charlton, 2015; Rehren and Freestone, 2015) develop different models regarding the organisation of artefact production, exchange and re-use that can be tested against the data. They also emphasise the variety of raw materials, manufacturing processes, cycles of recycling and other modifications affecting the geochemical signature of the metal and glass samples studied. These papers reinvigorate some of the important challenges facing traditional provenance studies. Far from shying away from these, however, they hint at a shift in orientation that is both promising and necessary. In addition, Rehren and Freestone (2015) urge researchers to transcend the simple documentation of inventions and innovations in technology in favour of trying to explain 'why' and 'how'. Rather than studying artefact technology and provenance as separate areas of interest, all of these authors recognise that considering both together is inevitable. It will be interesting to see how this broad focus on life-histories develops in comparison to studies of mobility patterns and social exchange within research on stone raw material and tools, since this field has a longer history of using staged manufacture and re-use to track human behaviour. Unfortunately, reconstructions of spatial patterns of lithics based on geochemical provenance data have run into serious difficulties