Journal of Archaeological Science 163 (2024) 105933

Contents lists available at ScienceDirect

Journal of Archaeological Science

journal homepage: www.elsevier.com/locate/jas

Editorial

Archaeological science in Africa: Twenty-one papers for the twenty-first century

A R T I C L E I N F O

Keywords
Africa
Archaeological science
Regional imbalances
Thematic diversity
Capacity-building

A B S T R A C T

Understanding of Africa's long, complex human history has been enriched by the work of archaeological scientists for over a century. Since 1977 over 500 papers on African topics have been published in the *Journal of Archaeological Science*. This paper briefly reviews the geographical location of the research that they report along with their authorship and thematic content. Significant imbalances highlight continuing disparities in archaeological opportunities within the continent and between Africa and the rest of the world. The twenty-one papers included in this special collection nevertheless showcase the breadth of archaeological science in Africa, focusing on papers that have shaped subsequent research, explored new methodological approaches, or introduced novel areas of study. Discussion of how to capitalise upon this diversity emphasises the importance of increasing funding for archaeological science on a sustainable basis, forging co-operation between archaeologists and other scientists, playing to strengths in less expensive (but potentially highly informative) areas of archaeological science, and developing regional hubs of expertise. Collectively, these efforts can enhance capacity and ensure a future for archaeological science research by African scholars within Africa.

1. Introduction

Africa has the longest — and arguably most complex — history of any continent. It saw not only the evolution of the hominin clade but also the emergence of *Homo sapiens* as well as some of the very earliest manifestations of the complex cognitive abilities associated with our own species (Barham and Mitchell, 2008). While many textbooks still neglect what followed *Homo sapiens*' expansion out of Africa, decades of research have documented a great diversity of pathways toward resource intensification, multiple strategies of food-production — some of them unusual at a global level (cf. Marshall and Hildebrand, 2002) — and a distinctive transition south of the Sahara from lithic technologies to iron-working that still demands clarification (Mapunda, 2013). Based on a combination of metallurgy and farming, in many parts of Africa over the past 2000 years communities then went on to develop their own particular configurations of urbanism, statehood, and long-distance trade, sometimes (but not always) enmeshed with exchange partners on other continents and frequently predicated on systems of power and resource control at variance with those found elsewhere (Connah, 2016). The result has been a rich historical tapestry that continues to surprise, one that challenges models developed in other parts of the world and encourages efforts to decolonise long-established Eurocentric understandings of the past (e.g. McIntosh, 1999; Chirikure, 2021).

Archaeological science is a crucial component of these efforts and has been almost from the start of archaeological research in Africa. Nearly a century ago, for example, geological observations along South Africa's Vaal River and at the Victoria Falls on the border between Zambia and Zimbabwe were used along with what we now know to have been a flawed correlation between northern hemisphere glaciations and periods of enhanced rainfall ('pluvials') in southern Africa to estimate the age of stone tool industries assigned to the newly devised Early and Middle Stone Ages (Goodwin and van Riet Lowe, 1929). At the same time, physical scientists and bead specialists analysed glass beads (which were also important chronological indicators) and metal artefacts from Great Zimbabwe, southern Africa's most architecturally impressive archaeological site, to identify their provenance and mode of manufacture (Beck, 1931; Stanley and Desch, 1931). Meanwhile, bioanthropologists investigated the individual life-histories of Egyptian mummies, notably that of king Tutankhamun (Derry, 1927), and pioneer anthropologists and colonial officials recorded the incredible diversity of African ways of making pottery and smelting and working metal (Chirikure, 2013; Gosselain and Livingstone Smith, 2013).

Such efforts gathered pace as fieldwork increased and new university and museum institutions were established when most African countries regained their independence in the late 1950s and 1960s. At the same time, archaeologists increasingly extended their interests from a much more distant Stone Age past to also encompass the more immediate histories of contemporary populations (e.g. Hall, 1990). Although in its earliest years contributions to the *Journal of Archaeological Science (JAS)* from Africa continued to emphasise the Pleistocene, a much fuller range of topics quickly established itself and has continued since. We are delighted to bring together a selection of those papers here.

All told, *JAS* published 550 papers on African topics between 1977 and 2023 (Fig. 1), representing a large regional focus for the journal, reaching >20% in some years, although more frequently accounting for around 10% of the total number of papers published in any one year. By far the largest number of these papers report on archaeological sites and materials from just two countries, South Africa (N = 200, 36.4%) and

https://doi.org/10.1016/j.jas.2023.105933

Available online 9 January 2024
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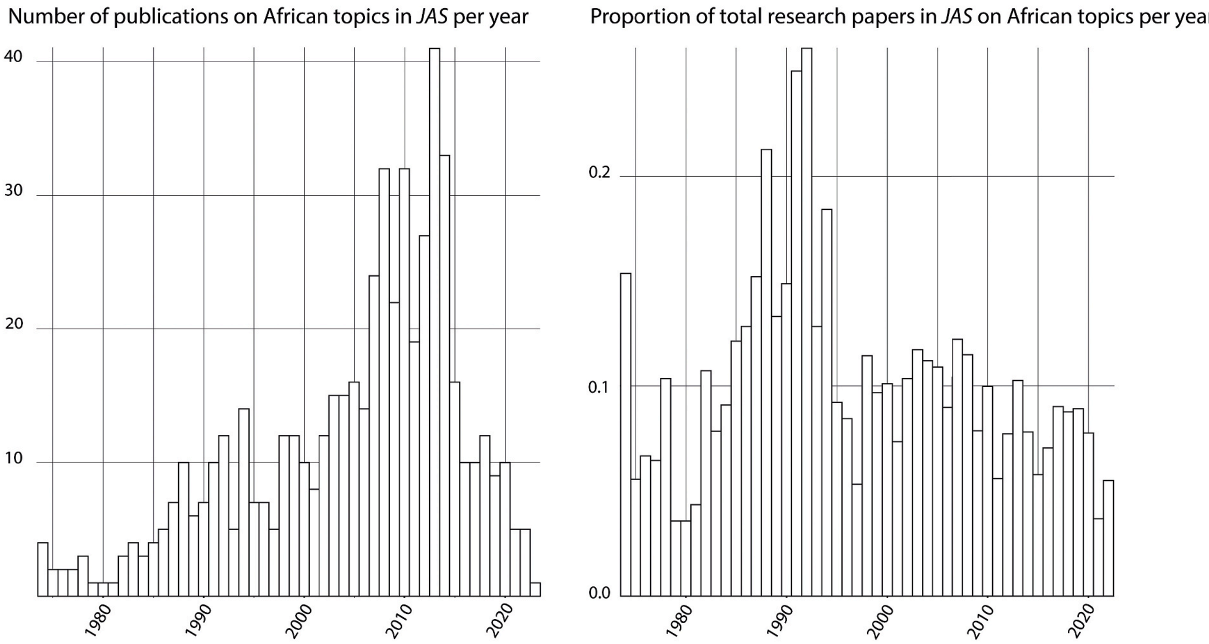

Fig. 1. Number of publications on African topics in the *Journal of Archaeological Science* by year (left) compared to the relative proportion of all papers published in the journal (right) between 1974 and 2023.

Egypt (N = 104, 18.9%) (Fig. 2). While this partly reflects the very large community of researchers engaged in uncovering the archaeological remains left by Pharaonic Egypt and its immediate prehistoric antecedents, in both Egypt and more particularly South Africa it is also due to the in-country presence of well-established research clusters in many fields of archaeological science. In South Africa, for instance, the push to create departments of archaeology at several universities in the 1960s and 1970s saw interest surge in archaeometallurgy, radiometric dating (following the establishment of the Pretoria radiocarbon dating laboratory in 1969; Vogel and Marais, 1971), and stable isotope research. Indeed, in the latter field it was South African researchers who pioneered many key methodological breakthroughs as they explored topics such as diet and seasonal mobility on a temporal scale ranging from early hominins to Iron Age farmers (Schoeninger, 2014; Loftus et al., 2016).

Compared to Egypt and South Africa, however, other parts of the

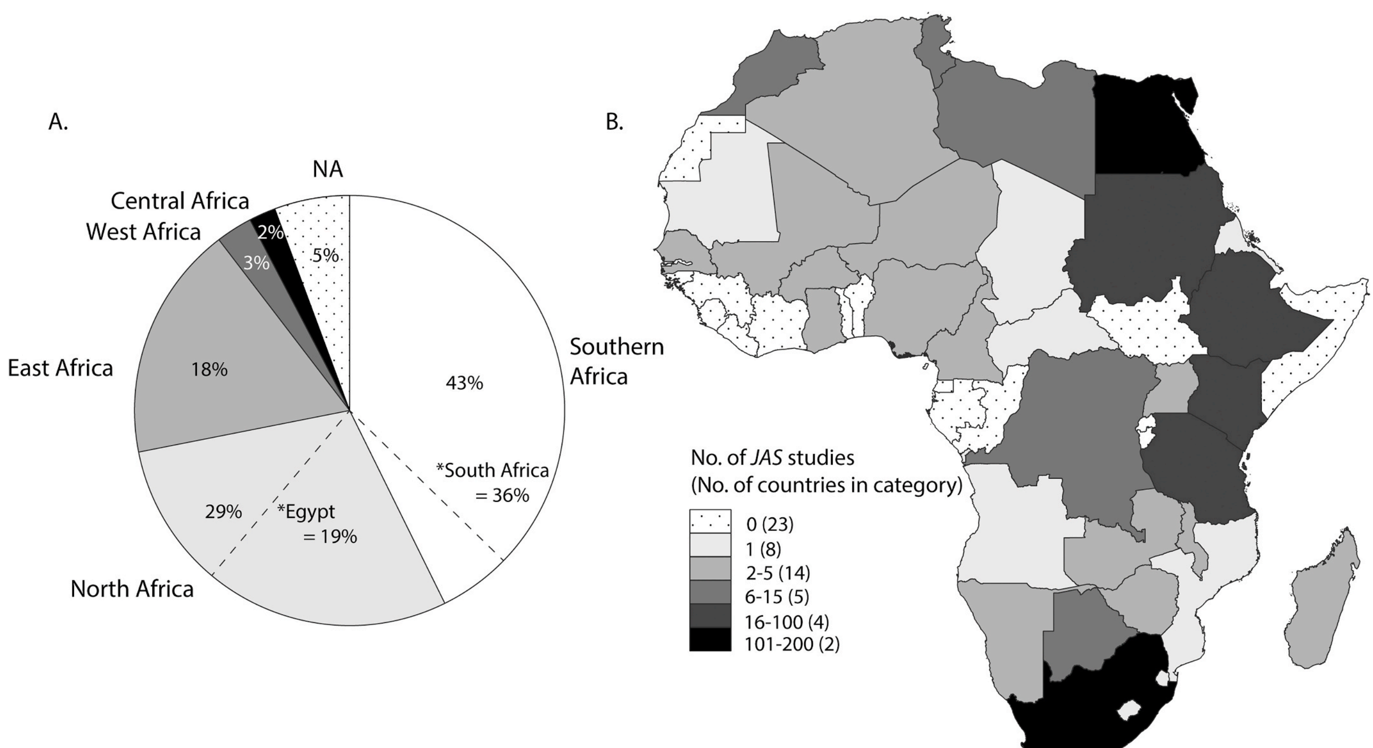

Fig. 2. Regional proportions of the 550 papers on African topics published in the *Journal of Archaeological Science* between 1974 and 2023 with Egypt and South Africa highlighted within their respective regions (left) and the absolute number of such publications by country (at right).

continent are woefully under-represented. Notwithstanding the creation and success of facilities such as the Cheiki Anta Diop radiocarbon laboratory in Dakar, Senegal, and the palynology laboratory at the University of Ibadan, Nigeria, West and Central Africa collectively account for well under ten percent of the total number of African-based papers that *JAS* has published since its inception, averaging between them less than one paper per year. Relative to South Africa, both regions have less well-funded archaeological infrastructures, even at these long-established departments, while political instability and less robust economies have frequently handicapped basic field research and the institutionalisation of the often-expensive facilities that archaeological science demands. Conversely, East Africa has featured considerably more often in *JAS*' pages, at least partly because of its greater stability and its centrality to key debates in hominin evolution.

If geographical coverage shows pronounced preferences for some countries and regions over others, thematic content has been broader. Analysis of authors' keywords underlines the importance of *JAS* as a venue for exploring human evolution, but also identifies a wide range of other topics, among them geochemical analysis of finds, palaeoenvironmental reconstruction, experimental archaeology, provenance studies, site formation processes, and chronology (Table 1). We have attempted to reflect this diversity in the content of this articles collection, although we are conscious that *JAS* is by no means the only outlet for papers in archaeological science that relate to African sites and themes. The *Journal of Human Evolution*, for example, unquestionably captures many of those concerned with the biological and cultural aspects of hominin evolution, while other scientifically focused analyses appear in international journals like *Antiquity* as well as those with a specifically African focus, particularly *African Archaeological Review*, *Azania: Archaeological Research in Africa*, the *Journal of African Archaeology*, and the *South African Archaeological Bulletin* (see, for example, Lane and Reid, 2015; Mitchell and Seneši, 2022; Gokee and Ogundiran, 2023).

The papers we have just cited identify two further trends of importance that are also evident among the African-related papers published by *JAS*. Both concern issues of diversity. First, male first authors are, as far as we have been able to judge based on author names, more common than those of female scholars, although this ratio has dramatically improved over time, from 0.25 in 1974–1999 to around 0.41 in 2000–2023 (Table 2). And second, the overwhelming majority of the 550 papers we have identified have European or North American, rather than African or African-based, scholars as their lead (or only) authors. Both disparities, but especially the second, demand continued disciplinary attention if African archaeology — and archaeological science within and about Africa — is to become the inclusive endeavour that we seek.

Table 1
Principal topics explored in African-specific papers published in the *Journal of Archaeological Science* between 1974 and 2023 as defined by keyword ($\geq$ 30 instances). Note that some papers use more than one of the keywords featured here and that the names of countries and regions have been excluded from the analysis.

Keyword	Number of papers in which present
Faunal analysis	100
Middle Stone Age	95
Taphonomy	86
Geochemical analysis	74
Lithic analysis	74
Bone	53
Palaeoenvironment	53
Experimental archaeology	48
Provenance	47
Site formation	45
Chronology	44
Hominins	44
Geoarchaeology	42
Forager	39
Technology	39
Microscopy	38
Later Stone Age	35
Spatial analysis	35
Palaeodiet	33
Archaeometallurgy	32
Dietary isotopes	21
Early Stone Age	31

2. The papers

Selecting less than two dozen papers from more than 500 to provide a sense of the diversity and strengths of archaeological science as it has been practised in Africa over the last half-century has not been easy. In making our choice as to what to include and what to exclude we have, in the first instance, sought to avoid overlap with other collations from *JAS*, such as that on stable isotope research (Makarewicz et al., 2023). Secondly, while we have noted differences in how far individual papers have, or have not, been widely cited, this has not been a determinant factor. More important has been our identification of papers that we think have contributed significantly by shaping the direction of subsequent research, initiating new areas of study, or showcasing major methodological advances. In doing this we have therefore sometimes prioritised relatively new papers reporting novel applications of techniques over others that apply to the African context what has already become well-established elsewhere. We have nevertheless attempted to cover all the main periods of the African past, while also seeking to include papers from as many countries and regions of the continent as possible. Other editors would undoubtedly have chosen a different mix of articles, but we believe that what we have put together here conveys something of the history, the variety, and the excitement of archaeological science in Africa.

We begin near the beginning with Semaw's (2000) seminal paper reporting the discovery of some of the earliest known stone tools from Gona in Ethiopia. While older artefacts and potential cut-marks have now been discovered elsewhere (Harmand et al., 2015; Plummer et al., 2023), Gona remains one of the least ambiguous such instances from the earliest stages of the archaeological record. Fittingly in the context of this collection, this is also a paper by an African scientist and helps draw attention to the many other studies of early stone tool use that have appeared in *JAS* over the years (e.g. Toth, 1985). Early hominins used stone tools, at least in part, to access meat and marrow from animals that they had killed and scavenged. John Speth's (1987) paper on how they may have structured their subsistence strategies in seasonal habitats initiated a large number of studies on the dietary importance of fat and protein, studies that have increasingly come to include the social and political dimensions of these nutrients as factors in hominin evolution (e.g. Speth, 2010). Determining in any one case the relative contributions of hominins and other actors (especially carnivores) to the faunal assemblages in question is a topic that has resonated through many issues of *JAS*. To exemplify work on faunal taphonomy we have therefore chosen a paper by James O'Connell et al. (1990) that also highlights the crucial value of ethnoarchaeological research (here among the Hadzabe of northern Tanzania) in making sense of how hominins decided what to transport and what to process for food.

We start with these three papers in recognition of Africa's central importance as the continent where the genus *Homo* first evolved. Over

Table 2
Patterns of male and female first authorship in the *Journal of Archaeological Science* between 1974 and 2023.

First authors	1974–1999		2000–2023		Total	
Female	37	24.8%	165	41.1%	202	36.7%
Male	90	60.4%	207	51.6%	297	54.0%
Undetermined	22	14.8%	29	7.2%	51	9.3%
Total	149		401		550	

the course of the past half-century one of science's most important contributions to understanding who we are has unquestionably been to replace multi-regional models of later human evolution with a clear understanding that our own species, *Homo sapiens*, evolved within Africa, only spreading out from there late in the Pleistocene. While genetic studies, including ancient DNA research, show that today's non-African populations, in particular, retain genes acquired through interbreeding with more archaic taxa (Neanderthals, Denisovans etc.), the fundamentally African basis of our species' emergence is no longer in doubt. Linked to this, fieldwork in several parts of the continent, but principally in South Africa, has been instrumental in documenting what would once have been thought of as improbably early instances of complex cognition. We showcase this here with a paper by Chris Henshilwood and colleagues (2001) that helped introduce the landmark site of Blombos Cave to the archaeological community. Simultaneously, this paper documents the important role that *JAS* has played in providing an outlet for detailed reports of individual sites (cf. Ambrose, 1998; Parkington et al., 2013), while also drawing attention to the many other articles that it has published over the years on instances of bone tool use, shell bead manufacture, heat treatment of stone to facilitate its knapping, and the complexities of adhesive production in the southern African Middle Stone Age. Experimental archaeology has an essential role in understanding how people made such artefacts and thus for learning about what they imply regarding the complexity of past cognition; in this collection, Marlize Lombard and Justin Pargeter's (2008) paper on hunting using Howiesons Poort stone segments exemplifies the growing importance of this field.

Moving now into the Holocene, one of the most striking characteristics of the last 10,000 years is the diversity of food-production systems introduced to, or developed on, the African continent. We illustrate this with two papers, both of which also speak to connections between Africa and other parts of the world. That by Christoph Mbida and colleagues (2000) is noteworthy for identifying phytoliths assignable to the genus *Musa* in pits and on pottery at Nkang, Cameroon. While both disputed (Vansina, 2003; Neumann and Hildebrand, 2009) and reaffirmed (Mbida et al., 2005), if correct, this identification is of enormous significance since banana/plantain is a crop of New Guinea/Southeast Asian origin that can only have been introduced to tropical Africa from across the Indian Ocean. Its presence in Cameroon in the mid-first millennium BC would thus attest not only to a surprisingly early age for such trans-oceanic connections, but also raise the possibility that bananas/plantains were involved in sustaining the expansion of Bantu-speaking cultivators through equatorial Africa then and in the centuries immediately thereafter (De Langhe, 2007). Kate Manning and colleagues' (2007) paper addresses the origins of a quite different crop complex, one rooted in the Sahel. Pearl millet (*Pennisetum glaucum*) is unquestionably an African cereal, so it was for a long time puzzling that its oldest domesticated finds came from India and Pakistan. Manning et al.'s article resolves this problem by directly dating morphologically domesticated forms of the cereal at Karkarichinkat in eastern Mali to *c.* 2600–2500 cal. BC. Not only does this confirm pearl millet's African origin, but it also suggests that the domestication process began several centuries earlier, quite possibly in areas now too dry to sustain cultivation, as part of adaptations to gradual mid-Holocene desiccation of the Sahara. Subsequent papers in *JAS* have likewise used directly dated archaeobotanical evidence to explore early agricultural origins with respect to other crops and other regions of the continent, including sorghum in Sudan (Barron et al., 2020, using microcomputer tomography scanning of potsherds) and the introduction of ultimately Near Eastern-derived wheat, barley, and pulses to Neolithic Morocco (Morales et al., 2013).

The ability to directly date items of archaeological interest is also evident in a second, much earlier paper from the Sahel. In this, David Killick et al. (1988) clarified claims for ancient metallurgy at sites in the Agadez region of Niger, showing through chemical and microstructural analysis of the fused materials from what had previously been thought to be smelting furnaces or forges that they are, in fact, vitrified soil that cannot be positively associated with any metallurgical process. Moreover, the only early date obtained that is so associated (with copper smelting; 3660 ± 100 BP, GIF-5176) probably reflects the use of old charcoal — and thus the 'old wood' effect — and cannot be taken at face value. In short, there is no credible evidence of metallurgical activity in the Sahel before the first millennium BC. Precisely the same questions of what is being dated and how closely it relates to the metallurgical activity of interest plague claims of iron smelting south of the Sahara in the second and third millennia BC (cf. Zangato and Holl, 2010; Killick, 2015a) and encourage caution even about recently reported, and much better contextualised, evidence of early (~1000 cal. BC) iron-production at Sodohomé 1, Bénin (Merkyte et al., 2019).

Pyrotechnologies of all kinds have nevertheless been crucial elements of the subsistence and cultural lives of African populations for millennia (Killick, 2016). Two papers illustrate the wealth of such studies published in *JAS* over the years. Remaining with metallurgy, Louise Iles and Marcos Martinón Torres (2009) showed how archaeological investigation of sites with evidence of iron working combined with optical microscopy, SEM-EDS (scanning electron microscopy and energy-dispersive x-ray spectroscopy) and Ed-XRF (energy-dispersive x-ray fluorescence) enabled a comprehensive analysis of iron production among pastoralist groups on Kenya's Laikipia Plateau, asking how far slag analysis and furnace design can identify consistencies in technological style that may have wider social implications. Moreover, the presence of titania-rich slag, which suggests the use of black sand in the smelting process, indicates a high level of efficiency in iron-smelting by Laikipia craftspeople, just as it does in Yorubaland, Nigeria (Ige and Rehren, 2003). Working in another thermodynamic area of material culture and using ethnoarchaeological ceramic studies in Cameroon, in a widely cited paper Gosselain (1992) suggested that identifying the temperatures at which pottery was fired does not permit us to infer anything about how it was made. Other aspects of his work have likewise emphasised the connections between technological choice and social affiliation through the concept of the *chaîne opératoire* (e.g. Gosselain, 2000).

Other studies applying physico-chemical analytical techniques to archaeological problems have focused heavily on identifying the likely provenances of artefacts recovered in excavation. We present two such papers here. The article by Francis Brown and colleagues (2013) exemplifies the importance of applying geochemical analyses to the materials from which people made their stone tools. In this case, electron microprobe analyses, laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) and x-ray fluorescence were used to identify the trace element composition of obsidian from multiple locations across Kenya, providing an essential foundation to more detailed studies of how obsidian moved across the East African landscape in prehistory (e.g. Goldstein, 2021). Peter Robertshaw et al. (2010), on the other hand, begin with actual artefacts — in this case — glass beads – and use LA-ICP-MS to document how eight previously identified bead series from southern Africa possess different glass chemistries. These differences, in turn, highlight changing patterns of trans-Indian Ocean trade into the region between the eighth and sixteenth centuries AD as Zhizo beads likely made in Iran were replaced by a succession of others manufactured principally in South Asia. The paper emphasises how such shifts need to be understood, at least in part, in terms of large-scale political and economic changes in the wider Indian Ocean region, changes in which southern African actors and glass beads held agency of their own (cf. Moffett and Chirikure, 2016).

Stable isotope analysis is a field to which African-based researchers and research have contributed prominently (Loftus et al., 2016). We illustrate this here using three articles, each from a different decade. The first, by Julia Lee-Thorp and Nic van der Merwe (1991), demonstrated that apatite from tooth enamel provides a viable alternative to collagen as a material for analysing past diets. In this foundational paper they then used the methodology they had devised on two fossil baboon species from 1.8-million-year-old contexts at Swartkrans Member 1, paving the way for a host of studies that have subsequently analysed the stable carbon isotope composition of early hominin teeth there and at other sites in both South and East Africa (Schoeninger, 2014). Fourteen years later Lorna Corr et al. (2005) broke new ground in another direction by undertaking compound-specific stable carbon isotope analysis of individual amino acids when exploring the diet of past hunter-gatherer populations in South Africa's Western Cape Province. Their work showed the potential of this approach in overcoming problems with using bulk collagen values to identify marine protein consumption in arid environments and differentiate between marine foods and the dietary contribution of C_4-photosynthesising terrestrial plants. Finally, the paper by Murilo Bastos and colleagues (2016) shows how a combination of stable isotope analyses (in this case $^{87}Sr/^{86}Sr$ — cf. Sealy et al., 1991 — $\delta^{13}C$, and $\delta^{15}N$) collectively work to reveal not only diet, but also geographical origin. They apply these techniques to the remains of enslaved Africans from Rio de Janeiro and Salvador, Brazil, highlighting how African archaeology encompasses not only the archaeology of people within the African continent but also the life histories and experiences of those forcibly removed from it and transported to other parts of the world as part of the African Diaspora (cf. Wang et al., 2023).

Biomolecular analysis is, of course, far from restricted to stable isotopes in bone and teeth. Indeed, it has undergone explosive growth over the past decade and more with the increasingly widespread deployment of both ZooMS (zooarchaeology by mass spectrometry), which identifies species based on differences in the amino acid composition of their collagen, and ancient DNA (aDNA) analysis. Application of the former has already delivered important results in, for example, identifying wild and domestic bovid taxa in Iron Age Kenya (Culley et al., 2021) and identifying the species used to make bone tools at the key late Pleistocene Later Stone Age site of Taforalt, Morocco (Desmond et al., 2018). Applications of aDNA success have been slower to take off, partly because of problems in preservation (although the situation here is constantly improving as enhanced protocols are applied; e.g. Lipson et al., 2022), partly because of the greater expense involved (see below), and, in some cases, due to controversy when DNA-based identifications conflict with those of traditional zooarchaeological identification (e.g. Horsburgh and Moreno-Mayar, 2015; Bousman et al., 2016; Horsburgh et al., 2017; Scott and Plug, 2016). For the purposes of this collection, we have opted to include a paper that speaks to a faunal dataset (fish) and a region of African archaeology (Madagascar) that are frequently neglected in wider syntheses. Alicia Grealy et al.'s (2016) paper innovatively deploys aDNA bulk-bone metabarcoding to identify the fish assemblages from a late precolonial site on the southwest coast of Madagascar, which, as is typical, are highly fragmented and thus resistant to standard identification techniques. Never used on fish bones or in a tropical context before, their work elegantly illustrates the potential of aDNA sequencing to rapidly documenting the range of resources and habitats that people exploited.

In all the cases we have mentioned, just as in the many others that *JAS* has published over the decades, clear understanding of how archaeological contexts formed is essential if we are to understand the strength and credibility of the associations between what is recovered. With few exceptions, most of them confined to the Middle Stone Age of South Africa (e.g. Goldberg et al., 2009) such work remains rare for rock-shelter sites in Africa. A paper by Julio Mercader and colleagues (2003) reporting on the site formation processes in operation at rock-shelters in the Ituri Forest on the northeastern edge of the Congo Basin is thus noteworthy precisely because it illustrates such work and does so from a region of the continent where fieldwork faces profound logistical and security challenges. Additionally, by obtaining stratigraphically secure dates reaching back to the beginning of the Holocene, this paper conclusively refuted earlier claims that hunter-gatherer groups could only exist in African tropical rainforests if able to obtain cultivated carbohydrates from neighbouring farmers (e.g. Bailey et al., 1989). To the contrary, it showed that human occupation of such environments was both much older and well-established, just as it is in other parts of the world (Roberts, 2019).

Site formation processes of a different kind are explored by Ruth Shahack-Gross and colleagues in several papers, of which we have selected their first in *JAS* for inclusion here. Also published in 2003, this geo-ethnoarchaeological study made a significant contribution to identifying the typically ephemeral settlements left by many African pastoralists through detailed micromorphological, mineralogical, and phytolith analysis of sediments from recent Maasai livestock enclosures. The distinctive traces they identified carry implications not just for East Africa's Pastoral Neolithic populations (Shahack-Gross et al., 2004), but also for other pastoralist communities elsewhere in the world (e.g. Whitlock and Lane, 2023), and encouraged further work that has shown how ancient herders enriched and altered the composition of African grasslands (Marshall et al., 2018).

Finding archaeological sites — and then preserving them and making them accessible to as wide a public as possible — stand at opposite ends of the trajectory of archaeological fieldwork but are equally essential. We conclude our selection of African articles from *JAS* with papers that illustrate these points from three different regions of the continent. That by David Wright and colleagues (2017) draws on methods not dissimilar to those used by Shahack-Gross et al. (2003) to analyse the taphonomy of open-air Middle Stone Age assemblages in Malawi. At the same time, it complements this approach to understanding the site formation histories of individual archaeological sites by using phytoliths, micromorphological data, and a variety of palaeoclimatic proxies from Lakes Malawi, Masoko, and Tanganyika in an elegant interweaving of site-specific and wider regional contexts. Jonathan Lim and Gonzalo Linares-Matás's (2023) article illustrates the growing power of remote sensing data (in this case high-resolution satellite imagery) in archaeological analysis. In a pioneering study, they use such evidence to calculate the volumes of late Holocene funerary monuments to infer labour energetics and thus degrees of social inequality in the Neolithic of southern Mauritania. As they point out, in geopolitical contexts like this part of the Sahara where fieldwork is not currently possible, such approaches can deliver powerful new insights using data that are freely available to all. Finally, Gaygysyz Jorayev et al. (2016) show how, at Olduvai Gorge in Tanzania, another kind of innovative survey technique, the use of drones, can promote understanding of archaeological landscapes by integrating archaeological and geomorphological data, while simultaneously delivering new tools with which to monitor and conserve cultural heritage. As with the papers by Wright et al. (2017) and Lim and Linares-Matás (2023), the approach they outline holds great potential across the African continent.

3. The future of archaeological science in Africa

We cannot close this introduction without expressing our thoughts on some of the challenges that archaeological science in Africa confronts. David Killick (2015b) summarised some of these concerns almost a decade ago. The most obvious relates to the enormous disparity in funding and resources between African-based archaeological scientists and those undertaking work on African materials from beyond the continent. Over seventy years after the technique's invention, for example, Africa has just three radiocarbon dating laboratories, the same number as Lithuania: one in Cairo, one in Johannesburg, and that in Dakar mentioned above. Only the laboratory in South Africa is capable of AMS dating and facilities for OSL dating and uranium-series dating are similarly constrained (Hare and Loftus, 2019). Other forms of archaeological science that demand expensive, high-maintenance equipment are similarly scarce on the ground, facilities for aDNA analysis above all, perhaps. The result is that these kinds of research must necessarily be undertaken outside Africa, although hopefully in collaboration with African colleagues and, wherever possible, by providing training for them or their students. Conversely, other facilities — such as archaeozoological and pollen analyses — are often better supported. We think here, for example, of the important comparative faunal collections of institutions such as the National Museums of Kenya in Nairobi (e.g. Prendergast et al., 2017) and of the facilities for pollen and sedimentological analysis at others such as the University of Ibadan, Nigeria (e.g. Ogundiran et al., 2021). Even so, the not infrequent embedment of archaeology within departments and faculties focused on the humanities often works against the development of an archaeological science capacity (Thondhlana et al., 2022, 465).

We draw two conclusions from these observations. First, without significantly greater — and sustainable — funding for both specialised equipment and the personnel to maintain and use it, it seems likely that African museums and universities will continue to work at the less expensive end of the archaeological science spectrum. This does not mean, however, that they cannot benefit from important new methodological advances. ZooMS proteomic identifications of mammalian and other species are, for example, much cheaper and faster than analysis of ancient DNA and likely to be well within the capacity of many institutions, while the comparative data ('collections') needed to make sense of results are freely available online (University of York 2023). More broadly, we emphasise here that archaeological science does not only consist of sophisticated biomolecular analyses or geophysical and geomatics methods: methodologically robust and detailed ceramic analyses using thin sectioning and fabric examination, for instance, also qualify. *JAS* could usefully help here by promoting publication of these lower level, but more widely accessible and equally necessary, forms of archaeological science, thereby boosting its global, and specifically African, coverage.

Second, we think considerable scope exists for the development of regional hubs of archaeological science specialisation within Africa (cf. Ogundiran, 2016), perhaps funded in part from abroad, in some cases perhaps with support from major multinationals (Thondhlana et al., 2022, 468). Such hubs already include the Department of Archaeology at the University of Cape Town with respect to both stable isotope analysis and archaeometallurgy, but many others could surely be developed to provide shared resources for training and analysis. Collaboration across departments could also be taken further, with African-based archaeologists embracing even more fully than at present opportunities to work co-operatively with colleagues in fields such as botany, chemistry, engineering, materials science, physics, and zoology to help circumvent the paucity of laboratories specialising in archaeological science *per se*. Working with geologists, for example, can provide relevant expertise in the sample preparation needed for ceramic petrography. Such co-operation should also extend between countries and between private and public sector universities, helping to promote the retention and transmission of accrued expertise within the continent to secure the long-term advancement of both African archaeological science and African archaeological scientists (cf. Thondhlana et al., 2022).

All of us who have the privilege of working on the African past, especially if based in the Global North, share the responsibility of making this possible, whether through hosting visiting scientists, facilitating access to students, engaging in mutually enriching collaborative research, building capacity via the donation of small-scale, but nevertheless valuable, laboratory equipment (microscopes, hand-held GIS units, Arc Software subscriptions etc.), publishing in African-based or African-themed journals as well as those with greater international reach like the *Journal of Archaeological Science*, enhancing access to published research, or supporting the growth of African-based research clusters. Hopefully, the 21 papers we have brought together here can form part of that effort by celebrating the achievements that archaeological science in Africa has already made and at the same time mapping out some of the exciting ways in which it may develop in the remainder of the twenty-first century.

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