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Archaeological discontinuities in the southern hemisphere: A working agenda

Ramiro Barberena [a,*], Jo McDonald [b], Peter J. Mitchell [c,d], Peter Veth [e]

[a] CONICET, Laboratorio de Paleocología Humana, Facultad de Ciencias Exactas y Naturales, Universidad Nacional de Cuyo, Padre Jorge Contreras 1300, Mendoza City 5500, Mendoza Province, Argentina
[b] Centre for Rock Art Research and Management, University of Western Australia, Perth, Australia
[c] School of Archaeology, University of Oxford, St Hugh's College, Oxford OX2 6LE, United Kingdom
[d] GAES, University of the Witwatersrand, PO Wits 2050, Johannesburg, South Africa
[e] School of Social Sciences, M257, University of Western Australia, Crawley, Western Australia 6009, Australia

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ABSTRACT

This introductory overview presents the frame of research and general goals of the special volume "Archaeological Discontinuities: Comparative Frameworks for the southern hemisphere". We begin by deconstructing archaeological discontinuities in terms of time and space in order to assess what sort of past phenomena are we dealing with when assessing discontinuities in different scales. It is one of our main contentions that we need theory and data connecting discontinuities as recorded on different analytical scales, thereby contributing to evaluate often-undescribed mechanisms that produce archaeological discontinuities. On this basis, we face the key task of deconstructing archaeological discontinuities from 'top to bottom', moving from the averaged material record that is visible in archaeological scale toward the short-term human decisions and interactions that, when occurring cumulatively, produce those discontinuities. Nevertheless, while an understanding of the short-term behavioral mechanisms and social agency behind discontinuities is necessary, it is certainly not sufficient for building a frame in which to make sense of the long-term record.

Archaeological discontinuities recorded at different spatial scales require different explanatory mechanisms that can be connected hierarchically. The most productive analytical take here would be to move from the bottom to the top, building from the site or local scales to the regional and continental levels. This strategy provides a solid frame for assessing the genesis of discontinuities at different scales by disentangling the incidence of sampling deficiencies in the field, the selection of samples for chronometric dating, taphonomic biases, the reorganization of mobility and technology, local and regional abandonments, and actual demographic changes.

We finish by selecting a few issues that we consider worthy of systematic comparative attention in the years to come. These issues impinge on different levels of theory and methods and can only be pursued with an interdisciplinary focus that encompasses not only archaeology but also ethnography, genetics, linguistics, paleoclimatology and paleoecology. We are convinced that there is much to learn from a comparative perspective in terms of structural similitudes in historical processes across regions and continents. The conceptual structure of a number of debates from South America, Africa, and Australia on is remarkably similar, notwithstanding important differences in terms of chronology and tempo. We look forward to international joint endeavors such as this one that help to formalize questions and data-collecting strategies for the southern drylands and beyond.

> "There is a genuine paradox here, and a familiar one: we cannot work out what tools we need until we know what sort of phenomena are there in the longer-term record to investigate, and we cannot investigate those different phenomena until we have some tools to do it with. And to solve that paradox we will need to work at both simultaneously."
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> [(Bailey, 2007, 220)]

* Corresponding author.
E-mail addresses: ramidus28@gmail.com (R. Barberena), jo.mcdonald@uwa.edu.au (J. McDonald), peter.mitchell@st-hughs.ox.ac.uk (P.J. Mitchell), peter.veth@uwa.edu.au (P. Veth).

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1. Archaeological discontinuities: An introduction

Change is the norm rather than the exception in archaeological scale, though its rate and mode are not uniform in time or space. Change accelerates its pace at given times and places along the course of human history, producing what we perceive as discontinuities or transitions in archaeological scale. Beyond its empirical or historical basis, recording and –above all – explaining archaeological discontinuities are eminently theoretical endeavors. Two of the most important sources of obfuscation of archaeological debate on discontinuities stem from this apparently obvious statement.

First, even some of the most widely used archaeological discontinuities in use today as the basis for archaeological taxonomies, such as the African Middle/Later Stone Age, involve research decisions made in the context of specific paradigms and goals (MacKay et al., 2014; Mitchell, 2002; Pargeter et al., 2016; Sampson, 1985). As Veth et al. (2017) suggest about the Australian Late Glacial Maximum, "The artificial, analytical barriers, that currently characterize work on many LGM sites should be 'unpacked' in favor of a more 'continuous scale' approach which allows intra-LGM variability to be investigated without artificially contrasting and promoting the LGM as 'inherently different'". The character of *discontinuities as artificial units of analysis* defined and characterized in the context of specific research questions, as opposed to purely natural phenomena, is one of the main sources of complexity when balancing arguments on rates of change and continuity vs. discontinuity debates in archaeological scale.

Second, *archaeological discontinuities are multidimensional phenomena* that can be recorded in different realms of past societies, such as population biology and genetics, linguistics, demography, technology, subsistence modes, and/or information flow, among others. The papers included in this special issue illustrate aspects of this variability, as well as some trajectories of interaction between different domains, which are inextricably linked in historical and evolutionary processes. This multi-faceted character of archaeological discontinuities can be yet another source of analytical obfuscation, since evidence supporting their presence/absence can be simultaneously invoked without there being necessary contradictions between them.

Two other factors are additional sources of complexity to the archaeological assessment of discontinuities: taphonomic and chronological biases. First, discontinuities may be the product of preservation biases acting at different temporal and spatial scales (Behrensmeyer et al., 2000; Farrand, 1993; Surovell et al., 2009). At a general level, it is arguable that the formation of the archaeological record is episodic by nature, because of combined sedimentary and pedogenetic dynamics (Birkeland, 1999; Farrand, 2001) on the one hand, and human patterns of spatial organization and use of the landscape (Binford, 1982; Borrero, 2001; Kelly, 1995; Harcourt, 2012) on the other. Regarding chronology, there is an incidence of problems associated not only with the resolution inherent to the dating techniques themselves, but also with the variation in how they are applied by archaeologists across the southern hemisphere. Too often, this is done sparingly across a site's sequence due to budget limitations. Bayesian modeling holds great potential for maximizing chronological resolution on the basis of limited sets of dates and without greatly increasing costs (e.g., Bronk Ramsey, 2008; Marsh, 2014).

Lack of sufficiently explicit formulations on the artificial nature of discontinuities –defined in the context of specific paradigms and research objectives – as well as on the multiplicity of historical domains at which relevant evidence can be sought for, are the main sources of analytical obfuscation interfering in productive debate. As in many other fields of archaeological enquiry, the best prospects for advancing debate lie in being as theoretically and methodologically explicit as possible. With theory, we have to fully describe the artificial units used to define discontinuities, the scale of analysis at which they are framed, and the historical domains and lines of evidence where we expect them to be represented (Shea, 2014). In the methodological realm, we have to operationalize the debate on discontinuities by providing material expectations about the magnitude and speed of change observable in archaeological scale.

Building on this perspective, this volume presents case studies and reviews ranging from the local to the subcontinental scale in deserts from Australia, southern Africa, and South America, based on diverse fields of evidence that operate on different temporal and spatial scales (Fig. 1). These papers, plus a few others that could not be included, were originally presented at a Wenner-Gren Foundation-sponsored symposium held at the *4th Southern Deserts Conference* (Mendoza, Argentina, 2014). Besides contributing to a series of regionally specific issues, the papers combine to construct a comparative frame for the study of human societies in desert ecosystems from the southern hemisphere (Smith and Hesse, 2005; Veth et al., 2005, 2016). The goal is to compare historical trajectories of socio-demographic change, seeking to identify shared and unique patterns across the continents. In doing this, we expect to converge eventually with other past and ongoing projects of comparative archaeology of different time periods and world regions (e.g., Anderson et al., 2007; Drennan and Peterson, 2012; Smith, 2012; Soffer and Gamble, 1990; Veth et al., 2005, 2016).

2. Deconstructing discontinuities I: time

As championed from different backgrounds by Braudel's (1958) *Annales* school and Bailey's time perspectivism, 'differing

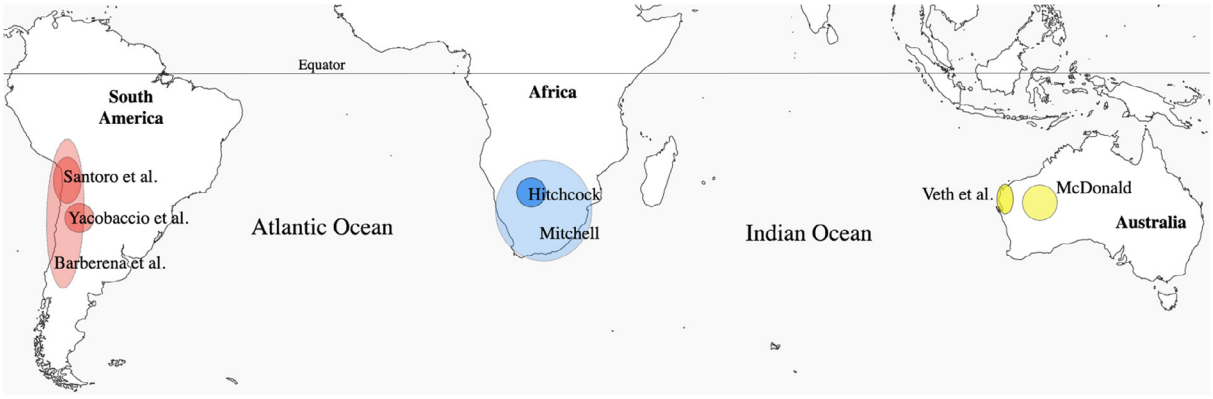

Fig. 1. Location of the case-studies in the volume.

timescales bring into focus different features of behavior, requiring different sorts of explanatory principles' (Bailey, 1981, 103; see also Bailey, 2007). This insightful assertion is nowhere more valid and in need of current attention than in the interpretation of archaeological discontinuities. What sort of past phenomena are we dealing with when assessing discontinuities in different temporal and spatial scales? One of our main contentions is that we need theory and data connecting discontinuities as recorded at different analytical scales. Different temporal scales offer us the chance to study potentially nested phenomena, thereby allowing us to evaluate otherwise hidden mechanisms that underlie discontinuities.

The papers by Hitchcock and Mitchell in this volume, which deal with discontinuities in the ethnographic and archaeological records of the deserts of southern Africa, provide a wonderful chance to realize a theoretical and methodological exercise on time perspectivism, by focusing on processes extending from the 'ethnographic present' to tens of thousand of years in the same regions. Hitchcock (2017) provides a glimpse of discontinuities on a micro-level, by illustrating 'on the ground' ecological trajectories and social mechanisms that, if continued in time, could be recorded as archaeological discontinuities. Working on this basis, we can begin to assess the short-term behaviors behind long-term discontinuities. If it is to be meaningful, this exercise should be guided by general and mid-range theory that explicitly connects the different analytical levels. Different – and complementary – theoretical fields are already at work with this goal in mind. O'Connell (2006) provides an insightful exploration grounded in evolutionary ecology and optimal foraging models of the role of ethnographic information to model inter-group social interactions with a focus on the 'Neanderthal-sapiens replacement' debate. As he suggests, the ethnographic record of the interactions between the Datoga and the Hadza in Tanzania illustrates how decision-making grounded on short-term social and economic factors has long-term consequences. This is especially evident at the level of competitive exclusion and geographic enclosure of the Hadza, mobile hunter-gatherers, by the Datoga, herding people with low mobility strategies, due to differences in diet breadth, mobility and, hence, higher capacity for demographic growth (O'Connell, 2006; see also Blurton Jones et al., 1996). Resilience theory is also being used to connect social processes occurring at different timescales, from the ethnographic to the archaeological, in the light of adaptive cycles (Widlok et al., 2012; see also Redman and Kinzig, 2003; Sauer, 2015). Short-term inter-group interactions under diverse socio-ecological circumstances and on different demographic scales were likely the arena for the initial formation of discontinuities. Face-to-face behavioral mechanisms and their long-term consequences at successive temporal scales should be a key field of enquiry.

The deserts of the southern hemisphere have witnessed processes of interaction between societies with different subsistence modes and social configurations during historic and prehistoric times. Several of these cases have left a record of linguistic discontinuities that may reveal underlying demographic processes of spread, usually associated with migration of people to varying extents (McConvell, 2001). Whether this occurs over previously empty or inhabited land is a key aspect, since it involves different sets of demographic and social mechanisms (Mitchell, 2017; Nichols, 2008; Veth, 2000).

Across the southern deserts, the cases of Pama-Nyungan in central western Australia, Khoe in southern Africa, and Mapuche or Mapudungun in South America stand out as processes of linguistic spread with diverse chronologies and tempos (to which we can add the Numic spread in the Great Basin of the United States; Bettinger and Baumhoff, 1982). This set of striking linguistic discontinuities highlights O'Connell's challenge: how can we investigate short-term social mechanisms that contribute to produce long-term discontinuities? A comparative perspective provides fertile ground for future research.

The historical and linguistic records of Patagonia and the Pampas of southern South America (Argentina and Chile) during the sixteenth to nineteenth centuries indicate a large-scale linguistic replacement of a set of currently extinct languages belonging to the historic Tehuelche complex, such as Gününa Küne, by the so-called 'Araucanian' languages - Mapudungun or Mapuche -, spoken nowadays in parts of Argentina and Chile (Adelaar and Muysken, 2004; Dillehay, 2007; Viegas Barros, 2005). The recent historical character of this process provides a well-known case of linguistic shift involving a relatively fast demographic and cultural spread over an already populated land, producing demographic and cultural assimilation rather than replacement. This could be a useful analogue for other cases of linguistic spread. From a comparative perspective, what we consider most striking about these cases is not linguistic shift *per se*, but the social mechanisms of interaction between societies of relatively similar socio-political scale that can account for such cultural trajectories. Interestingly, the Australian Pama-Nyungan case "shows a broad pattern of transfer from high-density populations to less densely populated regions" possibly as recently as 1500 years ago (Smith, 2013, 205; following McConvell, 2001; Veth, 2000). The former would be the region with higher linguistic diversity (Nettle, 1998), feeding the idea of deserts as spread zones in the long-term (Mitchell, 2017; Smith, 2013; Sutton, 1990). The rock art of the Western Desert in this recent time period (McDonald, 2017) provides additional insights into the nature of language movement and social signalling and archaeological discontinuities during this critical period – and adds to the suggestion (Veth, 2000, 17) that the movement and spread of new language speakers into the Western Desert may have been facilitated by existing endogenous Western Desert adaptations near the interface of the Pilbara and the Western Desert homelands (McDonald and Veth, 2013). The economic and demographic factors identified by O'Connell (2006) for the Datoga-Hadza case could entail differences between societies in the scale of social cooperation, providing an alternative mechanism to explain language shift and the source of archaeological discontinuities (Mathew and Boyd, 2011; see also Boccara, 2007).

Southern Africa provides a second example of the complex relationships between language, cultural identity and – in this case – subsistence. Here, from the late fifteenth century European explorers and settlers encountered both hunter-gatherers and herders in the drylands that occupy the western third of the sub-continent. Although the precise relationship between the populations practicing these ways of life is debated (see Orton, 2015, for a recent review), a growing body of linguistic and genetic data supports the view that some kind of demographic movement originating ultimately in East Africa was instrumental in the initial introduction of domesticated cattle and sheep to the region at the end of the first millennium BC (Güldemann, 2008; Lombard, 2014). That movement is likely to have had its origins in yet older Pastoral Neolithic herding societies in Kenya and the far north of Tanzania (Lane, 2013) and may have been quite rapid, perhaps because of the relative inhospitability of much of the intervening area (central and southern Tanzania, Malawi, Zambia) to livestock. The precise form that this movement may have taken – demic diffusion, leap-frog colonization, or more gradual (perhaps repeated episodes of) infiltration – remains to be determined (Sadr, 2015).

Nevertheless, once arrived in the environs of the Zambezi and Okavango Rivers where Zambia and Botswana now meet, incoming herders likely began to interact – and intermarry – with resident hunter-gatherers, some of whom may have sought to acquire livestock (probably sheep, rather than cattle, in the early stages of the process) for themselves, perhaps propagating the further expansion of livestock-keeping via some form of down-the-line exchange

(Jerardino et al., 2014). At least some forager populations probably changed language in the course of these interactions since many of the classic 'Bushman' groups of the Kalahari – such as the G/wi and G//ana studied by Tanaka (1980) and Silberbauer (1981) and the Nharo studied by Bleek (1928), Guenther (1986), and Barnard (1992) – now speak Khoe. Conversely, other 'Bushman' populations living in the northeast of the Kalahari (for example, the Kxoe, Shua, and Tshwa; Cashdan, 1986) may reflect a "cultural devolution by early pastoral Khoe to a foraging economy" (Güldemann, 2008, 123). Even this very brief set of comments indicates how the overall result of herder arrival in southern Africa was a complicated mix of groups with variable exotic and indigenous genetic, linguistic and cultural heritages, though one in which input from local forager populations became stronger with increasing latitude and thus distance from the zone of initial entry (both along the Atlantic coast and toward the Limpopo Basin on the eastern edge of the Kalahari; Güldemann, 2008, 123; Sadr, 2015). Patterning in lithic assemblages and in the style and technology of ceramics – which begin to appear at more or less the same time (and often in association with) livestock – is correspondingly complex, though with hints that intrusive populations may be identifiable in some aspects of the archaeological record (Orton, 2015; Sadr, 2015).

To summarize, when dealing with time, we face the crucial task of deconstructing archaeological discontinuities from 'top to bottom', moving from the averaged material record that is visible in archaeological scale toward the short-term human decisions and interactions that, when occurring cumulatively, produce those discontinuities. Questions regarding long-term processes, such as "could episodes of hyper-aridity have disrupted flows of genes and information between populations in the northern and southern halves of southern Africa to produce the differentiation evident across all three datasets [genomic, linguistic, and archaeological]?" (Mitchell, 2017), can be modeled in terms of potentially relevant short-term decisions such as "Under what conditions do people choose not to invest in maintaining long-distance exchange flows?" (Mitchell, 2003, 2017). As McDonald (2017) discusses for the Western Desert in Australia, rock art research provides a measure of the intensity and geographic vectors of social interaction. Rock art studies, particularly in Australia, have the potential to connect the anthropological and archaeological temporal scales and shed light to the possible meanings of discontinuities in information exchange (McDonald, 2017; McDonald and Veth, 2013; see also Challis, 2014).

As optimal foraging models suggest for socio-economic issues (e.g., Hawkes et al., 2001; Winterhader, 2002), human decisions framed at the *ethnographic scale* provide a fundamental starting point for modeling the genesis of different sorts of *archaeological discontinuities*. Short-term decisions and interactions regarding when to abandon or to recolonize given patches of the landscape, or when to enlarge diet breadth to include domesticated plants and animals — with all the social effects to which that can lead (O'Connell, 2006) — have long-term consequences, which is to say that archaeological discontinuities are the result of averaged decision-making at the scale of individuals or groups (Shennan, 2002). The approach should not be guided by historical analogy, but by relational analogy (Pargeter et al., 2016; Wylie, 1989). However productive when used strategically in specific cases and with demonstrable continuities of population and practice (Challis, 2012; Sauer, 2015), historical analogy is limited by the behavioral diversity represented in the ethnographic record (Bettinger, 2001; Mitchell, 2017; Wobst, 1978). In addition, while an understanding of the short-term behavioral mechanisms and social agency behind discontinuities is necessary, it is certainly not sufficient for building a frame in which to make sense of the long-term record (Bailey, 2007). Human responses to long climate cycles and emergent social processes that cannot be predicted from initial conditions are obvious examples of historical variation that cannot be fully accounted for on the basis of mechanisms visible at an ethnographic scale (Bird et al., 2016; Johnson et al., 2005; Widlok et al., 2012). In special cases, however, the ethnographic record may nevertheless offer insights into social agency at the scale of several human generations (Fitzhugh et al., 2011; Minc, 1986). Studies of the Dobe Ju/'hoãnsi, that began in 1963 and continue today, over 50 years later (Lee, 2013), contribute to bridging the gap between successive analytical scales. Different strands of general theory and mid-range models are currently contributing to this endeavor.

3. Deconstructing discontinuities II: space

Archaeological discontinuities recorded at different spatial scales would require different explanatory mechanisms that can be connected hierarchically (Delcourt and Delcourt, 1988). As Barberena, Méndez and de Porras (this volume) argue, we can use the multi-level character of historic processes in our favor by shifting spatial scales in order to visualize archaeological patterns. Complementing the strategy mentioned above for deconstructing discontinuities in time, the most productive analytical take here would be to move from the bottom to the top, building from the site or locality scales to the regional and continental levels. This strategy provides a solid frame for assessing the genesis of discontinuities at different scales by disentangling the incidence of sampling deficiencies in the field, the selection of samples for chronometric dating, taphonomic biases, the reorganization of mobility and technology, local and regional abandonments, and actual demographic changes (Barberena et al., 2017; Mitchell, 2017; Veth et al. 2017; see also Kelly et al., 2013; Méndez et al., 2015; Williams et al., 2015a).

The paper by Veth, Ward and Ditchfield (2017) provides a working scheme that is useful for making this essential point. The core of this suggestion lies in differentiating stratigraphic, chronological, and cultural discontinuities. Each level has the potential to reflect different mechanisms and processes.

Focusing on the smallest analytical level, hiatuses in occupation at the site scale are an obvious, but frequently overlooked, component of discontinuities in time and space. In the absence of unambiguous stratigraphic markers indicating a clear break in the accumulation of cultural material (i.e. horizons that are, to all intents and purposes, culturally sterile), the temptation remains to read excavated sequences as evidence of continuous human occupation, and thus of continuous presence in a particular area. As we have already noted, enhanced application of radiocarbon dating can help overcome this challenge, something well illustrated, for example, at Elands Bay Cave (EBC) on the Atlantic coast of South Africa (Fig. 2), where less than 2 m of post-LGM occupation was excavated in some 320 stratigraphically distinct contexts and dated by almost 40 radiocarbon dates (Parkington, 1992). The increasingly widespread employment of Bayesian modeling can but further help identify when occupation was focused, something now underway, in combination with additional dating efforts, at several other classic southern African sites, including those for which Sampson (1985) counseled long ago that stratigraphic breaks by no means necessarily coincide with shifts in material culture or changes from one gross cultural historical unit to another. Among many others, key examples come from southern Patagonia, where intensive and problem-oriented radiocarbon dating has allowed reassessing initial human peopling, the extinction of the megafauna, and the incidence of climate change and human activity (Martin et al., 2013; Villavicencio et al., 2015); and Puntutjarpa rockshelter, the archaeological site from the Australian Western Desert utilized by Richard Gould (1977) to build the classic

Fig. 2. Elands Bay Cave archaeological site, South Africa (credit: Peter Mitchell).

culture-history sequence (Smith, 2013, 179–181; Williams et al., 2014).

More than a half-century since the appearance of Binford's (1964) classic paper "*A consideration of archaeological research design*", archaeologists can still over-emphasize the extent to which 'their' site represents all aspects of a cultural system or a regional settlement signature. Paying insufficient attention to intensive survey of regional landscapes or to the dating of all kinds of sites within such landscapes is one of several problems that we must confront. Neglecting how changes in how one site is used may not necessarily document changes in the overall level of the system as a whole, and the question of how to differentiate the length of time people stayed somewhere from how many of them were present a third.

Developing the example we have just used, the Elands Bay area of southern Africa illustrates the level of chronological discontinuities. First, in the 1990s radiocarbon dating of shell middens encountered in mitigation-driven investigations, re-evaluation of the age of open-air deflated stone tool assemblages, and an expansion of fieldwork to areas just 30 km to the north overturned a longstanding supposition (Parkington et al., 1987) that people abandoned this stretch of the South African coast between 7800 and 4400 years BP (Jerardino, 1998; Jerardino and Yates, 1996). Even in well-investigated areas, then, the expansion of research to new kinds of sites and taphonomic modes can spring surprises. At both local and regional scales we must guard against confusing lack of use of particular sites or of some kinds of sites with overall occupation absence (cf., Kelly and Todd, 1988, with respect to the widespread – though not universal – absence of Paleoindian occupation in caves and rock-shelters in North America, a pattern that finds an almost precise mirror image in the kinds of sites from which we have occupational evidence in southern Africa during Marine Isotope Stage 2 [Mitchell, 2002]).

Second, rather than viewing the many changes in the EBC sequence across the Pleistocene/Holocene transition as reflecting differences in the 'culture' of those occupying the site (Table 1), Parkington (1988) has convincingly argued from increased deposition of items such as bone tools, ostrich eggshell beads and grindstones, the occurrence of burials, and shifts in the food resources that people exploited, that they more likely record changes in its 'place' (sensu Binford, 1982) within the regional landscape (see also Borrero, 2015). In other words, as sea-levels rose, coastlines moved east, climate changed, the local river became increasingly estuarine, and both terrestrial and marine ecologies were transformed, EBC ceased to be a sporadically occupied inland hunting station and instead developed into a campsite at which larger, family-inclusive residential groups stayed for much longer periods of time – a change, in other words, not in what people did, but in where they did it. But to say this necessarily raises the question of how we can measure occupation intensity and thus, by implication, the relative numbers of people on a landscape. Close to EBC, Jerardino (1995) has attempted to disentangle parameters such as settlement area, rate of deposition of domestic debris (such as food waste), and rate of deposition of artifacts that may attest to longer stays (such as ostrich eggshell beads that take a long time to make), emphasizing that variation by unit time may be more informative than variation by volume of deposit, at least where the latter's make-up changes (for example, when comparing shell middens with contexts much poorer in shell). As elsewhere (e.g., Mellars and French, 2011), her use of several parameters that can act as cross-checks on each other is clearly a desirable strategy for us to pursue.

As Barberena et al. (2017) suggest, "The most immediate response by mobile hunter-gatherers to increased risks would be spatial reorganization and/or relocation, which could lead to abandonment of regions in different spatial scales and for varying amounts of time" (see also Méndez et al., 2014). The inter-regional level of analysis is the most germane to assess processes of spatial rearrangements that include the abandonments of specific areas, concentration in others, and changes in the organization of mobility – and technology – that may range from an increase of residential mobility to the tethering to favored locales (refugia) combined with high logistical mobility as buffers against increased risk (Ambrose and Lorenz, 1990; Bousman, 2005; Garvey, 2008; Santoro et al., 2017; Veth, 2005; Veth et al., 2011). These different spatial responses would not necessarily imply demographic change, but only a redistribution of people on the landscape. The scaling up of analysis aiming to macro-regional and continental reconstructions is a key step that allows us not only to assess large-scale preservation biases, but also to determine the spatial extent of discontinuities (Gamble et al., 2004; Manning and Timpson, 2014; Peros et al., 2010; Shennan et al., 2013; Williams et al., 2015a). This is the scale that allows us to disentangle spatial rearrangements from actual demographic changes such as population growth, bottlenecks, and local extinctions. This is the kind of data that feeds studies of long-term demographic trajectories and the relations with climate change, changing dynamics along the colonizing process, and socio-economic changes (Beaton, 1990; Birdsell, 1957; Goldberg et al., 2016; Pennington, 2001; Williams, 2013).

Table 1
Key changes in the patterning of human occupation at Elands Bay Cave, South Africa, across the Pleistocene-Holocene transition (after Parkington, 1988, 1992). Shell lenses first appear in the stratigraphy c. 11,000 BP and dominate the overlying contexts (shown shaded).

Date BP	Ostrich eggshell (mass g)	Mammals (NISP)	Tortoises (MNI)	Flaked stone (N)	Ostrich eggshell beads (N)	Bone tools (N)	Human burials (N)
c. 8500–9600	650	2028	237	67	36	765	1
c. 10,000–10,700	2056	946	333	73	92	28	2
c. 11,000	65	22	22	43	19	50	–
c. 11,500–13,600	9	5	2	44	67	21	–

4. A working agenda

As we have already mentioned, archaeological discontinuities are a multi-dimensional set of phenomena with distinct expressions throughout the southern continents, though as we argue below, there are many shared processual aspects. Neither this introductory essay nor the papers contained in this volume encompass the full range of topics or approaches to this field. In this section we select a few issues that we consider worthy of systematic comparative attention in the years to come. These issues impinge on different levels of theory and methods and can only be pursued with an interdisciplinary focus that encompasses not only archaeology but also ethnography, genetics, linguistics, paleoclimatology and paleoecology.

4.1. Dynamics of dual inheritance systems as a source of discontinuities

The evolutionary frames of dual inheritance or coevolution focus on the dynamics of the different systems involved in the replication – with modification – of human societies through time, including genetic information encrypted in DNA and cultural information transmitted via various mechanisms of social learning (Durham, 1991; Richerson and Boyd, 2005; Fuentes, 2016). This frame is optimally suited to assess how interactions between the different transmission systems can be a source of diverse discontinuities (e.g., Shennan, 2011; Weber and Bettinger, 2010). One of the key issues is that behaviors that have successful social reproduction have the potential to be suboptimal or even deleterious in terms of biological reproduction (Durham, 1991), suggesting that maladaptation can be a powerful source of archaeological discontinuities. In addition, by focusing on the dynamics of mechanisms of transmission and their long-term outcomes, dual inheritance contributes to bridge different temporal scales of analysis. As Fuentes (2016, 17) suggests, "...any basal framework should include the possibilities of evolutionary processes influencing the individual, the group, and even the regional population in similar or different ways and intensities".

Insights obtained from the decoding of the human genome continue to change the world in which we live and they continue to change our views of the deeper past. Until comparatively recently their principal contribution has come from the genetic structures of contemporary populations, initially with an emphasis on mitochondrial DNA or the Y chromosome, then including a wider range of autosomal markers, and now drawing also on the analysis of whole individual genomes. Though published studies of the latter kind are still comparatively new in our regions (e.g. Schuster et al., 2010), they are becoming more common and we expect this to continue. Also on the increase is the recovery of ancient DNA (aDNA), and we think here not only of DNA from human remains, but also that of domesticated animals (e.g., Horsburgh and Rhines, 2010) and – conceivably – of symbiotic and commensal bacteria or pathogens recovered from dental calculus (cf., Weyrich et al., 2015). Though recovering aDNA from hot, arid environments is still not straightforward (e.g. Mohandesan et al., 2016), it is clearly not impossible (e.g., Heupink et al., 2016; Morris et al., 2014) and further methodological advances can be expected. Nor, importantly, are all the environments and taphonomic modes of concern to us uniformly hot and arid. However, the technical challenges of recovering aDNA and of avoiding sample contamination in the process are relatively straightforward. Much harder is how best to formulate the questions at which genetic and archaeogenetic research can profitably and synergetically be directed and how best to evaluate the results that such research produces. While the care and thoroughness with which genetic samples are obtained has improved considerably over the past decade, at least in southern Africa (cf., Mitchell, 2010), archaeologists and geneticists still struggle to comprehend each other's methods and data. From an archaeological perspective, concerns remain about the reliability of many of the chronological estimates employed, the appropriateness of some of the comparative data used, and the degree to which far-reaching conclusions can be drawn from what are often very small genetic samples (MacEachern, 2013). Greater efforts to involve archaeologists more fully in the planning of genetic research from the outset – and to include ancient DNA specialists in the planning and conduct of archaeological excavations – should help address these issues. For instance, recent research in northern Patagonia is exploring the potential of mitochondrial DNA from modern populations to estimate changes in the size of human populations since the early peopling, complementing estimations based on the –now more widely utilized- summed probabilities of radiocarbon dates (Perez et al., 2016). When available, as in the cases of Pama-Nyungan and Wati the Australian Desert, and Khoe in southern Africa (Güldemann, 2008; McConvell and Bowern, 2011; Smith, 2005; Veth, 2000), linguistic studies should also be integrated in the reconstruction of population history.

4.2. Landscape dynamics, human biogeography, and demographic discontinuities

Climate change and landscape dynamics impact the distribution of human populations in the landscape and human biogeography provides the most direct way to assess this (Harcourt, 2012). Within a number of related topics that are discussed in this volume, the issue of landscape fragmentation due to enhanced aridity and its impact on human societies connects key historical processes across the southern continents. Following the pioneer 'islands in the interior' study by Veth (1989), this subject is usually framed in terms of refugia, barriers – that can be continuous or temporary – and corridors. Yacobaccio (1994) and Núñez et al. (1999) have utilized related concepts for the Atacama Desert in northern Chile and the Puna plateau in northwestern Argentina respectively. Considering that deserts and semi-deserts are fragile ecosystems, dry periods recorded during the late Quaternary would decrease to varying extents the amount of habitat that is reliable for human occupation due to an increase in ecological unpredictability and associated risks (Mandryk, 1993). Since landscape desiccation and degradation are progressive processes (Stine, 2000), the intensity, tempo, and duration of arid events would have a cumulative impact on the structure of the landscape and its opportunities for human societies (or 'environmental services' in the terms suggested by Santoro et al., 2017). This is the appropriate frame to assess the conditions under which the abandonment of regions occurs (Cameron, 1993).

In this context, refugia constitute key areas within desert landscapes and neighbor ecological zones. The recognition of refugia in archaeological scale represents a number of theoretical and methodological challenges, beginning with the fact that refugia can operate at multiple spatial and population scales. Inversely, "Abandonment may occur on an increasingly inclusive scale from activity loci to large geographical areas" (Cameron, 1993, 4). As originally argued by Veth (1993), the concept of abandonment serves a heuristic purpose and effectively stands as a contradistinction to evidence for repeated occupation or persistence within refugia or corridors. The biogeographic structure of the landscape plays a substantial role in determining the demographic trajectories of human populations, particularly regarding spatial relocalizations and demographic contractions (e.g., bottlenecks, extinctions). As Mike Smith (2013, 112) suggests, we must assess the human ecology of refugia with an emphasis on their carrying capacity and the distribution of watering points in the landscape.

If watering points – refugia – are spatially clustered in just some parts of the landscape (e.g., oases), then there is a basis for the abandonment of the remaining areas (or their use as 'passing-through' places, Veth, 1993). If, on the other hand, refugia are more widely distributed in the landscape, then a wider network of mobility can be sustained. Yacobaccio et al. (2017) suggest ecosystem resilience as an additional aspect that we also consider of fundamental relevance. The authors provide the example of groundwater vs. surface-water dominated landscapes, where the former are largely independent of local precipitations and, accordingly, display higher resilience than the latter. These large-scale biogeographic patterns are determined by the combined action of climate and geomorphology (Thomas and Burrough, 2012).

The location and spatial structure of refugia during the late Quaternary is a topic that connects the archaeology of the southern continents. Evidence supporting the existence of coastal refugia at various times during the late Quaternary has been presented for Atacama in northern Chile (Marquet et al., 2012; Santoro et al., 2017), the Pilbara in northwestern Australia (Veth et al., 2017), and the Cape Floral Region in South Africa (Marean, 2011), among other cases. Riverine refugia within deserts have been suggested as well (Stewart and Jones, 2016).

From a methodological perspective, the main task that we face is how to identify refugia and barriers. When doing this, it is important to bear in mind that refugia may, in specific cases, have a cryptic character, implying a spatial distribution in very low densities that may have very low archaeological visibility (Bennett and Provan, 2008; Smith, 2013). In the last decade, summed probability distributions of radiocarbon dates have from archaeological contexts have been among the main lines of research invoked to assess long-term demographic trends (Barberena et al., 2017; Gamble et al., 2004; Manning and Timpson, 2014; Prates et al., 2013; Rick, 1987; Williams et al., 2015a; among many others). As suggested by many, this proxy would allow tracking changes in the distribution and size of human populations through time; this is exactly the type of information required to assess the existence of refugia, biogeographical barriers, and corridors. A number of arguments have been raised against the utility of summed distributions as a demographic proxy by questioning the chain of connections between radiocarbon dates and demographic reconstruction (Attenbrow and Hiscock, 2015; Bamforth and Grund, 2012; Contreras and Meadows, 2014; Torfing, 2015), which have been met by a number of responses (e.g., Timpson et al., 2015; Williams and Ulm, 2016). We consider that this method provides a productive approach to explore structure at a multiplicity of scales in datasets that are already available, although produced for purposes other than demographic reconstruction, helping to formulate hypotheses that can be subjected to scrutiny from independent proxies, genomic analyses in human remains paramount among them. Paraphrasing Williams and Ulm (2016, 2), "the use of dates as data can be a powerful tool in the archaeologist's arsenal" utilized to detect and explain archaeological discontinuities and their demographic basis.

4.3. Economic discontinuities, or variation on a subject: intensification, management, and domestication

One of the greatest potential discontinuities with which the archaeological records of southern hemisphere deserts must deal is the contrast between societies that grounded their subsistence base in the exploitation of domesticated plants and animals and those that did not. But this contrast is, of course, far more complex and open to debate than the way in which we have just phrased. First, and consistent with increasing acceptance of both the concept of the Anthropocene (Crutzen, 2002) and its potential applicability over much longer time-scales than were first envisaged (Foley et al., 2013), is the realization that people have deliberately sought to manage – and have, willy-nilly, impacted upon – the environments in which they live for tens of millennia. Australia, with its long history of people using fire to modify the productivity and structure of its vegetation, is a classic example (Bird et al., 2008, 2016), even if deliberate management strategies of this kind have yet to be convincingly demonstrated in southern Africa or the Southern Cone. More strongly evident there is the impact of human exploitation on food resources, particularly shellfish, which can sometimes be shown to have been exploited sufficiently heavily as to produce discernible shifts in mean size toward smaller (in general terms, less desirable) individuals (e.g., Jerardino et al., 2008; Sealy and Galimberti, 2011).

Common to all the southern drylands we discuss is the intensified emphasis that people sometimes placed upon collecting and consuming shellfish and other marine foods. Such resources likely have an immensely long history of exploitation, reaching back well over 100,000 years, but obscured in many regions by post-glacial rises in sea-level (though see Veth et al.'s [2017] discussion of Barrow Island, Western Australia, for a good counter-example). However, their intensification – and the potential for the concomitant development of more delayed-return-oriented economies – may have required very particular combinations of human demography, marine productivity, and the integration (or non-integration) of adjacent terrestrial habitats within people's seasonal rounds; phenomena like the megamiddens of the Elands Bay and Lamberts Bay regions of South Africa, for example, are both temporally and geographically restricted (Jerardino, 2010), even if the same period saw a more general increase in human presence along the broader Atlantic coast (Dewar and Orton, 2013). The specific conditions that promoted and discouraged intensified use of coastal resources of this kind and the kinds of social change that may have both made it possible, and have been made possible by it, provide a clear focus for further investigation, including exploration of the role of globally apparent episodes of climate change, such as the Neoglacial. In southern Africa, for example, it is surely not coincidental that it is precisely to this time that the megamiddens date, along with otherwise very rare evidence of inter-personal violence, multiple burials within possible cemetery sites along the Atlantic coast, and isotopic evidence interpretable as signatures of quite restricted territories focused on either marine *or* terrestrial resources (Dewar, 2010; Pfeiffer, 2016).

However, neither southern Africa nor Australia have produced conclusive evidence of intensification developing directly into economies dependent upon domesticated plants or animals. Instead, in these regions the critical species (cattle, sheep, goats, cereals, among others in southern Africa; dogs in Australia) were invariably exotic in origin – though low-level food production has been recently suggested for Australia – (Williams et al., 2015b). Recognizing this immediately identifies a series of questions: how, when, and by what routes did these resources arrive and to what extent was their arrival necessarily associated with the expansion of human populations? What ecological boundaries constrained, or facilitated, their take-up, for example in the form of total precipitation, rainfall seasonality or unpredictability, or disease? (Mitchell, 2015a). How far could they be readily assimilated into existing mobile hunter-gatherer ways of life without significantly changing them? (dogs everywhere? sheep, perhaps, if exploited at a low enough level? O'Connell, 2006; Sadr, 2003). To what extent did people keeping livestock did so for reasons of prestige and ritual, rather than to consume their meat or milk, and how far did they therefore retain a dependence on hunted and gathered resources? Above all, does the introduction and employment of domesticated plants and animals thus represent more of a continuity, than a discontinuity, in subsistence economies and regional

population histories, notwithstanding the non-native status of the species themselves in the cases of southern Africa and Australia? Precisely the same question arises, of course, in all three southern hemisphere regions with respect to the transformations wrought by the introduction of horses, dogs (in much of the Southern Cone), metal, glass, and other novelties in the aftermath of European contact, settlement, and expansion (cf., Mitchell, 2015b).

The South American deserts, in particular those from the South Central Andes (Peru, Bolivia, northern Chile, and northwestern Argentina) offer a somewhat different trajectory, since local intensification in hunting wild camelids – guanacos and vicuñas – appears to have opened the way for herd managing strategies that are initially visible in the zooarchaeological record between ca. 6200–5100 cal years BP and ultimately lead to domesticated llamas (see Fig. 3) and alpacas, respectively (Yacobaccio and Vilá, 2016; Yacobaccio et al., 2017; see also Stahl, 2008).

These preliminary contrasts brought up for the southern hemispheres trigger important comparative questions; for instance, what are the sources of intra and inter-continental differences in the process that, in some cases, leads from undirected intensification in the exploitation of certain species to domestication (Yacobaccio and Vilá, 2016), while not in others (Larson et al., 2014; Williams et al., 2015b)? A comparative frame for domestication studies across the continents is currently growing (e.g., Fuller et al., 2011; Larson et al., 2014; Marshall et al., 2014), and the discussions on the role of intensification processes in the southern hemisphere contained in this volume will contribute to it.

4.4. Comparative archaeology of discontinuities in the southern hemisphere

Finishing where we started, it is evident that the meaning of discontinuities in archaeological scale in terms of evolutionary and socio-demographic processes fits Bailey's (2007, 220) assertion that "we cannot work out what tools we need until we know what sort of phenomena are there in the longer-term record to investigate, and we cannot investigate those different phenomena until we have some tools to do it with. And to solve that paradox we will need to work at both simultaneously". This overview and the papers contained in the volume highlight a number of research strategies with the capacity to advance this task, which is empirical as much as it is theoretical. Several decades after the peak debates on mid-range theory (or whatever we choose to call it), which many would deem as over, we still find that a number of key debates are in need of theory and data bridging successive analytical scales. For instance, we still do not posses satisfactory answers to questions such as what are the actual short-term behaviors behind long-term discontinuities? We suggest that decision-making grounded on short-term social and economic factors has long-term consequences that can be perceived as archaeological discontinuities. This set of decisions may range from when to abandon given patches of the landscape, adopt new dietary resources, or stop exchanging information across given social or geographic 'boundaries' (McDonald, 2017). Long-term processes, on the other hand, certainly cannot be reduced to decisions occurring at the ethnographic scale, since the *long duree* introduces emergent phenomena not only due to cumulative social change, but also to changes in climate and ecology characterized by long temporal cycles.

We are convinced that there is much to learn from a comparative perspective in terms of structural similitudes in historical processes across regions and continents. For example, the conceptual structure of the debate on demographic discontinuities due to catastrophic volcanic impacts and climate change is strikingly similar across cases, notwithstanding important differences in terms of chronology and tempo of each of these cases. We look forward to international joint endeavors such as this one that help to formalize questions and data-collecting strategies for the southern drylands and beyond.

Fig. 3. Llamas from Pirquitas locality, Jujuy Province, Argentina (Credit: Alejandra Gasco).

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