In the summer of 1896, more than a hundred Arrernte tribesmen gathered at an isolated repeater station on the Overland Telegraph Line to stage a great *ingkuwere* cycle of ceremonies (Spencer and Gillen 1897). Lasting for more than four months, with ceremonies day and night, an *ingkuwere* (‘Engwura’) was normally held at the totemic site associated with the principal ceremonies (Strehlow 1947: 100–12). However, on the colonial frontier, Alice Springs telegraph station promised a measure of security, away from police, missionaries and cattlemen. The stationmaster, FJ Gillen, was the subprotector of Aborigines and local magistrate. Only a few years earlier, he had arrested Mounted Constable WH Willshire for murdering two Aboriginal men (Vallee 2004–6). For Aboriginal elders, the deciding factor was that Gillen – a keen ethnographer – was prepared to finance the ceremonies by providing rations for the participants.

Joining Gillen in a makeshift shelter on the ceremonial ground in the stifling summer heat was Oxford biologist Baldwin Spencer (Figure 2.1). The two men would later write *The Native Tribes of Central Australia* (1899), a detailed ethnography that revealed the richly elaborate religious life of these desert societies (Mulvaney and Calaby 1985; Mulvaney, Morphy and Petch 1997). It became one of the most influential books of its day (Kuklick 2006).

But it was not contemporary Arrernte society that excited most international interest. Under the influence of Spencer’s mentor, JG Frazer, the Arrernte entered European imagination as ‘humanity in the chrysalis stage’ (Frazer 1899: 648, in Kuklick 2006), a relic of an early stage in the evolution of religious and social institutions (Lang 1903; Durkheim 1912; Mulvaney 1964; PJ Bowler 1992; Hiatt 1996; Kuklick 2006). The Arrernte also provided prehistorians with analogues for Palaeolithic societies in western Europe (Reinach 1903; Sollas 1911; Lubbock 1912). For instance, the notion that Stone Age hunters in the Australian desert could create profound artistic and religious works led Salomon Reinach to suggest a magico-religious function for Palaeolithic cave art in France.
Ostensibly, this glossed over the fact that Central Australian societies might also have a history, that contemporary Arrernte society might be more complex than its ancestral form. But, in fact, ‘evolutionism’ did little to dampen speculation about the deep history of these desert societies. Ideas about the nature of the desert itself also changed. And shifting environments of lakes, rivers and dunefields implicitly framed a changing geography against which ideas about desert people were set.

This chapter follows this stream of ideas, examining how the past history of desert landscapes and desert societies has been interpreted since European explorers and scientists first encountered them. It interweaves two narratives: one explores emerging ideas about the environmental history of Australia’s deserts; the other looks at ideas about the prehistory of Aboriginal groups in this region. I want to chart the research that created the conceptual space within which we now work. I also want to highlight the recurrent themes that frame research into the natural and cultural prehistory of Australia’s deserts because these will provide the rationale and structure for later chapters.

THE DEAD HEART OF AUSTRALIA

Almost as soon as colonial exploring parties entered the desert, they encountered the large salt pans that dominate this landscape. In 1840, just 4 years after the founding of Adelaide, EJ Eyre led an expedition north, following the Flinders Ranges, until he found his route blocked to the west, north and east by a chain of large saltpans. Eyre thought these formed a single large ‘horse-shoe lake’. He suggested it was an old arm of the sea, describing the northern end of the ranges as ‘the termination of the island of South Australia, for such I imagine it once to have been’ (1845: I, 128).

J Lewis (1875) mapped the boundaries of Lake Eyre in 1874–5. Other reports soon established the presence of a fossil fauna that included large fish, crocodiles, chelids, ‘an emu-like bird’ (probably Genyornis) and Diprotodon optatum (Tate 1886: 54). By 1885, enough was known to suggest there had been major environmental changes in the interior. Ralph Tate was able to sum up: ‘A vastly increased rainfall over what is now the arid region of Australia in former times is demanded by the extinct rivers and lakes and the former existence of large herbivores’, adding that ‘a glacial period and a pluvial period mean the same to me’ (Tate 1886: 53; see also Tate 1879: lxvii).

The most striking evidence of these environmental changes was the discovery in 1892 of the fossil remains of hundreds of extinct giant marsupials and large flightless birds on the now-dry bed of Lake Callabonna (Stirling and Zietz 1899–1913). The following year, a museum field party excavated ‘a veritable necropolis of gigantic extinct marsupials and birds which have apparently died where they lie, literally in hundreds’ mired in lake muds (Stirling 1900: i–xv; see also Douglas 2006). In the title of his book, The Dead Heart of Australia
Figure 2.1. Baldwin Spencer with Arrernte elders at the 1896 ingkwerre ceremonies, Alice Springs, Central Australia. The publication of The Native Tribes of Central Australia in 1899 gave the Arrernte a prominent role in the public imagination, one not surpassed until the Western Desert Papunya Tula Art movement in the 1970s. (Photograph courtesy Museum Victoria – XP14279)

(1906), JW Gregory captured the consensus that a Pleistocene pluvial period had been followed by continental desiccation.

In the 1940s, TW Edgeworth David drew together earlier ideas about an enlarged Pleistocene lake (Tate 1879: lxvii, 1886; Gregory 1906; Howchin 1909: 102; David 1932), labelling it ‘Lake Dieri’ (Browne 1945: vii). This ancestral mega-lake had been 10 times the size of Lake Eyre and 20 m deep (David and Browne 1950: 616–17). Dating was uncertain. Although David and Browne suggested a middle Pleistocene age (180 ka), some writers took the view that pluvial conditions had persisted into the early Holocene (Crocker and Wood 1947). Later work was to show that ‘Lake Dieri’ conflated sediments and landforms of widely differing ages (Wasson 1983; Stevens 1991), although Löffler and Sullivan (1979) briefly resurrected the notion of an immense ancestral lake.

The great flooding of Lake Eyre in 1949–50 saw a resurgence of scientific interest in the playa (Mawson 1950; Peake-Jones 1955). This produced the first direct stratigraphic evidence of palaeo-shorelines around the lake (King 1956: 100) and the first use of radiocarbon (14C) dating in arid Australia (Baas-Becking and Kaplan 1956). But it was another set of palaeolakes, those in the
Willandra, that rapidly became the focus of research in the 1970s and prompted a radical rethinking of the notion that the glacial climate of the inland had been ‘pluvial’.

DESER T SOCIETIES

In 1699, the English buccaneer William Dampier explored the arid west coast from Shark Bay to Lagrange Bay but did not see Aboriginal people until he reached the Kimberley coast. French mariners were the first to encounter desert people. In 1803, at Shark Bay on the arid west coast, F Péron was confronted by a group of armed Malkana men (1824, II: 144–6). A generation later, PP King met family groups of Yaburara people on the Pilbara coast in 1818 (King 1827, I: 38–47). The Central Australian Expedition (1844–6) was the first to travel deep into the arid interior, following the ephemeral rivers feeding Lake Eyre to reach 25°S on the eastern side of the Simpson Desert in September 1845 (Davis 2002). This party, under Charles Sturt, was in the field for 17 months and encountered Aboriginal groups almost every day, providing a remarkable picture of a hunter-gatherer landscape peopled by family groups spaced a day’s travel apart (Figure 2.2).

The tempo of exploration and contact quickened in mid-century, when rival expeditions by J McDouall Stuart (1858–62) and Burke and Wills (1860–1) set out to cross the continent. Aboriginal groups along Cooper Creek came to public attention when they assisted John King, the only survivor of Burke’s advance party. In April 1860, McDouall Stuart became the first explorer to encounter the Arrernte people when he reached the MacDonnell Ranges in Central Australia. After his route north was blocked by armed Warrumungu men, the South Australian Parliament debated whether he should shoot his way through, justifying this on the basis that ‘the tribes on the northern coast were of Malay origin, and were not the original lords of the soil which they now occupied’ (see Exploration of the Interior [Parliamentary Debates, 9 October 1860]: 1008).

The construction of the Overland Telegraph Line from 1870 to 1872 brought Aboriginal groups in Central Australia into sustained contact with Europeans and provided a base for further exploration west into the Western Desert. The Elder Scientific Exploration Expedition (1891–2) and the Horn Scientific Expedition to Central Australia (1894) (Spencer 1896) were the first explicitly scientific expeditions to Australian deserts; the latter was the first to focus on the detail of Aboriginal life. But, by 1900, much of Central Australia had been occupied by pastoralists. In this context, the 1896 ingkure represented a remarkable attempt by senior Arrernte men to draw colonial authorities into their governing ideology and a virtuoso demonstration of their ritual property and knowledge.
Most writers accepted that Australian Aboriginal people shared a common origin – ‘all have originally sprung from the same stock’ (Eyre 1845: II, 151) – but differences in language, material culture and social organisation raised questions about the dispersal of people across the continent and their subsequent differentiation. In 1787, a year before the first British settlement in Australia, W Eden had argued that the uniformity of people and material culture evident on the northern and southern coasts of ‘New Holland’ implied not only a common origin but also rapid settlement, without time for differentiation of these groups to occur. Given the size of the continent, the only way this could have been achieved was if the spread of Aboriginal groups had been limited to ‘a narrow tract of sea coast’ and ‘continued circuitously along the coast, leaving the interior entirely desolate, or at least but partially inhabited’ (1787: 233).

With better information on cultural variability but little more on the geography of the interior, Eyre suggested three separate routes of migration radiating out from the northwest coast, with one directly crossing the centre of the continent (1845: II, 393, 405–7): ‘each offset appearing to retain fewer or more of the original habits... in proportion to the distance traversed, or its isolated position... modified also, perhaps, in some degree, by the local circumstances of the country through which it may have spread’ (1845: II, 405–6). The idea of a community of custom and organisation, subsequently modified by distance, isolation and adaptation to a varied ecology, was echoed by many later
writers (Favenc 1893; Spencer and Gillen 1899: 36, 117; 1904: 15, 17; Spencer 1921).

Better knowledge of the interior drove changes in ideas about likely migration routes. After 1845, many writers saw the Cooper, Diamantina and Darling River systems as key routes for initial human dispersal into the interior (Smyth 1878: lxvi; Mathew 1889; Spencer and Gillen 1899: 596; 1904: 17). To account for the ‘remarkable homogeneity’ in core beliefs and customs shown in their ethnographic work, Spencer and Gillen (1904: 18–19) argued for initial settlement during the late Pleistocene under a pluvial climate, with increasing regional diversity as ‘the gradual desiccation of the central area’ took place. However, Gregory (1906) had not found any trace of people in the fossil beds along Cooper Creek and Warburton River, although this was an explicit objective of his work. This suggested that people were not coeval with either the extinct giant marsupials or contemporary with pluvial conditions in the interior. Walter Howchin, the indefatigable geologist who laid the foundations of South Australian stratigraphy, later found crude stone implements on the desert plateau near Lake Eyre that led him to argue for a desert ‘Eolithic’ phase of ‘considerable antiquity’ (1921). However, these objects were quickly dismissed as the products of thermal fracture and other natural agencies (Jones and Campbell 1925; Tindale 1932).

A short chronology, however, sat uncomfortably with the notion of Stone Age survivals (Lubbock 1875: 427–9, 438–50; 1912; Spencer 1901: 12). R. Brough Smyth (1878, I: lv–lvii) argued that without a Pleistocene presence, Aboriginal society could hardly be a Palaeolithic survival. In Ancient Hunters and Their Modern Representatives (1911), W Sollas offered a solution. Calling the Arrernte and other Aboriginal groups ‘the Mousterians of the Antipodes’, he suggested ‘that the inferior tribes of the Neandertal race were driven by stress of competition out of Europe, and wandered till they reached the Australian region’ (1911: 208).

Time was not the only issue here: the extent of autonomous cultural development also posed a challenge to the notion that Central Australian society was a sociological fossil. Theories of global social evolution set much of the agenda for Spencer and Gillen’s research, but their field-based anthropology led them towards functionalist or sociological explanations of Arrernte life (Morphy 1997: 30–7). Recognising that these societies must also have a history of local development, they asserted that ‘it is impossible to believe that the far-away ancestors entered the continent provided with a highly complex set of customs and beliefs such as are now common to all the tribes. These have undoubtedly been elaborated in course of the long ages’ (Spencer and Gillen 1904: 15).

Their interest in the historical dimensions of tradition led them to suggest a sequence of changes in Arrernte social institutions. The four stages of the altyerrenge (‘alcheringa’ or ‘dreamtime’) (Spencer and Gillen 1899: chapter 10)
began with the creation of men and women, followed by introduction of the four-class section system, circumcision and the use of stone circumcision knives, then introduction of subincision rites by travelling *atyelope* (‘achilpa’ or native cat) ancestors, and finally the present system of marriage and social segmentation involving eight subsections. Although this was crude historicism at best, modern linguistic research on subsection systems (McConvell 1996) and archaeological work on sites associated with *atyelope* ceremonies (Smith 1988: chapter 9; David 2002) both offer a measure of support for this schema.

The implications concerned A Lang (1904, 1910). He pointed out that because the Arrernte could not be the most primitive of Aboriginal groups, any conclusions about the evolution of totemism and early social organisation were invalid. Sollas also noted that the presence of more advanced implements, such as ground-stone axes, indicated that these groups ‘though still remaining in the Palaeolithic stage have made a considerable advance on the culture of Neanderthal man’ (1911: 179, 207).

DS Davidson took the argument for local social evolution a step further, positing Central Australia as a centre of cultural innovation. The geographic distribution of cultural traits – such as subincision and class and subsection systems – ‘proved that Central Australia is the centre of cultural intensification and development of this trait [subincision] in addition to many others, regardless of the point of origin of each’ (1928: 139).

By the 1920s, a picture of desert prehistory had emerged: a Palaeolithic people had migrated into the interior by following the inland river systems, and there had been some differentiation of desert groups and local evolution of social institutions and material culture. The limited evidence available suggested this had taken place in the Holocene, after the extinction of the megafauna and after the Pleistocene pluvial lakes had disappeared. However, towards the end of his career, Spencer restated the case for a longer chronology: to account for the development of a common core of beliefs and customs across the interior, initial settlement must have taken place in ‘early Pleistocene times’ (1921: 26), when there were fewer environmental barriers to communication. Revising his ethnography in *The Arunta: A Study of a Stone Age People* (1927), Spencer noted that in the earliest traditions, the ‘country was covered with salt water’, coinciding with geological evidence for ‘the existence of a great inland sea’ (Spencer and Gillen 1927: I, 307, fn 3).

ANCIENT PETROGLYPHES

Rock engravings (petroglyphs) are the most tangible evidence of human antiquity in Australian deserts. Herbert Basedow (1907, 1914) was the first to recognise the significance of this ‘track and circle’ rock art, drawing on fieldwork in the Flinders Ranges between 1906 and 1911. Living Aborigines knew nothing of the engravings, he claimed. Some designs seemed to represent the tracks
of extinct animals, including *Genyornis* and *Diprotodon* (Figure 2.3). In most cases, the engravings were on fractured and broken rock surfaces and were covered with a ‘dark rust-coloured “patina” or glazed surface film’ – all of which indicated a ‘very considerable antiquity’. Anticipating modern research on these mineral films, Basedow obtained samples from Egyptian quarries dating to ‘about 3000 years B.C.’ and compared the two, noting that those on Australian samples were thicker (Basedow 1914: 199–200). By implication, the rock carvings were older than 5,000 years (an age remarkably close to some modern estimates; see Smith, Watchman and Ross 2009).

Basedow’s work led to a surge of research on rock engravings (Hale and Tindale 1925; Campbell 1925; Pulleine 1925; Mountford 1929a). More finds of extinct fauna followed – with Mountford famously identifying an engraving of an estuarine ‘crocodile’ at Panaramitee (1929b; Mountford and Edwards 1962) and Tindale identifying the tracks of *Genyornis* in engravings at Eucolo Creek (Hall, McGowan and Guleksen 1951; Tindale 1951). Mountford correlated his ‘crocodile’ with the ancestral Lake Eyre described by Gregory (1906) – although Berndt (1987) later showed it was probably a Ngadjuri hair-string ‘yarida’ sorcery figure.

By 1960, the uniformity of this ‘extinct art’ across 2.5 million km² of the desert interior was striking (Mountford 1960). Quantitative analyses reinforced the picture of an ancient continental rock art tradition (Edwards 1963, 1965, 1966, 1968; Mountford and Edwards 1964; Layton 1992; Franklin, 2004), labelled the ‘Panaramitee style’ (Maynard 1979), that extended to Tasmania prior to the postglacial rise in sea level. The consistency of this tradition implied a high degree of cultural homogeneity in Australian deserts during the late Pleistocene (Edwards 1966, 1971; Maynard 1979). This was taken as evidence that Pleistocene groups maintained open, extensive social networks, important for small mobile populations (Morwood, 1984). But this continental tradition had fragmented as populations grew in the postglacial period, resulting in greater regional diversity in rock art and an increase in territoriality.

**THE ‘GREAT AUSTRALIAN ARID PERIOD’**

The key to understanding postglacial environmental changes initially lay with desert dunes. Sturt’s 1844–5 expedition had been the first British party to enter the immense dunefields that ring the centre of the continent. When the expedition was finally blocked by the sandridges of the Simpson Desert, Sturt wrote to his wife:

Sunday September 7th 1845 . . . Ascending one of the sand ridges I saw a numberless succession of these terrific objects rising above each other to the east and west of me. Northwards they ran away before me for more than fifteen miles . . . How much farther they went with the same undeviating regularity God only knows . . . The scene was awfully fearful, dear Charlotte . . . It looked like the entrance into Hell. (Sturt 1984: 72–4)
Sturt doubted that ‘winds had formed these remarkable accumulations of sand’ as they were ‘as straight as an arrow . . . across six degrees of latitude’ and suggested instead that they were scour features created when the interior had been uplifted and an ancient sea had violently drained away (1849: 380–1). ‘They exhibit a regularity that water alone could have given,’ wrote Sturt, ‘and to water, I believe, they plainly owe their first existence’ (1849: 381).

There is an echo here of the ‘diluvialist’ ideas current in Britain when Sturt left for Australia in 1827. Steady-state geomorphic processes could not explain raised shell beds, glacial erratics, U-shaped valleys and glacial moraines. Most geologists in Europe accepted the reality of a geological deluge – even if a correlation with the biblical flood was doubted – and that parts of the continental landmasses had once been submerged. By 1840, however, the glacial origin of most of the anomalous landforms was clear, and diluvial ideas had morphed into ideas about a Pleistocene Ice Age (Rudwick 2008). In this context, Sturt’s ideas did not get much traction. Prior to 1870, geographical knowledge about the interior was simply too scanty to permit much of a debate about the origins of arid Australia.

Most observers saw the sandridges as aeolian landforms reflecting contemporary arid conditions in the interior of Australia (e.g., Jutson 1934: 330). The fact that dunes had built over dry lake beds and appeared to be blown out of older fluvial sediments indicated that they postdated Pleistocene pluvial conditions. However, by 1940, regional geomorphic mapping in western Queensland (Whitehouse 1940: 67–8) and soil erosion studies in the Cooper...
basin (Ratcliffe 1936, 1938) indicated that the dunefields themselves were fossil landforms. This implicitly raised questions of chronology.

Whitehouse thought the field evidence indicated that the dunefields had formed during the closing phases of the Pleistocene (1940: fig. 14). However, the most influential assessment was by RL Crocker, then a soil scientist at the University of Adelaide. In a series of papers, Crocker argued that ‘the Great Australian arid period’ was postglacial, probably dating to between 6,000 and 4,000 years ago (Crocker 1946; Crocker and Cotton 1946; Crocker and Wood 1947 – see also Browne 1945: xix). Impressed by exceptionally thick sheets of calcrete (locally termed kunkar) in soils in South Australia, Crocker argued that the likely source was windblown calcium carbonate (‘loessial lime’) deflating from shelly beaches formed during glacial low sea level. Later wind erosion of these soils had provided the sediment for dunes in this region. Given the time required for this chain of events, the arid period probably coincided with the thermal maximum in the first half of the Holocene (Crocker 1946).

‘A catastrophic decline in rainfall which initiated the aridity placed such a stress on the pre-arid flora,’ argued Crocker and Wood, so that ‘it was almost completely wiped out’. Under these conditions, both wind and water erosion were more aggressive ‘and carried considerable quantities of sand and silt into the drainage basins’ (1947: 103–4).

The idea of a short, sharp period of extreme aridity 6,000–4,000 years ago built on a decade of detailed regional mapping of soils, alluvial sediments and laterites and gained wide acceptance (Browne 1945; Gill 1965). But the only fixed point in this chronology was the last marine transgression, and this is where it began to unravel. The key evidence was the identification of submerged linear dunes and lunettes on shallow continental shelves, drowned by the postglacial rise in sea level (Fairbridge 1961; Sprigg 1964, 1979; Jennings 1975). RC Sprigg was quick to see the implications, concluding that ‘the extreme “desert” phases correlate with glacial eustatically low-sea levels, and in turn with recurring Pleistocene glaciation’ (Sprigg 1964). The dunefields were therefore significantly older than Crocker and Wood had proposed.

**Shifts in Climatic Belts**

One of the perennial questions the dunefields raised was whether Quaternary climate changes simply involved latitudinal shifts in weather systems. T Griffith Taylor (1919) popularised the idea that ‘an increase in the temperature of the middle latitudes . . . pushes the arid belt and the polar rain belts away from the equator’ (1919: 297). During the Pleistocene, the arid belt would have been centred on Darwin (a shift of 1,300 km). Taylor’s model of a ‘drift’ in the position of the arid belt was widely accepted (Spencer 1921; Keble 1947; Birdsell 1957: 60–1; Keast 1959; Tindale 1959: 50) and seemed to provide a plausible mechanism for environmental shifts in the Lake Eyre basin. Keble (1947: 30)
Figure 2.4. Robert Keble’s 1947 map of climatic belts in the interior 15,000 years ago. In this version, the arid zone is centred further north than today, and winter rainfall reactivates rivers in the eastern part of the zone, creating a large palaeolake ancestral to modern Lake Eyre. (Source: Keble 1947: 72)

supported this view, arguing that ‘with the advance of the belts, a region may have passed successively from desert into savannah to tropical rainforest’ (1947: 30) (Figure 2.4). Keast (1959) argued that the biology of the arid zone indicated ‘that desert was never eliminated from the continent’, and so it made more sense to think of shifts in the arid belt rather than a Quaternary succession of wet and dry climates (1959: 31). However, Gentilli (1961) was scornful of this notion, arguing that the Pleistocene ‘pluvial’ climate reflected the simultaneous encroachment of wetter climates from the equatorial and poleward margins of the continent, compression of the mid-latitude weather systems, and a major contraction of the desert.

Aerial mapping undertaken by Cecil Madigan in 1929 and Donald Mackay in the 1930s produced the first continental map of the dune fields (Madigan 1936). Using newly available national air photograph coverage, Jennings (1968) revised this – and this provided a basis for testing ideas about shifts in the prevailing wind systems (Brookfield 1970; Wason 1983, 1986; Hesse 1994). During the last glacial, the dune fields registered a small latitudinal shift (no
more than 3°, equivalent to 300 km) in pressure belts and expanded both to the north and south (Hesse 1994). The desert, it seemed, had neither swung as much as Griffith Taylor (1919) had suggested nor contracted as severely as Gentilli (1961) had argued. What the data showed was a more modest expansion and contraction of the desert and some readjustment of circulation on its southern margin.

CULTURE HISTORIES

A more detailed human history took shape in the 1940s and 1950s, as physical anthropologists, archaeologists and linguists attempted to account for variation, across the continent, in the physical characteristics of Aboriginal people, in stone artefact assemblages and in language.

Physical Anthropology

One outcome of a joint anthropological expedition by Harvard University and the University of Adelaide (1938–9) was the first detailed map of Aboriginal tribes across the continent, which was compiled by NB Tindale (1940). JB Birdsell, Tindale’s partner in this research, argued that the new data on physical variation in Aboriginal populations across the continent were best explained by successive waves of migration from the north (1941, 1957, 1967). His ‘trihybrid theory’ echoed earlier ideas, especially those of Howitt (1904: 31), who had suggested that Tasmanians were a relict pocket of an earlier population displaced on the mainland by Australian Aborigines (see also Mathew 1889; Flower and Lydekker 1891; Spencer 1921). None of these schemes had much impact on ideas about the population history of Australia’s deserts. And, except for Howchin’s ‘desert eolithic’, there was never any evidence to suggest a ‘Tasmanoid’ phase of occupation there. What Birdsell’s data did show was that apart from a latitudinal cline in skin colour, body proportions and body hair (Lindsell 2001; Gilligan and Bulbeck 2007), phenotypical variation in desert groups was so high that no cohesive patterns could be isolated (Birdsell 1993).

Stone Tools

NB Tindale also saw the desert in dynamic terms, using variability in stone artefact assemblages to argue for a succession of cultures across the continent and adopting the ‘culture-historical approach’ then current in North America and Europe. The task, as he saw it, was ‘an assessment of the ways of life, activities and effectiveness of peoples of a series of palaeolithic hunting tribal communities’ that had been ‘drawn off from the whole seething cauldron of Asia at various intervals of time’. Geographic distance and adaptation to
local ecological conditions had ‘rapidly introduced a diversity in modes of exploitation and spread’ (1959: 38–9).

Tindale’s 1957 scheme relied on identification of successive cultural phases, each characterised by a small number of distinctive stone implements (‘type fossils’) and differences in flaking techniques (Tindale 1957; Smith 2000). The first widespread phase of occupation in Australian deserts was during the Tartangan, which spanned the period between the last glacial maximum (LGM) and the mid-Holocene, and was contemporary with the megafauna and the rock engravings. From 4.7 ka onwards, people with Pirrian stone implements – including unifacial ‘pirri’ points – expanded across the desert interior, from the Lake Eyre basin westwards into Central Australia and the Great Victoria Desert. This spread was assisted by favourable environmental conditions and a new technology for ‘wet grinding of grass seeds to prepare grass seed meal’ that allowed Pirrian groups to exploit the expanding grasslands created by millennia of Aboriginal firing of the vegetation. Around 3,000 years ago, the Mudukian – with a microlithic tool kit – dispersed across the southern half of the continent and into Central Australia and the Western Desert. The later Murundian were an adze-using desert people, ‘pressing southward and eastward out of the desert areas into South Eastern Australia’ during the last millennium. This latest replacement, argued Tindale, reflected the impact of increasing aridity, prompting a shift to greater mobility and a more streamlined toolkit.

In a remarkable unpublished manuscript, ‘Archaeology of S-W Centralian Desert’ (1958), JE Johnson, a geologist working in the Mann–Musgrave Ranges, tried to apply Tindale’s classification to artefact sites in Central Australia. This was the first independent test of the stone tool seriation, and problems quickly became apparent. Many type artefacts, especially adzes and microliths, occurred together in the same assemblages. Some Tartangan sites were clearly modern. Others were coeval with Mudukian occupation. Tindale was quick to recognise the potential of radiocarbon dating, and, by 1957, he was able to cite five $^{14}$C dates in support of his pan-continental sequence. However, by 1963, empirical problems with the cultural-succession model had become acute. Later work did confirm a chronological shift from large flake-and-core assemblages to small-tool assemblages with adzes, points and geometric microliths, but no discrete groups of artefact assemblages corresponding to Tindale’s ‘cultures’ were found.

Historical Linguistics

Linguists also proposed a dynamic history of migration and population replacement. Although translation of the New Testament into Diyari – a desert language – was accomplished as early as 1897 (Reuther and Strehlow, 1897), there was little comparative data on Aboriginal languages until 1940. Schmidt
(1919) had drawn attention to a major division between the languages of northern and southern Australia. In a series of later studies, Arthur Capell (1937, 1940, 1956, 1962) also showed there was a division between prefixing languages in tropical northern Australia and the suffixing languages found elsewhere, including those in the arid interior. Languages in the north represented ‘the remains of a very early language group, swamped by later comers’ (1940: 432). Speakers of an ancestral language he called ‘Common Australian’ had spread across much of the continent and evolved in situ to produce a large group of interrelated languages belonging to a single phylum.

In the early 1960s, K Hale coined the term ‘Pama-Nyungan’ for this language family. Linguists proposed that the centre of dispersal was west of the Gulf of Carpentaria (Hale 1964) or in ‘the northern part of the Arandic speech-area’, or in areas immediately north or east of this (O’Grady 1979: 114–15). Because language spread involves the transfer of a complex semiotic system – in its entirety – linguists saw the expansion of Pama-Nyungan as a demographic event that effectively wiped out most of the continent’s existing languages and their speakers. The linguistic diversity within the Pama-Nyungan languages seemed to require 4,000–5,000 years to develop. S Wurm (1972) attempted to correlate these linguistic changes with new archaeological data on the spread of microliths and stone axes. Most archaeologists, however, thought that population replacement on such a scale was implausible (Mulvaney and Kamminga 1999: 72–5) – unless the linguistic patterns were remnants of much earlier events. RMW Dixon (2002), a prominent linguist, argued that rather than a phylogenetic group, Pama-Nyungan was the product of a long period of reticulate linguistic evolution in the open terrain of the desert, where millennia of borrowing, diffusion and typological drift had operated to create a Sprachbund or linguistic area.

Whatever the interpretation, comparative linguistics seemed to point to a pattern of ‘explosive and massive sociolinguistic’ events originating on the margins of the desert, each followed by periods of stability and in-situ efflorescence (Sutton and Koch 2008: 498). The cultural and linguistic homogeneity of the Western Desert suggested that speakers of Wati represented a recent expansion of people across the western half of the arid zone (McConvell 1996; Veth 2000). In contrast, the Arandic languages in Central Australia formed a more ‘deeply etched’ linguistic landscape (Capell 1962: 12–13; Wurm 1972: 166), an ancient Sprachbund created early in the initial breakup of Pama-Nyungan, and now displaying considerable internal variability in language and dialect.

THE AUSTRALIAN DESERT CULTURE

The first, long stratigraphic record from an archaeological site in the desert – supported by nine \(^14\)C dates – gave quite a different picture of desert prehistory. Between 1967 and 1970, RA Gould – an American archaeologist – excavated the Puntutjarpa rockshelter near Warburton in the Western Desert (1968,
1971a, 1977). The archaeological record here showed a long period of cultural and economic stability beginning about 10,000 years BP. Gould proposed the term ‘Australian Desert Culture’ (1971a; 1977: 168–82), arguing that this represented a distinctive way of life, one highly adapted to desert conditions. Its hallmarks were high mobility, a ‘risk-minimizing opportunism’, the harvesting of wild seeds as grain and a toolkit that included microliths and hafted adzes. Puntutjarpa rockshelter provided ‘evidence for the success of this ancient desert culture adaptation throughout the post-Pleistocene of the Western Desert, culminating in the ethnographic desert culture of that region, in what must surely stand as one of the most dramatic cases of cultural conservatism on record’ (1977: 182).

The underlying reason for this long-term stability was that the desert ‘limits the optional responses by anyone with a hunting-gathering mode of subsistence who tries to live there’ (1977: 182). In effect, this dismissed the possibility of internal pressures for socioeconomic change.

Gould was writing at a time when archaeologists were exploring equilibrium models for hunter-gatherer populations and when social anthropologists also stressed the deep conservatism of Central Australian and Western Desert societies (Meggitt 1962; Strehlow 1947, 1971; Tonkinson 1978). But the immediate inspiration was the notion of an American ‘desert culture’ (Jennings 1957) – a long stable ‘lifeway’, adapted to the aridity of the desert Southwest, and characterised by high mobility, broad-spectrum diets, a sparse but efficient material culture and the harvesting of small seeds as grain.

In Australia, the concept of a ‘desert culture’ never gained wide acceptance. Australian archaeologists soon pointed out inconsistencies in identifying microliths and in the dating (Glover and Lampert 1969) and showed that the earlier deposits did not contain either adzes (Hiscock and Veth 1991) or seed-grinding implements (Smith 1986a). The novel feature of Gould’s work, however, was that in proposing a long period of cultural stability in the interior, he portrayed desert groups as an ancient endemic society. It was also a distinctively ‘desert’ society rather than one derived from the desert margins, with an economic focus on the use of small seeds. This way of life had developed as a response to Holocene aridity, to ‘the onset and persistence of the rigorous environmental conditions of the last 10,000 years’ (Gould 1971: 175).

The desert had been settled during the more equable conditions of a Pleistocene pluvial climate, but Holocene desiccation of the interior meant that, in a sense, the desert had formed around the people. This argument hinged on a particular view of the environmental history of Australia’s deserts – and, by 1970, the notion of Holocene aridity was already seriously out of date.

LAKE MUNGO AND THE WILLANDRA LAKES

The prevailing view that higher rainfall, and active rivers and lakes, had marked the late glacial climate changed so abruptly in the mid-1960s that by 1975,
little trace of it remained. The crucial demonstration of glacial aridity was made by RW Galloway (1965), who derived numerical estimates of rainfall and evaporation during the last glacial by comparing the limits of periglacial action and snowlines in the Snowy Mountains with palaeo-shorelines at nearby Lake George. This showed that with large reductions in temperature and evaporation, enlarged lakes did not necessarily imply greater rainfall. The terms ‘wetter’ and ‘drier’ became increasingly ambiguous without ‘separate thermal and effective precipitation histories’ (Bowler et al. 1976: 361).

In arid and semi-arid Australia, much of the new evidence for glacial aridity was from lunettes: crescentic clay-rich dunes, found on the downwind side of palaeolakes. Hundreds of lunettes and small palaeolakes are dotted across southern Australia. They are clearly relict landforms, although the process of their formation was not understood for some time (Hills 1939, 1940; Stephens and Crocker 1946). Observations of modern clay dune formation in hyper-saline lagoons on the Gulf Coast of Texas eventually resolved the issue: the dominant process was the deflation of sand-sized clay pellets, formed by wetting and drying and increasing salinity on exposed lake margins and blown by strong winds into clay-rich dunes (Bowler 1968). Lunettes quickly became an important indicator of seasonal drought and salinity (Bowler 1971).

The Willandra Lakes, which include Lake Mungo, make up a chain of small palaeolakes, each bordered by a lunette, in western New South Wales (Figure 2.5). Fed by flood discharges from the southern highlands, the now-dry lakes were active systems during the late Pleistocene. In 1968–9, the first series of $^{14}$C dates for lunettes confirmed they were glacial-age landforms (Bowler 1971), but it was their potential as environmental and archaeological archives that caught most international attention (Bowler et al. 1970; Barbetti and Allen 1972; Bowler, Thorne and Polach 1972).

In a now-classic paper, ‘Pleistocene salinities and climatic change’ (1971), Jim Bowler showed that lunette sediments recorded facies change from quartz sand dunes (freshwater environments) to clay-rich dunes (saline environments). Each cycle began with quartz beach sands blown into dunes during high lake stands. As lake levels fell and salinity increased, clay pellets were blown into the lunettes, carrying with them salts recording the chemical ‘ageing’ and increasing salinity of the lake water: first carbonates, then chlorides and finally sulphates were precipitated. As the water table fell, the lake dried sufficiently to switch off the formation of pelletal clay, the lunette stabilised and a soil formed. ‘These ancient lakes preserve in considerable detail the imprint of past changes in the physical environment to which they responded with particular sensitivity,’ wrote Bowler (1971: 47).

These lakes also preserved a rich archaeological record. Interstratified within the lunette sediments at Lake Mungo were numerous small archaeological sites – including burials, a cremation, hearths, grindstones and shell middens – mostly dating between 20,000 and 30,000 years BP (Bowler et al. 1970;
Figure 2.5. Jim Bowler's 1971 map of the geomorphology of the Willandra Lakes, a chain of Pleistocene palaeolakes in western New South Wales, each bordered by a lunette. This was the first map of the Pleistocene lake system. (Source: Bowler 1971: fig. 5.4)
Barbetti and Allen 1972; Bowler, Thorne and Polach 1972). Taken collectively, these gave a detailed picture of a Pleistocene economy based on fish, crayfish, waterfowl, freshwater mussels, small mammals and grass seeds. It was, HR Allen argued, indistinguishable from the riverine economy practiced by the Darling River Bagundji during the last century (1974: 315–16).

One effect of the new data was to push the notion of a phase of mega-lakes, followed by continental desiccation, back into the Pleistocene (Bowler 1976). But although the chronology had shifted, the drying of the lakes – and the destruction of the late Pleistocene economy they once supported – reinforced Gould’s picture of a society forced to adapt to increasing aridity.

INITIAL COLONISATION OF THE DESERT

The timing of initial human moves into the desert had not been at issue (Birdsell 1957; Tindale 1959; Mulvaney 1961). As John Mulvaney, writing in 1961, said:

Any migration southwards from the Gulf could easily move across to the inland drainage basin, which in a pluvial period would provide a passage down the Diamantina River or Cooper’s Creek systems towards central Australia, or down the Darling River and tributaries to the south and south-east of the continent. (1961: 62)

But the translocation of Crocker and Wood’s ‘great arid period’ into the late Pleistocene created problems for this scenario and raised new questions about the pattern and timing of initial human settlement in the interior. Was the arid interior of Australia settled as part of the initial dispersal of people across the continent, or was the aridity of the region a barrier to settlement by these early human groups?

In the ‘coastal colonisation hypothesis’, S Bowdler (1977) argued that early settlement of the continent was focused on coasts and littoral resources (cf. Eden 1787; Tindale 1959: 38). Any late Pleistocene sites in the interior, she argued, represented either a ‘transliterated coastal economy’ centred on the rivers and lakes of the last glacial (for example, at Lake Mungo) or merely the inland extension of territories otherwise anchored in coastal regions (in the case of then-known Pleistocene sites on the Nullarbor or in the Pilbara). Effective cultural and economic adaptation to aridity – such as the harvesting of grass seeds and the hunting of large macropods – was a consequence of late glacial drying of palaeolakes in the Willandra, with effective settlement of the desert core only after 12 ka (Bowdler 1977: 229–30, 236). This echoed ideas popular early last century, including the ‘oasis theory’ (Pumpelly 1908), in which increasing aridity forced local hunter-gatherers to develop new ways of living (in Trigger 1989: 248), and Childe’s idea that desiccation associated with
postglacial temperature rise led to the domestication of plants and animals in the Middle East (1928).

Horton (1981) took more explicit account of the evidence for active rivers and lakes in the interior prior to the LGM. Using the distribution of fossil megafauna as a proxy for the distribution of potable surface waters, he suggested that much of the continent could have been settled before 30,000 BP, with the exception of the central part of the interior. From 25,000 to 12,000 BP, the human population was restricted to coastal regions by the harsh conditions that prevailed across inland Australia. Then, 12,000 years ago, people ‘moved back, first into some of the areas previously occupied where sufficient water was now available again, then, with improving knowledge and technology, into the arid core itself, which had never previously been occupied’ (1981: 26).

In its various forms, the idea that ‘the Mungo Lacustrine Phase would have given major access to the reactivated river and lake systems which ringed the arid heart’ (Jones 1979: 453) gained some currency (White and O’Connell 1982; Ross, Donnelly and Wassen 1992; Thorley 1998a; Hiscock and Wallis 2005: 43). In effect, the desert margins were seen as an adaptive filter, allowing ‘gradual conditioning by Aboriginal populations to increasing aridity . . . in western New South Wales, northern Australia and elsewhere’ (Ross et al. 1992: 101), shaping the way of life of Aboriginal groups on the periphery of the desert in ways that positioned them to colonise the arid core of the continent.

The use of wild grass seeds as grain was widely seen as the key economic adaptation to the arid interior (Tindale 1959, 1977; Gould 1977; Bowdler 1977) and instrumental in initial settlement of the region.

We propose that the onset of arid conditions 17,000–18,000 BP led to critical reductions in the abundance of high-ranked foods and favoured the adoption of more expensive items, including seeds. Once the technology for processing seeds was available, it was possible for Aborigines to move to previously uninhabited or sparsely inhabited parts of the continent. (O’Connell and Hawkes 1981: 115)

It was some time before archaeological fieldwork identified late Pleistocene occupation sites in the arid heart of the continent – and the new data shattered this neat picture of desert prehistory. The decisive evidence came from Puritjarra, a large rockshelter west of the MacDonnell Ranges in Central Australia (Jones 1987; Smith 1987). Initial excavations showed this site had been occupied 22,000 BP and later work extended this back to 35,000 years ago (Smith 1987, 2006; Smith, Prescott and Head 1997). Other finds confirmed late Pleistocene occupation in Central Australia (at Kulpi Mara) (Thorley 1998a) and in the Western Desert (at Serpents Glen) (O’Connor, Veth and Campbell 1998). These finds also broke the nexus between seed use and early occupation: none of the early sites contained seed-grinding implements (Smith 1986a, 2004).
As the earlier dates gained acceptance, interest shifted from questions of chronology to questions about the impact of intensified aridity during the LGM.

**BEYOND THE WILLANDRA**

Perspectives from the Willandra dominated the environmental history and archaeology of the arid zone into the 1980s. The Mungo lacustral phase was extrapolated as a major period of expanded lakes across Australia between 50 ka and 30 ka (Bowler 1982: fig. 8). Bowler acknowledged its limitations, but ‘while the actual age of the expanded lacustral phase in northern Australia remains speculative, the evidence of greatly expanded water bodies is beyond doubt’ (1982: 42). The problem was that the history of the desert was being written from rivers and lakes on its southeast margin.

In 1981, Australian National University (ANU) researchers (on Bowler’s initiative) launched an ambitious program to rectify this by exploiting the potential of palaeolakes across the continent as environmental archives, looking at climate change, O and C cycles, groundwater interactions, geo- and biochemical evolution of the lakes and vegetation history (Chivas and Bowler 1986). Called SLEADS (‘salt lakes, evaporates and aeolian deposits’), this was initially a four-year drilling program to extract cores from inland lakes. By the mid-1990s, when the project concluded, cores were available for half a dozen inland lakes (Lakes Eyre, Frome, Callabonna, Woods, Lewis and Amadeus), although not all produced detailed late Quaternary records. Dating was a problem in the early stages of SLEADS (especially at Lake Eyre; see Gillespie et al. 1991), but the wider availability of first TL and later OSL dating techniques resolved this. SLEADS was followed by John Magee’s detailed study of the palaeohydrology of Lake Eyre from 1989 to 1997 (Magee et al. 1995; Magee and Miller 1998), which used a combination of the new Quaternary dating methods to provide a solid chronology (AMS $^{14}$C, U/Th, AAR, TL and OSL). This provided the first fine-grained, well-dated sequence of environmental change spanning the last 100 ka in central Australia and shifted the focus back to Lake Eyre as the centrepiece of a suite of palaeolake studies.

The picture that emerged from SLEADS, and the projects that flowed from it, unpacked the idea that there had been a single ‘lacustral phase’. The new evidence not only provided a longer time frame but also a stronger picture of variability in landscape response across the continent. The northern lakes (Lake Woods and Lake Gregory) showed a series of ‘lacustral’ phases over the last 300 ka, each centred on an interglacial (Hesse, Magee and van der Kaars 2004). Elsewhere in the Australian desert, most dates for enhanced fluvial activity (such as along channels feeding Lake Eyre) or high lake levels (for example, Lake Eyre and Lake Lewis) centre on 100 ka, late in the last interglacial.
The last deep-water phase of Lake Eyre in Central Australia ended 60,000 years ago (Magee and Miller 1998), and this also marked the decline of the Cooper and Warburton River systems feeding the lake (Maroulis et al. 2007).

Along with SLEADS, the first detailed 14C chronologies for the continental dunefields came in the 1980s, with RJ Wasson’s work on the Quaternary history of the Strzelecki and Simpson dunefields (1983). Most dune-building occurred ‘between 25,000 and 14,000 B.P., with a peak between 20,000 and 16,000 B.P.’ focussed on the extreme conditions of the LGM (Wasson 1986: 59–60). There were limitations, however, to what could be achieved with radiocarbon dating. Organics are rare in dune sequences, and Wasson found he needed to rely on the interdigitation of aeolian and fluvial records to build a reliable chronology. This tied him to the floodplains of Cooper Creek and the Warburton River. Although he experimented in the mid-1980s with TL dating of dunes (Gardner et al. 1987; Wasson 1986: 59), luminescence dating was not widely deployed for another decade. A suite of studies using TL and OSL now provides fine-grained chronologies for dune activity in the western and northern Simpson Desert (Nanson, Chen and Price 1995; Hollands et al. 2006; Twidale et al. 2001) and in the Strzelecki and Tirari Deserts (Fitzsimmons et al. 2007). These show both a longer and more nuanced history of dune-building, as well as contrasting records of dune activity in the arid core and desert margins.

The first long vegetation record from the interior was from Lake Frome. Gurdip Singh had begun work here in 1975, building on his success in extracting pollen records from dry lakes and saltpans in Rajasthan (Singh 1981). A second core was drilled as part of the SLEADS program and, by 1991, Singh could claim that apart from his work in Rajasthan, this provided the only pollen record from deserts around the world that extended back to the LGM (Singh and Luly 1991). The Lake Frome work neatly confirmed the emerging picture of late Pleistocene aridity and Holocene amelioration. Singh argued that the Lake Frome record reflected changes in the extent to which the summer monsoon had reached into the interior. The monsoon had been significantly weaker during the late Pleistocene. The accumulation of evidence for intense aridity during the LGM raised questions about how human populations had coped.

**DESSERT REFUGIA**

‘A mountain,’ said Charles Darwin, ‘is an island on the land’ (1859: 371). It is not surprising, therefore, that one of the aims of the 1894 Horn Scientific Exploring Expedition to Central Australia was the discovery of ancient endemic plant species that had survived the desiccation of the continent in montane refugia. Ralph Tate, the expedition’s botanist, commented: ‘I had
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picted a vast mountain system capable of preserving some remnants of that pristine flora which had existed on this continent in Palaeocene times – probably a beech, possibly an oak, elm or sycamore’ (Tate 1896: 118).

This, said Tate, indicated ‘the desirability of a systematic exploration of the oasis of the McDonnell Range’ (1896: 118). But the low relief of these ranges was a disappointment. The ‘awakening came suddenly and rudely’ because ‘there exist no such features as could possibly maintain . . . a fauna and flora of a sub-alpine or cold temperate clime’ (1896: 119). Although the expedition recorded relict palms (*Livistona*) and cycads (*Macrozamia*), its major contribution to biogeography was the idea that the arid zone constituted a single biogeographic zone, which botanists, following Tate (1896), called the ‘Eremian’ or ‘Eremean’ zone, and zoologists, following Spencer (1896), called the ‘Eyrean’ zone.

It was not until the work of Crocker and Wood, in 1947, which drew on a century of work on plant distributions, that refuges and aridity became the dominant paradigm (see also Crocker 1959). Their 1947 paper not only put a ‘Great Australian arid period’ on centre stage, it also provided a major explanatory model for plant distributions in the interior. Aridity in the early Holocene had destroyed the existing vegetation of the interior so abruptly that it was impossible even for xeric species to colonise the region quickly enough to stabilise bare ground. ‘The present-day plant communities are the result of re-colonisation of vast, virtually bare, areas,’ argued Crocker and Wood, who compared the effects of aridity to ‘the Pleistocene ice-ages in the northern hemisphere’ (1947: 129–30).

Their vocabulary of refuges, barriers, migration and recolonisation has framed biogeographic thinking about arid-zone biota ever since. Burbidge (1960) argued that expansions and contraction of the arid zone had driven plant speciation but that the region now had its own ‘autochthonous’ flora. Jacobs (1982) suggested that speciation in spinifex (*Triodia*) had been driven by a series of expansions and contractions from refuges. Gentilli (1949) suggested that the avifauna of the desert derived from a series of colonisations from the desert margins, whereas Smith-White (1982) proposed that the desert margins had acted as an ‘adaptive filter’ for species dispersing into the desert.

Much of this constituted a running debate over the extent to which the biota of the arid zone was structured by dispersal or vicariance – paralleling arguments in historical linguistics. Cracraft (1991) argued for a ‘historically cohesive’ biota in the desert – an ancient regional fauna (including birds, mammals, snakes, frogs and lizards) with links to the north and northeast that pre-dated the Pleistocene. Crisp, Linder and Weston (1995) put the contrary view: the biota of the arid zone is related to adjacent coastal areas and does not form a coherent grouping. Part of the problem, suggested Stafford Smith, West and Thiele (1996), is that intermittent isolation and small populations lead to ‘reticulate evolution’ and ‘noisy taxa’.
For arid-zone refugia, the analogue of northern hemisphere ice sheets proved to be misleading (Byrne 2008). In Australian deserts, refugia tend not to be discrete regions. Inland ranges may have been refugia for birds and fish and some mesic plant species (Heatwole 1987), but the wider picture is of a mosaic of localised ‘species-specific, idiosyncratic’ refugia (Byrne et al. 2008: 4411).

**Islands in the Interior**

Evidence for a significant intensification of aridity during the LGM (20–18 ka) suggested that refugia might also have been an important factor in the human history of the region. Many archaeologists thought that inland ranges – with their gorge systems and waterholes – represented one of the few possibilities for the survival of late Pleistocene hunter-gatherer groups in the interior (Lampert and Hughes 1987; Hiscock 1988a; Smith 1988; 1989b; Veth 1989b; 1993; Thorley 1998a), with abandonment of other parts of the arid zone during the LGM likely. Mabbutt (1971a) had been the first to put this forward, writing well before the discovery of late Pleistocene human occupation in the arid zone:

The favoured environments of upland and piedmont and riverine tracts would have persisted throughout, although with fluctuating limits and changes in relative importance which would lead to associated changes in the range and frequency of human migration into adjoining desert lowlands. (Mabbutt 1971a: 78)

The most systematic exploration of these ideas was by Peter Veth, in *Islands in the Interior* (1993). As aridity increased, human groups had retreated to glacial-age refuges in the major ranges – the Pilbara, Kimberley, Flinders Ranges and Central Australian Ranges. These ‘islands’ formed important nodes of adaptation to aridity, fostering development of social, technological and behavioural adaptations to arid lands.

Although this was widely accepted in principle, there were doubts about the specifics. The persistence of occupation at Puritjarra in spinifex and sandhill country west of the main MacDonnell Ranges warned against too easy a correlation of refugia with inland ranges. Some refugia appeared to have been dispersed and cryptic: human groups at Puritjarra may have survived in sandhill country because a network of small waters provided access to a block of country large enough to support a viable population (Smith 1989a).

Veth (1989a, 1989b) also drew attention to the lack of evidence for occupation of the major continental dunefields prior to 5,000 years ago and argued that these regions would have been first colonised in the mid-Holocene. At issue was whether access to the sandy deserts was determined by climatic fluctuations – and their impact on wells and soakages, and plant and animal resources – or whether there were other more fundamental barriers to
settlement of these regions (Smith 1993; Veth 1995b). Veth argued that a combination of demographic factors, new technology and new modes of social organisation allowed their settlement and that these had developed during a period of adaptation in the glacial refuges and in the long process of slowly recolonising the more accessible desert lowlands. Later finds of late Pleistocene or early Holocene sites in the sandridge deserts (O’Connor, Veth and Campbell 1998; Veth, McDonald and White 2008) undermined this scenario, showing that Aboriginal people were using the sandy deserts at least 25,000 years ago.

These biogeographic and archaeological models were important for the way they emphasised the diversity of Australian deserts. However, the idea of well-defined glacial refugia – each a centre of dispersal for a coherent biota – was a northern European perspective that foundered on the more complicated situation in Australia’s deserts. A sandy desert was not the equivalent of an ice sheet. Some Australian species show evidence for expansion and migration from mesic habitats outside the arid zone, whereas others show persistence in multiple localised refugia over several glacial maxima (Byrne et al. 2008). For human prehistory, these models suggested a long uninterrupted occupation of the major inland ranges and river systems, contrasting with an ebb and flow of population in desert lowlands – with recolonisation of abandoned areas from centres within the arid zone. The cultural and genetic implications of rapid range expansion from a small subset of preglacial populations have barely been explored, but they point to the likely importance of bottlenecks for small desert populations repeatedly cut back by environmental change (Bennet and Provan 2008).

‘THE AUSTRALIAN ABORIGINAL AS AN ECOLOGICAL AGENT’

Not all changes involved humans responding to climatic shifts. Tindale saw ‘the Australian aboriginal as an ecological agent’, arguing that ‘much of the grassland of Australia could have been brought into being as a result of his exploitation’ and firing of the vegetation (1959: 42–3). Millennia of human fires not only allowed arid tropical grasslands to expand but also provided the basis for an economy based on the harvesting and wet milling of grass seeds (Tindale 1957, 1959: 49) – later labelled the ‘Panara or grass seed culture’ (Tindale 1977). Rhys Jones (1969) also emphasised Aboriginal use of fire to manage the land, calling it ‘firestick farming’, and speculated on its long-term impact on the face of Australia.

_A Land Transformed?

One issue was whether the initial entry of people into Australia around 50,000 years ago had led to a massive increase in fires that transformed the continent’s vegetation and denuded its soils (Latz 1995, 2007). Working with isotopic
signatures in fossil emu and *Genyornis* eggshell, G Miller argued that the modern desert landscape was a human artefact, the historical legacy of a landscape irrevocably altered by the initial impact of human settlement (Miller, Fogel, Magee et al. 2003). The decline of C4 plants in the diet of emus, and the extinction of *Genyornis* around 50 ka (Miller et al. 1999), signalled the destruction of a distinctive mosaic of palatable trees, shrubs and tropical grasses. Furthermore, the removal of woodlands in northern Australia had diminished moisture transfer into the Lake Eyre catchment, altering the hydrology of the desert core (Miller, Mangan, Pollard et al. 2003b).

This neatly stitched together ideas about fire and megafauna extinction (Flannery 1994) and the catastrophic fire histories of Peter Latz (1995, 2007; Megirian et al. 2002), and it stressed the influence of people not just on landscape but also on climate. However, none of the long records of palaeovegetation provided much support for these ideas (Kershaw, van der Kaars and Moss 2003; Kershaw et al. 2006; Smith 2009a). Rather, the evidence suggested that weakening of the summer monsoon circulation was the predominant factor at play (Johnson et al. 1999), with a train of regional responses to increasing aridity in the Lake Eyre–Cooper Creek region. Archaeologists also had problems with Miller’s thesis (O’Connell and Allen 2012). Aboriginal population densities in the arid interior appear to have been low throughout much of the late Pleistocene. This means that human fires would have been localised and patchy and are unlikely to have had a major impact on desert vegetation (Bowman 1998; Bird et al. 2008).

**Landesque Capital**

Tindale’s work had also drawn attention to the more subtle and incremental effects of Aboriginal fires on local ecology. Arid Australia was one of the last places where the effects of a traditional burning regime could be observed at first hand (Gould 1971b; Bird et al. 2008). In the 1990s, Flannery’s ideas stimulated renewed interest in the issue of fire ecology (Bowman 1998; Burrows et al. 2006; Bird et al. 2008). These studies showed that repeated burning of vegetation during foraging trips led to the formation of small-scale successional mosaics, which in turn increased the productivity of the country in respect of plant foods and small game. The main effect was on the grain of the country, with greatest impact on habitat structure at the local rather than regional level. The effect of this patch-burning was cumulative and concentrated in localities were people spent the most time. ‘Aboriginal foragers,’ said Bird et al., ‘thus construct their own ecosystem’ (2008: 14799). Some archaeologists saw this as a form of ‘landesque capital’ (improvements to a productive estate), associated with the growth of population and the expansion of settlement that was increasingly evident in the last 1–2 millennia (Smith 1988; Veth 1993; Smith and Ross 2008a).
SOCIAL INTENSIFICATION

Fire was not the only area where people were seen as having some agency. Large intergroup ceremonial gatherings, such as the Arrernte ingkwere, were a powerful demonstration of the way that religion housed the ruling ideology in these hunter-gatherer societies, as well as the way in which wealth and prestige were defined in terms of ritual property and knowledge. This raised the question of whether incentives to increase the size and scale of ceremonies could have constituted an autonomous driver of social and economic change, independently of any pressure from environmental or demographic shifts.

H Lourandos (1985, 1997) suggested that from about 5,000 BP, an escalation of competitive changes in social relations in the arid zone (including an increase in communal gatherings, territoriality and the scale of exchange and alliance networks) would have put pressure on production systems, leading to a reliance on grass and acacia seeds as staple foods, and that this in turn triggered growth in regional population and settlement of marginal areas, such as the sandy deserts.

As a heuristic framework, these ideas were readily adopted by archaeologists interested in exploring a richer social history than ecological and environmental perspectives alone could provide (Veth 1989a; Ross, Donnelly and Wasson 1992; David 2002; Ross and Davidson 2006). However, they proved difficult to test empirically. There were problems in explaining why these changes were triggered in the late Holocene and not earlier. And the available archaeological evidence suggested a different sequence of events: changes in ceremonial structure appeared to lag behind, rather than lead, changes in population and economy (Smith 1988; David 2002; Smith and Ross 2008a). These ideas were important, however, because they represented a renewed interest in the political and social dynamics of desert groups and in the development of their key institutions.

WRITING THE HISTORY OF THE DESERT

Looking back over this history, several aspects stand out. First, ideas about the history of the land and its people have been intertwined almost from the moment colonial exploring parties first encountered the desert. This is seen most clearly in the impact the new Quaternary dating methods had in the 1960s and 1990s, when ideas about land and people shifted rapidly to accommodate the new chronologies.

Colonial scientists were able to provide an outline of the Quaternary history of the Lake Eyre region by the 1880s, less than 40 years after the first British exploring parties entered the interior. By 1886, a broad outline was in place that read the field evidence as indicating that the climate of the interior had been much wetter in glacial times and that this had been followed by the onset
of aridity and the creation of the immense dunefields that ring the centre of the continent. The fundamental problem was that there was no way to establish a timescale for these events: the order of events could be worked out tolerably well, but their chronology was utterly uncertain. This framework collapsed in the 1960s, as radiocarbon dating began to provide an independent chronology, and it changed again in the 1990s, as luminescence dating provided the means to unpack the environmental history of the interior into a series of arid and fluvial phases, and as the marine isotope chronology (Martinson et al. 1987) provided a new global framework for Australian data.

Another striking aspect is the way in which the history of the desert has been written largely from its southeastern corner. The sense of a fossil, ‘dead’ landscape is strongest in the Lake Eyre region, with its saltlakes and stranded beach ridges, abandoned or buried river channels and rich fossil fauna. It is not surprising that into the 1950s, this area drove most thinking about the environmental history of the desert. The same is true of early research into desert rock engravings, work that between 1900 and 1950 was concentrated in the Flinders Ranges, the Olary upland and the Broken Hill region, those parts of the arid zone most accessible to researchers in Adelaide, Sydney or Melbourne. Research in the Willandra continued this trend, shifting the focus of field research to the desert margins, where the rich palaeoenvironmental and archaeological records from Lake Mungo dominated thinking about the prehistory of arid Australia throughout the 1970s and 1980s. The major dune chronologies also relied on sequences worked out in the Strzelecki Desert and Cooper basin, because even with radiocarbon dating, aeolian sequences were difficult to date directly, except where they were intercalated with fluvial or lacustrine sediments.

In contrast, the classic desert ethnographies follow the frontier: beginning with JG Reuther’s work at Killalpaninja on Cooper Creek between 1888 and 1906, followed in 1899 by Spencer and Gillen’s accounts of the Arrernte in Central Australia and WR Roth’s research in northwestern Queensland between 1897 and 1910, and shifting to the Western Desert after 1950 as the last remaining desert hunter-gatherers were drawn into missions and government settlements at Warburton, Jigalong, Balgo, Yuendumu and Papunya. After a tentative start at the Koonamore research station in the Olary region in 1926, arid-zone ecology has also centred on research in the spinifex and sandhill country of northern and central Australia. Given the diversity of Australia’s deserts, there is a danger here that while the history of the arid zone is written from its southeastern margin, the processes that govern its people and ecology are framed by work in central and northern Australia.

A third aspect is the way in which recurring themes in different disciplines collectively provide an outline of persistent historical structures in Australia’s desert. The desert margins – the zone most affected by expansion and contraction of the arid zone – are widely seen as an area where species are conditioned
to aridity, allowing them to disperse widely across the interior. Desert uplands, in contrast, are more stable nodes within the desert, centres of endemism and local dispersal, as well as more deeply etched human landscapes. The desert lowlands experience rapid spread of species, languages or cultural traits, periodically integrating large areas of the desert, followed by local differentiation until the next event.

Finally, there is a surprisingly rich field of ideas about the social development of desert societies – their languages, economies and key institutions – that runs counter to the notion that these were somehow a static relic of an earlier time. For desert people themselves, notions of historical change are subordinated to the ruling ideology, the ‘dreaming’. As Tonkinson says, ‘nowhere does their ideology admit structural change as a possibility’ (1978: 112). However, a century after the Alice Springs ingkwere, most Western scholars see these societies as the product of a long period of indigenous development, with their roots in the late Pleistocene but having been transformed by structural changes in the late Holocene and cultural efflorescence during the last millennium.