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Archaeology and Petroglyphs of Dampier (Western Australia)
an Archaeological Investigation of Skew Valley and Gum Tree Valley

by

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edited by

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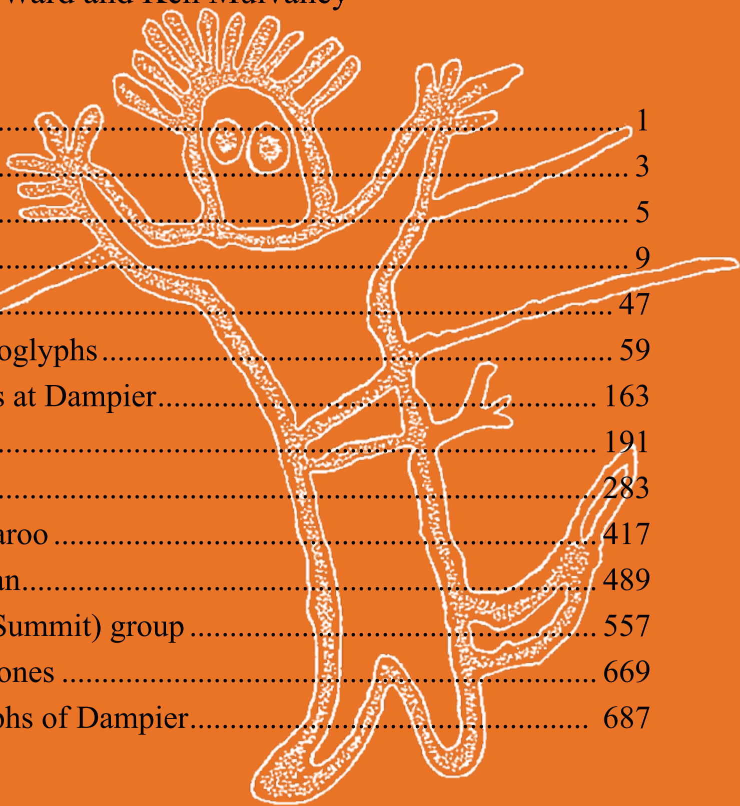

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Author

Michel Lorblanchet joined the *Centre national de la recherche scientifique* (CNRS, France) in 1969 to study the Palaeolithic rock art of France. After graduating in 1972 from Université Sorbonne (Paris) with a doctorate in Prehistory, he was employed from 1974 to 1977 at the Australian Institute of Aboriginal Studies to conduct research into indigenous Australian rock art. From his base in Canberra, he participated in projects in Far North Queensland and in western Victoria. Between 1975 and 1976, he conducted the fieldwork at Dampier, Western Australia, on which this monograph is based, and made two further fieldtrips there in 1983 and 1984. He returned to France in 1977 to the *Centre de Préhistoire du Pech Merle* (Cabrerets). Lorblanchet was appointed *Directeur de recherches au CNRS* in 1995; he retired in 1999 and lives near Saint Sozy in the Lot Valley where he continues to research and publish about rock art. He is the author of many papers and several books on European Palaeolithic art (some are listed in the editors' introduction) as well as reports and this monograph on his Australian researches.

Volume Editors

Graeme K. Ward has conducted archaeological and ethno-archaeological fieldwork in the island Pacific and Australia. He gained his doctorate from The Australian National University and was employed at the Australian Institute of Aboriginal Studies where he was involved with administration of research programs including the national Rock Art Protection Program. Subsequently, as Research Fellow and Senior Research Fellow at the Australian Institute of Aboriginal and Torres Strait Islanders Studies he undertook research into Indigenous cultural landscapes in northern Australia with traditional knowledge-holders of cultural heritage places. He is the author of various research papers, of three monographs and editor of many collections of archaeological papers; he served as the editor of the Institute's journal, *Australian Aboriginal Studies*, for several years. Currently he is a visitor at the Department of Archaeology and Natural History, School of Culture, History and Language, College of Asia and the Pacific, of The Australian National University.

Ken Mulvaney has lived and worked for the past ten years on the Burrup Peninsula, where he is the Principal Advisor Cultural Heritage for Rio Tinto Iron Ore. Prior to this, Ken spent many years in the Northern Territory working with Aboriginal traditional owners documenting their cultural heritage places and land affiliations. He first came to the Burrup in 1980 when employed by the Western Australian Museum as member of a team documenting archaeological sites in areas destined for construction of a petrochemical processing plant. His doctorate from the University of New England is the first such study on the prehistory of the Dampier Archipelago. He is author of many articles on rock art and Aboriginal culture, and is currently affiliated with the Centre for Rock Art Research and Management, University of Western Australia.

Chapter 2, Part II

First Excavations at Dampier

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The First Excavations at Dampier (Western Australia), and their Place in Australian Archaeology (with Addendum on Radiocarbon Dating of Skew Valley Midden)[1]

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Dampier is a small port in Western Australia on the tropical coast of the Indian Ocean (20°30'S 160°30'E) established in 1965 for the exportation of iron ore and salt (Fig. 1). Before the creation of the town of 3000 inhabitants, the rocky sun-scorched coast was almost deserted except for the modest town of Roebourne, 50 km to the east, and some scattered large pastoral properties.

Once, the area was intensively populated by Aboriginal tribes, the Mardudunera and Jaburara N'Galuma (Tindale, 1974).

A. Regional history

The European settlement happened in three phases:

1 A maritime exploration phase beginning in the seventeenth century with the discovery of the entire western coast of Australia by the Dutch, who drew the first maps. The coastal region of Dampier was discovered in 1628 by Gerrit Frederikszoon de Witt who recorded its general outline; it was re-visited by Abel Tasman in 1644 (Schilder, 1976). It was the English navigators, the buccaneer William Dampier (August 1699), and especially Phillip Parker King (February 1818), who described in more detail the archipelago where they anchored (Dampier, 1939; King, 1827). However, it is the French, Nicolas Baudin (1801) and Louis de Freycinet (1818), who set foot onto the western and eastern coasts, who interest us (Baudin, 1974; Peron and Freycinet, 1824). These mariners were the first foreigners to encounter the local Aboriginal peoples. Their logs are sometimes studded with notes and details of stories from life; they provide a fascinating, although brief, insight into a traditional Aboriginal culture that had developed over millennia in this 'lost' territory of the southern lands, remote from outside influence.

2 Settlement followed Francis Thomas Gregory's expedition in 1861. Landing in Nickol Bay and setting out to search for potential pasture and arable land, he explored the extensive interior (Gregory, 1884).

3 Between 1863 and 1865, the small port of Cossack and the town of Roebourne were founded and this the marked the start of the agricultural and pastoral colonization of the region that was to upset irreversibly the living conditions of the Aborigines.

4 First used by Whites as pearl fishers (1866–1890), the Aborigines were soon decimated by the harsh conditions of their work and by severe epidemics of smallpox. The survivors gathered on the large stations of the interior and in the new town of Roebourne, and by the beginning of the century their traditional culture was already extinct.[2]

The twenty or so kilometres of rocky shoreline are literally covered with petroglyphs, the total number perhaps exceeding 100 000. Shellfish middens and

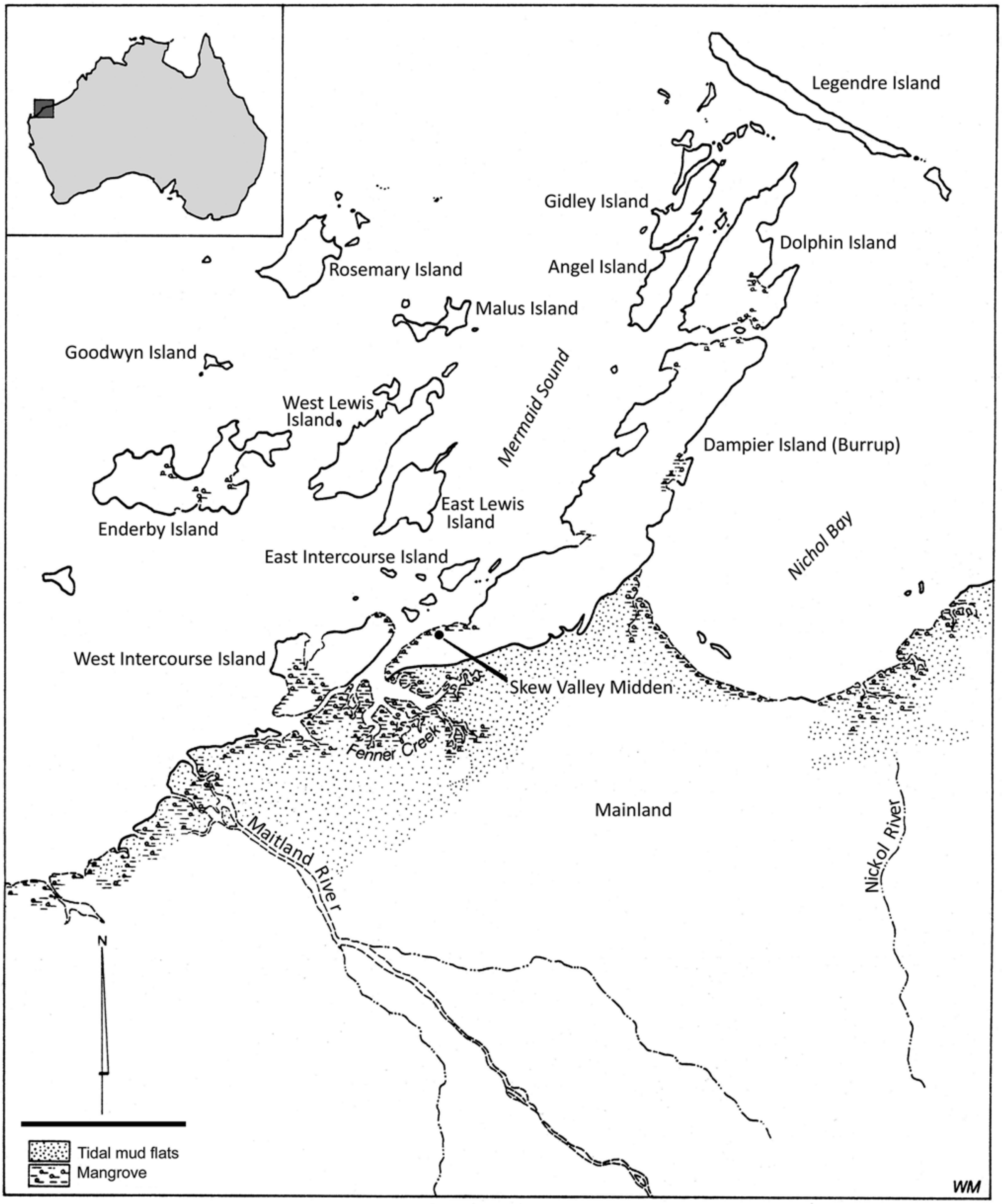

Figure 1. Dampier Archipelago showing streams and hilly areas, mudflats and mangrove habitats, and location of Skew Valley midden. Inset: Regional location on map of Australia [original map by W Mumford, ANU]. Scale: 10 km.

various archaeological sites, such as quarries for making stone tools, are conspicuous and show a close association between potable water and groups of carvings. So, it is on deserted rather than empty land, bearing the mark of multi-millennia of human occupancy, that Dampier was built in 1965.

The industrial development of the area would result in the destruction of part of this then-unknown and unrecorded archaeological heritage, but would also promote its discovery.

By mapping and photographing the carvings, Mr FL Virili, the engineer-manager for Dampier Salt, drew them to the attention of archaeologists and the local population. Without assistance from the Western Australian Museum in Perth, the protection of sites in this region of industrial development would have been more devastating than it actually was. In 1974 Virili requested assistance from the Australian Institute of Aboriginal Studies (Virili, 1977; Dix & Virili, 1977).

One of us (ML) was sent to Dampier by AIAS[3] and, during a stay of six months, excavated the shell midden and carried out a survey of more than 600 petroglyphs in Skew Valley and Gum Tree Valley (Lorblanchet, 1977). It is this excavation that is discussed here.[4]

Figure 2. The Skew Valley shell midden during excavations. Almost all of the boulders around it are carved.

B. The site

The region consists of very old lava (basalt) and various intrusive materials (granophyre, gabbro, dolerite) of Archaean Age. The vast undulating lowlands are dominated by chains of rocky hills whose dark brown mass contrasts strikingly with extensive clear areas of spinifex and sparse stands of Eucalyptus. These chains are formed of gigantic boulders of intrusive rock that often are adorned with numerous carvings.

Four geographical regions can be distinguished in the vicinity of Dampier. They stretch out along the coast in parallel zones oriented southwest-northeast (Fig. 1):

1. The edge of the continent, mainly granitic and rough.
2. A swampy depression, uncovered at low tide and occupied by mangroves and mudflats, furrowed by a small stream, Fenner Creek. This depression, 20 × 7 km, opens onto Nickol Bay. It is currently occupied by the salt works of the Dampier Salt Company.
3. Dampier Island, a rocky stretch of granophyre and gabbro 20 × 4 km, is surrounded almost completely by a narrow belt of mangroves. The Skew Valley shellfish midden, the subject of this study, is located on the shore to the north of this area.
4. Ten large, rocky, basalt islands (Rosemary Island, Enderby Island, West Lewis Island, etc.) that comprise the rest of the Dampier Archipelago.

Archaeological sites abound in all four zones. The excavated mound is located in a small valley—open to the sea—about 500 m from the shore and 14 m above the level of the mangroves.

Protected from the cyclones that sometimes ravish the coast between November and March, the Skew Valley midden is close to the mangroves, sandbars and a mud bank—rich in shellfish—that the tide (4.8 m in spring) uncovers between the shore and the islands of the archipelago (East and West Intercourse Islands), only 1.5 km distant.

The deposit is near the ponds and semi-permanent water holes along the Skew Valley stream and adjacent to a small gorge.

The supply of drinking water raises an important issue since the region receives only 200–300 mm of rain per year, almost exclusively from the cyclonic rains in summer (November-March), and winter is particularly dry. Summer temperatures can reach 50°C. The very sparse vegetation consists of a variety of shrubs and spinifex (*Trioda pungens*) from which Aborigines collected seeds for making damper.[5] The only trees are occasional eucalyptus (*Eucalyptus patillaris*) bordering the streams.

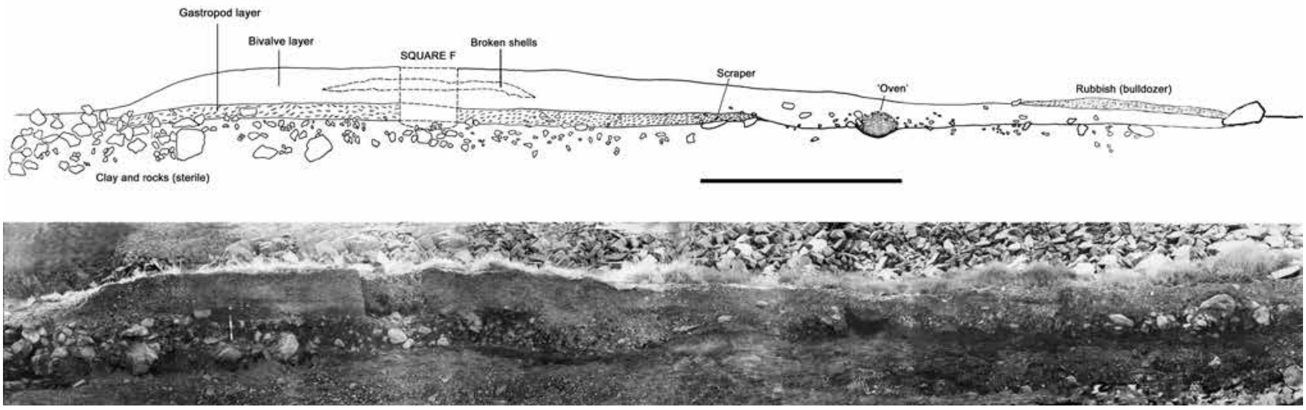

Figure 3. Cross-sections of Skew Valley shell midden. Scale: 5 m. [This figure enlarged on following pages.]

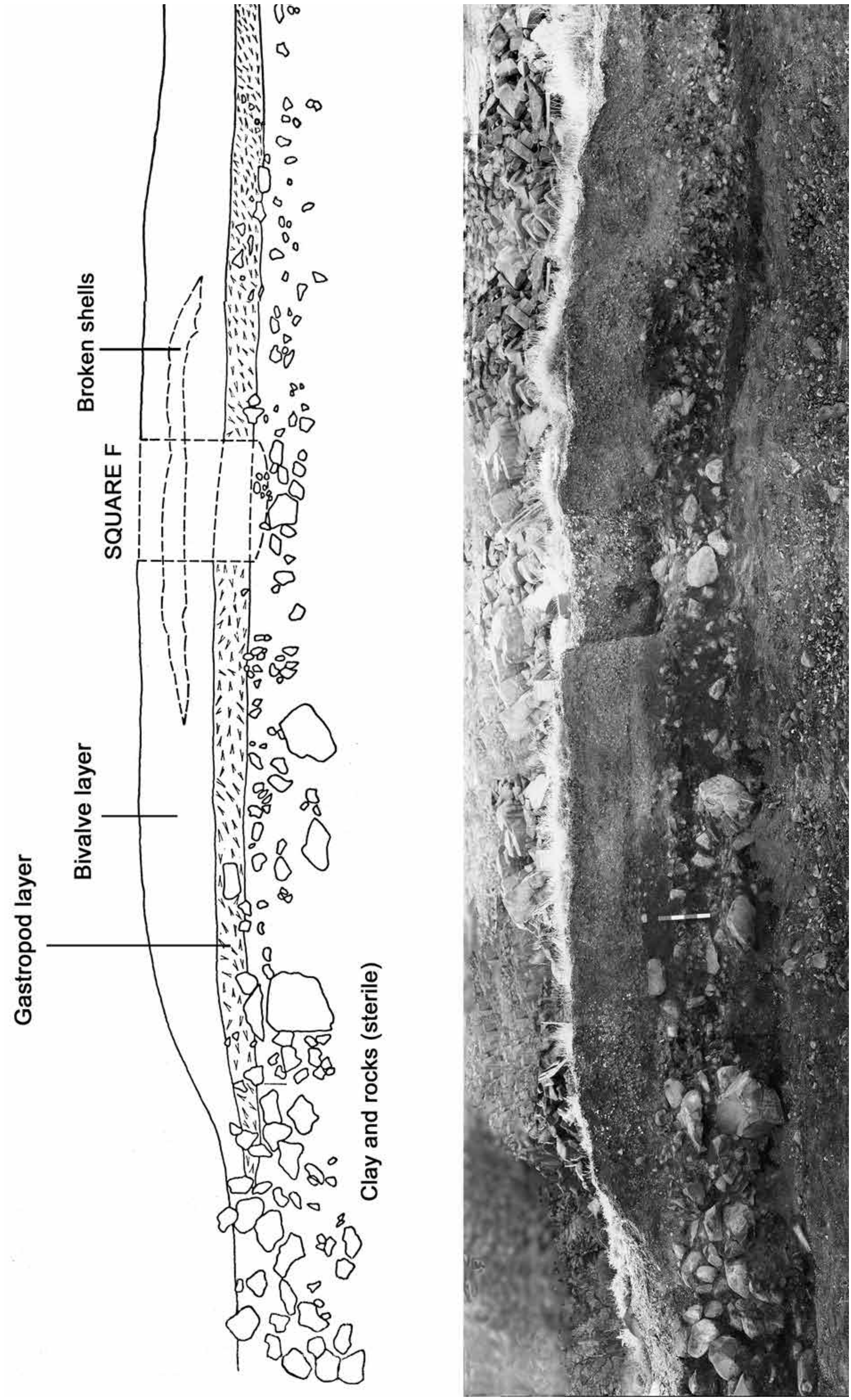

Figure 3 (enlarged left half, continued next page). Cross-sections of Skew Valley shell midden. Scale: 5 m.

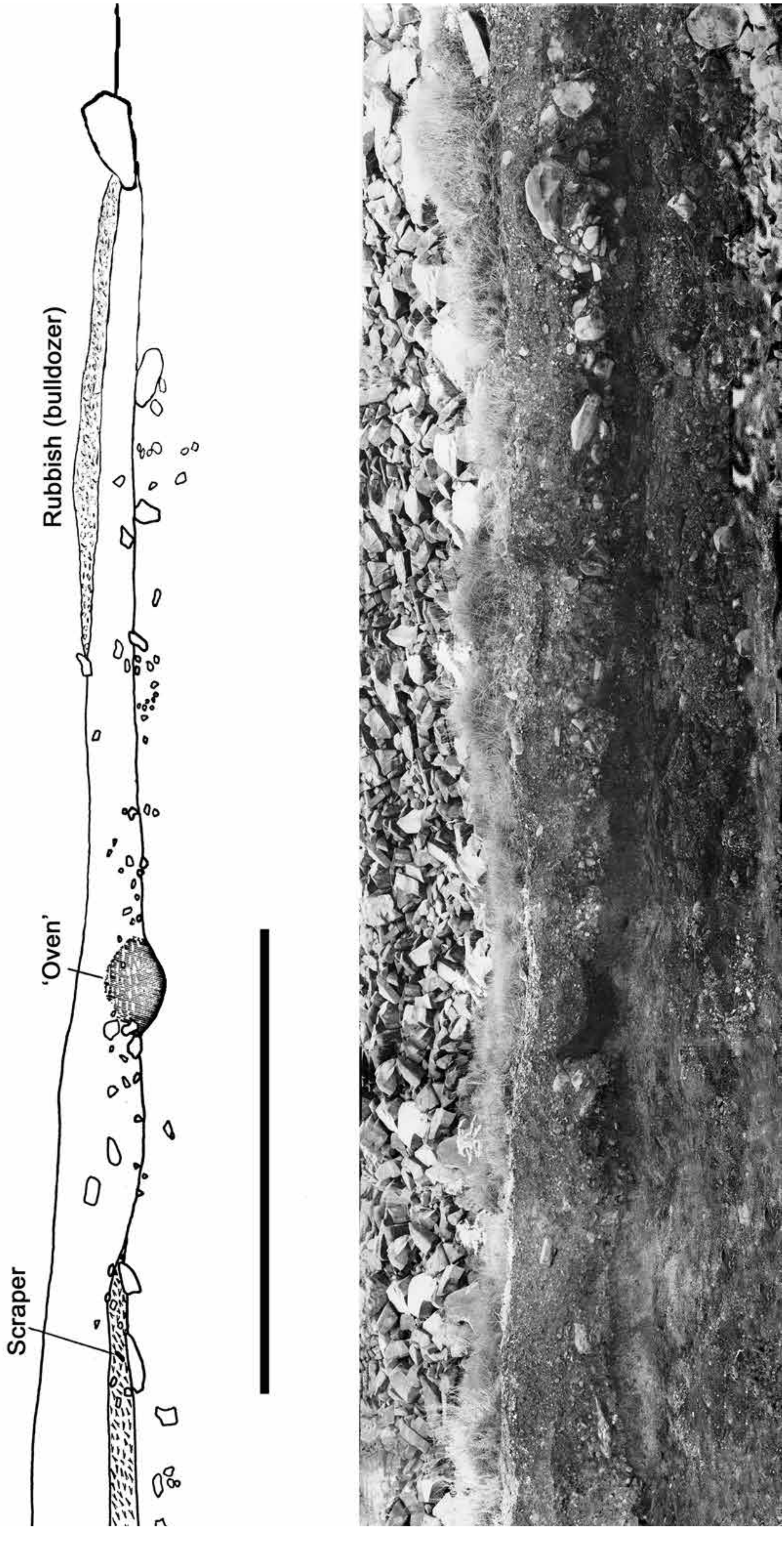

Figure 3 (enlarged right half, continued previous page). Cross-sections of Skew Valley shell midden. Scale: 5 m.

The Skew Valley shell mound, which is 21 m long, eight wide and one metre high, rests on the eastern side of the Valley, which is covered with boulders of granophyre, almost all of which bear petroglyphs (Fig. 2). The association of water sources, carvings and the shell midden is constant here. During construction of a road for transportation of salt, part of the deposit (at least one third, it seems) was destroyed, revealing an interesting section and facilitating the development of an archaeological project. The goal of this work was threefold: To make use of a partially-destroyed deposit to effect an archaeological salvage; to develop a method applicable to a thorough search of other shell middens in the region; and to discover *in situ* carved slabs able to be dated using radiocarbon analysis.[6]

C. Stratigraphy and dating

The stratigraphy consists of two main layers[7] within which sub-layers were distinguishable locally (Fig. 3):

1. an upper layer (I), dark brown, 0.70 m thick, is mainly made up of bivalve shells and extends over a maximum distance of 21 m;
2. a lower layer (II), reddish brown, 0.30 m thick, is more compacted, and consists of gastropods and extends over 12 m in length.

Layer I, has been dated to between about 4500–2200 years ago (Fig. 15, p. 191, *Boulderside excavation*, 4400–2240 cal BP) by seven radiocarbon age measurements made on our samples of marine shells. Layer II was dated to between about 7500–7000 years ago (7600–6840 cal BP) by three radiocarbon age determinations on marine shell.[8] Although the main occupation ceases at around 2300 years ago, it appears that the site has been visited occasionally until quite recently because a flake and a tool (adze) made of bottle glass were found near each other on the surface of the mound.[9]

D. The lifestyle of the Skew Valley inhabitants

The excavations revealed that the Skew Valley deposit had in the past three simultaneous functions.

1. Habitat

Skew Valley provided a habitat where a group of Aborigines stayed while the natural pools of the creek provided drinking water.

Today, the creek bed is completely dry from July, but it is possible that the climate has changed slightly over a few millennia. It is more likely that the inhabitants of Skew Valley had as yet unknown water resources available during the dry season. They maintained water holes and accessed groundwater by digging wells in the sandy beaches.

Near the excavation site (less than 1.5 kilometre distant), two large shell middens are visible on the western side of the ocean near a waterhole that persists longer than the Skew Valley ones, and over a dozen other mounds are clustered about an opening to another small valley, Gum Tree Valley, on the shore of the marshy areas of Fenner Creek (Zone B).

Moreover, various explorers noted in their journals that they had seen groups of 20–30 'natives' on the Dampier coast at different times of the year (in 1699 [Dampier 1939]; 1861 [Gregory, 1884]; 1818 [King, 1827]). They also reported seeing fishermen with nets and with traps for fishing, collecting shellfish and even going to the islands of the archipelago using trunks of mangrove trees as simple rafts (Fig. 4).

Figure 4. A Dampier native travelling to the islands of the archipelago on a wooden Mangrove raft. Lithograph from King 1818.

Thus, the reports of the first European visitors, the local distribution of deposits and our excavation data combine to suggest that the Skew Valley Aborigines stayed around all year by moving from one site to another within a radius of only 10 km and sometimes travelled to nearby islands.

Excavation showed that their way of life was characterized by the predominant importance of collecting shellfish. This was highly specialized collecting since it was almost exclusively two species of gastropods (*Terebralia palustris*) in Layer II and bivalves (*Anadara granos*a) in Layer I. Minor molluscan species (*Turbo lunella*, *Monodonta lapio*, *Melo amphora*, *Syrinx aruanus*, *Amphineuran*, etc.) represent less than 0.5% of the total weight of shells. These shells were identified by George Kendrick of the Western Australian Museum, Perth.

In total, shellfish probably provided an important part of the meat consumed at the site. Table 1 lists the animal species consumed at Skew Valley according to the identifications made by David Horton (Horton n.d.).

Large mangrove crabs were consumed regularly. Fishing played a significant role, with six species of fish living in sub-littoral shallow waters being identified; these confirm the use of nets and fish traps formed by stone walls, as noted by the early navigators. Contrary to what some excavations have revealed along the Australian Pacific coast, neither hooks nor barbed harpoons were found in the Skew Valley deposit.

Hunting seems to have been a secondary activity. Large sea turtles and rock wallabies rarely featured on the menu.

The exact role that plants played in the diet of the Skew Valley population remains difficult to assess since no plant remains were found during excavations. However, the existence of a series of large grinding stones on a grassy plateau about 100 m east of the mound implies the use of natural seeds.

Skew Valley Aborigines primarily inhabited the littoral, and were fishers and collectors mostly living from the mangroves, reefs and the sand and mud shoals exposed at low tide and in the shallow sub-tidal water.

Such an economy was closely adapted to the immediate environment. This environment was impacted both by the rise in sea level that happened between 6500 and 4500 BP,[10] and by the stability of vegetation revealed by the pollen analysis of sediments of the mound (a study made by Geoff Hope of the Department of Biogeography and Geomorphology, The Australian National University, Canberra). The sea level change would explain the shift in the dietary regime of the area's inhabitants—from the gathering of gastropods to the collection of bivalves).

The discovery of structures at Skew Valley and of variations in the spatial distribution of remains is new to the study of Australian shellfish mounds.

The structures are represented by postholes and two types of hearths (individual hearths with large wood charcoal and fireplaces or types of 'ground oven' with scant charcoal) and areas of finely crushed shells interpreted as the floors of dwellings. A study of the horizontal distribution of remains showed that the areas interpreted

Table 1. Animal species identified in the Skew Valley shell-mound (after Horton n.d.).

English name	species or family	total number of individual items	minimum number of individuals
Fishes			
Wrasse (parrot fish)	Labridae	84	84
Catfish	*Arius* sp.	53	27
Barramundi	*Lates calcarifer*	29	18
Bream	*Mylio* sp.	6	5
Parrot Fish	*Scaridae* sp.	4	4
Whiting	*Sillago*	2	2
Undetermined		4	4
Marsupials			
Rock Wallaby	Macropodidae	39	20
Kangaroo	Macropodidae	1	1
others			
Crab	*Scylla* and *Portun* spp.	95	24
Reptile	?	2	2
Bird	?	1	1

as the floors of habitations had been swept and cleared of the bulky tools—which then had been piled at the margins of the site in less accessible parts.

In addition, groups and small piles of shells of the same species (*Turbo lunella*, *Monodonta labio*) are evident in relation to certain hearths, and slabs that probably served as seats during meals.

Ultimately, all these observations allowed us to define both several different activity areas in the site (with slightly different types of tool) and by superimposition to see that these sometimes moved over time.

Such shifts make it a little more difficult in places to observe the changing trends in the evolution of basic tools, but these, however, remain visible.

As with studies of other prehistoric sites, investigations of shell mounds must comprise both a study of the fundamental evolution of tools and the changes in patterns of occupation, and include the constant interactions between these elements.

Figure 5. Carving on rock located in the immediate vicinity of the shell midden (bird holding a snake in its beak, two eggs and a crab). Panel length: 1.10 m.

2. A quarry site

The Skew Valley site was also a quarry for making stone tools. It has been pointed out that the mound is in contact with the side of the valley covered with boulders of granophyre. This durable, fine-grained material is perfectly suited to the manufacture of large tools: scrapers of miscellaneous types, horsehoof cores, etc. In fact, the edges of many rocks on the very edge of the mound or in the immediate vicinity show clear traces of knapping. The scars of the flakes are patinated.

The excavation provided 13 445 flakes but only 21 cores and 170 tools. The tools represent 1.2% of the stone artefact assemblage.

Many tools probably were prepared at Skew Valley, if we are to judge from the amount of waste left, but these tools have been lost or spread over different sites during of the travels of their owners.

3. A petroglyph site

Finally, the Skew Valley site was an important centre of rock art. On the very edge of the shell mound, 54 carved panels provide 153 carved motifs (Fig. 5).[11] The density of petroglyphs here is 1.5 per square metre. Their number in a radius of 100 m around the site can be estimated at between 5000 and 7000.[12]

Four slabs schematically carved with human figures were uncovered in the excavation. They have been dated by radiocarbon to a period prior to 2500 years ago, and one of them to a period prior to 3640 years ago (2240–2700 cal BP (ANU-1838) and 3420–3870 cal BP (ANU-1837)).

Although the practice of carving seems to have persisted after the abandonment of the mound by the shell-collectors, it is certain that they made a large number of motifs.

It is still too early to learn from the excavation data what characterizes a petroglyph site and distinguishes it from a simple habitation. Comparative excavations of several local deposits are needed to clarify this point.

E. The economic system of the Aborigines of coastal tropical Australia

During the scientific revolution experienced by Australian archaeology over the past 15 years, most research on Australian shell middens has been concentrated along the southeastern coast of the continent bathed by temperate waters whose biology is similar to that of all high latitude waters of the globe.

Along the 9000 km of the tropical Australian coast, research has been, by contrast, rare, so that detailed comparisons between the Skew Valley shell midden and other tropical sites are difficult.

However, recent ethnographic work on the diet of the hunters and gatherers of the coastal Gidgingali tribe occupying the mouth of the Blyth river, on the northern coast of Arnhem Land (latitude 12°S, Meehan 1975/1982: Fig. 6), provides a baseline with which the economy of Dampier Aborigines can be compared, despite the distance between them (2200 km and more than nine degrees of latitude). As we shall see, the degree of similarity between the two economies is striking:

The bivalve *Anadara granosa* is one main species of shellfish consumed by Gidgingali groups when they visit the shorelines of thick mud banks where this species lives and where women of the tribe come to gather them at low tide.

Terebralia palustris is one of gastropods of the mangrove sediments that also is occasionally collected from the aerial roots of the mangrove trees. These are less abundant than the *Anadara*.

The large *Melo amphora* and *Syrinx aruanus* are often gathered by men at the extreme limit of low tide during spear-fishing expeditions. Not only is the flesh of these huge shellfish consumed, but their shell is used as a water container.

The range of fish species in the Skew Valley stratum (Horton n.d.) corresponds to the species exploited by the Gidgingali fishermen. The similarity of the species range consumed in the two regions is striking, especially if one takes into account the fact that, unlike the Gidgingali, the Dampier Aborigines had, according to both ethnographic and excavation data, neither hook nor barbed harpoons.

The fish identified from Skew Valley match those that the Gidgingali catch with various traps (both simple barriers and woven traps) and nets:

The catfish *Ariidae* (probably *Arius leptaspis*), bream (*Mylio*), barramundi (giant perch *Lates calcarifer*) can all be obtained using traps placed in the wetland streams within the Mangroves between ocean and the seasonal supplies of freshwater.

Whiting (*Sillago*) are captured using barriers or nets on the open beaches. Shellfish and fish together provide 80% of weight of the meat consumed by Gidgingali (Meehan, 1977) and, as at Skew Valley, hunting wallabies provides a supplementary source of meat.

If it can be seen that the Gidgingali currently consume 3.5 times more weight of fish meat than shell-fish meat, it is difficult to apply this rule to the data from the excavation of a prehistoric shellfish mound. Test-pits in the current shellfish mounds of the Gidgingali have revealed very few fish bones among the thousands and thousands of shells. The chances of the survival of bone in a tropical climate and the interference of dogs swallowing the fragile bone fragments do not permit a reconstruction based on statistics of the exact composition of dietary regimes of the past. It is likely that fish played a much larger role in the diet of the Skew Valley residents than simple analysis of remains found at the excavation would suggest.

During a single day, 30–40 members of a Gidgingali Group covered a wide variety of ecological zones in their search for food: from high tide to the mangrove swamps, to the sand dunes and to the woods of the hinterland, eating and spreading food scraps and broken tools both at sites briefly frequented at meal times and on the ground of the base camp where they gathered at the close of a day. Debris abandoned in their daily pilgrimage therefore was scattered sometimes over a dozen different sites and an area of 5–10 km when the base camp was directly on the coast (Fig. 6).

During the course of a year, each base camp was moved between three and eight times over distances of 5–10 km, so that the area visited annually by all groups forming a tribe of 300 people extended 45 × 30 km, with some seasonal excursions beyond to the islands.

If one projects the theoretical limits of these territories onto the map of Dampier (Fig. 6 lower), one finds that all shell mounds of the Dampier Peninsula (especially Skew Valley), from the ocean shore to the mangrove and mud beaches of Fenner Creek, could be exploited daily.

If one wants to have an idea of annual movements of the tribe (Fig. 6 upper) one must include in the areas visited certain remote area of the archipelago and as far as the fringe of the continent itself; that is, mainly geographical Areas B, C, D, and the edge of Area A (Fig. 1). This range, therefore, supports a single and unique ecological system.

Despite the importance of what is yet to be resolved by future research at Dampier, it remains likely that the Gidgingali would recognize themselves in the Skew Valley occupants since they would find not only the resources that they use but also the same strategy that they use in their quest for food.

The coast of Arnhem Land abounds in shellfish mounds identical to those of Skew Valley, dating to a few thousand years ago and containing the same species of shellfish (Mulvaney, 1975: 246–248; Peterson, 1973; Meehan, 1975/1982; RMJ, pers. obs.). It is the same along the coast of Cape York (Wright, 1964; Mulvaney, 1975: 246).

On the approximately 9000 km of shoreline of tropical Australia that is characterized by monsoons and mangroves, a nearly uniform environment has developed that supports, and has supported in the past, similar economic systems. It is already possible to define this tropical coastal economy as different to that of the temperate zones of southeastern Australia and Tasmania, both in species consumed and in the settlement patterns and the seasonal movements. At some distance south of Dampier, an enigmatic zone extends along a coast of 3000 km to the Flinders Gulf (Western and South Australia) where shell mounds appear to be absent or rare (Dortch & Gardner, 1976; Hallam, 1977). This situation, which surprised the first European explorers, needs to be clarified by extensive archaeological research.

The Dampier deposits, therefore, not only bring this tropical coastal region into the archaeological realm, but also mark nearly its southwestern boundary.

F. Stone tool assemblage

1. Overview

The same basic lithic industry, one of large flakes where blades are almost absent and where large scrapers of various types abound, was encountered from the base to the top of the deposit. Layer II (lower) is less rich in fragments and stone tools than Layer I (the densities are respectively 1756 and 2640 pieces per cubic metre of the layer).

Flakes and tools are coarser and heavier in Layer II (average weight of pieces: 9.4 gram) than in Layer I (average 7.4 gram). Flakes of Levallois type are nowhere abundant, but they are rarer still in the lower than in the upper layer. Cores are less frequent and less sophisticated at the bottom than at the top.

In addition, quartz and non-local materials (chalcedony, chert, jasper, quartzite) were not used in the lower (gastropod) layer, but they were present in the upper (bivalve) layer where, in places, they abound.

The percentage of tools in relation to the total number of artefacts is a little smaller at the base (1%) than at the top (1.6%). The same basic tools, especially the large steep-edged scrapers, are present in both layers, but microliths (bladelets, triangles, trapezoids, segments, points) exist in only the upper two thirds of Layer I.

2. The lithic units

The tool assemblages from Layers I and II can be subdivided into three successive time units; these can be described, from a developmental perspective, from the base of the deposit and progressing towards the top (Figs 7a, 7b):

Unit 3: From about 7500–4000 years ago. This can be subdivided into Unit 3a, to include Layer II, which has gastropods with use of only local material (granophyre),

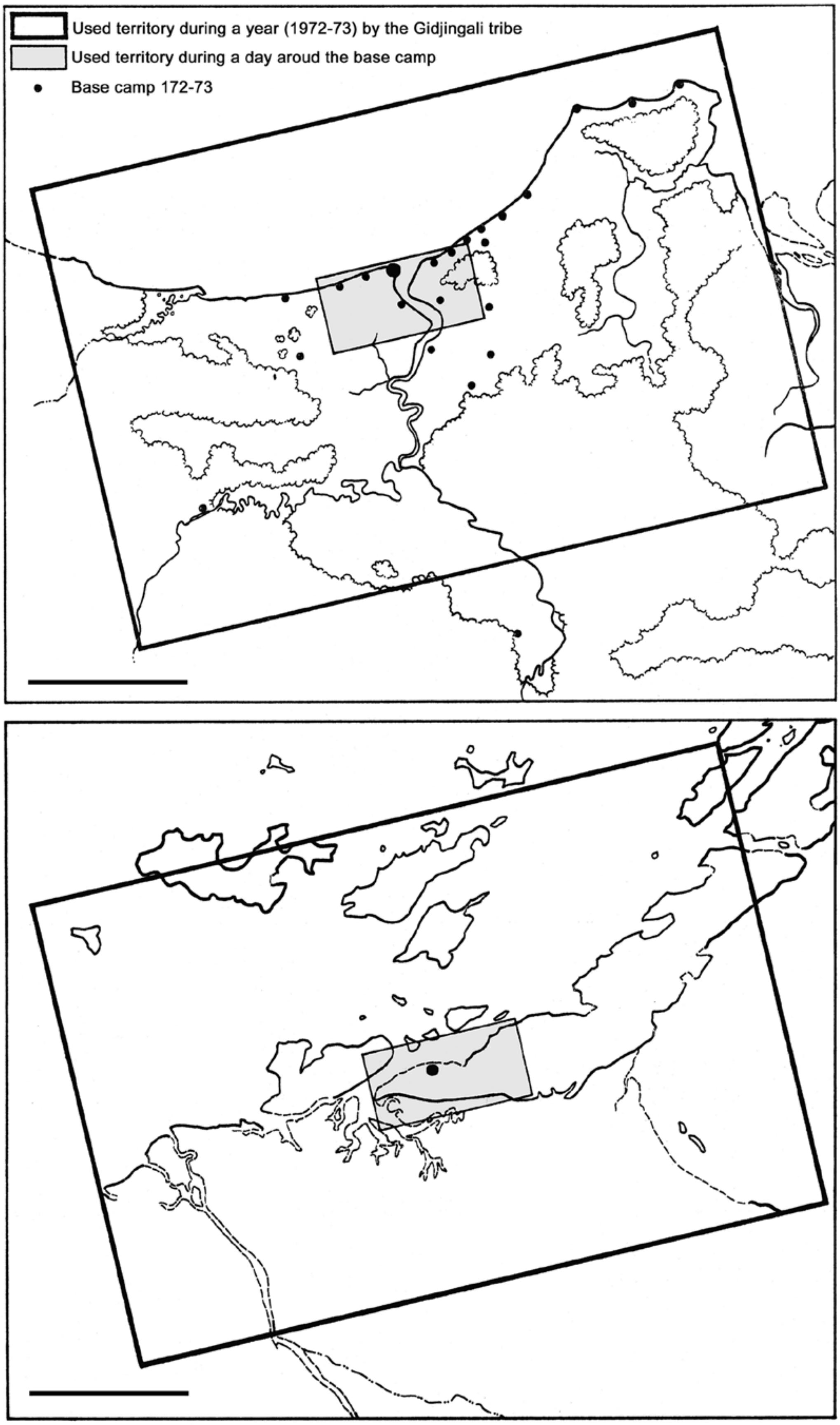

Figure 6. *Upper:* daily (small rectangle) and annual (large rectangle) movements of the hunters and shell collectors from the Gidgingali tribe (Blyth River, Northern Territory; observations of B Meehan and R Jones). Scales: 10 km. *Lower:* hypothetical daily movements (small rectangle) and annual (large rectangle) movements, of Skew Valley hunters and shell collectors.

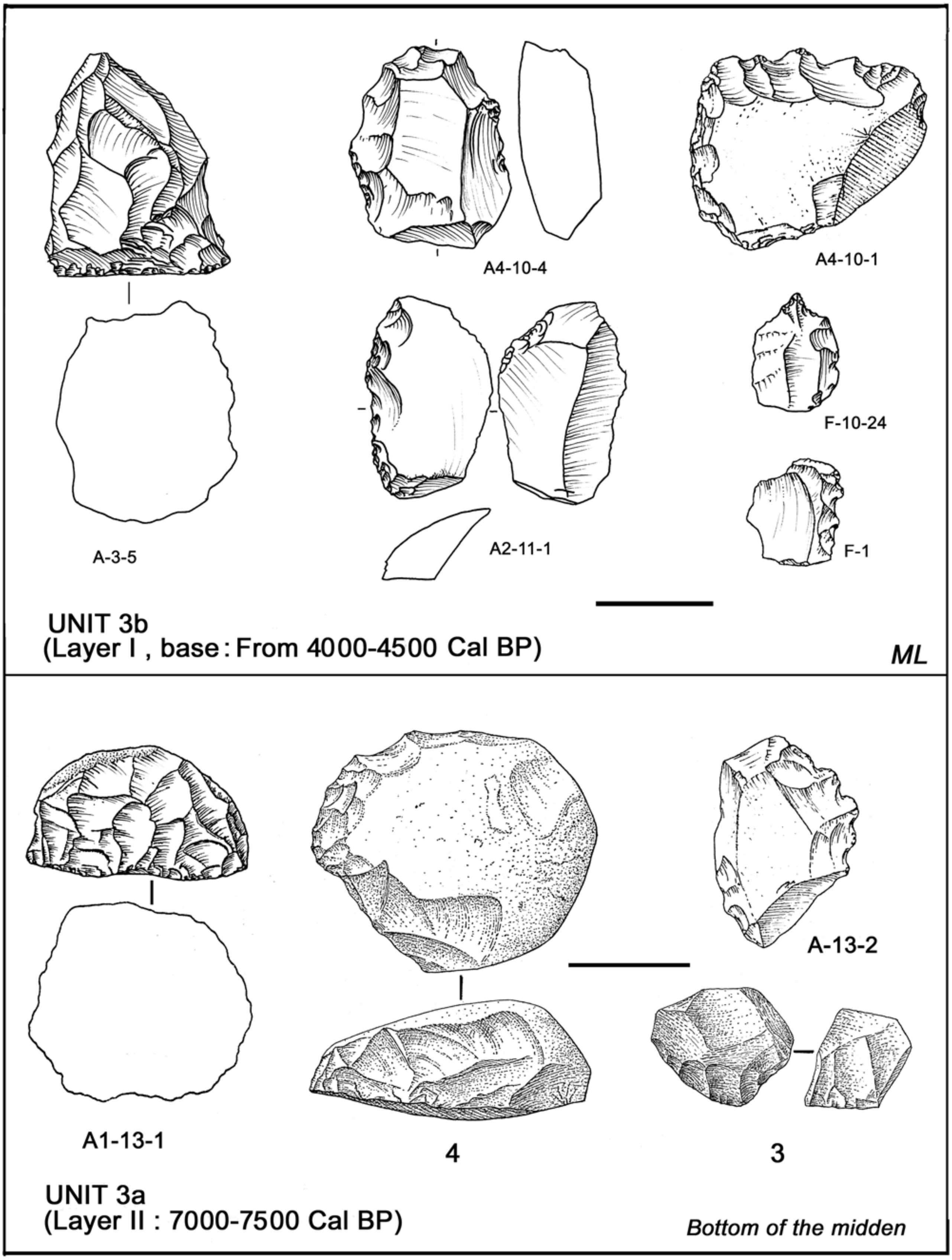

Figure 7a. Tool assemblage from the Skew Valley shell midden (from top to bottom of the midden). Unit 3, pre-microlithic. Scales: 50 mm. *Upper:* Unit 3b. Horsehoof core (A-3-5) and various scrapers (A4-10-4, A4-10-1, A2-11-1, F-10-23, F-1). [Fig. 7 continued next page … Fig. 7b].

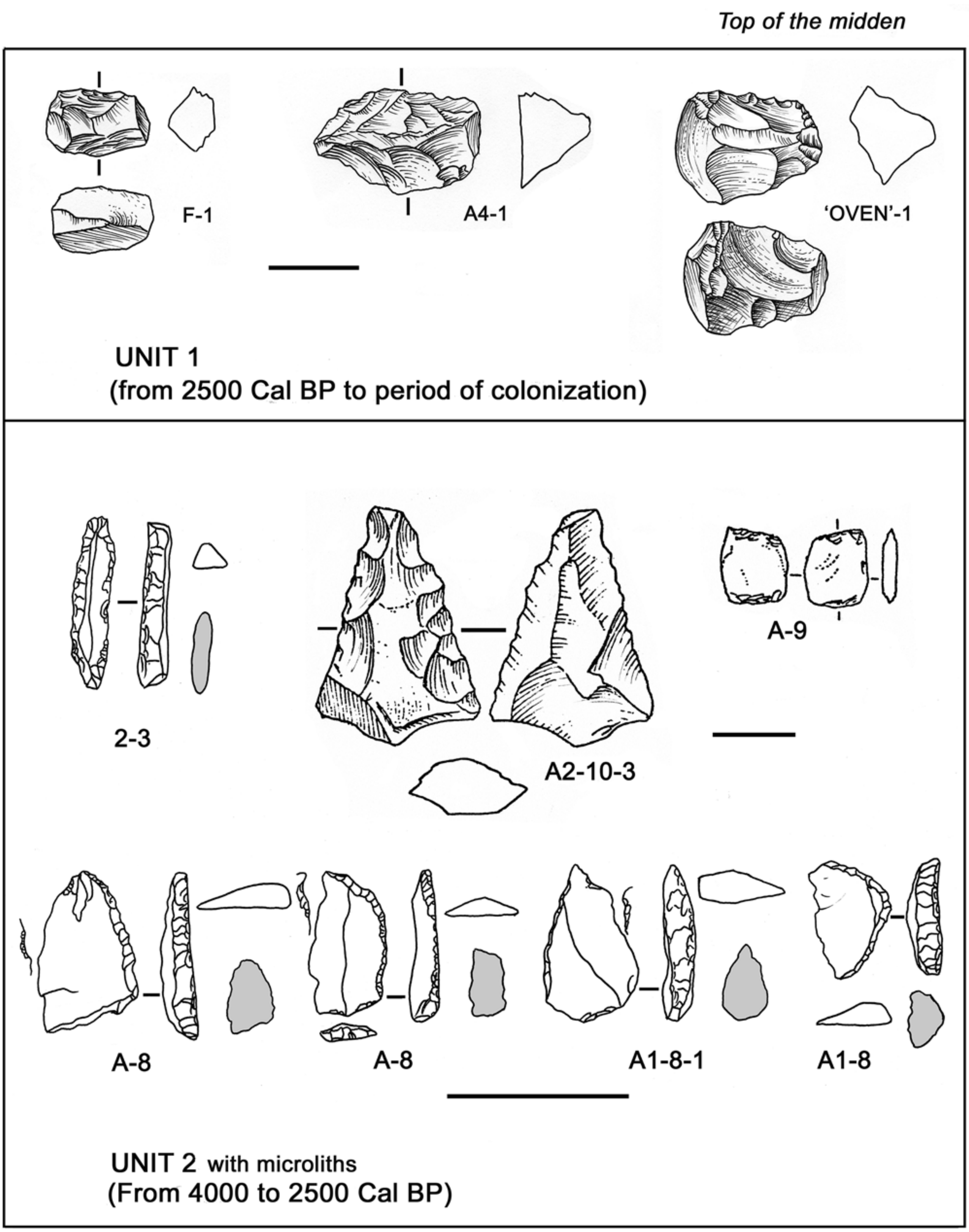

Figure 7b. Tool assemblage from the Skew Valley shell midden (from top to bottom of the midden). Scales: 20 mm. *Upper:* Unit 1 characterized by 'Tula-slug' adzes (F-1, A4-1). 'Oven-1' is made from bottle glass. *Lower:* Unit 2 with microliths (2-3, A-8, A-1-8-1, A1-8), a point (A2-10-3), a flaked piece (A-9 = fabricator).

Table A. Skew Valley Lithic Unit 2: stone tools assemblage.

tool type	number	percentage
horsehoof cores	6	5.0
steep-edged side-scraper	41	33.6
notched side-scraper	10	8.2
concave nosed scraper	18	14.8
flat straight side-scraper	5	4.1
end-scraper	4	3.3
unifacial point (Fig. 7: A2-10-3)	2	1.6
burin	5	4.1
flaked piece ('fabricator' Fig. 7: A-9)	2	1.6
microliths	29	23.7
total	122	100.0

and Unit 3b, the base of Level I, which has bivalves and additional use of quartz.

Unit 3 has a pre-microlithic tool-kit formed of some horsehoof cores (Fig. 7a: A-3-5, A1-13-1), and, throughout, various scrapers (in the description of Skew Valley cores and scrapers, ML used RJ's typological system), with steep edges (A4-10-4, A2-11-1, 4), notched, concave and nosed (A4-10-1, F-10-24, F-1, A-13-2, 3), to which rare and crude burins are added. To facilitate comparisons, a cumulative graph of this small industry is given in Fig. 8.

Unit 2: From 4000–2500 years ago. This assemblage with microliths (Table A, Fig. 7b: 2-3, A-8, A1-8-1, A1-8), represented by the cumulative diagram (Fig. 8), is characterized by a diversification of sources of raw material. Not only local materials such as granophyre and quartz were used for heavy tools, but also a few tools were manufactured in materials of an origin foreign to the site, such as chalcedony, jasper, chert, quartzite.

Unit 1: From 2500 years ago to the period of colonization. As previously noted, although the accumulation of shells may have been interrupted over 2300 years, the site continued to be sporadically visited. The first centimetres of the deposit are poor in material and mixed (on the surface), deriving from different periods; it is characterized by the absence of microliths and the emergence of genuine 'Tula'-type adzes with their last stage of utilization, the 'slug' (Fig. 7b upper: F-1; A4-1; Oven-1). Tula adzes are scrapers made from flakes with steep retouch located both on the side opposite the striking surface and on the very edge of the striking plane. These stone tools are still in use in Central Australia (Mulvaney, 1975: 79–82) where they are used for woodworking and are hafted, fixed with resin. Constantly being re-struck, they finish up at the end of their usefulness as 'slugs', sometimes tiny, with a quadrangular or often triangular section, when all the striking plan has been destroyed by re-use. It is only when they reach this final stage that one can see unequivocally that they were hafted (also Mulvaney & Joyce, 1965).

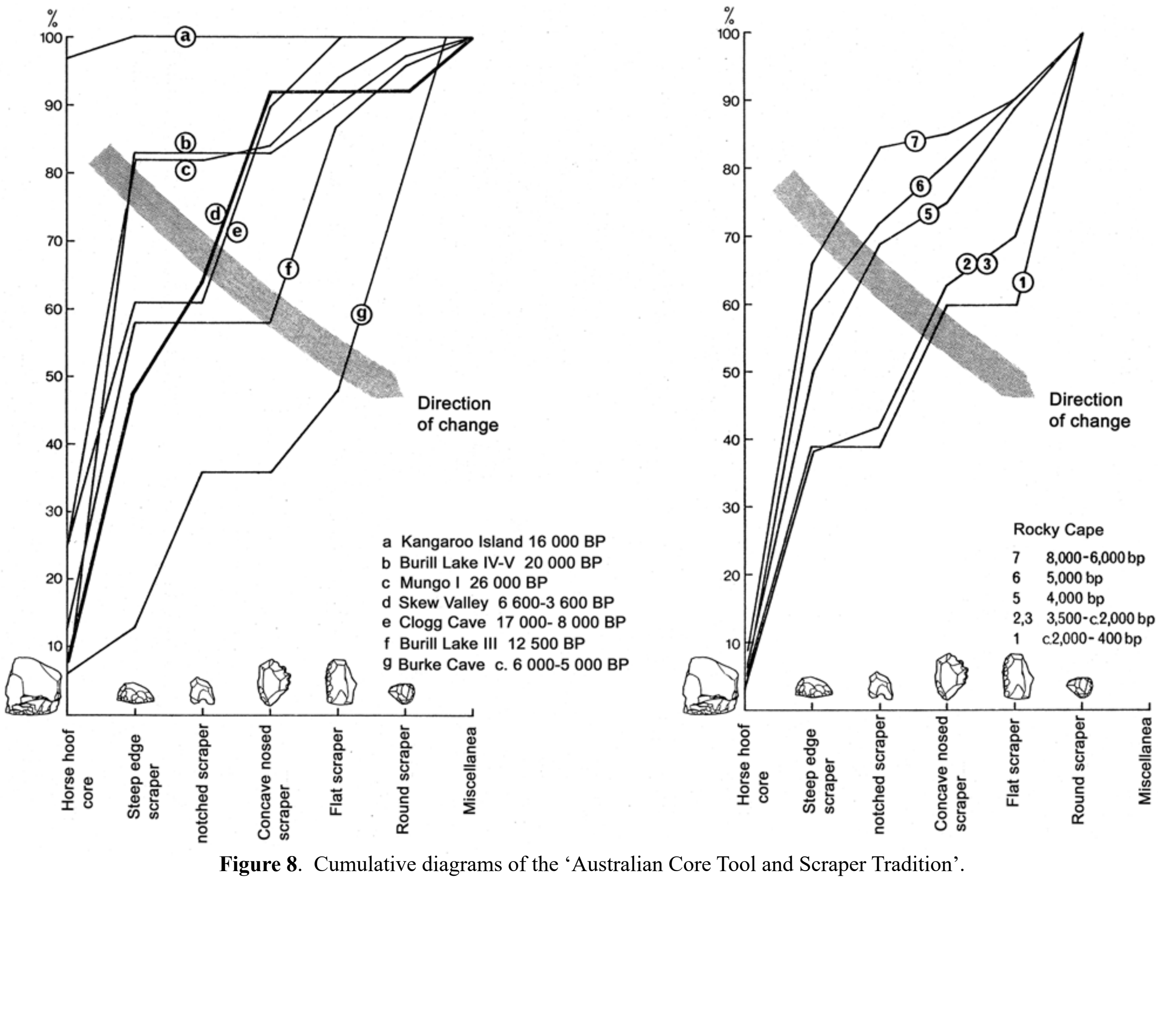

Figure 8. Cumulative diagrams of the 'Australian Core Tool and Scraper Tradition'.

3. Typological problems

The key characteristic of this tool assemblage is, in fact, a scarcity of specialized tools and an abundance of common, multiple-purpose tools. The design of stone tools by Australian Aborigines seems to have been radically different from that of prehistoric Europeans.

The typological classification of this assemblage presents some problems because, alongside tools meeting the classic definitions, there are less standardized specimens. In each category, the general shape and dimensions of tools are highly variable. There is no homogeneous series; the worked edges often appear as composite in character: on the same tool they can be, in certain instances, at the same time, straight, curved, dentate or notched. The re-touching is often discrete, discontinuous and hasty. The existence of transitional forms shows that the passage from one type to another is gradual.

It could be considered—ultimately—that there is only a single type of large tool, a versatile implement whose different forms represent only successive states of manufacture. This basic implement contains all the tools whose potential rapidly could be realized to meet the immediate needs, and that could be adapted to the specific task to be accomplished.

Enough stone artefacts, therefore, bear the marks of repeated changes of function, having been successively cores, convex scrapers, dentate scrapers, straight side-scrapers, and then reverting to a previous function without following any consistent rule.

Moreover, the abundance of material explains the general lack of 'finish' of the tools. Many of them were grouped on the margins of the midden in rock crevices and inaccessible crannies where they had been placed or thrown after use so that they did not clutter the floor of the habitation and/or were stored in anticipation of a possible return to service.

4. Changes over time in the tool assemblage

From the base to the top of the Skew Valley shell midden, the development of stone tools showed two aspects:

1. abrupt typological changes marked by the emergence of new types, and
2. slow and gradual changes in the size and mass of the basic large tools where scrapers prevail.

Both types of development are independent of each other.

Emergence of new types: It has been reported that the geometric microliths appear in Unit 2 around 4000 BP; very few remain at about 2500 BP and they no longer exist at the very surface of the mound dated to around 2300 BP (2240–2700 cal BP). Their disappearance shortly after this date, however, needs to be confirmed by the excavation of other local deposits. Fig. 9 places Skew Valley microliths within a broader framework of Australian stone tool industries.

Adzes (Tula adze and slugs) were encountered in very small numbers also in the top and at the very surface of the mound (Unit 1). The fact that one of them is formed from

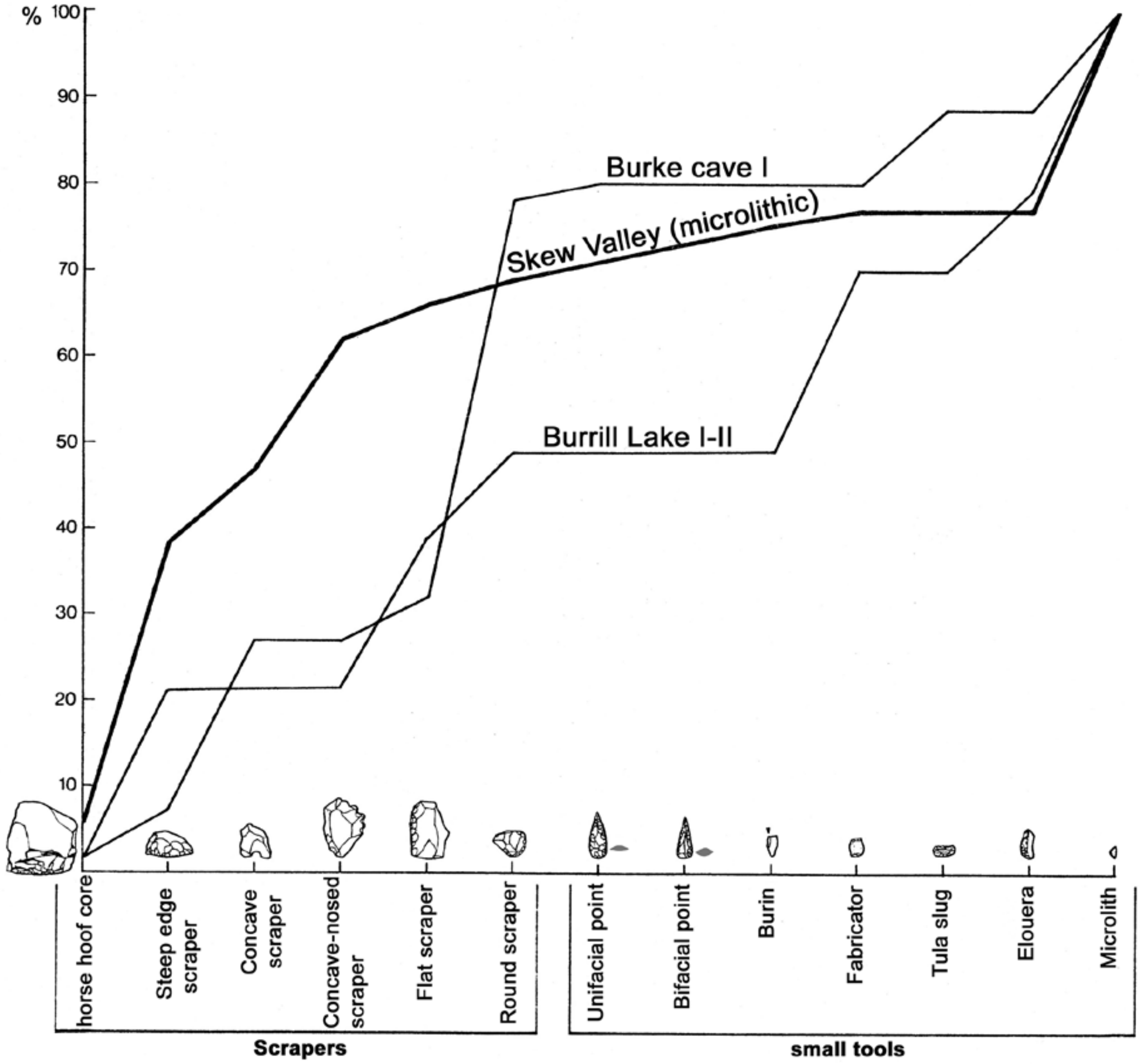

Figure 9. Cumulative diagrams of some Australian microliths industries.

bottle glass shows the persistence of this type after the arrival of Europeans. Such dating also should be supported through further excavations.

Change over time in flakes and large tools: This change is marked by both a decrease in the average weight of artefacts, and an increase of their dimensional variety and effectiveness.

A. Decrease in mass. The graph (Fig. 10) shows the constant decrease in the average mass of artefacts (tools and flakes) of Layer I by spits in the excavation of the eastern part of the mound. Average weight and standard deviation are shown together. Measurement of the striking angle has also revealed that the general decrease in tool weight is accompanied by a progressive diminution in the striking angle from between 105 and 110 degrees at the start, to 95–98 degrees at the end.

B. Increase in the variety of tool dimensions. From bottom to top of the mound, the percentage of pieces of medium size, and especially minor stone tools, increases at the expense of more bulky pieces, so that the upper units have a more varied tool size than the lower layers. This change is expressed in Fig. 11.

C. Increase in the effectiveness of tools. The total efficiency can be defined as the ratio of the length of the useful edge in relation to the mass of the tool expressed in mm per gram. As shown in Fig. 14, this value increases from base to top of the deposit, the tools becoming both lighter and more retouched over time. During the occupation of the site, the average length of useful edges per gram for scrapers increases from 0.9–3.6 mm and this improvement is already apparent in the pre-microlithic levels since the ratio rose from 0.9–1.7 before the appearance of microliths.

G. The Australian archaeological context

1. Overview

The Skew Valley site is, from every view, archaeologically isolated (Fig. 12).

The nearest excavated sites are at Miriwun, 1400 km to the north, Devils Lair (*la Tanniere du Diable*) and the deposits of the Perth region such as those at Bullsbrook and Gwambygine, about 1300 km to the south, and Puntutjarpa in the desert 1600 km to the east. These deposits are themselves hundreds of kilometres from their neighbours and are particularly remote from the dense concentrations of excavated sites in eastern Australia and the Northern Territory which are the current basis for most of our knowledge (Mulvaney, 1975: 284–285). Given such isolation and the importance of gaps in documentation, it is surprising how the Skew Valley sequence seems consistent when compared in detail with those found in the eastern regions. It almost seems that the 4000 km between them do not exist!

The Skew Valley deposit shows basically the same succession of industries that have emerged across the continent: It is a basic industry made up of core tools and scrapers to which is added, in the course of change over time, a ‘small tool complex’, especially backed microliths, flake adzes (and slugs) and points (Lampert, 1976).

All these last artefacts were elements of composite tools and their appearance and proliferation 3000–6000 years ago by region (it is possible that the adzes appear much earlier in the Central Desert: Gould, 1971) indicate a fundamental change in hafting technique.

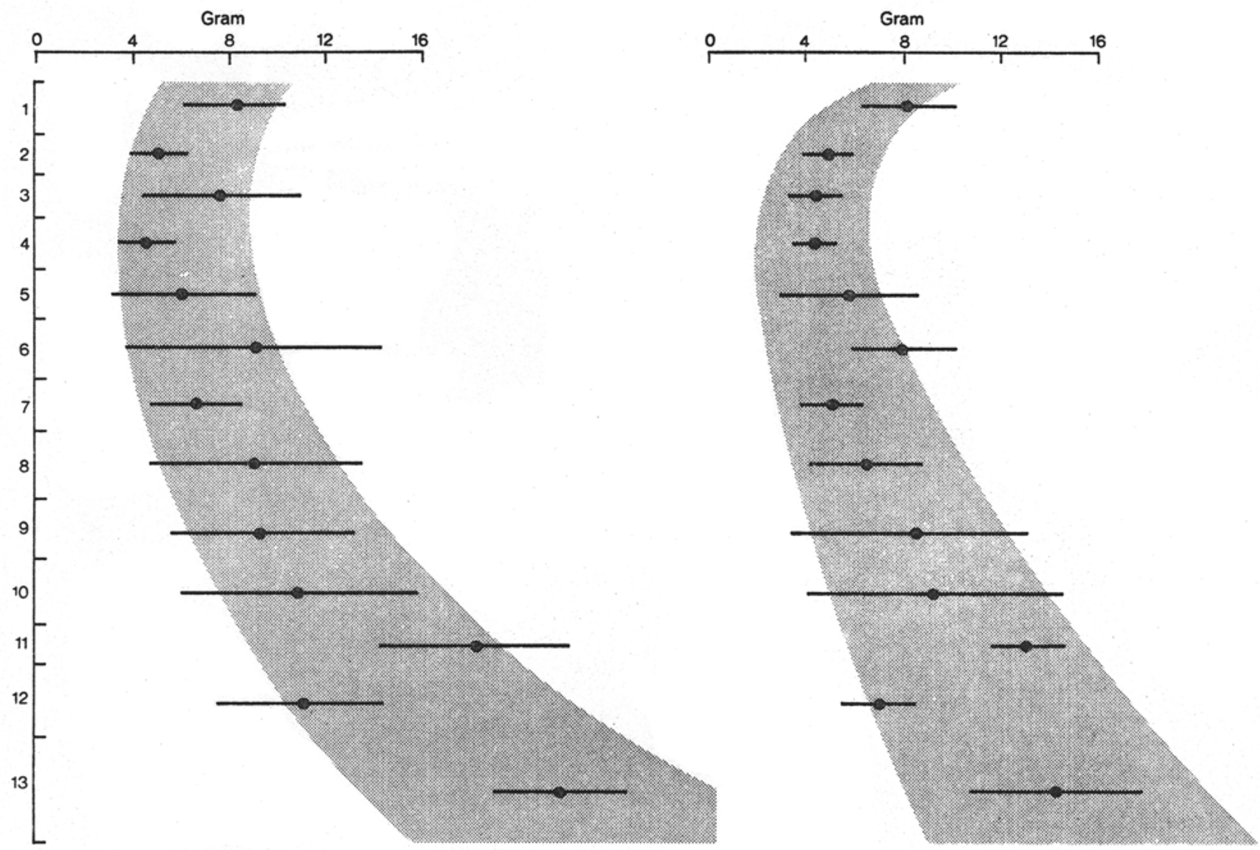

Figure 10. Decrease in the average mass of Skew Valley tools by excavation spits (eastern part of the mound). Left: flakes and tools together. Right: flakes only (mean mass and standard deviation are represented for each excavation level). [Spits = thin layers—defined by the excavator—of sediment, a few centimetres thick, successively removed during the process of an excavation—Editors]

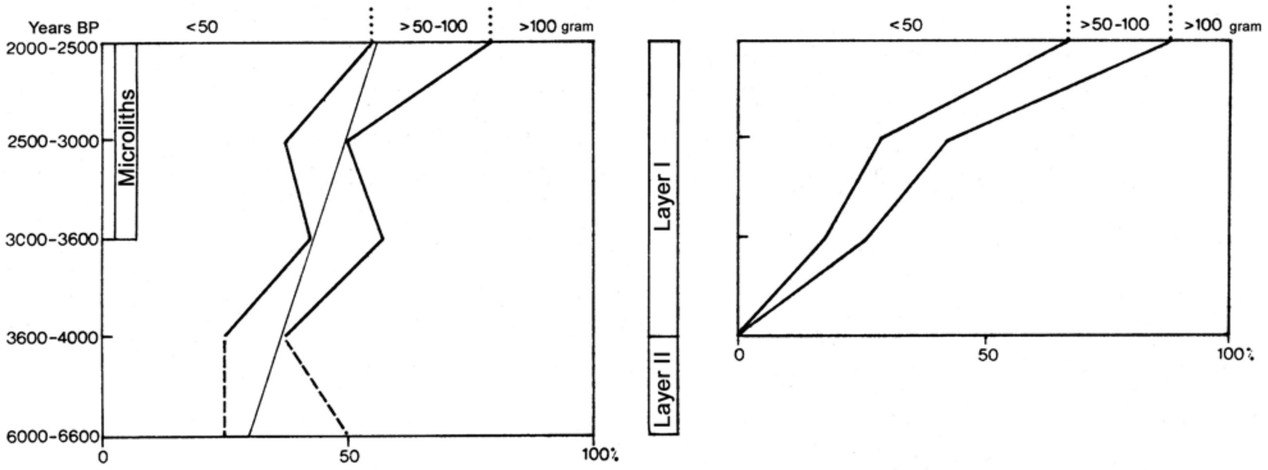

Figure 11. Dimensional change of scrapers Skew Valley. Left: change in all scrapers collected from the excavation (the oscillation at 3000–3600 BP is due to the presence of a habitation structure where big tools were missing). Right: change in scrapers in the eastern part of the mound.

2. The Australian Core Tool and Scraper Tradition

Such a sequence was developed for the first time by John Mulvaney at Kenniff Cave in Queensland (Mulvaney & Joyce, 1965) where the basic industry dated back to about 1900 BP. More recent research has shown that the industry was part of a vast technological tradition that became called the 'Australian Core Tool and Scraper Tradition', a lithic industry that had developed across the continent, including Tasmania and New Guinea, and went back in time—at least at the site of Lake Mungo in New South Wales—to about 26 000–30 000 years ago (Bowler *et al*., 1970; Jones, 1973, 1976; Flood, 1973; Mulvaney, 1975; Lampert, 1976).[13]

This Australian tradition characterizes and defines one of the major traditions of the stone industry of the late Pleistocene in the world. In the postglacial isolation of Tasmania, it has survived almost unchanged up to modern times (Jones, 1976), and in New Guinea few changes have been recorded since the earliest tools dating from 26 000 BP up to those of recent times, despite significant economic changes, including the development of horticulture (White, 1972; Golson, 1977).

The industries of the Core Tool and Scraper Tradition to which Unit 3 of Skew Valley belongs have defied any definition and quantitative analysis because of the typological problems described above. European typological classifications do not apply to such industries.

After the first attempts at classification (Mulvaney & Joyce, 1965; Lampert, 1971; White, 1972), a solution appears to have been found by the statistical study of the worked edges rather than the tools themselves. The tools are defined in statistical rather than in absolute terms; the same piece—as has been said—can have had, at the same time or successively, several different types of edge.

This concept of a multi-tool, the technology of '*bricolage*' (Lévi-Strauss 1962: 17), observed at Skew Valley as in other places on the continent, distinguishes the Australian Palaeolithic tool assemblages from the more specialized European Palaeolithic and Mesolithic industries that offer prehistorians opportunities for typological refinement.

The classification system proposed by Jones and Allen (in Bowler, 1970) for the material from Lake Mungo and refined further in the study of tools from Rocky Cape in Tasmania (Jones, 1971) was used by Flood (1974) in Cloggs Cave in Victoria and by Allen (1972) on sites in the lower Darling River in New South Wales. By demonstrating that such a system was applicable to the core tools and scrapers at Skew Valley, one of us (ML) has confirmed that there is opportunity for detailed comparisons between industries across the entire continent.

The basic tools of Skew Valley fit well with the definitions established for sites in eastern Australia and Tasmania (horsehoof cores, steep-edged scrapers—notched, concave, nose, flat and end-scrapers). To be convinced of these similarities, we only need to compare the drawings of the Skew Valley artefacts with those tools from Mungo, Burrill Lake, Kenniff Cave and Rocky Cape illustrated in articles by Lampert and Jones.

Table 2 compares the average size of horsehoof cores and steep-edged scrapers described from Skew Valley with the same tools in other deposits, some of these data having been taken from Flood (1974: 186). We find that the tools described from Skew Valley are a little larger than the others, although characteristically the edges themselves, in terms of elements such as angle and height of the retouch, are identical. The larger size of the Skew Valley pieces must simply be due to the abundance of knapping material (granophyre) at that site.

The cumulative diagram of the pre-microlithic tool assemblage of Skew Valley (Fig. 8) is the same as those that may be drawn for roughly contemporaneous tools from Burrill Lake on the coast of New South Wales, and Rocky Cape in Tasmania, even though these two deposits are located 4000 km from Skew Valley and on the other side of the continent. The persistence of the large form of basic tools made up of horsehoof cores and scrapers after the appearance of microliths, which are a simple addition such as that described at Skew Valley, has also been highlighted by other researchers: McCarthy (1964) at Capertee, Mulvaney & Joyce (1965) at Kenniff Cave, Lampert (1971) at Burrill Lake, and more recently by Allen (1972) at Burkes Cave, and Gould (1971: 157–159 and pers. comm.) at Puntutjarpa.

Probably still in use at time of the arrival of Whites in the Central Desert and Tasmania, the horsehoof cores and some types of large hand scrapers were the ultimate expressions of a cultural tradition still alive after 1200 human generations.

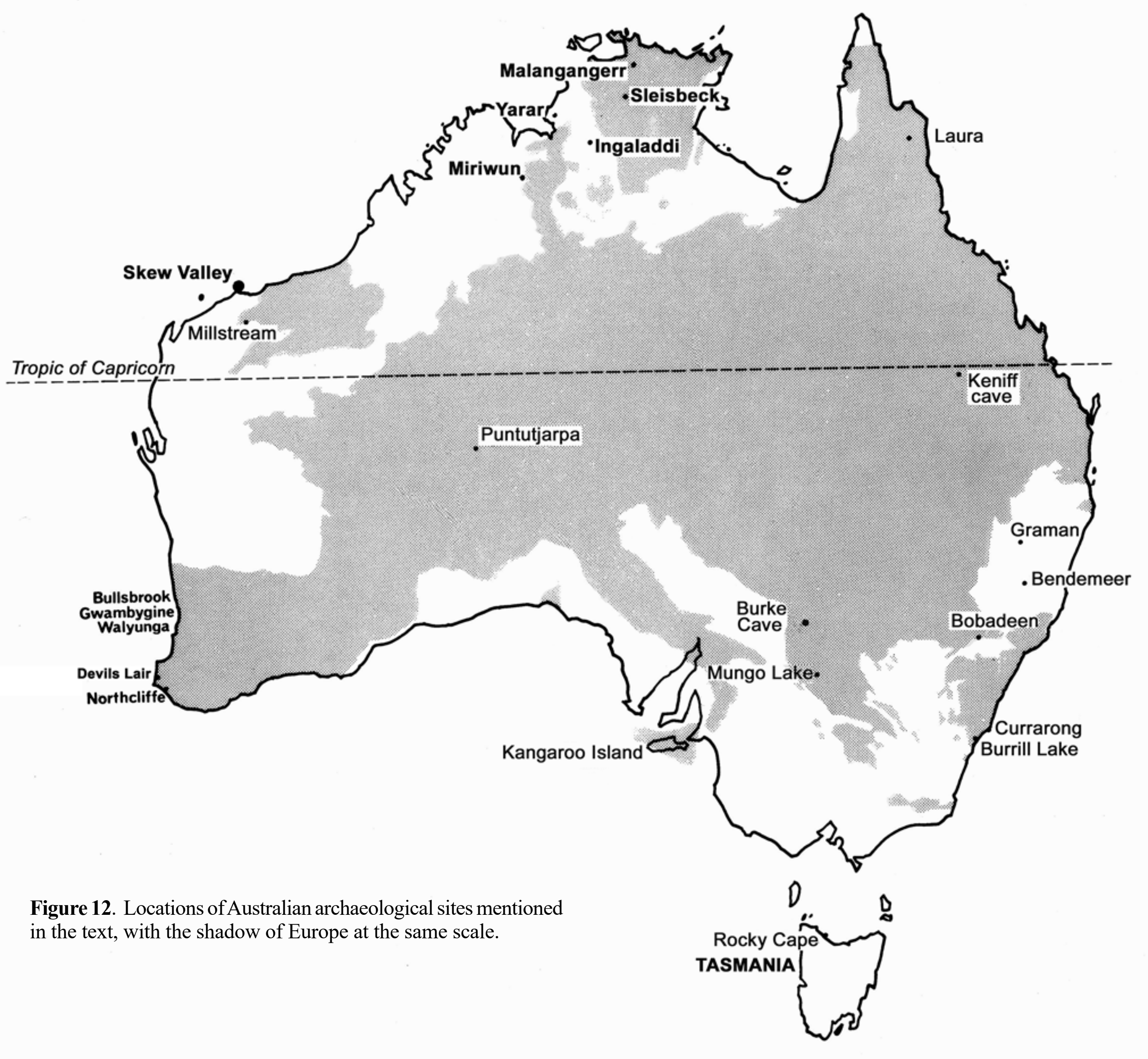

Figure 12. Locations of Australian archaeological sites mentioned in the text, with the shadow of Europe at the same scale.

3. Small tools

One of the problems facing the analysis is a deliberately somewhat vague term of 'Small Tool Tradition' (Gould, 1971; Mulvaney 1975: 210–237), which describes tools or sets of tools that have different, regional distributions.

Unifacial and bifacial points, therefore, some of which are flat, re-touched Solutrean type, were found in the tropical North and the Centre of Australia. The Tula adzes and slugs reach their highest concentration in the Central Desert of northern and southern Australia but are not encountered on the East Coast.

Eloueras, the concave-backed 'orange segments', are found especially on the coast of New South Wales, while other tools, such as the large pointed blades (the Leilira knives), and the rounded tip blades used as spoons ('*yilogwa*'), are characteristic of the Central Desert (Mulvaney, 1975: 210–235; O'Connell, 1974; Jones, 1977).

The distribution of these tools extends over areas that overlap significantly. On the other hand, some of these pieces disappear and reappear at different times in the regional sequences.

The chronological and geographical distribution of microliths is probably the point that has been most widely discussed (Mulvaney, 1961: 79, 1975: 223–226; Glover, 1967; Pearce, 1973, 1974; Wright, 1974). Geographically, they meet in an area that runs obliquely from the whole southern half of the mainland from the east to the west coast, but no microlith assemblage has yet been found beyond 20 degrees latitude south (Fig. 13 after Mulvaney, 1975, and Pearce, 1974).

Steep-sided points resembling microliths have been reported by Dortch along the Ord River in northwestern Australia (Dortch, 1977; Mulvaney, 1975: 223), but they are larger and the retouch technique is a little different from that of microliths. Are they genuine microliths or a regional variant, with oblique retouching, of the technique of making small points?

Research into geometric microliths in tropical sites was one of the main goals of expeditions of Golson, Mulvaney, Wright, and White around 1963. In sites as important as Ingaladdi, Sleisbeck, Malangangerr and Laura, not a single microlith was discovered.

Comparison with the microlith industries of India and Ceylon led Glover (1967: 245) to suggest that this tradition had been introduced to Australia by immigrants from Southeast Asia who gained a foothold on the northwestern coast of the continent, whence the new technology spread to the east.

The situation of Skew Valley in the northwestern corner of the Australian microlithic zone (Fig. 13) is therefore of

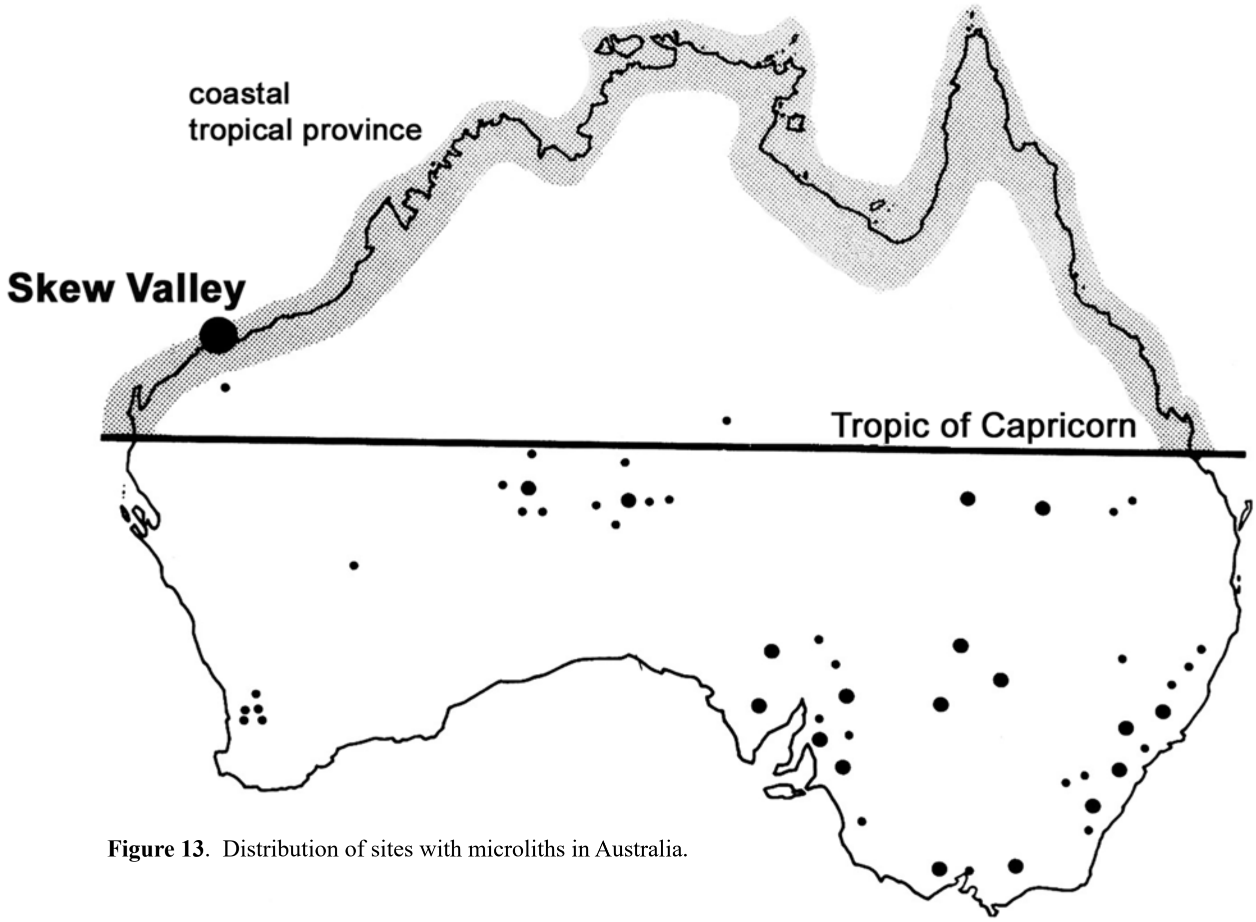

Figure 13. Distribution of sites with microliths in Australia.

particular interest. The date of about 4000 years ago for their first appearance in this site is earlier than the date of 3000 radiocarbon years BP obtained at Gwanbygine and consistent with the age of the microliths from the stratified dunes at Walyunga and at Northcliffe near Perth (between 6000 and 3200 BP: Pearce, 1974; Hallam, 1977; Dortch & Gardner, 1976).[14]

In the Centre, in the desert at Puntutjarpa, the first appearance of microliths is at 4000 BP, a date similar to that of Skew Valley. Until now, the only secure dates available for microlith industries throughout Australia were obtained at three sites: Graman, Bobadeen and Burrill Lake, located relatively close to one another on the coast of New South Wales. These dates are respectively 5000, 5200 and 5300 BP (McBryde, 1974; Lampert, 1971). Elsewhere in southern Australia, dates are clustered around 3500–4000 BP as at Skew Valley (Pearce, 1974: 304; Mulvaney, 1975: 289–291).

Given the vastness of the Australian mainland and the relative scarcity to date of well-studied sites, the degree of contemporaneity for the appearance of microliths in different regions is striking. The new technology of hafted small tools was powerful enough to spread rapidly throughout all of southern Australia. Its absence in the tropical north is, thus, even more enigmatic.

Until now such data barely support Glover's (1967) proposal since the western sites are not the oldest. If confirmed by further research, they will, instead, support the hypothesis of Pearce (1974) that microliths are a strictly Australian innovation, having its origin in the southeast and perhaps on the coast of New South Wales.

Caution is obviously necessary in this field because only less than half a dozen sites have been dated in the west of Australia, so that the oldest microliths of this vast region probably have not been recorded.

Typologically, the Skew Valley microliths are almost identical to those of coastal New South Wales. Table 3 compares their size with microliths of other representative Australian sites. The small metric differences between the regions do not contest the fundamental unity of these tools, as has been emphasized by Glover in his analysis of the Millstream surface collection located 150 km east of Skew Valley.

Small regional differences also appear in the typology of microliths. At Skew Valley, two-thirds of microliths are geometrical shapes (crescent, triangle, trapeze, asymmetric points) and the remaining third is made of straight or slightly curved backed blades. These last, rod-shaped blades are also numerous at Millstream, while they are rare elsewhere (Glover 1967: 419). They may help in the future to define a local variant of the microlithic industry.

At the level where they appear at Skew Valley, microliths constitute 24% of the assemblage, while scrapers of various types total 68%. The 'index of microliths' at Skew Valley is closer to that of the coastal sites of New South Wales (with 28 and 39%) than that of the central desert (only 8% at Puntutjarpa and 11% at the Burke Cave: Table 4). This similarity between the coastal microlithic industries of the east and west of Australia is shown by the cumulative diagram of Fig. 9.

Table 2. Horsehoof core tools and steep-edged scrapers. * Denotes number of tools at each site on which the measurements were based. Data in both parts of this table are after Jones (1971), Lampert (1971), Allen (1972), and Flood (1973, 1974). [Shiner *et al*. (2007) recently have discussed the Burkes Cave flaked stone assemblage in a regional context—Editors].

Horsehoof core tools

site (n) *	Skew Valley (10)	Mungo 1 (25)	Walls of China 1 (near Lake Mungo) (12)	Burkes Cave (19)
mass (g)	359 ± 204	284 ± 273	165 ± 174	70 ± 45
length of edge (mm)	123 ± 51	103 ± 53	75 ± 26 (n = 16)	60 ± 30 (n = 28)
height of tool (mm)	56 ± 10	50 ± 14	38 ± 10	32 ± 7
edge height (mm)	55 ± 10	40 ± 16	26 ± 9 (n = 15)	23 ± 6 (n = 26)
edge angle	96 ± 5	93 ± 7	91 ± 12 (n = 16)	95 ± 6 (n = 28)

Steep-edged scrapers

site (n) *	Skew Valley (58)	Mungo 1 (54)	Walls of China 1 (32)	Burkes Cave (49)	Cloggs Cave (11)	Burrill Lake (45)	Rocky Cape (113)
mass (gm)	138 ± 183	54 ± 28	97 ± 168	59 ± 84	56 ± 35	55 ± 41	48 ± 39
length of edge (mm)	85 ± 69	51 ± 25	55 ± 23 (n = 45)	46 ± 20 (n = 70)	39 ± 10	43 ± 15	36 ± 16
height of tool (mm)	26 ± 14	22 ± 6	27 ± 10	23 ± 7	26 ± 6 (n = 15)	25 ± 8	23 ± 10
edge height (mm)	19 ± 9	16 ± 5	19 ± 8 (n = 40)	16 ± 6 (n = 64)	14 ± 6 (n = 15)	—	14 ± 7
edge angle	83 ± 7	81 ± 8	79 ± 10 (n = 45)	82 ± 11 (n = 72)	87 ± 8 (n = 15)	90 ± 12	89 ± 11

The site of Yarar (1800 km northeast of Skew Valley) has, for example, 97% of points in an assemblage of almost 3000 tools (Flood, 1970: 38). Thus, at Skew Valley, where the economy is identical to that of tropical coastal regions, the stone industry spanning the Central Desert shows affinities with the east. It is an interesting paradox.

Nowhere in Australia were microliths found in the panoply of contemporary Aborigines, though they come very near modern-times at Burkes Cave, at Puntutjarpa and Bendemeer (Pearce 1974: 306; Allen, 1972). The Skew Valley excavation shows that, at the time of the arrival of Whites in the region, microliths were no longer used; they are lacking in the higher levels, while Tula adzes were still present.

4. Technological change in Australia

Most discussion of the stone industry in Australia is about typological aspects and, in particular, seeks to understand the role of small tools (Mulvaney & Joyce, 1965; Lampert, 1971; Jones, 1977). The emergence of these tools and their prominence in some recent assemblages have thus diverted archaeologists from the study of the development of the basic tools that developed over a period of more than 20 000 years before the appearance of small tools and that persisted after that time.

By analysing the substantive tool-kit, one of us (ML) detected and measured quantitatively the three trends identified above, operating continuously from base to top of the deposit. We examined whether the changes observed at Skew Valley reflected the general trends developing across the continent.

A decrease in the average weight of scrapers and horsehoof cores has been recorded and discussed by researchers for several Australian regional sequences, though it is difficult to obtain quantitative data from their publications. The oldest sequence came from a series of sites of the lower Darling Basin in New South Wales, at Lake Mungo. An assemblage from Mungo I is dated to 2600 BP (Bowler *et al.*, 1970), and the tool-kit from the 'Wall of China' I is more recent than 15 000 BP and attributed by Allen (1972) to a period between about 8000 and 12 000 BP. The last four or five thousand years are covered by four sets of cave stratigraphy at the Burkes Cave of which the three upper sets are characterized by the appearance and the presence of microliths (Allen, 1972).

At the end of this sequence, the average weight of scrapers and horsehoof cores is less than half what it was at first, although the types and general shapes of pieces remain the same; this change is characterized by a constant miniaturization of tools.

A similar trend to the reduction in weight has been reported in the old levels (19 000 BP) of Kenniff Cave (Mulvaney, 1965 and pers. comm.), and in the industries dated from 20 000 years of Burrill Lake (Lampert, 1971), those in South Australia including Kangaroo Island (Lampert, 1977) and in sequences such as the shorter, however important, ones of Ingaladdi (Sanders, 1975).

In Tasmania, which has been isolated from the mainland since 12 000 BP, the same trend is observable at Rocky Cape (Jones, 1971, 1976). The average weight of the steep-edged scrapers that make up about 30% of all tools was 55 grams in the assemblages of 4000–8000 BP but was not more

Table 3. Dimensions of microliths (mm). * Denotes number of tools of each part of the assemblage on which the measurements were based.

site	coastal region		interior		coastal region	
	Skew Valley		Millstream (Glover 1967)		Burrill Lake	Currarong
part (n)*	Group A geometrics (18)	Group B complete bladelets (3)	Group A (7)	Group B (51)	(19)	(14)
length	19.4 ± 6	22.5	22.5	28.4	25.7 ± 4.2	22.5 ± 4.3
width	11.2 ± 2.5	7.2	15.1	8.0	8.1 ± 1.3	8.6 ± 1.6

Table 4. Composition of Australian microlithic tool-kits. * Including adze; some of these are probably included with scrapers in other sites. [Shiner *et al.* (2007) recently have discussed the Burkes Cave flaked stone assemblage in a regional context—Editors].

tool types	Skew Valley microlith level (%)	Puntutjarpa Bx – Hx (%)	Burkes Cave Units 2 and 3 (%)	Burrill Lake Unit II (%)	Currarong Shelter I Level III (%)	Kenniff Cave (%)
microlith	24	8	11	28	39	62
scraper	68	33	80	52	36	29
other	8	58 *	9	20	25	9
number	122	506	440	54	81	?
situation	WA coast	WA desert	NSW western desert	NSW South Coast	NSW South Coast	Queensland Plateau

than 27 grams in the upper level more recent than 3500 BP (Jones, 1971).

Table 5 and the cumulative diagrams of Fig. 8 show the change over time in the Core Tool and Scraper Tradition. The older industries have the highest percentage of horsehoof cores. These are then gradually replaced by scrapers, first a steep-edged one and then by more sophisticated elements such as concave and nosed pieces, and end-scrapers. Mungo I, dated to 26 000 BP, has 26% horsehoof cores and 56% steep-edged scrapers; these proportions are almost identical to those of the roughly contemporaneous industry at Burrill Lake dated to 20 000 BP. In the more recent assemblages of the pre-microlithic levels of Skew Valley, from 6900–4000 BP (about 7500–4000 years ago), 8% are horsehoof cores and 40% are steep-edged scrapers. The pre-microlithic levels of Burke Cave (5000–6000 BP) have only 6% cores and 7% steep-edged scrapers, scrapers representing slightly more than half of the total.

Such trends can be found over large areas by following the same model. They are also clearly visible in Tasmania in the levels of Rocky Cape dated 8000–450 BP. Thus, in its isolation, the island has evolved parallel to the mainland.

The most extreme curve (a) of Fig. 8 shows the Kartan of coastal South Australia, where 97% of the assemblage consists of horsehoof cores on pebbles or blocks with only 3% of scrapers (Lampert, 1977). Our analysis would seem to support the hypotheses of Tindale (1937) and Lampert according to whom the Kartan or similar industries represent the oldest technological base from which arose the Australian tradition of cores-scrapers that has developed over a period of more than 30 000 years.

The progressive miniaturization of the tools described above is only one aspect of a fundamental change that is also expressed by the constant increase of the efficiency index of cores and scrapers as shown in Fig. 14. Improvement in this index is certainly a general value because it is seen in different regions: the lower Darling over a period of 26 000 radiocarbon years, Skew Valley over 5000 years, and the northwest of Tasmania over 8000 years.

Hunters at Mungo, 26 000 radiocarbon years ago, had only 0.5 mm of useful cutting edge per gram, and it was the same at Burrill Lake. But in more recent times, 1500 radiocarbon years ago, the length of the useful edge was increased by a factor of seven, to 3.8 mm per gram. Similar values were obtained in contemporary levels at Skew Valley. At Rocky Cape, it changes from 0.6 mm at 8000 BP to 2.4 mm per gram in modern times.

This trend in the efficiency index developed in parallel in Tasmania and on the continent; then it accelerated on the continent after the introduction there of small tools.

Despite large differences in types of materials available and in the uses of sites, and in spite also of the small size of the sample, the consistency of this trend is truly remarkable.

So, even if we consider the basic tools of Australia as the result of a process of adaptation both opportunist and unspecialised, such adaptation happened within a cultural context that itself was changing.[15]

Table 5. Composition of pre-microlithic Australian tool-kits (upper part of table). Rocky Cape (Tasmania) tool-kits without microliths (lower part of table).

Composition of pre-microlithic Australian tool-kits

site	Kangaroo Island KIC	Lake Mungo 1	Burrill Lake IV-V	Burrill Lake III	Cloggs Cave (pre-microlithic)	Skew Valley (pre-microlithic)	Burkes Cave Unit 4
age BP	>16 000	26 000	20 000	12 500	17000–3000	6900-4000	<6000–5000
core-scraper (%)	97	26	7	14	26	8	6
steep-edged scraper	3	56	76	44	35	40	7
notched scraper	0	0	0?	0?	0	16	23
pointed concave scraper	0	2	0?	0?	29	28	0
'flat and straight'	0	10	7	29	10	0	12
scraper (*grattoir*)	0	5	7	10	0	0	51
other	—	—	3	4	—	8	—
number	61	96	67	65	31	127	129

Rocky Cape (Tasmania) tool-kits without microliths

unit	1	2 and 3	5	6	7
age BP	400–<2000	3500–2000	<4000	<5000	8000–6000
pebble chopper (%)	3	4	5	2	5
steep-edged scraper (%)	36	34	45	57	61
notched scraper (%)	0	4	19	13	17
pointed concave scraper (%)	21	21	6	9	2
'flat and straight' (%)	0	7	14	9	5
scraper (*grattoir*) (%)	40	30	11	10	10
number	33	44	63	47	41

Conclusion

The excavation of the Skew Valley shell mound must be seen primarily as a simple exploration of the problems raised by our study of archaeological sites of the Dampier Archipelago.

If the extensive comparisons and attempts at synthesis that we have just explained are justified, the fact remains that they call for more extensive work, especially a full excavation of an intact shell midden in the region, to obtain a consistent picture of the activities of occupants of the site and not truncated data, which can be misleading. Comparison excavations of other local sites are also necessary to define the particular relationship between very numerous petroglyphs and different habitats and various sites.

Suffice it to note for now that the Skew Valley excavation data sit well with the existing development of current archaeological research in Australia.

These data confirm that the emergence of a stone tool tradition has expanded throughout the continent. It is characterized by a large basic tool kit dominated by cores and scrapers (made on flakes or cores), gradually becoming lighter and more re-touched, and supplemented by the post-Pleistocene development over time (especially between 6000 and 3000 BP) of small tools, mostly microliths, points and adzes, with variations according to period or region of the continent. This change is accompanied by an improvement in the quality of material used for making tools.

We see at Skew Valley a marked contrast between what may be characterized as 'commonplace' Australian stone tools, including those discovered in other parts of the continent, and a rather narrowly specialized economy adapted to the tropical coastline fringe. This is not an isolated phenomenon.

In the current state of research, stone industries throughout Australia appear relatively uniform and do not reflect the ecological diversity of natural environments in which they have developed.

It is likely that such an impression of uniformity may be due in part to gaps in research. To identify a regional culture, it is necessary to conduct a series of comparative excavations in neighbouring deposits of various types to provide additional data. At Dampier, it would be appropriate to examine shell mounds not only along the coastal shorelines, but also in the valleys where they are surrounded by petroglyphs, at such deposits in the hinterland, and substantial quarries.

This impression of uniformity is also due to the fact that the Aboriginal stone toolkit is mainly composed of multi-purpose tools and not specialized tools. Extensive comparisons between the tools of the Australians and those of prehistoric Europeans, for example, would better define the specific mindsets of both worlds.

It is nevertheless fascinating to detect at Skew Valley, as throughout Australia, the constant and slow technological progress towards a more effective tool, already reported in Europe (Leroi-Gourhan, 1943, 1964; Bordes, 1967) and Asia (Hayden, 1977: 281), which reflects the depth of human efforts for greater control of the natural environment.

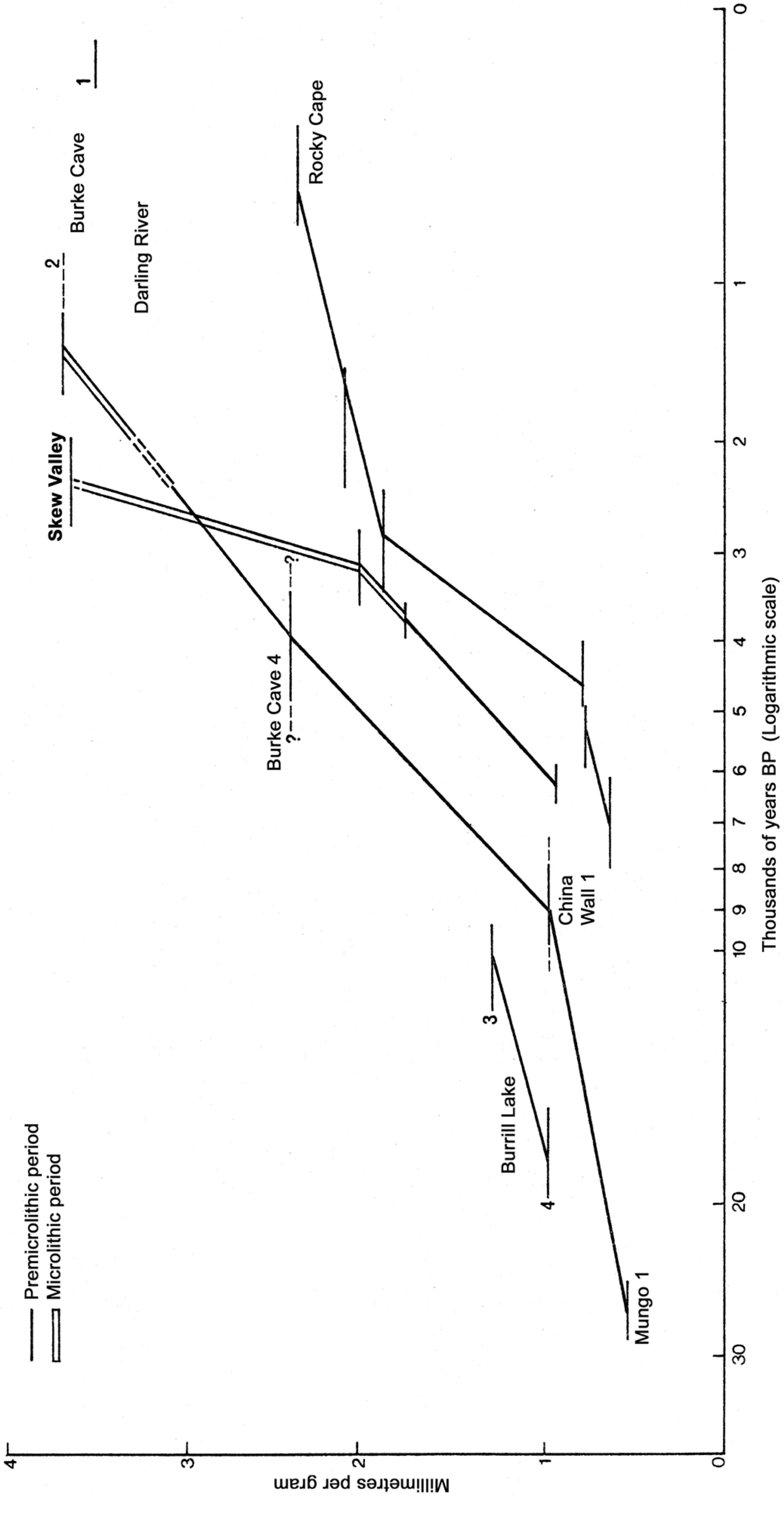

Figure 14. Variation of the efficiency index of some industries in Australia.

Acknowledgments[16]

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Mrs S. Hallam, professor of prehistory at the University of Western Australia, has contributed to the achievement of this research by offering the help of three archaeology students to assist with the excavations. She is offered here an expression of our gratitude.

The outcome and success of this work would not have been possible without effective collaboration and the generous persons who helped us on the ground, especially Maguy Lorblanchet, Ulrick and Rainer Sackic, Louis Genot, Toni Barker, Myra Stanbury, Wendy Wolfe-Okongwu and Mathew Johnson, who came later to join Ken Lyon (AIAS), Cyril Peck and Trevor Wilkes when the team was working at Gum Tree Valley.

This study has also benefited from the interpretations of various experts who undertook to study some of the data collected during the excavation: Kari Bartz, John Clark, Geoff Hope, David Horton, Phillip Hughes, Vince Roberts. ML sincerely thanks Ian Johnson who both checked the English text of the monograph and has advised in the use of certain statistical tests.

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Editorial note

This paper was originally a presentation to the ninth congress of the International Union of Prehistoric and Protohistoric Sciences, Nice, 1976 (Garanger, 1976). The French language version subsequently was published in 1979 in the *Bulletin de la Société préhistorique française* (volume 76). This English language version has some minor, non-substantive, editorial changes to text, including the tabulation of some material (Table A), addition of endnotes (those within square brackets) by author and editors, and the relocation of details of radiocarbon results from original footnote 5 to the Addendum to this Chapter 2 (p. 187); original references have been added, updated and supplemented.

Dr Michel Lorblanchet retired as *Directeur de Recherches au CNRS* and lives in the Quercy region of France. At the time of their collaboration, Rhys was Senior Fellow in the Department of Prehistory of the Research School of Pacific Studies, The Australian National University. Professor Rhys M Jones died in 2001. We are grateful to Rhys' literary executor, Dr Betty Meehan, for permission to deal with Rhys' contribution to the original paper.

A draft of the unpublished monograph on Skew Valley research (Endnote 2) prepared by Lorblanchet and others is held by the AIATSIS Library (Lorblanchet, n.d.).

Hiscock & Allen (2000) have provided a useful review of the significance of the 'Australian Core Tool and Scraper Tradition'.

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Addendum
Skew Valley midden radiocarbon samples[18]

We submitted 12 samples from both layers of the Skew Valley excavation to the radiocarbon dating laboratory of The Australian National University, and results of the analyses were reported by Henry Polach (Table 6). Un-calibrated age determinations originally were cited in a footnote on page 466 of the BSPF paper. To allow further analysis and discussion these results are placed in this appendix to accompany the translated version.

Nine of the 12 determinations obtained for the Skew Valley midden were made from samples of marine shells, and the other three were made on charcoal. All samples were collected by ML; all sample weights were adequate. Shells from the upper layer were all the marine bivalve *Anadara granosa*, and from Layer II the gastropod *Terebralia palustris*. The results obtained from charcoal samples were in significant disagreement with the results from shells and it was considered that there had been contamination of the carbon.[19] The charcoal results are not considered further here.

About one sample (ANU-1835; SK-3B), the analyst, Henry Polach, wrote: "The results obtained for the two fractions A and B indicate possible contamination by younger carbonate in the outer layers of the shell. The result for fraction A of 6600±100 BP is therefore the most reliable age for the shell". The result for ANU-1835 fraction B is not included in the further analyses below.

Two further results should be included here. Mr Robert Bevacqua, salvage archaeologist from the Western Australian Museum, collected two shell samples from the exposed section of the Skew Valley midden along the Dampier Salt road (on 24 August 1974; no excavation done).[20] In October 1976, these two samples also were analysed by the ANU radiocarbon laboratory. Sample size in all instances was 'adequate'. Mr Bevacqua kindly agreed to the publication of the dates obtained together with all the data from the excavation of the same midden (Table 7).

The two samples were collected at a location corresponding to square G (whereas ML samples came from square F) in the area that ML called 'the road-side excavation' (the second part of the excavation was 'the boulder-side excavation'). The two sets of samples were collected 1.0–1.5 m apart. The results are in good agreement: ANU-1502A (Bevacqua) and ANU-1834 (Lorblanchet) gave the same result; ANU-1503 (Bevacqua) and ANU-1836 (Lorblanchet) are close.

The results from Bevacqua's samples are included in the analysis below. Combining them with those from the excavation would provide securer and more precise results for each sample context.

Table 6. Skew Valley excavation: layers 1 and 2 shell and charcoal samples. Un-calibrated radiocarbon results; determinations on shell uncorrected for marine reservoir effect. *F*, 'roadside' excavation square; *A4*, Boulderside excavation square (see Fig. 1).

sample	sample context				material	laboratory code	uncalibrated 14C ages BP	collector / laboratory comment
	square	layer	spit	depth below surface (cm)				
SKV-1A	F	1	3	13.5–14	charcoal	ANU-1833	500 ± 70	shell-charcoal pair
SKV-1B	F	1	3	12–13	*Anadara granosa*	ANU-1843	3540 ± 80	shell-charcoal pair
SKV-2	F	1	13	53–54	*Anadara granosa*	ANU-1834	4150 ± 80	
SKV-3A	F	2	1	67–71	*Terebralia palustris*	ANU-1835A	6600 ± 100	some degradation of outer 'B' part of sample
SKV-3B	F	2	1	67–71	*Terebralia palustris*	ANU-1835B	6280 ± 90	
SKV-4	F	2	5	92–93	*Terebralia palustris*	ANU-1836	6960 ± 100	
SKV-5	A4	1	top of 10	45–50	*Anadara granosa*	ANU-1837	3770 ± 80	
SKV-6	A4	1	4	10–17	*Anadara granosa*	ANU-1838	2770 ± 80	
SKV-7	A4	1	base 7 top 8	30–37	*Anadara granosa*	ANU-1839	3410 ± 80	
SKV-8A	F	1	7	30	charcoal	ANU-1844	2180 ± 60	shell-charcoal pair
SKV-8B	F	1	7	29–31	*Anadara granosa*	ANU-1845	3910 ± 80	shell-charcoal pair
SKV-9	F	1	10	53.5	charcoal	ANU-1870	2010 ± 70	

Table 7. Skew Valley excavation area: further shell samples. Un-calibrated radiocarbon results; shell determinations uncorrected for marine reservoir effect.

sample	sample context				material	laboratory code	uncalibrated 14C ages BP	collector / laboratory comment
SKV-	square	layer	collected from	depth below surface (cm)				
B1A	G	1	exposed section	50–60	*Anadara granosa*	ANU-1502A	4150 ± 80	inner part of shell
B1B	G	1	exposed section	50–60	*Anadara granosa*	ANU-1502B	4290 ± 70	outer part of shell
B2	G	2	exposed section	80-90	*Terebralia palustris*	ANU-1503	6620 ± 100	inner part of shell

Calibration of the Skew Valley midden radiocarbon determinations

All age determinations made have been calibrated using the Calib Radiocarbon Calibration Program (Stuiver & Reimer, 1993) incorporating the 2009 international calibration datasets including the Marine09.14c radiocarbon age and southern hemisphere terrestrial calibration curves (Reimer *et al*., 2009; McCormac *et al*., 2004). Input data follows the recommended Calib input format (Table 8); the results are reported here in Table 9.

The most likely results (as indicated by the factor in the 'relative area' column) are summarized in Table 10 along with rounded cal BP age ranges at two standard deviations.

These data indicate an age range for the midden of up to 5360 years between the extremes of the age ranges (7600 and 2240 cal BP) at two standard deviations, or more conservatively, a range of about five millennia (about 7500–2500 cal BP).

The graph (Fig. 15) shows the relation between dates and depths in the Skew Valley midden. There is a clear gap of about 2500 years (between 6820 and 4400 years ago: using the extremes of the two-sigma cal BP ranges), between the end of the *Terebralia* shell midden and the beginning of the *Anadara* shell midden. It could be that the SKV site was abandoned for a few millennia, but new excavations of other middens are needed in the area to check this and to know if this is a local phenomenon or a general one.

Table 8. Skew Valley midden shell samples. Calibration input data.

lab code	sample code	14C BP (CRA)	14C SD lab error or added years variance f**2	age span years	d13C per mil	d13C SD years	Delta R years	Delta R SD years	marine carbon percentage	Cal curve
ANU-1843	marine	3540	80	1	0	0	52	35	100	3
ANU-1845	marine	3910	80	1	0	0	52	35	100	3
ANU-1837	marine	3770	80	1	0	0	52	35	100	3
ANU-1834	marine	4150	80	1	0	0	52	35	100	3
ANU-1502A	marine	4150	80	1	0	0	52	35	100	3
ANU-1835A	marine	6600	80	1	0	0	52	35	100	3
ANU-1836	marine	6960	100	1	0	0	52	35	100	3
ANU-1503	marine	6620	100	1	0	0	52	35	100	3
ANU-1838	marine	2770	80	1	0	0	52	35	100	3

Table 9. Skew Valley midden shell samples. Calibrated radiocarbon results generated by *calib611.exe*.

lab code	radiocarbon age	Delta R	calibration data set	1-sigma ranges	relative area	2-sigma ranges	relative area	mean probability
ANU-1845	3910±80	52±35	marine09.14c	cal BP 3691: cal BP 3930	1	cal BP 3590: cal BP 4066	1	3820
ANU-1837	3770±80	52±35	marine09.14c	cal BP 3529: cal BP 3767	1	cal BP 3422: cal BP 3868	1	3643
ANU-1834	4150±80	52±35	marine09.14c	cal BP 4011: cal BP 4275	1	cal BP 3906: cal BP 4396	1	4149
ANU-1502A	4150±80	52±35	marine09.14c	cal BP 4011: cal BP 4275	1	cal BP 3906: cal BP 4396	1	4149
ANU-1835A	6600±80	52±35	marine09.14c	cal BP 6950: cal BP 7161	1	cal BP 6844: cal BP 7254	1	7059
ANU-1836	6960±100	52±35	marine09.14c	cal BP 7315: cal BP 7508	1	cal BP 7224: cal BP 7601	1	7416
ANU-1503	6620±100	52±35	marine09.14c	cal BP 6959: cal BP 7207	1	cal BP 6817: cal BP 7309	1	7077
ANU-1838	2770±80	52±35	marine09.14c	cal BP 2318: cal BP 2565	1	cal BP 2209: cal BP 2218	0.004017	2227
					1	cal BP 2227: cal BP 2233	0.002508	2241
					1	cal BP 2241: cal BP 2697	0.993475	2445
ANU-1839	3410±80	52±35	marine09.14c	cal BP 3108: cal BP 3335	1	cal BP 2966: cal BP 3418	1	3214

Table 10. Skew Valley midden shell samples. Summary of calibrated radiocarbon results (cal. BP rounded).

SKV midden	lab code	uncalibrated 14C ages	error factor	cal curve	95.4% (2-sigma) age range (cal BP) (rounded)	relative area under distribution
Sq F Layer 1	ANU-1834	4150	80	3	3910–4400	1.000
Sq F Layer 1	ANU-1843	3540	80	3	3150–3590	1.000
Sq F Layer 1	ANU-1845	3910	80	3	3590–4070	1.000
Sq G Layer 1	ANU-1502A	4150	80	3	3910–4400	1.000
Sq F Layer 2	ANU-1835A	6600	100	3	6840–7250	1.000
Sq F Layer 2	ANU-1836	6960	100	3	7220–7600	1.000
Sq G Layer 2	ANU-1503	6620	100	3	6820–7310	1.000
Sq A4 Layer 1	ANU-1838	2770	70	3	2240–2700	0.994
Sq A4 Layer 1	ANU-1839	3410	80	3	3000–3420	1.000
Sq A4 Layer 1	ANU-1837	3770	80	3	3420–3870	1.000

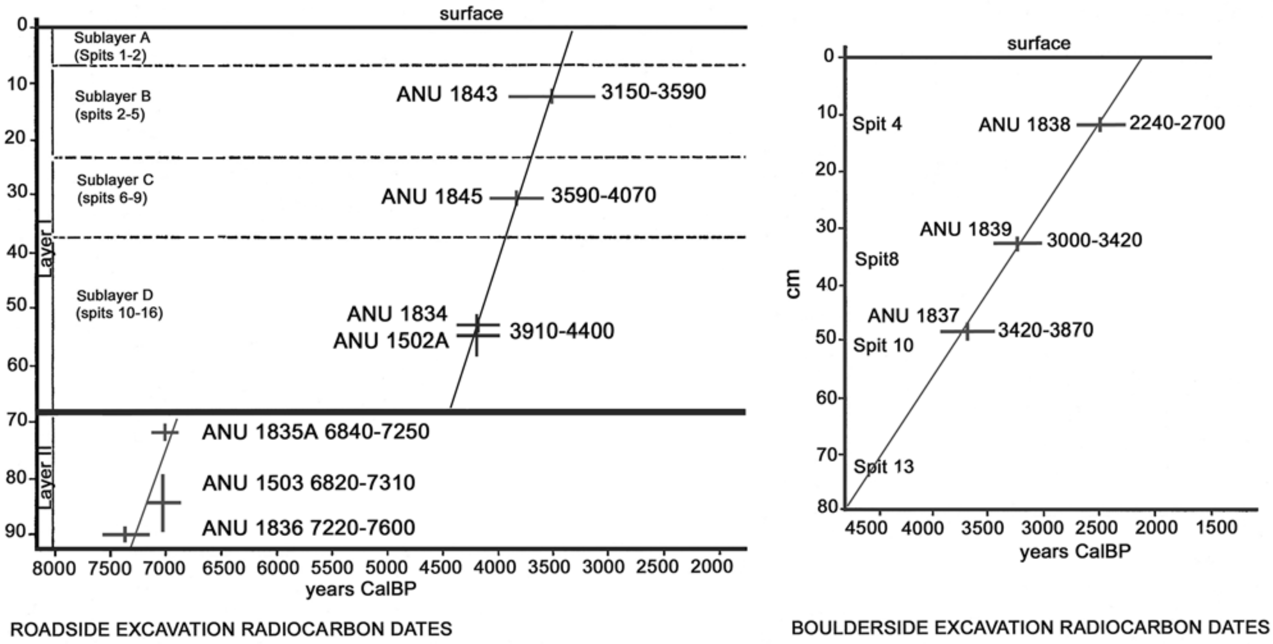

Figure 15. Age-depth curves: cal BP results compared with excavation depth.

Conclusions

The *Terebralia* midden spans a period of as much as 7600–6800 years ago (two-sigma cal BP ranges), and the *Anadara* midden from about 4400–2200 (two-sigma cal BP ranges). *Anadara* gathering stopped probably more than two millennia ago, but the excavation showed a discrete and intermittent use of the site up to the contact period.

There is a gap between the two midden components of about two-and-one-half millennia (roughly between less than 7000 and more than 4000 BP) during which the shell gathering stopped, but it is impossible to know if the site was completely abandoned. New excavations of other middens (for example of the large midden in the centre of Gum Tree Valley) are necessary to date more precisely the human occupation of the area (since it is not possible to date directly the petroglyphs).

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Endnotes

1 Paper presented to the ninth Congress of the International Union of Prehistoric and Protohistoric Sciences, Nice, 1976. [This appendix is an edited translation of Lorblanchet & Jones (1976)—Editors].

2 Literature searches by Maguy Lorblanchet have collected numerous and varied materials enabling a reconstruction of the history of the region and the last moments of traditional Aboriginal life [Lorblanchet, Maguy n.d.—Editors].

3 [This was in 1976, the second visit to Dampier by ML, and was followed by others in the late 1970s and early 1980s as described in our introduction—Editors].

4 ML is preparing a monograph entitled *Skew Valley—Shell Midden and Carvings* for publication by the Australian Institute of Aboriginal Studies. Besides being a study of the deposit and carvings written by the author, various specialists collaborate in this work, including F. L. Virili (Dampier Archaeological site description), K. Bartz (statistical study of shell dimensions), J. Clark (study of the patination of prints), G. Hope (pollen study), D. Horton (study of the fauna), P. Hughes (sedimentology), R. J. and M. L. (Australian archaeological context), G. Kendrick (identification of shells), Maguy Lorblanchet (regional ethnohistory and statistical study of shellfish species), V. Roberts (regional geology and identification of materials used for making tools).

5 [*Triodia pungens* was identified by Nathan Sammy (Dampier Salt biologist)—ML.]

[*Triodia* is a genus of perennial, hummock-forming grass endemic to arid regions of Australia, commonly known as 'spinifex', but not of the coastal genus *Spinifex*—Editors].

6 Eleven square metres and over 10 tonnes of sediment were excavated, representing one-twelfth of what remained of the mound. The excavation lasted two and a half months and represented a total of 396 days of human labour. Previously, on 18 August 1974, Mr R. Bevacqua of the Western Australian Museum in Perth, had taken for dating two shell samples from a section of the mound. The dates he obtained fall within the chronological time-frame set by our excavations and our samples. [Details in Addendum, pp. 189–192—Editors].

7 [Original paper referred to 'level I' and 'level II'—Editors].

8 [Results of radiocarbon analyses (originally as 'Footnote 5') are presented here as an addendum (pp. 189–192). Note that the Skew Valley age estimates used throughout this version of the paper may be either the calibrated dates (cal BP) or, where comparisons are being made with uncalibrated age estimates from other sites, the original BP values—Editors].

9 [To estimate the duration of Level I it is necessary to rely not only on the radiocarbon dates but also on the location of the dated samples in the site stratigraphy. This is because the dated samples are not situated right at the top or at the bottom of the layer. The age-depth graph (Fig. 15) shows for the Boulderside excavation that Level I began earlier than 4500 and ended about 2300 years ago—ML.]

10 [There is recent evidence for sea level at modern levels in Western Australia between 8000 and 7500 years ago (Lewis *et al.*, 2013)—Editors].

11 [Cf. Chapter 2, Part I: Fig. 2.5—Editors].

12 [Details of the character and distribution of motifs are provided in Chapter 2, Part I—Editors].

13 [Hiscock & Allen (2000) have provided a useful review of the significance of the 'Australian Core Tool and Scraper Tradition'. Bowler *et al.* (2003) have reviewed dating of Lake Mungo materials—Editors].

14 [It was impracticable to attempt to calibrate age estimates from other sources, so that the dates from other sites discussed here and subsequently may or may not be directly comparable with the Skew Valley excavation calibrated dates (cal BP). To allow the argument to be followed, the original Skew Valley age estimates in radiocarbon years (BP) are retained in the text and tables with the calibrated dates added in parentheses. For Australian archaeology Hiscock (2008) provides many relevant data, and for rock art in particular, the recent paper by Langley & Taçon (2011) has a link to a useful compilation of age estimates—Editors].

15 [Here, in the original article, the authors used the term *bricolage* in describing the basic Australian stone tool assemblage. A direct translation would have been along these lines: "… the result of an opportunistic and non-specialized bricolage, …". However, their usage was based not on the common English usage but on a discussion by Lévi-Strauss, one which Lorblanchet sees as emphasising the adaptive genius of the Australian tool-makers (pers. comm. 2 March 2014 to GKW)—Editors].

16 [Thanks to Dr Graeme K. Ward (AIATSIS) for his accurate translation and editing (including calibration of the radiocarbon age estimates of this paper). Thanks also to Dr Betty Meehan who inspired a substantial part of the original paper though her enlightening study of tropical shell collectors in northern Australia—ML]

17 [Also Mulvaney & Kamminga (1999)—Editors].

18 Addendum prepared by Michel Lorblanchet and Graeme Ward.

19 The lack of agreement between the results for the shell and charcoal samples probably was caused by 'pollution' of the charcoal samples. There are three causes in this phenomenon: (1) Rain carrying charcoal dust to contaminate charcoals thus producing a younger age. (2) Fire burning younger roots that have penetrated charcoal even into the deepest layers. (3) Mixing of small pieces of rotten roots with prehistoric charcoals (during excavations such black rotten roots can appear exactly like charcoal).

20 Bevacqua reported that he collected his samples from the exposed section at 10 cm depths, whereas those from the excavation were collected in spits three or four centimetres thick. This is the cause of the differences in the sizes of the crosses in the graph comparing depths with dates.