context: not an absolute but an artificial one. The skill of an excavator is seen in an ability to identify original contexts and give them definition, or otherwise to create a viable, useful and coherent set of relationships for found objects. The nature of these constructs allows, limits or determines the possible interpretations placed upon them.

In short, archaeologists create archaeological data out of sites. The previous (unknown) physical structure of a site is changed – irrevocably changed (or destroyed) – and a new (formally defined) abstract structure is given to them. Some potential information will be lost in the process, but other data are extracted and given meaning and significance. The analogy is perhaps to the sculptor, who destroys a block of stone to find a statue within, who discards or loses some of the material to isolate and define one previously hidden model. So we should see the excavator extracting one of many possible structures of material, with coherence, with meaning and with value, from an otherwise relatively meaningless block of deposit.

In terms of the processes that make and change sites and knowledge, the excavator should be seen not simply as a destroyer, but as a particular agent of transformation, which creates our structured archaeological record.

Shell beads from Mandu Mandu Creek rock-shelter, Cape Range peninsula, Western Australia, dated before 30,000 b.p.

KATE MORSE*

A site dated well back into the Pleistocene in Western Australia yields modified shells, seen as a further evidence of the attributes of modern humans from an early Australian context.

Recent reviews (Mellars 1989; Marshack 1990) have highlighted the continuing debate over the biological and behavioural origins of modern human populations. Research in Australasia has demonstrated that anatomically modern humans were present by 30,000 b.p. (Wolpoff *et al.* 1984; Webb 1989), although the region was first colonized at least 40–50,000 b.p. and possibly much earlier (Pearce & Barbetti 1981; Groube et al. 1986; Allen *et al.* 1988; Jones 1989; Roberts *et al.* 1990). This paper reports the recent discovery of shell beads, dated *c.* 32,000 b.p., from an archaeological site on the Cape Range peninsula, Western Australia. These artefacts are the earliest ornamental material yet recovered from the Australasian Region and provide important new evidence for the development of sophisticated behavioural patterns by early Australian populations.

Background

Cape Range peninsula forms a finger of land, once known as Madman's Corner, which stretches into the Indian Ocean on the western extremity of the Australian arid zone (FIGURE 1). The back-bone of the peninsula is formed by Cape Range, an extremely rugged and largely inaccessible limestone range dissected by numerous intermittently flowing creeks. Its western coast is bordered by Ningaloo Reef, and on its eastern margin are the shallow and sheltered waters of Exmouth Gulf. Of major significance to archaeological research in this area is the proximity of the edge of the continental shelf to the modern shoreline. At a distance of only 10 km, the western margin of Cape Range peninsula is the nearest point on the Australian continent to the edge of the continental shelf.

In 1985, excavations in Mandu Mandu

* Department of Anthropology, Western Australian Museum, Francis Street, Perth WA 6000, Australia.

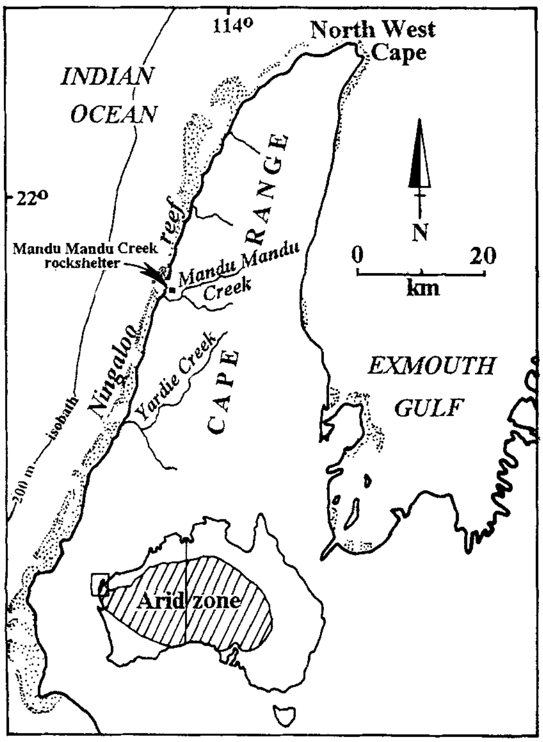

FIGURE 1. *Cape Range peninsula, showing locations mentioned in text.*

Creek rock-shelter (FIGURE 1), a small limestone cave in the western foothills of Cape Range, yielded archaeological evidence of intermittent human occupation of the coastal margin of Cape Range peninsula, from 25,000 b.p. to at least 430 b.p., by people exploiting a variety of coastal resources including fish, crab and at least three species of marine mollusc (Morse 1988). This was the first unequivocal Australian evidence for the Pleistocene exploitation of marine resources (Jones 1989; Morse 1988).

Two stratigraphic units, distinguished by colour, texture and content and separated by a marked disconformity, were identified in this excavation. The upper late Holocene unit contains the great majority of archaeological material. A basal carbonate radiocarbon determination of 25,200±250 b.p. (SUA-2354) and a date of 20,040±440 b.p. (SUA 2614) on baler shell (Melo sp.) bracket the lower unit. Archaeological material, including stone artefacts, marine and terrestrial bone and marine shell, while sparse in the Pleistocene unit, comprised a comparable faunal range to that found in the Holocene unit.

There are no archaeologically sterile layers in the deposit at Mandu Mandu Creek rock-shelter and sediment analysis suggests that there is a strong correlation between the intensity of human use and the rate of sediment accumulation at this site (*cf.* Hughes & Lampert 1982). The Pleistocene unit consists of lenses of red to yellowish-red, fine to very fine quartz-calcarenite sands and coarse silts with abundant carbonate nodules. All archaeological material in the lower unit is encrusted in a red carbonate cement and there is no evidence for post-depositional bioturbation. The disconformity between the two stratigraphic units is considered to represent a hiatus in occupation, when use of this rock-shelter ceased as the arid conditions of the last glacial period intensified, and it was not re-occupied until late Holocene times. Midden sites on the nearby coast indicate, however, that people had re-occupied the area by at least 7000 years ago (Kendrick & Morse 1982; 1990).

The 1989 excavation

In 1989 two further 1-m square pits, Squares C1 and E2, were excavated at Mandu Mandu Creek rock-shelter and a similar stratigraphic and archaeological sequence to that outlined above was identified (FIGURE 2; Morse in press a). Baserock in Square C1 is 91 cm below floor surface, some 10 cm deeper than the original Square C3 excavation. In Square E2 baserock is 80 cm below the floor surface. As before, archaeological material including stone artefacts, marine shell and bone, and terrestrial bone is present throughout the deposit, becoming increasingly sparse with depth. The stone industry can broadly be classified as typical of the Australian core tool and scraper tradition with the addition of typical late phase tools such as adzes and a significant decrease in flake size in the Holocene layers (*cf.* White & O'Connell 1982: 105). To a great extent, the faunal assemblage reflects the changing proximity of the coast. In the lower Pleistocene unit, a time when the sea was retreating between 3–10 km west of the site, faunal material is for the most part sparse and the marine faunal assemblage is far less diverse than that found in the Holocene layers. However, in Square C1, in the basal 9 cm of deposit, a marked abundance of archaeological material

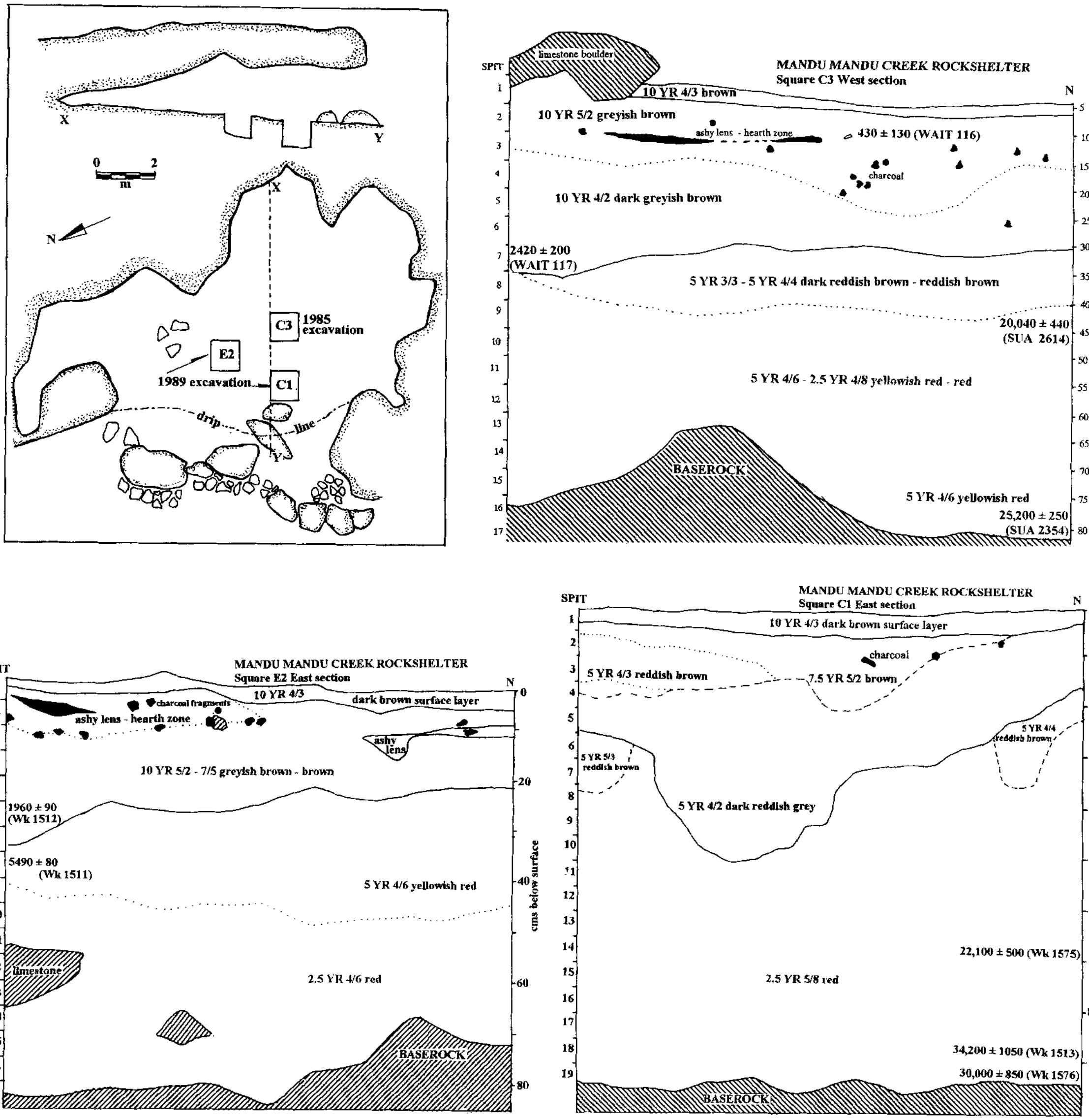

FIGURE 2. *Mandu Mandu Creek rock-shelter, profile, plan and dated stratigraphic sections of squares C3, C1 and E2.*

including over 75 g of marine shell, 140 g of bone and some 50 stone artefacts was recovered.

A 2.7-g fragment of baler shell collected from just above baserock in the southwest corner of Square C1 yielded a radiocarbon determination of 30,000±850 b.p. (Wk-1576). A 9.1-g baler sample from the northwest corner at a depth some 6 cm above baserock was determined as 34,200±1050 b.p. (Wk-1513). X-ray diffraction analysis demonstrated that the dated samples consisted of primary aragonite. However, isotopic analysis indicated that there was a 30% contamination with ground-water carbon dioxide, leading to the samples appearing to be between 950 and 1250 years too old (C. Hendy pers. comm.). An uncalibrated determination of *c.* 32,000 b.p. is taken as an approximate age for this occupational horizon.

Nine radiocarbon dates have now been obtained from Mandu Mandu Creek rock-shelter (TABLE 1). All are conventional dates and, with the exception of one charcoal sample and the

lab. code	square	spit	unit	depth (cm)	material	new age (yr b.p.)	conv. age (yr b.p.)
WAIT-116	C3	2/3	1	10	charcoal	–	430±130
Wk-1512	E2	6	1	25–30	marine shell	2010±80	1960±80
WAIT-117	C3	7	1	30–35	charcoal	–	2420±200
Wk-1511	E2	8	1	35–40	marine shell	5650±80	5490±80
SUA-2614	C3	9	2	40–45	marine shell	–	20,040±440
Wk-1575	C1	14	2	65–70	marine shell	22,700±500	22,100±500
SUA-2354	C3	16/17	2	81	marine shell	–	25,200±250
Wk-1576	C1	19	2	91	marine shell	30,900±850	30,000±850
Wk-1513	C1	18	2	85–90	marine shell	35,200±1050	34,200±1050

depths are in cm below floor surface; **new age** is based upon the more accurate half-life of 5730 years; **conv. age** = conventional age. None of the age determinations is calibrated.

TABLE 1. *Radiocarbon dates from Mandu Mandu Creek rock-shelter, listed in order of age.*

carbonate sample from Square C3 noted above, all have derived from marine shell. The dated sequence from this rock-shelter now spans from *c.* 32,000 b.p. to at least 430 b.p., although the site appears not to have been occupied between 20,040 and 5490 years b.p., corresponding with the onset of the arid conditions of the last glacial period. Radiocarbon dates from two other nearby rock-shelters now indicate that a human presence in this area was certainly re-established by at least 12,000 b.p. and may in fact have continued throughout the last glacial period (Morse in press a; b).

The modified shells

Twenty-two small cone (*Conus* sp.) shells and fragments were recovered from the basal occupational horizon in Square C1. The great majority (nearly 75%) were derived from residue excavated from the two western quadrants. With the exception of one shell, the small size of which presumably precluded its use, all the *Conus* sp. material appears to have been deliberately modified as beads. Six of the cones are whole shells that have had their apex perforated and their internal structure cleanly broken to form a hollowed-out shell with a round hole in the top. The diameters of the holes range between 2.5 and 3.7 mm; mean diameter is 3.2 mm. The largest of these predominantly intact shells has a maximum length of 21.1 mm and a maximum diameter of 12.4 mm. Two are fractured and have their anterior ends broken. After cleaning they appeared slightly calcined and grey suggesting they have briefly come in contact with fire. One other shell is broken in half length-ways.

The two best-preserved cones have a small notch worn into the shell edge at the posterior end of their aperture (FIGURE 3). In some species of cone a notch occurs naturally in this position. However, inspection of these notches under magnification (400×) showed that they had very abraded edges. This is consistent with the notch being formed by wear from a string

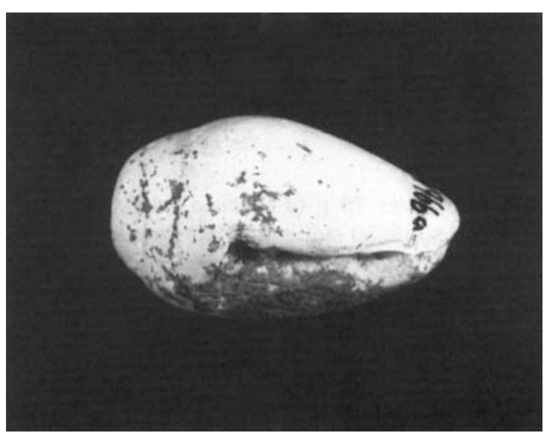

FIGURE 3. Conus *sp. shell bead showing notch worn on posterior end of aperture. Actual length 19.6 mm.*

on which the beads could have been threaded. By virtue of a shell's weight, a string inserted in the hole in the apex is most likely to emerge from the shell at the posterior end of the aperture, thereby eventually causing a notch to form. Growth lines, visible at high magnification on the shells surface, appear to have been cut through by the notches. Comparison of notches on the *Conus* sp. material with similarly threaded shell artefacts from north Western Australia, held in ethnographic collections at the Western Australian Museum, show analogous wear patterns.

The other modified cone shells and fragments consist of a section of the spire of each shell. Like the shells described above, the apex of each shell is perforated and a rounded hole has been formed. The diameter of the hole is generally larger than that recorded in the intact shells, ranging between 1.3 and 6.5 mm, though the mean diameter is the same. These shells have been further modified and have their last whorl removed. Both their posterior and anterior ends have been well rounded and smoothed. The result is a shell ring between 2.9 and 9.6 mm long (mean length 6.3 mm) and between 7.2 and 12.7 mm in diameter (mean diameter 10.06 mm). Some of the shell rings are partially broken; measurements are the maximum that could be taken.

It is suggested that the beads were made by rubbing the weakest part of the shell, the apex, against an abrasive surface. Once a rough hole had been worn, the internal structure would then be broken, perhaps using a piece of bone or stick. The edge of the top hole would be rounded and the still largely intact shell threaded on a fine string. The shell rings appear to represent a secondary modification following breakage of the last whorl, whether accidental or deliberate, during modification. It is estimated that if assembled, the strand of at least 22 beads would have had a length of 180 mm (FIGURE 4).

All the shells show evident selection for size and genera. Their worn and battered appearance suggests they were probably collected as dead shells in the beach drift where they can often be found in abundance. Comparison of the archaeological shells with modern and fossil shells shows some important differences. While the apex of some of the natural shells is perforated, the resulting hole is irregular and has a very fine, often jagged edge. In addition, in all specimens examined, the internal structure of the natural shells is more or less intact.

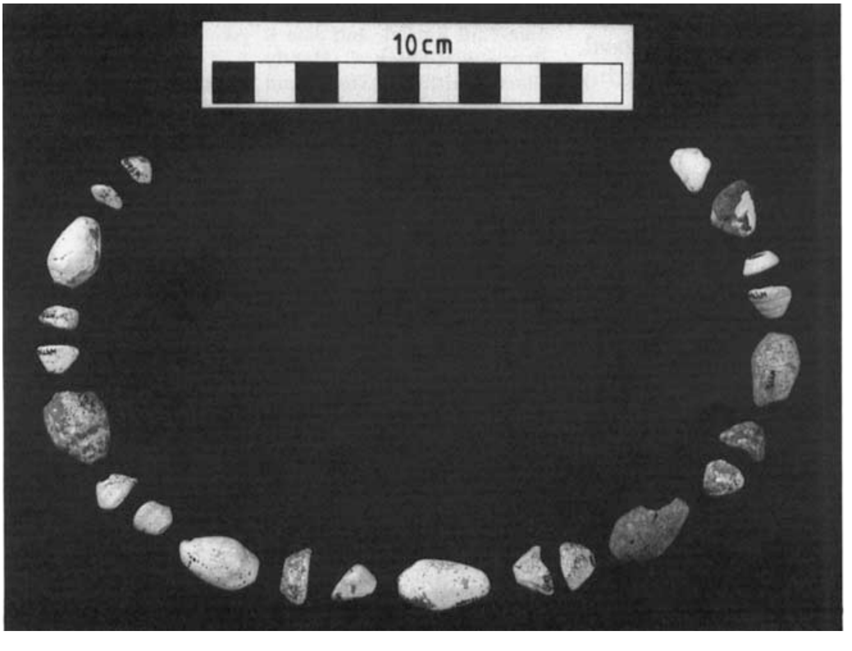

FIGURE 4. *Hypothetical arrangement of the 22 shell beads as an ornament.*

Species identification of the cones from this site is problematical as they have very worn and etched surfaces. They are provisionally identified as *Conus dorreensis* (G.W. Kendrick pers. comm.), a species which typically lives in shallow waters on reef platforms, and in sand under rocks, environments consistent with the predominantly reefed shoreline of the western coast of the Cape Range peninsula. Cone shells, with over 300 known species, belong to one of the most diverse shell families in Australian waters (Wells & Bryce 1985). Though edible, many are venomous and they are not generally considered to be a dietary species. In view of the condition and very small size of the cone shells described here, it is considered most unlikely that they were collected for human consumption.

Further excavation to baserock of squares immediately adjacent to Square C1 may yield additional cone shell material. Ochre and fragments of pearl shell (*Pinctada* spp.) and scaphopod shell (family Dentaliidae), materials well documented in Australia as being used to make decorative objects (Akerman in press), are present in later Pleistocene layers of this excavation. In addition, three other fragments of cone shell, one of which may be deliberately modified, were recovered from spits 10 and 11 in Square E2. While no direct date is available from this depth their estimated age is *c.* 21,000 years b.p. At this time Mandu Mandu Creek rock-shelter would have been located some 8–10 km from the shore and, while equivocal, this evidence may point to a continuing tradition of site use.

Discussion

The decorative and ceremonial use of ornaments, including shell beads, was well established in Australia by mid–late Holocene times (Pretty 1977; Macintosh 1971). While no record has been found describing the use of cone shells, many other shell species were used in the manufacture of decorative material (Akerman in press). Pleistocene evidence, on the other hand, is sparse. The Devil's Lair bone beads, ranging in age from 12,000 to 19,000 b.p. (Dortch 1984), and the ochred burial Lake Mungo III (Bowler & Thorne 1976) dated some 30,000 b.p., have provided the best evidence to date for the antiquity of Aboriginal decorative or ceremonial traditions. The shell beads described here extend the age of human use of decorative ornaments in Australia to a time comparable with some of the earliest such evidence from Europe (Mellars 1989; Soffer 1985; White 1989). It seems, then, that behavioural patterns commonly thought to be associated with biologically modern human populations were occurring contemporaneously in both the southern and northern hemispheres.

Acknowledgements. This research was funded by grants from the Australian Institute of Aboriginal Studies and the National Estate Program. I would especially like to thank George Kendrick, Peter Bindon, Sylvia Hallam and Jean-Paul Raynal, and also K. Akerman, S. Bowdler, C. Bryce, B. Gehlen, C. Hendy, A. Hogg, M. Lofgren, S. Slack-Smith, M. Smith and L. Strawbridge for their various help.

References

AKERMAN, K . In press. *The use of bone, shell and teeth by Aboriginal Australians.* Paper presented at the Lubbock Lake Landmark International Symposium, Texas, USA, October 1990.

ALLEN, J., C. GOSDEN, R. JONES & J.P. WHITE. 1988. Pleistocene dates for human occupation of New Ireland, northern Melanesia, *Nature* 331: 707–9.

BOWLER, J.M. & A.G. THORNE. 1976. Human remains from Lake Mungo: discovery and excavation of Lake Mungo III, in R.L. Kirk & A.G. Thorne (ed.), *The origin of the Australians*: 127–38. Canberra: Australian Institute of Aboriginal Studies.

DORTCH, C.E. 1979. Australia's oldest ornaments, *Antiquity* 53: 39–43.

GROUBE, L., J. CHAPPELL, J. MUKE & D. PRICE. 1986. A 40,000 year old ocupation site at Huon Peninsula, Papua New Guinea, *Nature* 324: 453–5.

JONES, R. 1989. East of Wallace's Line: issues and problems in the colonization of the Australian continent, in Mellars & Stringer (1989): 743–82.

KENDRICK, G.W. & K. MORSE. 1982. An Aboriginal shell middens deposit from the Warroora coast, Northwestern Australia, *Australian Archaeology* 14: 6–12.

1990. Evidence of recent mangrove decline from an archaeological site in Western Australia, *Australian Journal of Ecology* 15: 349–53.

MACINTOSH, N.W.G. 1971 Analysis of an Aboriginal skeleton and a pierced tooth necklace from Lake Nitchie, Australia, *Anthropologie* 9: 49–62.
MARSHACK, A. 1990. Early hominid symbol and evolution of the human capacity, in P. Mellars (ed.), *The emergence of modern humans: an archaeological perspective*: 457–98. Edinburgh: Edinburgh University Press.
MELLARS, P. 1989 Technological changes across the Middle–Upper Palaeolithic transition: economic, social and cognitive perspectives, in Mellars & Stringer (1989): 338–65.
MELLARS, P. & C. STRINGER (ed.). 1989. *The human revolution: behavioural and biological perspectives on the origin of modern humans.* Princeton (NJ): Princeton University Press.
MORSE, K. 1988. Mandu Mandu Creek rock-shelter: Pleistocene human coastal occupation of Cape Range Peninsula, Western Australia, *Archaeology in Oceania* 23: 81–8.
In press a. New radiocarbon dates from Cape Range Peninsula, Western Australia: a preliminary report, in M.A. Smith, M. Spriggs & B. Fankhauser (ed.), *Sahul in review: Pleistocene archaeology in Australia, New Guinea and island Melanesia.* Canberra: ANU Press.
In press b. Who can see the sea? Prehistoric human occupation of the Cape Range peninsula, in W.F. Humphreys (ed.), *Biogeography of Cape Range.* Records of the Western Australian Museum, Supplement.
PEARCE, R.H. & M. BARBETTI. 1981. A 38,000 year old archaeological site at Upper Swan, Western Australia, *Archaeology in Oceania* 16: 173–8.
PRETTY, G. 1977. The cultural chronology of the Roonka Flat, in R.V.S. Wright (ed.), *Stone tools as cultural markers*: 288–331. Canberra: Australian Institute of Aboriginal Studies.
ROBERTS, R.G., R. JONES & M.A. SMITH. 1990. Thermoluminescence dating of a 50,000 year old human occupation site in northern Australia, *Nature* 345: 153–6.
SOFFER, O. 1985. *The Upper Palaeolithic of the Central Russian Plain.* London: Academic Press.
WEBB, S.G. 1989. *The Willandra Lakes hominids.* Canberra: Australian National University, RSPacS.
WELLS, F.E. & C.W. BRYCE. 1985. *Sea shells of Western Australia.* Perth: Western Australian Museum.
WHITE, J.P. & J.F. O'CONNELL. 1982. *A prehistory of Australia, New Guinea and Sahul.* Sydney: Academic Press.
WHITE, R. 1989. Production complexity and standardization in Early Aurignacian bead and pendant manufacture: evolutionary implications, in Mellars & Stringer (1989): 366–90.
WOLPOFF, M.H., WU XINZHI & A.G. THORNE. 1984. Modern Homo sapiens origins: a general theory of hominid evolution involving the fossil evidence from East Asia, in F.H. Smith & F. Spencer, *The origin of modern humans: a world survey of the fossil evidence*: 411–83. New York (NY): Alan R. Liss.

* Ancient Monuments Laboratory, English Heritage, 23 Savile Row, London W1X 1AB, England.