3 CENTRAL AUSTRALIA: RESEARCH DESIGN AND METHODS

The Central Australian ranges lie at heart of the continent, surrounded by dunefields, sandplain and stony desert. The explorer Sturt commented that "girt round by deserts, it almost appeared as if Nature had intentionally closed it upon civilised man" (1849:2). One could expect therefore that the Centre was remote, if not isolated, from the effects of demographic and environmental changes on the margins of the arid zone. Thus it shares some of the advantages of an island, as a laboratory for the study of cultural processes uncomplicated by external events.

This chapter begins with an outline of the physical features of Central Australia, summarises the extent of previous archaeological fieldwork in the region and then presents details of the approach adopted in this project. Figure 3.1 shows the position of the study area in relation to the rest of the arid zone and plots the location of the excavated sites.

CENTRAL AUSTRALIA

The history of the European exploration and settlement of Central Australia is described in great detail by Hartwig (1965). The region was first traversed by the explorer Stuart in 1860 and European settlement in the region began with the construction of the overland telegraph line in 1872. Scientific research into the

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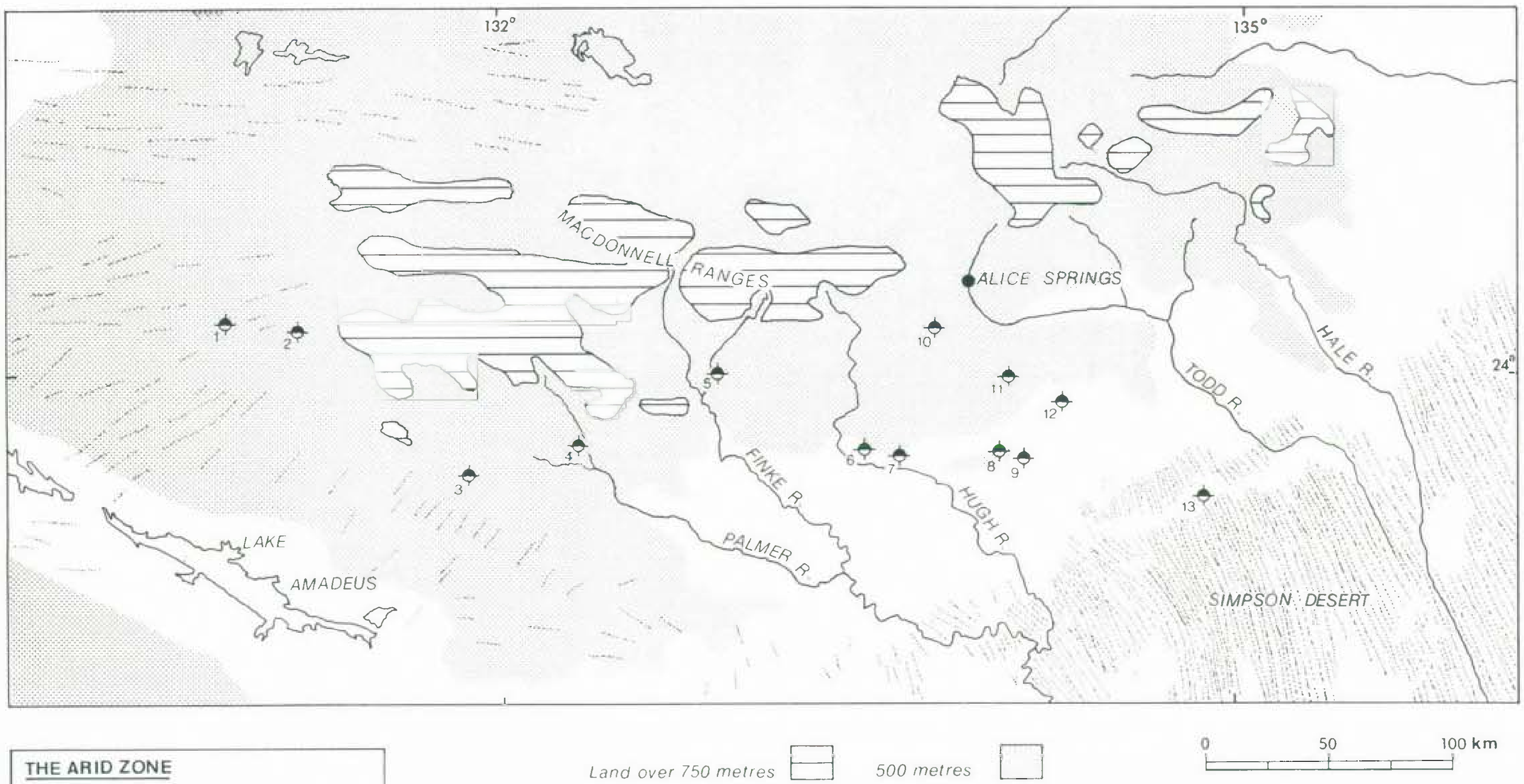
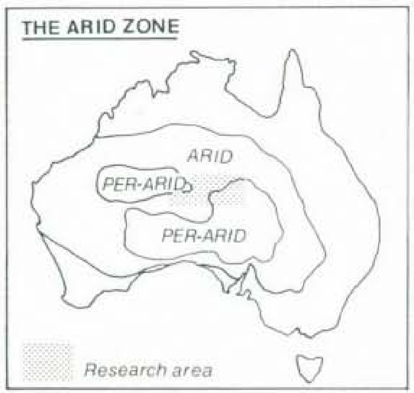
Overleaf **Figure 3.1 :** The research area showing the location of the excavated sites.





1. Puritjarra
2. Tjungkupu
3. Wanmara
4. Ilarari
5. Rrewurlpmurlpme kweke
6. James Range NW
7. Urre
8. Intirtekwerle
9. Kwerlpe
10. Kweyunpe
11. Urwemwerne
12. Keringke
13. Therreyererte

geology and natural history of the region can be said to properly begin with the Horne expedition in 1894 and work by Chewings (1891, 1894) and Brown (1890). Subsequent anthropological research by Spencer and Gillen in 1896 brought international attention to the region.

The first detailed assessment of the physical and biological resources of Central Australia was made by the CSIRO Division of Land Research in 1956-57 (Perry _et al_ 1962) and the natural history, soils and geology of the region are now comparatively well known. The archaeological fieldwork described below was largely restricted to the southern part of Central Australia, between the Tropic of Capricorn and the 25th parallel, although other areas were reconnoitred. Figures 3.2 - 3.4 illustrate the main habitats in the region and further examples can be found in chapters 4-9. The following summary of its salient features is derived from Perry _et al_ (1962), Lazarides (1970), Jackson (1962), Mabbutt (1967), Jennings and Mabbutt (1977) and Jessop (1981).

Topography.

Within the study area there are two major physiographic provinces; the central ranges, and the desert lowlands lying to the south of the ranges.

The central ranges

These are the main topographic feature in the region. They strike east-west across the region in an almost unbroken belt more than 400 km long and up to 160 km wide. The northern part of the MacDonnell ranges and the Harts Range are rugged uplands of crystalline and metamorphic rocks. Local relief commonly exceeds

300 m and Mt Liebig (1524 m), Mt Zeil (1510 m) and Mt Sonder (1346 m) are the highest points in Central Australia. The southern part of the ranges - including the Krichauff, James, and eastern MacDonnell ranges - consists of a series of low parallel ranges of sandstone, quartzite or dolomite, separated by narrow sandplains or alluvial valleys.

The central ranges form the watershed between the large internal drainage basin centred on Lake Eyre and a region of uncoordinated drainage to the north and west. Many of the river systems of Central Australia have their headwaters in the research area. The Palmer, Finke, Hugh, Todd and Hale rivers all rise in the MacDonnell ranges and flow southeast towards Lake Eyre.

Southern desert lowlands

The Simpson desert lies to the southeast of the ranges and is an extensive tract of linear dunes broken on its northwest margin by several sandstone ridges. The Lake Amadeus lowlands lie to the southwest of the ranges and consist of a shallow basin with extensive saltlakes or playas at the centre and with dunes and sandplain on the flanks. Between these two regions is an area of dissected stony plains and tabletop hills.

Rainfall.

The research area is a comparatively well watered part of the arid zone, situated between the Western desert and the Simpson dunefield, two areas that Gentilli (1972) classifies as PerArid

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Overleaf **Figure 3.2 :** Mountainous country in the central ranges. View east from Mt Sonder. September 1987. **Figure 3.3 :** Sandplain near Deep Well, with desert oak (*Casuarina decaisneana*) and hard spinifex (*Triodia basedowii*). May 1986. **Figure 3.4 :** River Red Gums (*Eucalyptus camaldulensis*) in the sandy bed of Roe creek, near Simpsons Gap. August 1987.

(see fig. 3.1). The mean annual rainfall for Alice Springs, using the long-term average based on readings from 1874 to 1986, is 283 mm. This decreases from north to south across the region and the MacDonnell ranges have a minor rain-shadow effect on the land to the south.

Rainfall may be received both in summer and in winter, a distribution known as bixeric. In the study area there is a likelihood of some rain in late summer, from the northern monsoon system, and some winter rain especially in early winter. There is usually a marked intermission in seasonal rainfall in spring, with September and October as virtually rainless months.

The mean annual rainfall figures for the period from 1874 to 1986 show a sequence of short periods of high rainfall, separated by longer dry periods (fig. 3.5). The short periods of high rainfall have significant environmental consequences. For instance, they are periods of major perennial plant recruitment, high biological activity and widespread wildfires (Griffin 1984:7; Morton 1986). They also recharge local aquifers and groundwaters (Jones and Quinlan 1962:153) and some of these effects are long lasting. For instance, the initial series of wells sunk on Atartinga station in the 1950's and 1960's reached groundwater at 70 feet (21.7 m) but after the exceptionally high rainfall received in 1974 the watertable rose to 30 feet (9.3 m) and it remains at this level today (B. Purvis pers. comm.). The short episodes of high rainfall also cause widespread flooding and recent work suggests that extensive tracts of alluvium were

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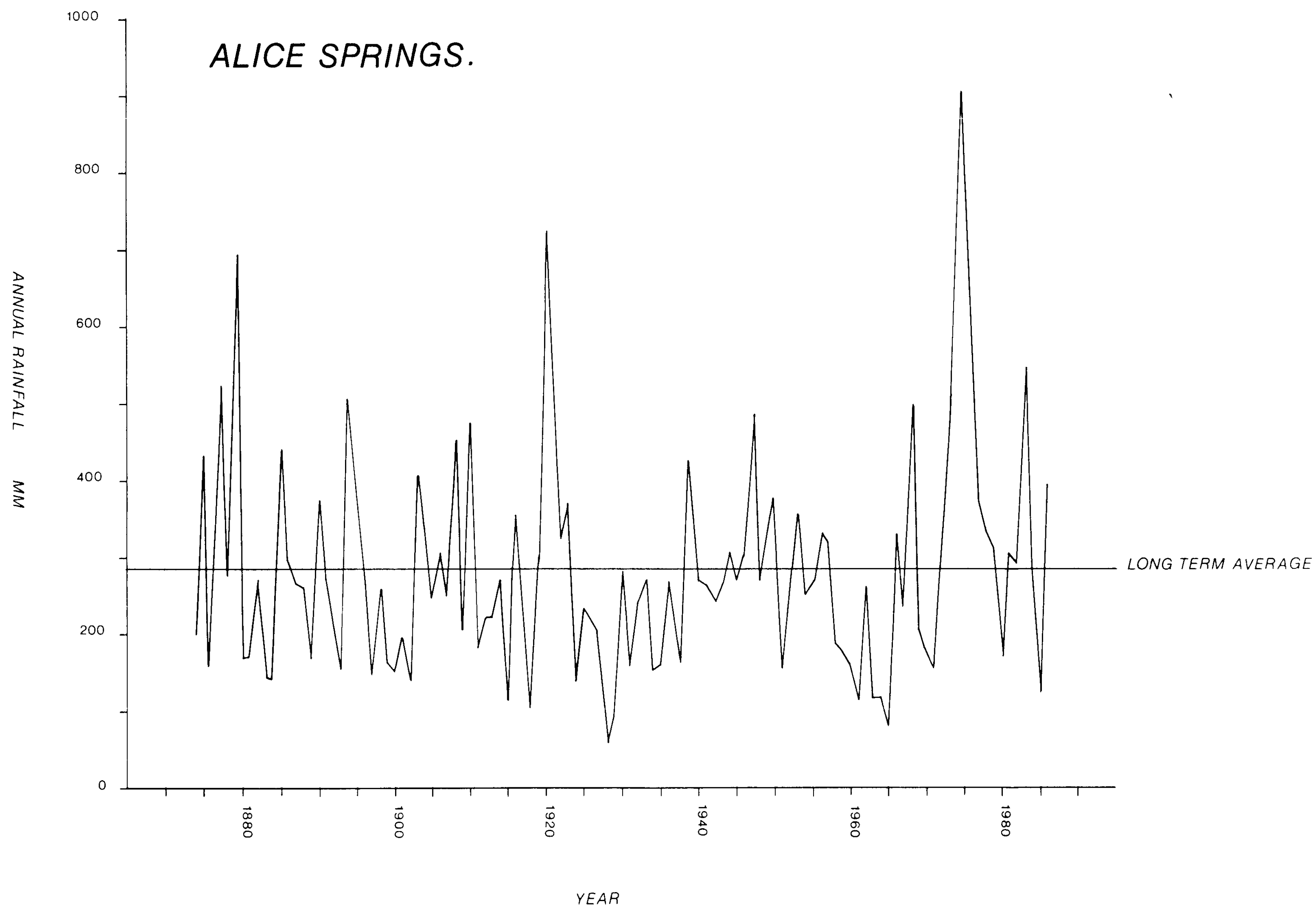
Overleaf **Figure 3.5 :** Mean annual rainfall at Alice Springs, 1874-1986, showing the sequence of short periods of high rainfall alternating with longer periods of drought.


ALICE SPRINGS.
1000
800
600
400
200
0
ANNUAL RAINFALL MM
LONG TERM AVERAGE
1880
1900
1920
1940
1960
1980
YEAR

deposited within the last 1000 years by a series of large palaeofloods (Patton and Pickup pers. comm.).

Soils and vegetation.

Extensive areas of Central Australia are covered with deep, undifferentiated red silicious sands. These support various types of spinifex, stands of large trees such as Casuarina decaisneana and scattered trees such as Brachychiton gregorii and Eucalyptus terminalis.

Red soils, or red clayey sands, are formed on the flanks of the ranges or on old alluvium and these also cover large parts of the study area. The red soil often supports dense stands of mulga (Acacia aneura) woodland with a predominance of short perennial grasses in the understorey. The largest area of this type occurs as a belt 15-25 km wide extending along the northern flanks of the MacDonnell, Strangeways and Harts Ranges.

Young alluvial floodplains border the major rivers and cover the adjoining sandplains. The stream channels are fringed by Eucalyptus camaldulensis. The floodplains support Acacia estrophiolata, Hakea eyreana and E. microtheca. Alluvial soils in the region are generally brown or grey in colour with no profile development.

Palaeosols and prior streams.

In Central Australia there are a number of examples of landforms of probable Pleistocene or early Holocene age. Unfortunately none have been securely dated.

On the southern piedmont slopes of the western MacDonnell ranges there are thick dissected sheets of red consolidated colluvium that Offe and Shaw (1983:17) tentatively date to the last glacial maximum. Similarly, Mabbutt (1967:170) identified the scree mantles and short colluvial aprons along the north face of the Heavitree range as stable relict landforms which are now dotted with the large quartzite blocks produced by present day weathering.

Litchfield (1969) described a sequence of palaeosols on the floodplains of Burt creek and the Todd river and tentatively correlated one palaeosol with the last glacial maximum. Other palaeosols exposed along Dashwood creek and Ross river may also date to the late Pleistocene as they are heavily oxidised and partly indurated. Jackson (1962:66-67) noted that mottled, acidic soils with a horizon of ironstone pisoliths are present on the watershed between Rudalls creek and Deering creek. He suggested that these represent a palaeosol formed under much wetter conditions than at present.

A network of prior streams has been identified on the Burt plain and these are responsible for thick deposits of old alluvium (Jackson 1962:8; Litchfield 1969). Jackson (1962:11, 28) has also identified a palaeochannel of the Todd which indicates that at some time the river entered the Simpson desert by flowing through Wallaby gap. Williams (1973:121) reports that the aggradation of alluvial fans near Alice Springs ceased shortly after 5300 yrs BP but further details of his study of the late Quaternary geomorphology of the Todd river valley (see North Australia Research Directory 1974:8-9) have yet to be published.

ARCHAEOLOGICAL RESEARCH 1960-1982

Prior to 1982 a small body of archaeological information about the study area had accumulated as a result of excavations and surveys carried out by E. D. Stockton, R. A. Gould, L. K. Napton and K. L. Hutterer. The results are mainly reported in unpublished notes and correspondence on file with the Northern Territory Museum. In 1982 the only published accounts of these investigations were by Stockton (1971) and Gould (1978, 1980) although L. K. Napton, with my encouragement, subsequently published an account of his work at Kweyunpe (Napton and Greathouse 1985). In contrast, the region was better known for the research on rock engravings by R. Edwards (1966, 1968, 1971) and for a series of ethnoarchaeological studies (Hayden 1977, 1979; O'Connell 1974, 1977).

In table 3.1 I have listed the main archaeological research programs that have been carried out in the Central Australian ranges between 1960 and 1982. Three main strands of research are evident. Firstly, the early ethno-archaeological research by Gould from 1966 to 1970 was followed by studies by Hayden in 1971 and O'Connell in 1973. Secondly, the survey of rock art sites by R. Edwards was the basis for the more detailed investigation at N'Dahla gorge by Forbes (1982).

The third strand began with Gould's excavation of Puntutjarpa rockshelter, in the southwestern part of the Central Australian ranges, and continued with a series of projects carried out by American archaeologists. In 1973 Gould extended his fieldwork into the James range with the general aim of comparing the archaeological sequence there with his earlier work at

Table 3.1 : Archaeological surveys and excavations in the Central Australian ranges 1960-1982.

1966-1970	R. Edwards recorded rock engraving sites, and other rock art sites, including Thomas reservoir in the Cleland Hill (Edwards 1966, 1968, 1971).
1966-1970	R. A. Gould undertook an ethnographic and archaeological project at Warburton (in Western Australia). Four sites were excavated, including Nyawar, Winpuly and Puntutjarpa (Gould 1968, 1971, 1977). The sequence from the excavations at Puntutjarpa rockshelter, in 1967, 1969 and 1970, formed the basis for Gould's Australian desert culture model. Details of the other three excavations remain unpublished which suggests that none had substantial archaeological deposits.
1969	E. D. Stockton surveyed the Santa Teresa area and conducted a pilot excavation at Keringke (Stockton 1971).
1971	B. Hayden excavated two ethnographic campsites south and southeast of Lake Mackay (Hayden 1977,1979).
1973	R. A. Gould carried out an aerial survey of the area from Oodnadatta to the James range and L. Kyle Napton and A. Albee carried out a ground survey of sites (unpublished notes on file). R. A. Gould and K. L. Hutterer excavated three sites - James Range NW shelter, James Range E rockshelter (now Intirtekwerle), and one of the shelters at Kwerlpe. L. K. Napton and A. Albee excavated two other shelters at Kwerlpe but these had minimal deposit. They also tested three other rockshelters but none contained substantial archaeological deposits.
1974	In 1974 Gould undertook a major excavation at the James Range E site (Gould 1978). A small elevated shelter nearby - the south cave - was also tested but had very shallow deposits.
1973-1975	J. F. O'Connell undertook an archaeological and ethnographic reconnaissance of the Sandover river area, investigated intersite differences in assemblages of stone artefacts and excavated a number of ethnographic campsites (1974, 1977, 1987; O'Connell et al 1983; Binford 1984; Binford and O'Connell 1984).

Table 3.1 : (Continued from page 65).

1975	K. L. Hutterer made a major surface collection totaling nearly 50,000 artefacts at Kwerlpe with the aim of studying patterns of distribution and intrasite patterning (correspondence on file).
1979-1980	L. Kyle Napton and E. A. Greathouse excavated two rockshelters at Kweyunpe, and a rockshelter at Urwemwerne (Greathouse 1985; Napton and Greathouse 1985). They also began recording archaeological sites in the Rodinga range, building on the 1973 survey.
1980-81	S. Forbes studied rock art sites in N'Dahla gorge (Forbes 1982).
1981-1982	R. A. Gould and S. Saggers carried out a survey of rock sources within a 24 km radius of Intirtekwerle (Gould and Saggers 1985).
1982	J. Webster analysed the faunal material excavated in 1974 from Intirtekwerle rockshelter.

Puntutjarpa. The 1973 field season provided an introduction to the region for L. Kyle Napton and K. L. Hutterer and both began independent field projects in subsequent years.

Despite such a promising start, research after 1973 was poorly articulated and idiosyncratic in its objectives. The individual projects were essentially carried out without reference to each other and none of the authors have commanded enough of the data to attempt an overview of the prehistory of the region. Gould, Hutterer and Napton were not primarily concerned with the strong ecological interests or broad regional questions that are of central importance to archaeological research in Australia. As one might expect, Gould's initial analysis of the Intirtekwerle (James Range East) material was aimed at a comparison with his earlier work at Puntutjarpa, but his later concerns were to identify an archaeological signature of ecological stress through a comparison of bone fragmentation (1980:194-195) and the amount of exotic stone in an assemblage (1980:157). His most recent fieldwork was aimed at validating what he now terms the exotic stone hypothesis (Gould and Saggers 1985). K. L. Hutterer's work at Kwerlpe has yet to come to fruition though his stated aim was to develop a methodology for studying intrasite patterning in assemblages of stone artefacts on open campsites. L. Kyle Napton's research has nominally aimed at identifying the factors determining site location, based upon the SARG project in the southwestern part of North America (SARG 1974).

RESEARCH STRATEGY 1982-1986

General approach.

To test the model outlined in chapter 2 a substantial corpus of archaeological data is required. Whereas such information now exists for a number of regions - for example the western Arnhemland escarpment, the highlands of central Queensland and the south coast of New South Wales - no suitable database had been built up in Central Australia when I began this project. The work carried out prior to 1982 provided a nucleus of such information but in planning the scale of my fieldwork I was conscious of the need to investigate a wider series of archaeological sites, both rockshelters and open campsites, in a variety of locations across the region.

In practical terms these excavations needed to be limited to small operations, aimed at extracting basic information about the stratigraphy, chronology and sequence of occupation with a minimum of digging. There were two important considerations here that also suggested that the size of the excavations should be kept to the minimum. Firstly, excavations in rockshelters have the potential to offend the moral sensibility of some Aboriginal people. Secondly, it was necessary to keep the bulk of excavated material to an amount that I could process in a reasonable time without assistance.

Given these constraints, the immediate objective of this project was an extensive archaeological sounding of the region using small excavations to investigate gross changes in the occupation of a series of sites. With such an approach I hoped that it would be possible to distinguish regional trends in occupation from site-specific events - to separate what we might term the "regional signal" from "local noise". This is precisely the type of information needed to resolve questions about the stability of settlement and landuse in the region.

There was also another compelling reason for structuring the project in this fashion. Without the benefit of local information about late Quaternary environments and landforms to guide the field survey, and without the background archaeological information necessary to formulate a more sophisticated sampling procedure, an extensive program of excavation was the only strategy likely to succeed in locating archaeological deposits older than 10-12,000 yrs BP. When I began this project, the antiquity of human settlement was the most pressing of the research problems in the region. It was also the most difficult to tackle in a planned fashion.

Field strategy.

The sites chosen for excavation are situated on the southern flank of the MacDonnell ranges and extend across the region from the edge of the Western desert to the northwestern part of the Simpson dunefield (see fig. 3.1). Table 3.2 summarises the environmental setting of these sites, showing that a range of different land systems are represented in the sample.

The excavations carried out prior to 1982 were concentrated in the James and Ooraminna ranges, located south and southeast of Alice Springs. To extend this sample I used the following approach.

Table 3.2 : The environmental setting of the excavated sites in the research area. Map coordinates are from the 1:250,000 scale topographic maps. Landsystems are from Perry et al (1962).

site	map coord-inates	landsystem	environment
Puritjarra	Mt Liebig SF 52-16 384034	Sonder Simpson	A. aneura/T. clelandii on sandstone escarpment; C. decaisneana/T. basedowii on deep sands in adjoining dunefield; permanent waterhole within 3 km.
Tjungkupu	Mt Liebig SF 52-16 435032	Middleton	A. aneura/T. clelandii on low sandstone ridges; sparse shrubs & trees over short grasses on red soil in adjoining sandplain; reliable soakage.
Wanmara	Lake Amadeus SG 52-4 489965	Krichauff Amulda	minor A. aneura over T. pungens on bold sandstone plateau; shrubs and low trees on young alluvial fans or colluvial aprons; permanent springs in piedmont & permanent waterholes on dissected margins of plateau.
Ilarari	Henbury SG 53-1 550972	Gillen Middleton	sparse shrubs over T. clelandii on sandstone ranges & foothill ridges; C. decaisneana/T. basedowii & short grasses on deep sands in adjoining plain; permanent spring-fed waterhole in river channel.
Rrewurlp -murlpme kweke	Henbury SG 53-1 607007	Krichauff	Bold sandstone plateau; woodland of E. camaldulensis along meandering entrenched river channel; gravel beds river sands; permanent waterholes and soakages in otherwise dry channel.
James Range Northwest	Henbury SG 53-1 674983	Gillen	A. aneura/T. clelandii on sandstone foothills; A. aneura/E. eriopoda & T. basedowii on red soil on alluvial flat in transverse gap in range; ephemeral soakages in creek bed.
Urre	Rodinga SG 53-2 139968	Sonder Simpson	sparse shrubs and minor A. aneura over T. clelandii on bold sandstone range; C. decaisneana/T. basedowii and short grasses on red soil on adjoining sandplain. Ephemeral rockholes in ranges.

Table 3.2 : (Continued from page 70)

Intirte -kwerle	Rodinga SG 53-2 182969	Sonder Simpson	sparse shrubs and minor A. aneura over T. clelandii on bold sandstone range; C. decaisneana/T. basedowii and short grasses on deep sands on adjoining sandplain. Ephemeral rockholes in ranges.
Kwerlpe	Rodinga SG 53-2 190971	Sonder	A. aneura/T. clelandii and sparse shrubs on summit of bold sandstone range; skeletal stony soil; large ephemeral rockhole.
Kweyunpe	Alice Springs SF 53-14 LP7566	Gillen Ewaninga	sparse trees and shrubs over T. clelandii on foothill ridges; A. aneura/T. basedowii or short grasses on red soils on adjoining sandplain. Ephemeral rockholes in ranges.
Urwemwerne	Rodinga SG 53-2 180010	Amulda	sparse shrubs and low trees over T. basedowii; red soil on undulating sandplain adjacent to low sandstone and silcrete hills; semipermanent rockhole.
Keringke	Rodinga SG 53-2 211994	Allua	sandstone ridges and foothills; sparse low trees and shrubs over short grasses on shallow stony soils or red soils on erosional lower slopes; ephemeral rockhole.
Therreyer -erte	Rodinga SG 53-2 274960	Sonder Singleton Simpson	low shrubs and A. aneura/T. clelandii on bold sandstone range; sparse shrubs over sparse short grasses on sandy alluvial fan & fanglomerate; T. basedowii on deep sands in adjoining dunefield; ephemeral rockholes in range.

I began by compiling a list of target areas - areas with immediate potential for investigation in the field - using the following criteria.

a) areas identified in the ethnography as important foci of settlement.

b) other areas likely to be important foci because of the presence of large rockholes, springs or permanent waterholes.

c) areas with physical characteristics - usually dissected sandstone terrain or dolomite ridges - suggesting some potential for the preservation of stratified deposits in caves and rockshelters.

d) exposures of palaeosols or other relict landforms.

e) other reports of caves, rockart, or large open campsites including promising sites culled from existing museum site files, travellers accounts (eg. Madigan 1944; Groom 1950) and newspaper reports.

Between 1982 and 1986 I progressively investigated these areas. Several opportunities to travel with local Aboriginal people provided the chance to inspect traditional camping places in some of the best watered parts of the ranges. My main trips in this fashion were with William and Nahasson Ungwanaka, from Old station on the Ellery, downstream through Irrpmangkire on the Finke to Monument waterhole; with Jack Coulthard from Irrpmangkire across the south face of the ranges to Ilarari and along the George Gill range to Ipidilkiti; and from Wanmara west along the George Gill range to Lila and the important ochre quarry at Ulpunyali with Ben Clyne, Leo Williams and family. On other occasions I was able to carry out the initial reconnaissance from a light aircraft.

During the reconnaissance I found no archaeological material in any of the exposures of palaeosols, or old colluvial aprons, that I inspected. However, this is not surprising given the nature of these landforms - scree slopes and flood deposits - and given the possibility that some are older than 50,000 yrs BP. I reconnoitred the Barrow ranges and parts of Burt plain and the eastern MacDonnell ranges without finding suitable stratified sites. I also examined several caves in the Alice Springs district, including the caves known as Urlpere near Roe creek, Antyiperepentye on Numery station, and others near Jesse Gap and Ross river - but none of these contained archaeological deposits.

In choosing sites for excavation I was conscious of the fact that the main residential site within each estate - sites that Aboriginal people today refer to by terms such as "main camp" or "homestead" - were likely to best reflect any long-term changes in the distribution of population or other aspects of land use. In practice many of these were in locations where any archaeological deposits are periodically scoured by floodwaters or by the overflow from the larger rockholes. Others near important waterholes are subject to heavy human traffic and disturbance. Therefore the choice of sites for excavation was determined as much by the chance preservation of archaeological deposits as by any consideration of the strategic position of individual sites within the settlement pattern. In cases where the main residential site is a loosely defined locality containing a cluster of sites I have attempted to excavate more than one site to place any trends in site use on a firmer footing - see for example the excavations at Kweyunpe and Tjungkupu.

Analytical framework.

In chapter 2, I have suggested that shifts in the pattern of settlement, and changes in population density, will be represented by changes in the occupation of archaeological sites in the study area. Before turning to the archaeological sequences described in chapters 4-9 it is necessary to have some framework for analysing changes in site use.

Binford (1980) provides some theoretical guidelines here. He sees the relatively undifferentiated settlement patterns produced by _foragers_ - such as Central Australian Aborigines - as strongly contrasting with the network of functionally differentiated sites produced by _collectors_ - such as the Nunamiut Eskimo. Thus foraging economies have,

> ...high residential mobility, low-bulk inputs, and regular daily food-procurement strategies.

The result is that,

> variability in the contents of residential sites will generally reflect the different seasonal scheduling of activities (if any) and the different duration of occupation. The so-called "functionally specific " sites will be relatively few; given low-bulk inputs and short or limited field processing of raw materials such locations will have low visibility...(Binford 1980:9-10).

This implies that much of the variability in the contents of archaeological sites, in terms of both quantity and type, can be reduced to a single variable - duration or intensity of occupation. My experience in studying settlement patterns elsewhere in the arid zone (Smith 1980) has led me to a similar view.

Other aspects of site use are likely to be more difficult to reconstruct using archaeological evidence. For instance, O'Connell (1977:280) concludes that;

> ...seasonal systems, insofar as they exist in central Australia, are unlikely to be reconstructed or verified on the basis of lithic material. Direct evidence of diet in the form of plant and animal remains will be essential to achieve these objectives.

However, both O'Connell (1977) and Cane (1984) stress a broad agreement between the composition of the assemblage of stone artefacts on a site and access to three of the basic resources in the desert; wood, isotropic stone and seedfoods. The classification of an assemblage into broad functional categories associated with processing each of these materials can provide some information, albeit very general, about site use.

In this project, my approach has been to delineate gross changes in intensity of occupation at a site and then to look for further information about the nature of these changes, either in the form of discordant shifts in the type of debris deposited or in terms of gross changes in the assemblage of stone artefacts. To understand the broader significance of the changes I have relied upon ethnographic information to establish the role of individual sites in the settlement system - in what one might term the "cultural landscape".

Australian archaeologists have often commented on apparent changes in intensity of occupation - see for example see Mulvaney and Joyce (1965) or Lampert (1971:16). However, interest in this type of information has increased following the accumulation of sufficient archaeological data to indicate that regional trends can be identified (Hughes and Lampert 1982; Attenbrow 1981, 1982; Ferguson 1985; Jones 1985). To plot changes in the intensity of occupation at a site raw counts of artefacts are converted into rates of accumulation by estimating their <u>density</u> (number of artefacts per unit volume/weight of deposit) (cf. Jones 1985) and <u>time-density</u> or <u>artefact discard rate</u> (number of artefacts per m^2 per unit time) (cf. Bailey <u>et al</u> 1983:34-39; Hiscock 1986). In practice the calculation of time-density estimates for each excavation unit usually requires bold assumptions about the fine chronology of a site. In my analysis I have preferred to work with artefact densities, plotted within the broad chronological limits established for each layer.

Hiscock (1981, 1986) and Smith (1982) have discussed some of the pitfalls in using changes in artefact density, or in discard rates, as an indication of gross changes in intensity of occupation. They point out that similar changes in artefact density could also be produced by changes in depositional behaviour. For example, the amount of refuse produced per capita would be fundamentally altered if improvements in access to isotropic stone led to more wasteful use of this material; or if there was a shift towards exploiting animals with a different meat/weight ratio; or if new stone working techniques led to more economical use of stone and less debitage. Changes in the disposal of refuse could also produce changes in artefact density, particularly if they involve changes in both size sorting of debris and the extent to which refuse is cleared from the site (see O'Connell 1987 for a description of contemporary Alyawara site structure). Most researchers have of course been aware of these caveats - see for example Hughes and Lampert (1982:26) and Attenbrow (1981:170).

One might also expect that the physical structure of a site will influence the extent to which any changes in site use are visible. For instance, it is likely that any changes in intensity of occupation will be less marked on open sites than in rock shelters. This is because people have more latitude in the siting of their camps in the open and because the accumulation of debris is not as confined - for example compare the changes below at Tjungkupu 1, a rockshelter, with those at Tjungkupu 2, an open site.

Other problems arise from the potential for sampling error. For instance, a small excavation is likely to sample only a small part of the available floor area of a site. The problem then is to establish whether the trends identified represent changes in use of the site or simply shifts in the location of activities within the site. This is more likely to be a major problem on open campsites or in rockshelters with several hundred m^2 of floor area than in small rockshelters, which generally have a relatively confined living area. However, in either site a single event may result in an isolated peak in the density of a particular type of debris. For instance, the reduction of a core may produce a peak in artefact density in a particular excavation unit, or a hearth that falls within or near the boundaries of a trench will produce a peak in the concentration of charcoal in that level. In many cases this type of event will be self-evident. Various examples can be found in chapters 4-9.

Most of these problems can be overcome by comparing changes in the density of different types of debris within a site and by comparing the sequence and chronology of changes at a series of sites, including both rockshelters and open sites. Widespread and roughly synchronous changes in occupation, particularly changes reflected in a wide range of archaeological debris and in different types of sites, are unlikely to be the product of inadequate sampling or to result from changes in depositional behaviour. In this project my approach has been to compare changes in the concentration of chipped stone artefacts, grindstones, ochre, bone and charcoal in order to identify gross changes in the intensity of occupation. In most cases similar trends were present in all of these materials. For each site I have also carried out pilot studies to establish whether there are grounds for suspecting that changes in raw material, manufacturing techniques or in the degree of reduction have significantly contributed to the changes evident in artefact density. In most sites reported here these factors appear to have been stable throughout the duration of occupation. In the case of Puritjarra rockshelter, which has a long chronological sequence spanning periods of major changes in stone industries, I have taken care to show that the trends in site use are independent of technological changes. Finally, to secure a regional overview of the changes in occupation I have compared sites, allowing for some differences between open campsites and rockshelters and taking into account the ethnographic context of individual sites.

Radiocarbon dates.

The chronology for this project rests on a series of 22 radiocarbon dates in addition to those obtained by Stockton, Gould and Napton. For easy reference the new dates are listed in table 3.3.

All of the new radiocarbon dates are on detrital charcoal recovered from the various sediments by flotation. This is obviously less satisfactory than charcoal samples taken directly from hearths. However, in the excavations such features were rarely encountered except in the uppermost levels of sites where in any case they could be presumed to date within the last 200 years.

Table 3.3 : New radiocarbon dates for archaeological sites in Central Australia.

site	excavation unit	sample code	conventional radiocarbon age yrs B.P.
Puritjarra	N10/3	Beta-21273	570+/-50
	N10/6	Beta-18882	5860+/-150
	N10/9	Beta-18883	12020+/-240
	N10/11	Beta-19901	21950+/-270
	N10/13	Beta-18884	22440+/-1370
	Z10/4	Beta-21274	3120+/-100
	Z10/6	Beta-21275	7170+/-340
Tjungkupu 1	K17/6	Beta-16303	840+/-80
	K17/11	Beta-16304	330+/-80 ***
	K16/6	Beta-19821	230+/-60 ***
Tjungkupu 2	J50/6	Beta-16305	940+/-70
Wanmara	G30/4	Beta-16307	970+/-70
	G30/14-15	Beta-16308	2550+/-110
Ilarari 17	L10/22-23	Beta-5349	3210+/-90
Rrewurlpmurlpme kweke	I13/3	Beta-5350	3550+/-70
Urre	D40/4	Beta-16306	980+/-80
Intirtekwerle	L11/7	SUA-2247	670+/-100
	L11/19-21	SUA-2125	1460+/-210
Kweyunpe 6	F19/5	SUA-2096	590+/-80
	F19/16	Beta-5348	400+/-70 ***
Therreyererte	Z90/6	SUA-2520	400+/-50
	Z90/10	SUA-2519	1830+/-110

*** dates considered to be anomalously modern.

The strong agreement between the sites, in respect of chronology and sequence of occupation, demonstrates that there is nothing seriously amiss with the chronological framework presented here. This is strengthened by several factors which indicate that most of the charcoal derives from human activity at the sites. Firstly, in all sites except Kweyunpe 6 and Ilarari 17, the concentration of charcoal shows the same pattern of distribution as that of stone artefacts and bone. Secondly, the natural soil in the region is thoroughly grazed by termites and contains very little charcoal or other organic matter. Jackson (1962:62) also comments that the soils in Central Australia are typically reddish and do not have sufficient organic matter to significantly darken even the surface horizons. The difficulty of dating the lower part of the deposit in each of the archaeological sites reflects the light use of the sites before about 1000 yrs BP and the consequent scarcity of charcoal in the sediments - see for example layer III at Intirtekwerle where I was able to recover only 1.2 g of charcoal from one m^3 of sediment.

In chapters 4-9 I have given estimates of the rate of sediment accumulation and of the chronological span of various stratigraphic units. These estimates are calculated directly from the conventional radiocarbon ages. Information about the respective calibrated ages, according to tables by Klein et al (1982), was received too late to be incorporated into the site reports. In any case, Polach et al (1983:151) have argued that it is premature in the Australian context to attempt definitive correction of radiometric dates. The main effect of using calibrated dates in this case would be to slightly reduce the spread of dates for the beginning of the major late Holocene change in occupation and to extend the duration of the underlying occupation by up to 400 years.

Development of the project.

Even before the start of this project it was evident from the reports produced by Stockton, Gould and Napton that there was a substantial increase in the use of some sites in the middle or late Holocene. However, the extent and the timing of this event was far from clear. In 1982 the balance of the evidence suggested a progressive increase over time in the number of sites occupied.

My first series of excavations, at Rrewurlpmurlpme kweke, Ilarari 17 and Kweyunpe 6 in 1982, did little to change this picture. They did however reveal that the accumulation of deposit in some sites bordering the sandplain had been phenomenally rapid during the last 3000 years. In this respect Gould's published chronology for Intirtekwerle (1978) was anomalous - see my comments in (Smith 1983). As there were also other reasons for doubting his chronology I re-excavated the site in 1983 to gather further radiocarbon samples - reported in Smith (1986b).

By the end of 1984 the new evidence indicated that the widespread changes in site use were roughly synchronous and that they began around 1000 yrs BP, somewhat later than similar events in the southeast of the continent. During my fieldtrips I had also noted that there were many other sites in the region where archaeological materials appeared to be limited to the top 30-40 cm of the stratigraphy. These included exposures in gullies around the base of Uluru, artefacts restricted to aeolian veneers at Ross river and at Lila, and material exposed on the banks of Bonney creek.

At this stage little progress had been made towards establishing the antiquity of settlement in the region. The rapid rate of sediment accumulation seemed to rule out any likelihood of locating older material in Central Australia without deep excavations. At the time it appeared to me that trenches up to 5-6 m deep would be needed in some sites even to plumb the early Holocene. The gully which cut into the archaeological deposits at Intirtekwerle offered a means of probing relatively deep deposits without further unnecessary excavation of the rich upper layer. Furthermore the 1974 and 1983 excavations had been stopped by rockfall without reaching the base of the deposit. I decided on a more determined effort in 1985 and returned armed with equipment to cut up large boulders. However, the bedrock was reached at about 2.80 m without substantially adding to the chronology of occupation at the site. In 1985 I also extended my work further north to include an excavation at Lake Woods, near Newcastle Waters. Although this was well outside the study area I felt it was prudent given the poor prospects for locating direct evidence of Pleistocene occupation in the Centre itself. The results of this work are reported elsewhere (Smith 1986c) but again the artefacts proved to be younger than originally suggested by Jones and Bowler (1980:15).

I embarked upon a second series of excavations in Central Australia in 1985 and early 1986. At Tjungkupu separate excavations at two sites near a strategic waterhole - a rockshelter and an open campsite - produced the now familiar late Holocene sequence. The results strongly suggested that the late Holocene changes reflected a major increase in the population of the region rather than simply a redistribution of population. This was an important matter to follow up. Thus the subsequent fieldwork was largely aimed at extending the sample of excavated sites to include major open sites - such as those at Wanmara, Urre and Therreyererte.

Therreyererte was to have been the last of the excavations. However, a chance request from the Australian Heritage Commission for information on the Cleland Hills engravings at Alala, provided an opportunity to search part of the range that I had earlier ear-marked for investigation. This led to the discovery of the enormous rockshelter at Puritjarra. Excavations here in late October 1986 produced the first unequivocal evidence of Pleistocene occupation in the interior of the arid zone (announced in Smith 1987).

EXCAVATION AND RECORDING METHODS

The methods used in this project closely follow the procedure and conventions described in detail by Johnson (1979:145-165) and Johnson and Jones (1985). This system is now widely used in Australia and there is little point in reiterating the details here. In table 3.4 I have set out basic information about the recording system and sieving procedure as applied in this project. Figure 3.6 gives an example of the preprinted worksheets that were used to record information about each excavation unit during excavation and subsequent processing.

Plans and levels.

My first step in each excavation was to establish a nominal horizontal grid system and a vertical datum point and to commence mapping the site. Site maps were prepared using a 30 m fibreglass tape and prismatic compass. The position of individual stations was fixed by triangulation from two points along a base line. For rockshelters the height of the overhang was generally determined with a plumb bob but in the case of _Puritjarra_ a theodolite was necessary because of the height involved. Ideally, the vertical datum was established on an easily identified bedrock feature above the level of any deposits which might be excavated. In practice, some improvisation was necessary on many of the open sites. From the site datum a dumpy level or theodolite was used to establish subsidiary datum points and to level in the surface of the deposit and the base of the excavations. For ordinary leveling during excavation a water-level with a fixed reservoir was used - see Johnson ~~(1980).~~ (1979:appendix 1).

Surface finds.

The last phase of occupation is recorded by the abandonment of useful implements, such as complete millstones, wooden spearheads, metal dishes, and large cores and by caches of raw materials, especially firewood, on the surface of sites in the region. Prior to excavation these items were marked on the site plan and any that I considered were likely to be stripped from the sites by casual visitors, or damaged during excavation were collected.

Excavation.

Each excavation unit, an arbitrary spit 5-10 cm thick, was numbered consecutively within the grid square and was handled separately throughout processing. During excavation, notes about the character of the deposits, their archaeological contents, and any signs of disturbance were made on preprinted worksheets (see fig. 3.6). These sheets also include more detailed information about the provenance of significant artefacts or charcoal samples. Archaeological features, or stratigraphic units less than 5-10 cm thick, were treated as separate excavation units. Thus an intact hearth was treated as a single excavation unit and as far as possible the fill of an animal burrow was also removed as a unit, preferably before the surrounding deposit was excavated.

Field processing.

The gross weight of sediment for each unit was recorded and then the excavated sediments were dry sieved through nested 6mm and 3mm sieves. Rocks larger than 5 cm in any dimension were then extracted, counted, weighed and discarded in the field. To reduce the weight and bulk of the material that needed to be transported back to the laboratory I often found it necessary to sort the rubble - defined as rocks less than 5 cm in size from the 6mm sieve - in the field. The rubble was then weighed and discarded. Apart from this the sieve residues were bagged unsorted and the different size fractions were kept separate.

Laboratory sorting.

In the laboratory the sieve residues from each unit were tipped into a bucket of clean water and stirred to allow charcoal and plant material to be be skimmed off using a fine mesh strainer. The sieve residue and the charcoal were then placed in shallow flywire trays to dry. After it had been allowed to dry I sorted the 6mm residue into its various components - chipped stone artefacts, grindstone fragments, ground-edge fragments, bone,

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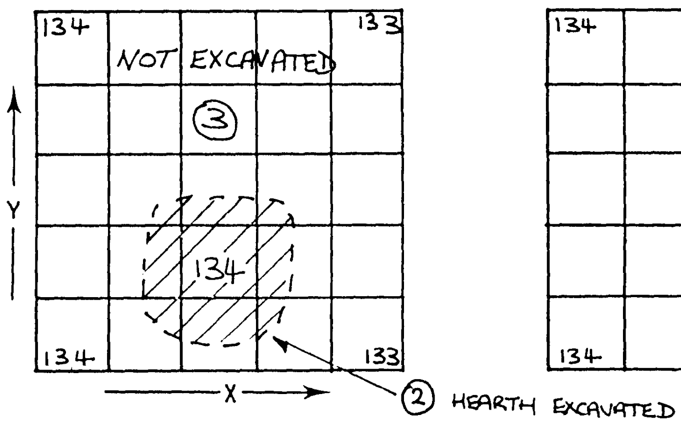
Overleaf **Figure 3.6 :** An example of the worksheets used for each excavation unit, during excavation and in subsequent processing.

Site..PJ..Grid-square..N/0...Excavation unit..(2)..

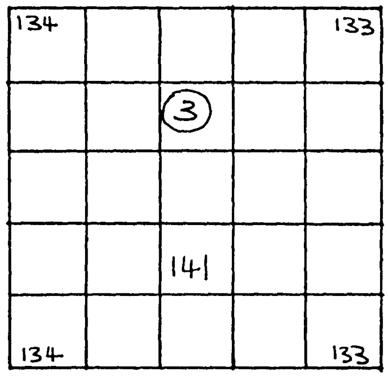
Initials and date..AMR 28·10·86..

Strata/feature..HEARTH..

START LEVELS cm



END LEVELS cm



If only part of square excavated indicate portion

NOTES: sediment description, stratigraphic relationships, disturbance.

Removal of unit ① exposed surface of compact brown sand. The hearth, unit ②, is dug into this surface as a shallow circular basin, up to 7cms deep, filled with charcoal, ash and brown sand.

Mean start z..134..(44)......cm
Mean end z..141..(50)......cm

Gross sediment wt. less tare wt. of buckets ..10.1....kg

Rocks >5cm discarded #..–......
wt..–.....kg

wt. rubble discarded from 6mm sieve fraction ..–......kg

OBJ	X	Y	Z	DESCRIPTION
1	No. individualised finds in ②			
2				
3				
4				
5				
6				
7				
8				
9				
10				

Grid-square..........Excavation unit........

MEAN Z mean depth of unit corrected to cm below site datum	48
GROSS SEDIMENT weight in kg of unit	10·1

---

weight in kg of ROCKS >5 cm	–
number of ROCKS >5 cm	–
weight in kg of 6MM SIEVE fraction	1·29
weight in kg of 3MM SIEVE fraction	0·35

6MM FRACTION weights rounded to 0.1 g

weight of CHIPPED STONE artefacts	41·3
number of CHIPPED STONE artefacts	26
weight of GRINDSTONES	....
number of GRINDSTONES	....
weight of GROUND-EDGE fragments	....
number of GROUND-EDGE fragments	....
weight of BONE	....
weight of EGG-SHELL	....
weight of OCHRE	....
weight of RUBBLE (gravel between 6mm and 5 cm)	820·0
total weight of CHARCOAL (6mm + 3mm by flotation)	431·6

NOTES: typological counts, identifiable species, pigment colour

no retouched artefacts.
no bone.

Table 3.4 : Summary of excavation recording system.

Horizontal grid	1 metre squares identified by letter/number combination. Letters along x axis and numbers along y axis.
Excavation units	Arbitrary spits within natural stratigraphic units. Averaging 5-10 cm thick. Start and end levels each recorded by 4 or 5 spot heights. Recording of coordinates in three dimensions limited to artefacts or charcoal samples where more detailed provenance data required. Depths reported as either <u>cm below zero datum</u>, or <u>cm below ground surface</u>, depending upon size of excavation and whether the ground surface was level.
Stratigraphic grouping of excavation units.	Excavation units grouped according to depth, type of sediment and trend of stratigraphy.
Finds numbering system	Format follows the site/square/unit/find -number convention. Thus <u>TRT/Z90/4-1</u> is find 1, from unit 4, square Z90 at <u>Therreyererte</u>.
Sieving procedure.	1. Gross weight of excavation unit recorded. 2. Deposit dry sieved in field using 6mm and 3mm nested sieves. Rocks (>5 cm) counted, weighed and discarded. 3. Sieve residues weighed and separately wet sieved in laboratory to separate charcoal and plant material. 4. Residue from 6mm sieve sorted into components - chipped stone, grindstones, groundedge artefacts, ochre, eggshell, bone, and rubble (rocks <5 cm) All sorting carried out by author.

ochre, eggshell and sandstone rubble. Any remaining charcoal, sufficiently dense to have been missed during flotation, was extracted at this stage. Apart from the separation of charcoal, I did not process the 3mm residue unless I had specific questions in mind. Note that in the site reports the weight of charcoal is given as the total weight for each excavation unit, combining the material from both sieve fractions.

CLASSIFICATION OF STONE ARTEFACTS

Scope.

In this thesis I have not attempted a detailed attribute analysis of the stone industry. With one exception, the results of my pilot studies of raw materials, flaking techniques, degree of reduction and typology suggested that a more detailed study was not necessary to account for the changes in site use. In any case, substantive results were unlikely given that the excavated assemblages from levels predating 1000 yrs BP are very small. This is not to rule out the possibility that such a study may add to our understanding of the adjustments in technology and logistics that the changes in settlement pattern must have entailed.

In the case of Puritjarra rockshelter any temporal shifts in the artefact assemblage are of fundamental interest because of the long chronological sequence at this site. The analysis presented in chapter 4 gives some preliminary results which show that a more detailed analysis is warranted but also that a larger sample of artefacts from the Pleistocene layers is required. This awaits further excavation of the site in 1988.

Raw materials.

In the site reports I have used the following categories of raw material for the chipped stone artefacts, based on attributes such as fracture, colour, texture and translucence:- quartz; chalcedony; chert; metaquartzite; silcrete and poorly silicified sandstone. The identification of the first three materials is straightforward. The remaining categories require some explanation as previous archaeological studies in the study area have confused the identification of silcrete and quartzite.

Metaquartzite, by definition, consists of quartzite where the constituent grains have recrystallised forming an interlocking texture with no trace of cementation. In some sites, such as Rrewurlpmurlpme kweke, extensive use has been made of metaquartzite river cobbles originally derived from the Chewings range.

The silcrete in the region ranges from material with a yellow or brown groundmass and isolated quartz grains to a grey or white silcrete with densely packed quartz grains in a groundmass of chalcedonic silica. The latter is confused with orthoquartzite in previous archaeological work - see for example Gould (1980); Gould and Saggers (1985); Napton and Greathouse (1985). Both forms of silcrete are formed as duricrusts on tertiary landsurfaces in the region and the latter is commonly found on the crest bevels and plateau summits of the James and Krichauff ranges (pers comm. M. Freeman; Mabbutt 1967:151). The silcrete capping is of variable thickness and quality. In the site reports I have distinguished between the material with good fracture and well defined flake scars and the poorer silicified sandstone, although both of these materials ultimately derive from the same source.

Typological categories.

The following pages provide a brief list of the typological categories used in my classification of the excavated stone artefacts.

Ethno-archaeological studies in the Australian arid zone have consistently shown that apart from a few specialised implements and cores and debitage, most stone artefacts served as general cutting or woodworking implements (Long 1971:269; Gould et al 1971; Hayden 1977, 1979; O'Connell 1977; Cane 1984). There is also a basic dichotomy between expedient and curated implements. The former are amorphous hand-held implements, which are selected for a suitable edge and grip and are not extensively retouched. This contrasts with curated implements which often serve specialised functions or conform to tight design criteria, sometimes as components of composite tools, and which are extensively retouched, resharpened or rejuvenated. In Central Australian assemblages the main examples of this class of artefact are backed blades, tula adzes, ground-edge axes and seedgrinding implements.

backed blades

These are segments of thin blades or flakes with abrupt blunting retouch along part or all of one side. They are usually triangular in cross-section and most are between 1-3 cm long. Definitions are given by numerous authors - for example see Mulvaney (1975), Kamminga (1980); White and O'Connell (1982:106, figs 5.3-5.4). Although the use of backed blades was not observed ethnographically, use as barbs on composite spears is widely accepted as their most likely function - for a discussion of this issue see Kamminga (1980).

The specimens from Central Australia (see fig. 3.7) are made on both blade segments or on flakes. Generally they in the form of geometric microliths but specimens made on flakes are often asymmetrical in shape. Elongate "Bondi" point forms are rare. The retouch is usually bi-directional and a wide range of fine-grained or cryptocrystalline materials have been used. In size the Central Australian specimens generally fall within the range of backed blades from New South Wales and Queensland. Among the excavated sample many appear to be unfinished as the backing ceases abruptly leaving an irregular outline. In the site reports this category also includes several informal backed artefacts. I have indicated in the reports where the inclusion of these specimens is likely to alter any conclusions about the stratigraphic distribution of this type.

<u>tula adzes</u>

These are short, wide flakes which have been unifacially retouched back to the margin of a large, prominent bulb of percussion. This results in a semi-discoidal artefact with a pronounced convex undersurface and a convex cutting edge profile. Characteristically the striking platform is at an obtuse angle, usually about 120°, to the bulbar surface. Early ethnographic studies by Spencer and Gillen (1904), Roth (1904) and Horne and Aiston (1924) show that the tula was mounted in a resin haft on a curved wooden handle and served as a sophisticated adzing implement for working desert hardwoods. Experimental studies by

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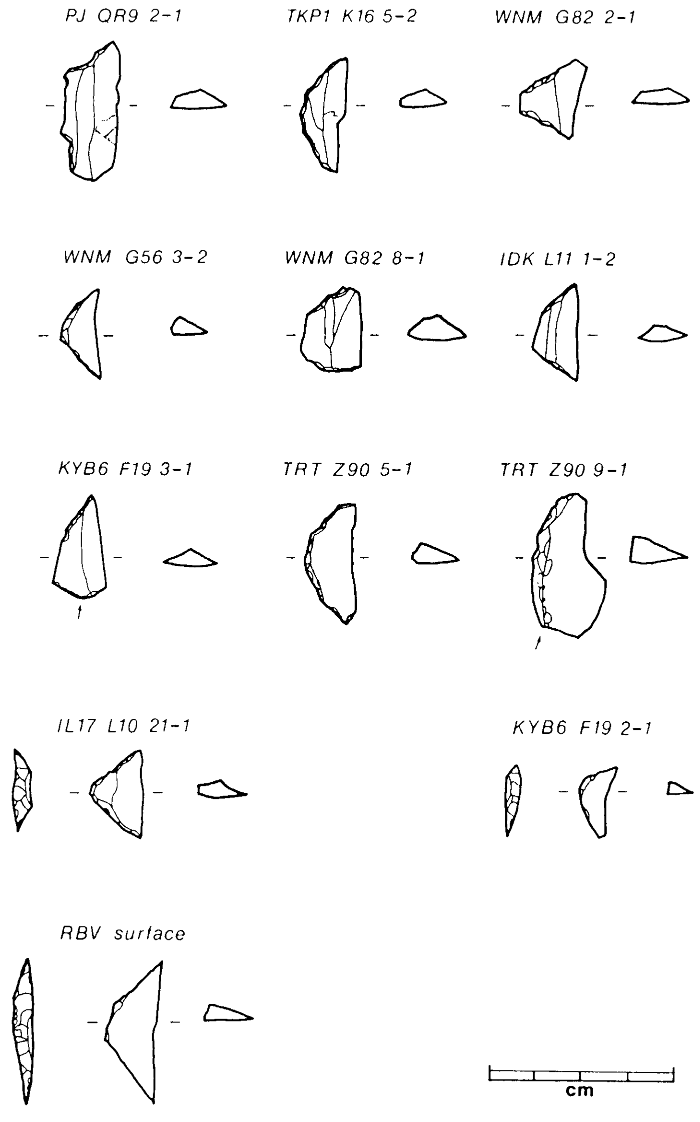
<u>Overleaf</u> **Figure 3.7** : Examples of backed blades from Central Australia.


PJ QR9 2-1
TKP1 K16 5-2
WNM G82 2-1
WNM G56 3-2
WNM G82 8-1
IDK L11 1-2
KYB6 F19 3-1
TRT Z90 5-1
TRT Z90 9-1
IL17 L10 21-1
KYB6 F19 2-1
RBV surface
cm

Kamminga (1978) and Sheridan (1979) have shown that the morphology of the stone artefact gives the composite implement greater cutting effectiveness and also serves to prolong the life of the hafting cement by reducing impact forces during adzing.

Cryptocrystalline materials, such as chert or chalcedony, were sought for this artefact as quartzite and silcrete were considered too brittle - see for example O'Connell (1977:272). The majority of tulas in Central Australian assemblages are between 20-60 mm in width. During use the area of the convex bulbar surface was progressively reduced. Below a certain size a tula ceased to function effectively as an adze but was recycled and continued to be reduced as a hafted scraper - for example see Cane (1984:159). Most of the excavated specimens from Central Australia are in the form of the end product, a heavily step-flaked slug with the remains of both a broad obtuse-angled striking platform and pronounced bulb of percussion (see fig. 3.8).

Despite the tight functional design of the tula there has been considerable confusion in the archaeological literature over the recognition of these artefacts - see the detailed critique by Sheridan (1979). Many authors have included a range of semi-discoidal scrapers which lack the formal attributes listed above (eg. Gould 1977; O'Connell 1977) and have confused tulas with the informal scrapers often hafted on spearthrowers - see Tindale's explicit comments about the differences between these two types (1965:154) and also the comment by Cane (1984:172) that

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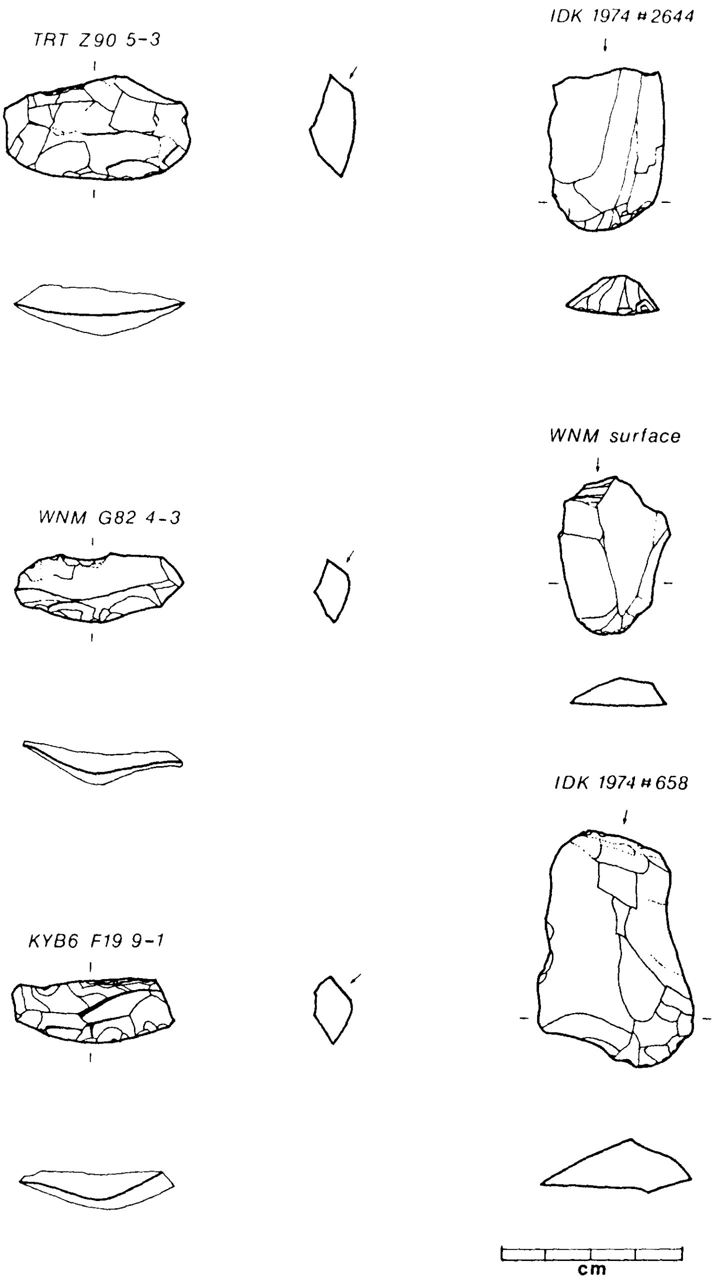
Overleaf **Figure 3.8 :** Three examples, shown at the left, of tula adze slugs from Central Australia. The cross-sections are drawn to show the pronounced bulb of percussion, the convex cutting edge profile and the broad obtuse-angled striking platform. Three examples of endscrapers are shown at the right. The two specimens from the 1974 excavations at Intirtekwerle are from layer I.


TRT Z90 5-3
IDK 1974 #2644
WNM surface
WNM G82 4-3
IDK 1974 #658
KYB6 F19 9-1
cm

Gugadja/Pintupi speaking Aborigines distinguished tula adze flakes as superior woodworking implements. These problems make nonsense of some of the attribute studies that have been carried out (eg. Saggers 1982; Gould and Saggers 1985) and obscure the chronology of this artefact. In a reassessment of excavated specimens Kamminga (1982:102-3) concludes that the tula is not securely dated before about 3000 yrs BP.

small endscrapers

In the excavated assemblage from Intirtekwerle small endscrapers are a common artefact (see fig. 3.8). These are small, narrow flakes or blade sections with invasive unifacial retouch on the distal end to produce an even and very convex edge. In a few examples a lateral or proximal projection has been trimmed in this fashion. Fine step-crushing is usually present on these edges and in places the edge may be slightly undercut. A few specimens have abraded or rounded distal edges. In many respects these implements are similar to the yilugwa described by O'Connell (1974) but they are much smaller, ranging between 30-70 mm in length compared to 52-120 mm for the latter. Comparable artefacts are shown by Gould (1977:fig. 58, 1978:figs. 8c and 13) and O'Connell (1977:fig. 4g-h). The function of these implements is not known but may be similar to the range of uses recorded for yilugwa, as spoons, knives and scrapers used to scrape and eat fibrous roots and tubers. On the other hand the recurrent morphology of these implements may simply be a product of a particular mode of resharpening flakes dulled by use - see my comments below. Whilst they are a striking component of the large assemblage from Intirtekwerle very few specimens were recovered in my excavations at other Central Australian sites.

amorphous retouched artefacts

Ethno-archaeological studies in the arid zone have invariably pointed out that the predominant function of most retouched artefacts, and other artefacts with some form of edge damage, was to cut, scrape or shave wood (Gould *et al* 1971; Long 1971:269; Hayden 1977; O'Connell 1977:275-6; Cane 1984:157). Differences in overall form, edge shape and edge damage within this class of artefacts are the result of such factors as the degree of use and the type of raw material - see O'Connell (1977:280); Hayden (1977:185). In some cases the different recurrent morphological types, such as scrapers, notches and denticulates, recognised by archaeologists represent stages in the resharpening and reduction of the same implement. Most studies also suggest that the aim of secondary retouch was to resharpen or rejuvenate a dulled working edge (eg. Hayden 1977:179-80) and that the proportion of retouched artefacts - that is, resharpened implements - in an assemblage is an indication of the extent of woodworking and the ease of access to stone.

In this category I have included any retouched artefacts that do not clearly fall into one of the above categories of specialised implement. This class therefore mainly consists of irregular artefacts with short lengths of retouch on one or more edges, small heavily step-fractured implements that lack the diagnostic features of tula adzes and fragments of retouched artefacts.

cores

The identification of the following types of cores is straightforward and comparable examples can be found in other site reports (eg. Stockton 1971; Gould 1977, 1978; Cane 1984). Firstly, there are cores with unidirectional flaking from a striking platform. These range from single-platform cores to multi-platform and horsehoof cores depending upon whether a core has been rotated after the original platform has given problems or whether the original platform has been used until extensive step-fractures have made further removal of flakes impossible. Secondly, there are discoidal, or bifacial, cores in which flakes have been removed from alternate faces using one edge as a platform. Ultimately this method produces a disc-shaped core with a sinuous edge. Thirdly, there are informal or amorphous cores which have numerous flake scars but no discrete striking platforms. The fourth group consists of blade cores. These have three or more blade scars originating from a striking platform and may be either single or multi-platform cores. Amongst the excavated cores there are also one or two examples of bipolar cores but this technique has not been extensively used in Central Australia.

redirecting flakes

Redirecting flakes are elongated flakes or blades removed along the length of a ridge which has previously been retouched. They represent either ridge straightening attempts on cores (Flenniken and White 1985:135-136) or trimming flakes removed from the edge of a retouched artefact (Johnson 1979:101-104).

use-polished flakes

These are usually small to medium sized flakes, with a pronounced use worn facet along part of one edge. This use wear is identical to the heavy abrasion described on yilugwa by O'Connell

(1974). It is also present on other types of artefacts, such as small endscrapers, a core from _Intirtekwerle_ and on the chord of a backed blade from _Puritjarra_. On some flakes the abrasion forms a facet up to 2 mm wide. The transverse striations that are visible on some specimens suggest use with a scraping rather than slicing or cutting action. All the excavated specimens are on silcrete.

The most likely cause of this abrasion appears to be the working of soft wood. For instance, Hayden (1977:187) reports that stone artefacts used to work the soft wood of _Erythrina vespertilio_ quickly developed gloss and striations. Similarly, Kamminga (1982:94) came to the conclusion that the use polish on flakes from western Arnhemland was from scraping very light wood and bark.

unretouched artefacts and debitage

This category includes unretouched flakes, artefacts with minor edge damage, flake fragments or other pieces of broken isotropic stone and fine debitage. In the excavated assemblages the number of whole unretouched flakes is generally too low to warrant separate treatment.

ground-edge artefacts

These are small to medium flakes of igneous rock, usually basalt or dolerite, that retain part of a ground surface or edge. Presumably they are fragments of ground-edge axes. Complete specimens of axes are occasionally found on surface sites in the region. At 300-350 g these tend to be somewhat lighter than the mean weight of 500-600 g for these implements in northern and eastern Australia (Dickson 1981:115). The Central Australian specimens are usually entirely ground except for the butt where traces of hammerdressing often remain.

millstones

These are large flat surfaced slabs with one or more long shallow grooves worn into the surface (see fig. 3.9). Many specimens have a flaked or hammer-dressed edge and in some cases the faces have also been hammer-dressed or pecked. The use-wear on millstones is in the form of a shallow well-defined ground groove about 100mm wide and 10-20mm deep. These surfaces are finely abraded and a reflective polish is often present. Millstones are resharpened when the surfaces become too smooth by using a topstone to lightly peck the surface forming a stipple-like pattern of small puncture marks. These implements were used, together with mullers, in the wet milling of seeds. Further details of the morphology and function of millstones and the other seedgrinding implements is given in Smith (1985, 1986) - see also O'Connell (1977) and Cane (1984).

In the excavated assemblages millstones are represented by easily identified fragments retaining sections of the ground groove, the rim or the median keel between grooves.

mullers

These are hand-sized implements that vary from oval to triangular in outline and from plano-convex to bi-convex in section. In use the implement is tilted upwards with the pressure on the rear edge. This produces a ground facet at an angle to the main axis of the implement. Heavily worn specimens have several ground surfaces which intersect to form the edges of the implement or to form pronounced ridges on the face of the implement (see fig. 3.10). Some specimens have been carefully flaked to shape and some also have evidence of resharpening.

Several almost complete examples of this type of implement were found in the excavations. However, most archaeological specimens are small fragments preserving part of the edge or median keel where two ground facets intersect.

mortars

These are flat surfaced sandstone blocks with a shallow oval or circular basin ground into one or both faces. These implements were used with pestles to pound hard coated seeds into a coarse meal that could then be wet-milled. Only one or two examples of this implement were recovered in the excavations. These were fragments retaining part of the circular ground surface.

pestles

These are fist-sized water-worn cobbles with a flat or slightly convex ground surface on one face.

amorphous grindstones

These are irregular pieces of rock with some light abrasion. The abraded or bruised surfaces are usually only lightly worn,

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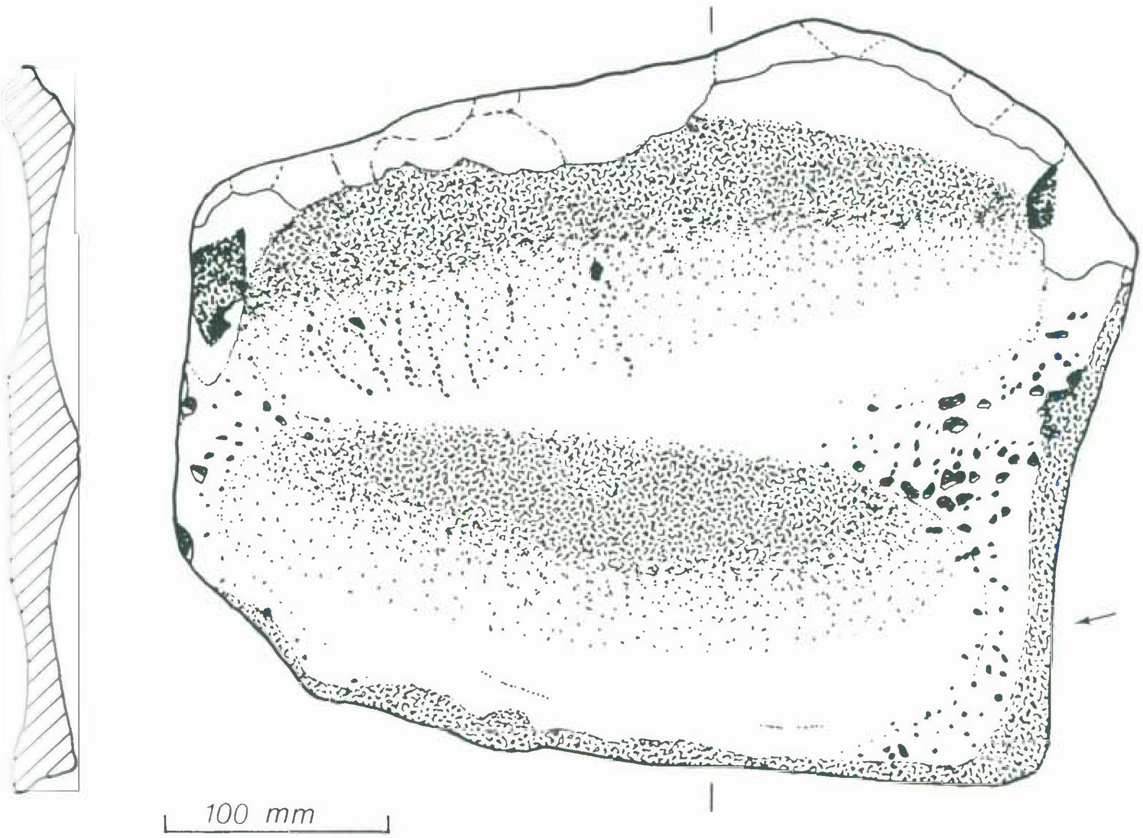
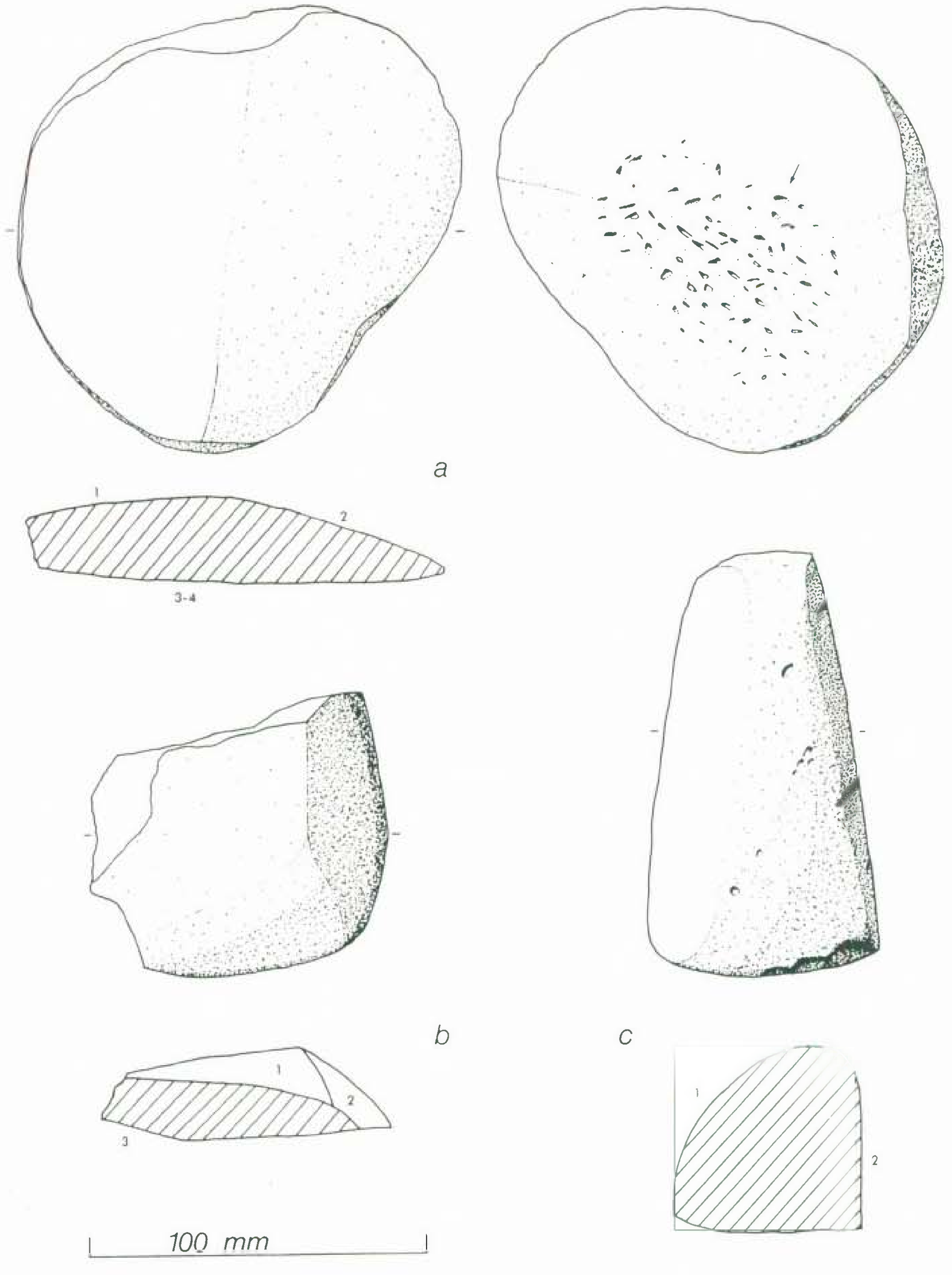
Overleaf **Figure 3.9 :** An example of a millstone from Santa Teresa, Central Australia. This specimen shows residual rejuvenation pitting around the milling surfaces (arrowed) and has a roughly flaked edge. **Figure 3.10 :** A series of mullers from Central Australia showing some of the range of variation of these implements. The small numbers shown on the cross-sections identify discrete ground facets. (a) is a surface find from Urre and shows rejuvenation pitting (arrowed) on one surface. (b) is a surface find from Wanmara. (c) is from Santa Teresa and is made on a block of sandstone rather than a tabular piece.


100 mm



a
1
2
3-4
b
1
2
3
c
1
2
100 mm

poorly defined and restricted to a small part of the face of the implement. By definition there are no signs of deliberate manufacture or of attempts to resharpened or rejuvenate the implement. Ethnographic accounts suggest a range of uses for these expedient implements, such as the casual preparation of bush tobacco (Brokensha 1975:29-31), the pulverising of cartilage and small animals (Hayden 1979:141; Gould et al 1971:163-4), the preparation of pigment, the cracking of nuts (Thomson 1964:402), the preparation of resin (Brokensha 1975:64-66) and the sharpening of wooden implements (Hayden 1979:114; Horne and Aiston 1924:56; Thomson 1964:408-9). Elsewhere I have argued that it is important that formal types of grindstones, such as the various types of seedgrinding implements, be distinguished from these expediently used amorphous grindstones (Smith 1985).