CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

> *Quartz has been regarded variously as one of the following : hard and intractable and therefore undesirable, variable in quality and therefore difficult to work, a material that 'splinters' and is therefore dangerous to knap, a material that splits and is difficult to interpret*
> Hiscock (1982:38)

Given the above statement, it is not surprising that the presence of quartz artefacts in stone assemblages poses problems for archaeologists. Quartz artefacts do not, generally speaking, display attributes that make their identification as stone artefacts simple. For example, bulbs of percussion - the most widely used attribute to identify flaked stone artefacts, are often not present. Other technological attributes (such as overhang removal and platform preparation) that could help researchers to assess the strategies used by knappers, are also absent or difficult to identify on most occasions.

The difficulty associated with initial quartz artefact identification, would not be of much importance if quartz was a minor raw material component of stone assemblages, however, there has been widespread use of quartz for the manufacture of stone artefacts in Southeastern Australia (Witter 1992:43). Furthermore, Witter stated that many stone assemblages in a variety of landscapes in Southeastern Australia were dominated by quartz artefacts but "the technology is poorly known" (Witter 1992:43). The archaeological problems associated with quartz artefacts are not confined to Australia as many assemblages containing quartz are found throughout the world, for example, China (Breuil and Lantier 1965 :117), South Africa (Deacon 1976:57), Central Africa (Van Noten 1977:35), the USA (Flenniken 1981:41), Ceylon (Noone 1940:1-23), Scotland (Saville 1993:59).

1.2 AIM OF THE THESIS

The general aim of this thesis is to make the technology of quartz artefacts better known, and to assess the problems and potential of assemblages containing quartz. Five stone assemblages from the Coonabarabran/Warrumbungle Region of NSW will be used for this research as assemblages in this region are known to be dominated by quartz artefacts (see Gaynor 1987, Wall 1993). It is possible to state from these earlier analyses, that quartz played a role in the lives of the prehistoric knappers of this region, just how important this role was, is the main subject of this research. The results will then be used to indicate which aspects of human behaviour would have been missed, if only the fine grained portion of the assemblages had been analysed. This will involve assessing which methods can be successfully used to identify and analyse quartz artefacts and quartz assemblages. The assemblages from the surface of the five sites in the Coonabarabran/Warrumbungle region will be used to test this contention. One of these sites (the Crazyman Shelter) has a 20,000 year sequence and this sequence will be used, to probe the importance of quartz over time. The sites to be investigated are :

1. Kawambarai Cave - abbreviated to KACA in tables and graphs.
2. The Crazyman shelter - abbreviated to CMS in tables and graphs.
3. Camp Pincham - abbreviated to CP in tables and graphs.
4. The Ukerbarley Hayshed site - abbreviated to UKBH in tables and graphs.
5. Jack Halls Creek Camp site - abbreviated to JHCC in tables and graphs.

1.3 PREVIOUS ANALYTICAL APPROACHES

A lithic classification according to Sheets (1975:369) is :

> *the ordering of stone artefacts in groups on the basis of perceived relationships.*

Sheets (1975:370-371) claimed that a classification can be "applied" (in as much as it is used to solve particular problems such as those connected with function, technology, adaptation or cultural change), or it can be pure (and be devoid of explicit theory and application).

Any objective classification of stone artefacts, according to Sheets (1975:370) must be:

> *internally consistent and use verifiable criteria to create and distinguish the various taxa.*

It must also :

> *develop its own body of theory and method to meet its specific objectives.*

A lithic analysis that attempts to go beyond a descriptive classification, tries to find the variables that are responsible for differences. These variations could be connected with subsistence strategies, the environment, trade and social contacts, demography, political and social strategies (Sheets 1975:370-371).

Basically there have been two types of classification and analytic methods used on Australian

Aboriginal stone artefacts (including quartz) in the past - Typological and Technological. The Typological approach was the accepted Australian approach up until the middle 1980s. Typology has been used since at least 1883 (Mulvaney 1977:265). The "Australian Core Tool and Scraper" industry, which had its beginnings in the Pleistocene but continued into the Middle Holocene, had a number of particular artefacts that archaeologists have called pebble choppers, steep-edged scrapers, horsehoof cores, notched scrapers (Mulvaney (1975 :231-233, 1990:68-69)). Researchers such as McCarthy (1976:96) defined cultures, sequences or industries by the artefact types found in them (for example the Kartan culture, the Gambieran Industry, the Eastern Regional sequence with three phases - Capertian, Bondian, and Eloueran. Others such as Mulvaney (1975 :231-233, 1990:68-69) divided the Australian sequence into "traditions" (for example the small tool tradition and the Core Tool and Scraper tradition) on the basis of the type of artefacts found in them. The "Australian Core Tool and Scraper" industry, which had its beginnings in the Pleistocene but continued into the Middle Holocene, had a number of particular artefacts that archaeologists have called pebble choppers, steep-edged scrapers, horsehoof cores, notched scrapers (Mulvaney (1975 :231-233, 1990:68-69)). Flood (1995:146]) has stated that Pleistocene assemblages were much more homogeneous than those attributed to the Holocene period.

TYPOLOGICAL ANALYSES

The typological approach to studying stone artefacts according to Cahen, Keeley and Van Noten (1979:660) is :

> *somewhat limited, as it registers differences or resemblances between the assemblages provided by the excavations without being able to explain them*

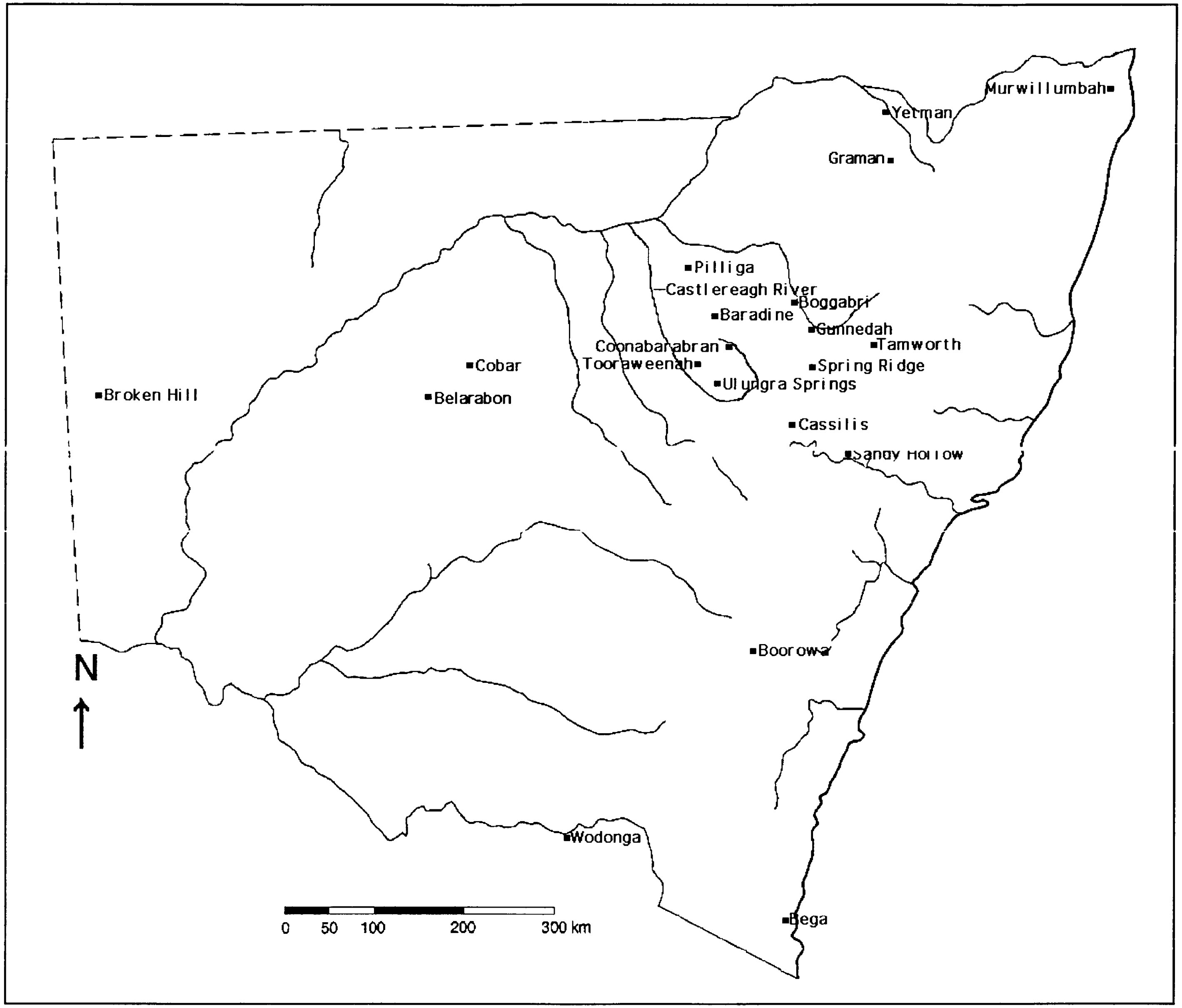
Cahen et al. (1979:660) claim that typologists argue that stone assemblages represent :

> *the activities that have taken place on a particular site and that typological differences reflect different activities*

According to Cahen et al. (1979:660), the validity of the suppositions on which this "functional argument" depends upon, has never been demonstrated. Typology, however, has been used extensively in Australian archaeological analyses.

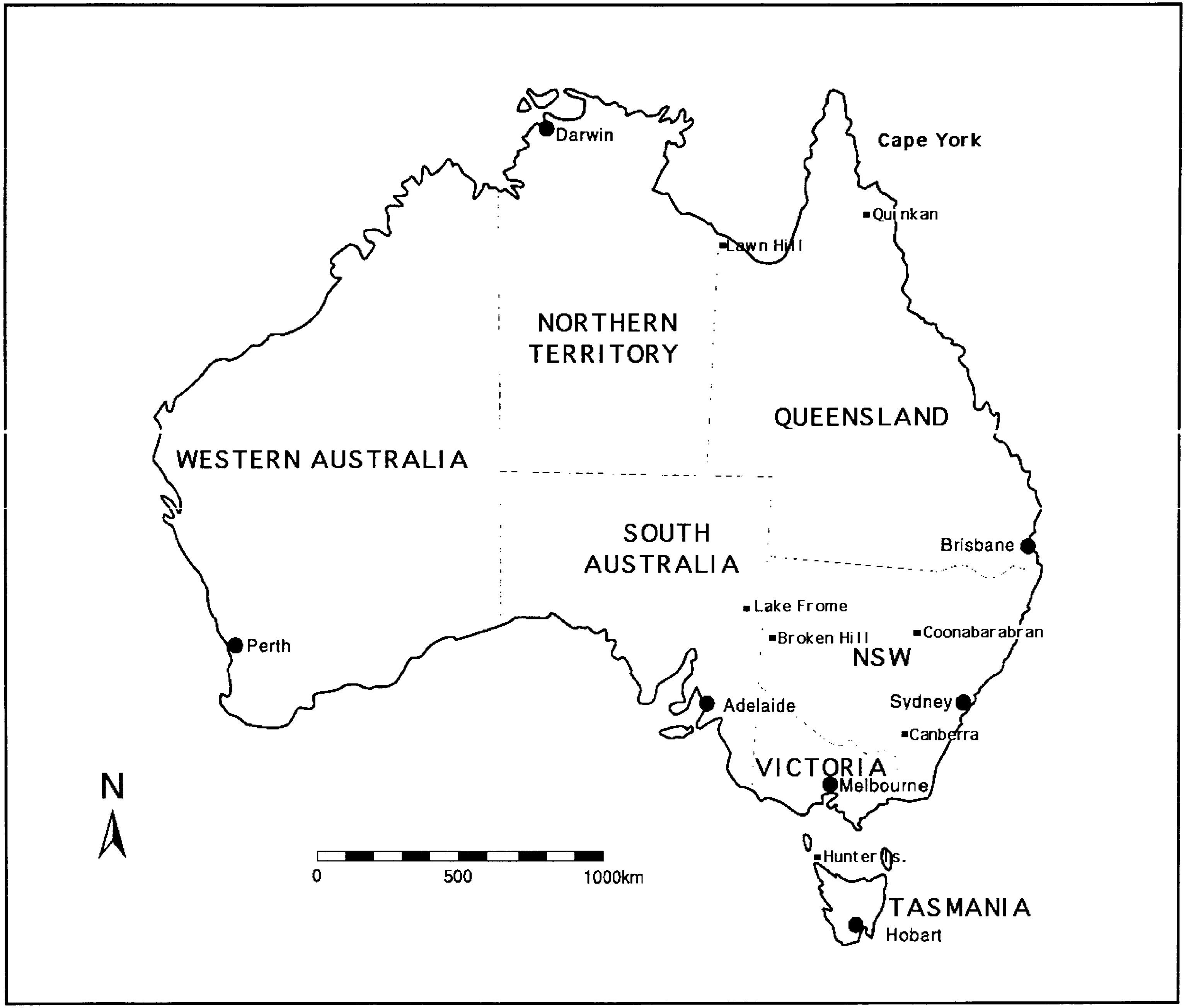
Moore (1970:45-57), for example, carried out a typological analysis of an assemblage excavated at Bobadeen near Cassilis NSW (see map 1.1), which included both quartz and grey

NSW TOWNS ASSOCIATED WITH REFERENCES TO SITES IN THIS RESEARCH



MAP 1.1

INTERSTATE PLACES OR LOCATIONS ASSOCIATED WITH REFERENCES TO SITES IN THIS RESEARCH



MAP 1.2

chert artefacts. Bobadeen is situated on the eastern extremity of the Pilliga Sandstone Formation, and about 120 km SE of the Crazyman Shelter.

This analysis was an earlier attempt to analyse quartz. Moore analysed the whole assemblage but concentrated on what he called implements and in particular the size and shape of Bondi points (Bondi points were interpreted as representing the Bondian culture). According to Moore (1970:53), Bondi points were used as cutting instruments, but he based this purely on the fact that, with some regularity, they displayed "work-use". His results showed that over half the Bondi Points from Bobadeen were made on quartz but they were much stubbier than the chert Bondis. Moore remarked that in spite of the difficulty of satisfactorily flaking quartz, he assumed that quartz Bondi points were favoured by the prehistoric knappers for their acute cutting properties over the chert Bondi points (Moore 1970:59-60). Moore (1970:59-60) also suggested that because the quartz Bondi points were such short stubby artefacts they would have had to be hafted to be functional. He also suggested on the basis of the number of Bondi points with "work-use" and/or retouch on them, that Bondi points may have been a more general purpose hafted and boring tool than simply a spear barb or point as suggested by McCarthy and others (Moore 1970: 59). An uncalibrated radiocarbon date 7750 ± 120 BP was obtained from sieve charcoal from the lowest occupational level of his excavation (Moore 1970:48). Although this analysis was a thorough one incorporating all the assemblage, it did not explore any differences in the technology used to produce the Bondi points. An analysis of what Moore termed the "waste", may have been the means of providing more clues to the technology than the Bondi points themselves.

Holdaway (1995:784-797) is a great supporter of typological analyses but emphasises that typologically based industrial schemes (that were common overseas) never took hold in Australia due to the efforts of Mulvaney (1961). According to Holdaway (1995:787), the single "Australian Core Tool and Scraper" tradition used by Mulvaney and Joyce (1965) has simply been expanded to fit the the ever increasing chronology of the suggested length of occupation by Aborigines in Australia. He deplored the division of Australian assemblages into just two units - pre 5000 BP and post 5000 BP and stated that :

> *Australia lacks the modern studies that in other regions of the world have sought to make sense of stone tool systematics*

However, recent studies, according to Holdaway (1995:788), have used Typology to advantage, for example McNiven (1994), who suggested that the appearance of thumbnail scrapers in Pleistocene sites in Tasmania, denoted a change in settlement patterns; and

Morwood and L'Oste-Brown (1995) for the Quinkan Region of Cape York in Northern Queensland (see map 1.2), where three industries were regionally differentiated to show typological and technological changes in the artefacts over time. According to Holdaway (1995:795), these recent uses of typological analyses have not been sufficient to convince most archaeologists that the typological approach is an efficient means of analysis. Holdaway suggests that in order to address and overcome the resistance to typological analyses, a reassessment of what constitutes a "type" in Australia should be undertaken.

However, according to Sheets (1975:373), a typological analysis defines artefacts in a system that seems to be an ideal logical order but this ideal logical order is the archaeologist's view, and probably not that of the original knappers. There is unfortunately, no way of testing whether the typological analyst's logical order of artefacts was the same as that of the knappers. Dunnell (1979:673) warns that :

> *rational artifact categories, irrespective of their intended inferential associations, are usually complex, unanalysed mixtures of style, function, and technology*.

This then throws some doubt on the effectiveness of Typological approaches to stone artefact analyses.

TECHNOLOGICAL ANALYSES

> *Archaeologists study stone tools in order to learn about the past conditions of human behaviour. Lithic data are potentially informative about a variety of past events, processes, and conditions including mobility, foraging patterns, and raw material availability.* (Kuhn 1991:76).

A technological analysis can be instrumental in identifying the techniques by which flakes are removed from the raw material in order to achieve a certain type of goal. The sequence by which these flakes were removed and the particular technique used, formed an identifiable cultural pattern. A detailed inspection of the stone artefacts from sites can sometimes identify these patterns (Flenniken and White 1985:131-132). These techniques can vary according to the skill of the knappers and the raw material used.

Witter (1987:166) stated that at each technological stage of the manufacturing process of the artefact, there was a range of options, but these options were restricted by the quality of the raw material and the stress mechanics of the stone. According to Witter, the highest amount of variation in an assemblage could be caused by the distribution of raw material and/or the manufacturing strategy.

Kuhn (1991:76) warns that to obtain the full benefit of the technological record, which contains inferences of human behaviour, it is necessary to isolate the effects of each individual factor. In particular, raw material availability can only be identified on certain assumptions about raw material acquisition.

A technological analysis according to Phagan (1976:2), is :

> *the establishment of a theoretical framework or system within which various traits of flakes or implements can be seen to have technological significance.*

That approaches to analyses are more successful when based on technological aspects, instead of typological ones has been well argued by Hiscock (1982 :79). As mentioned by Witter (1992:25) they avoid suggesting that the knappers had a mental template of a desired type of artefact (see Deetz 1987:7, Clarke 1968:135).

In 1941 Tindale and Noone described such technological attributes such as platform angles, width, overhang removal (platform trimming), flake termination, core rotation, and the presence of cortex when analysing a hoard of knapped flint which was found near the South Australian/Western Australian border. They remarked that artefact pieces they termed scrapers, points, adzes, etc, in the survey, were only used to conform to established classifications and for convenience (Tindale and Noone 1941:116-122). This seemed an early attempt at a technological analysis, although some typological categories were still used.

According to Flenniken and White (1985:150), typological approaches do not take into consideration aspects of the raw material on which the artefacts are based, which can have a large influence on the broad classes in a typological analysis. Flenniken and White (1985:150) state :

> *Many of the smaller typological categories based on morphological variation within broad classes (backed artefacts, unifacial points, scrapers) are as much the result of variations in size, availability and exact nature of the raw material along with knapper's skill as they are of deliberate design .*

Many archaeologists that have worked with stone artefacts since 1980, (for example, Lampert 1981, Sullivan and Rosen 1985, Anderson 1985, Hiscock 1986, Hiscock and Hall 1989, Stevenson 1991, Knight 1991, Witter 1992), would agree with Flenniken and White (1985:150) who claimed that :

> *Analyses of assemblages need to start with technological studies, and use 'cultural' variation only as a residual category.*

"Cultural" in this instance could be associated with typological aspects of an assemblage, such as Bondi Points and Eloueras.

According to Sheets (1975:370-371), factors influencing stone assemblages may be connected with subsistence strategies such as the environment, trade and social contacts, demography, political and social strategies. Patterns of land use and mobility are two factors that influence the energy needed to procure stone for knapping (Kuhn 1991:78). Very mobile populations (although they may use that mobility to procure stone en route to other activities - see Binford 1979:273) are hampered by the amount of stone they can carry. Hayden (1989:8) has suggested that the absolute limit that a family could carry would be between one and two kilograms of stone. This limit would have been influenced by the size and physical condition of the family group, the availability of carrying equipment and the environment and geomorphology of the area (for example, hilly country would require more energy for the transportation of loads than the flat Plains country to the west of the Warrumbungle mountains). The Coonabarabran region is hilly to mountainous in the area of the five sites, so this would be a factor if operating in an area without good supplies of flakeable raw material. Quartz and quartzite (coarse grained material), however, are still plentiful in most of the area researched, so transportation of these raw materials should not have posed a problem around these sites Fine grained material on the other hand, because of its scarcity most probably would have had to be carried long distances even if the raw material was in small pebbles, nodules or in reef type form.

Hiscock (1984:183-186) determined that rationing of stone materials by prehistoric knappers at Lawn Hill could be detected by observing several attributes on the artefacts. In order to do this, Hiscock located the raw material sources of both the chert and greywacke artefacts used in the Lawn Hill area. This knowledge of the sources of raw materials was critical to Hiscock's research. By comparing technological attributes on artefacts discarded at varying distances from these sources, Hiscock was able to ascertain that :

1. The percentage of each raw material found decreased as the distance from the

source increased.

2. The proportion of flakes with overhang removal increased, as the distance from the source increased.
3. The proportion of flakes with focalised platforms increased, as the distance from the source increased.
4. Retouching of artefacts increased as the distance from the source increased.
5. The number of flakes with edge damage increased as the distance from the source increased.
6. Flake and core sizes decreased, as the distance from the source increased (this applied to both the greywacke and chert artefacts).
7. Flake elongation increased as distance from the raw material source increased but then decreased rapidly (according to Hiscock [1984:185] this was due to increased core rotation).
8. Flakes with cortical platforms decreased as distance from the raw material source increased for the greywacke but increased for the chert (Hiscock suggested this reverse trend may have been connected with an increase in core rotation).
9. Cortex on cores and flakes decreased as the distance from the raw material source increased.
10. Core rotation increased as the distance from the raw material source increased. This was detectable on both flakes and cores.

Taking Hiscock's research as a starting point, Wall (1993) analysed five open sites in the Coonabarabran/Warrumbungle region to determine if there was any signs of rationing on quartz artefacts. Two of the sites researched by Wall were situated inside the Warrumbungle National Park (Mt. Naman and Burbie Camp - see map 1.3), while another three sites were located near Baradine (40 km north of Coonabarabran - see map 1.1), with the remaining one situated at Pilliga (about 120 km to the northwest - see map 1.1). Only the Pilliga site was outside areas that had a ready supply of quartz pebbles. Previous analyses of stone artefacts in the Coonabarabran/ Warrumbungle region have been carried out using a technological approach and some comparisons were desirable with these analyses. A technological analysis has, in my view, more scope to offer than a typological one because many artefact types commonly made on fine grained material (for example, Backed Blades, Eloueras, Tulas) are more difficult to make using quartz and generally quartz has not been used extensively for this purpose in the past. Because of this difficulty, quartz has not figured greatly in typological analyses. A technological analysis, because it is not confined by typological aspects, is more suited for the analysis of quartz.

In the past, archaeologists had four choices when analysing the technology of stone artefact assemblages partially made up of quartz. These were :

1. Ignore the quartz and analyse only the fine grained raw material comprising the rest of the assemblage (such as the chert or mudstone artefacts), in the hope it would reveal the answers they were seeking (e.g Hiscock (1986).
2. Conduct a partial analysis on the whole of the assemblage including quartz but concentrate on particular artefact types such as flakes, cores and retouched tools. This also ignores the majority of quartz artefacts (debitage). This type of analysis would address selected aspects of the stone technology used (e.g Morwood and L'Oste-Brown 1995, Pearson 1990).
3. Use aspects of technological and typological analyses (e.g. Dortch and McArthur 1985). This also ignores the analysis of the "waste".
4. Conduct an analysis on all raw material and artefact types in an assemblage (Gaynor 1987).

All four methods, I believe, have their place in archaeology, depending on the question/ questions being asked. In order to answer my question about the relative importance of quartz, then approach (4) must be followed.

Holdaway (1995:793) deplored the use by researchers of a single attribute technological change (usually in raw material or size) as the main indicator of change in assemblages. An example of this type of analysis was contained in Hiscock (1986:40-50,) who used the results of a technological analysis of a Sandy Hollow assemblage from the Hunter Valley NSW (see map 1.1), to suggest changes in knapping ability through time. For the analysis, Hiscock used only unretouched mudstone flakes and basically ignored the rest of the assemblage (which besides containing the balance of the mudstone artefacts, included artefacts made from silcrete and quartz). I fully agree with Holdaway in deploring the use of just one attribute to signify change, and it is my contention that in a technological analysis, all raw materials should be analysed so that all variation or lack of it in an assemblage could be investigated in order to address variations in a region.

1.4 BACKGROUND TO THE STUDY AREA

The Coonabarabran/Warrumbungle region was chosen because it contains many sites with surface assemblages, which are dominated by quartz and have been relatively well studied archaeologically (eg. Gaynor 1987, Cooper 1989, Beck 1989, Murphy 1992, Wall 1993, Purcell 1994). The Coonabarabran/Warrumbungle region is defined as having a radius of 30 km from Coonabarabran for the purposes of this thesis (see map 1.3). It includes the

Warrumbungle Mountains which contain a variety of landscapes ranging from steep volcanic peaks to flat topped sandstone ridges with associated sandstone cliffs containing a variety of overhangs and caves. This region is intersected with areas of undulating sandy, red and black soils. Stone, suitable for flaking (in the form of quartz and quartzite pebbles), is available around most sandstone cliffs and in streams in the region. The main sources of fine grained material (chert, jasper and chalcedony) have not been found, but are thought to be available in limited supply as pebbles and nodules in local creeks.

An extensive search for ethnographic material on Aboriginal customs at contact time in the Coonabarabran/Warrumbungle region, failed to find any written documents (Balme 1986, personal observations). Present local Aboriginal knowledge extends only to post contact times. Memories and experiences connected with the Aboriginal community of the Coonabarabran region since the 1860's are well documented in the recently published book "Sun Dancin' (Somerville, Dundas, Mead, Robinson and Sulter 1994), but even in that book, it is lamented by contemporary Aborigines that nothing was written down concerning the way of life of their ancestors (Somerville et al. 1994:65). This knowledge would have included the location of the fine grained stone resources, the path of the seasonal journeys around the region in search of resources and the sizes of the tribal and family groups, to name a few.

1.5 THESIS STRUCTURE

Following Chapter One, Chapter Two will examine previous attempts to analyse quartz, and will examine the previous archaeological research conducted in the Coonabarabran/ Warrumbungle region. Evidence for climatic changes will be investigated along with the phases of the Aboriginal land-use model formulated by Witter (1986b:3-7). A revised model for the region will then be formulated. This predictive model will use known climatic data as well as Witter's model, and will be divided into four phases covering the period 20000 BP to 200 BP.

Chapter Three will present and define attributes and classes used for this analysis and raw material types will be discussed. Attributes that can be used to infer patterns of human behaviour will be listed and discussed together with those inferences that may be useful in highlighting the importance of quartz in assemblages.

Chapter Four will describe the five Coonabarabran sites selected for this analysis and then present a background to each site before discussing their relationship to each other. This Chapter will provide information on geology and soil types of the area as these could affect assemblage variability in a site. In order to make a systematic comparison between sites, only artefacts from surface units of excavated sites will be compared with unexcavated open sites, giving an analysis of stone artefacts that roughly covers the period between contact with Europeans and the cessation of the manufacture of backed blades in the region (Gaynor 1987:168).

Artefacts from a 1 metre by 1 metre square from the Crazyman Shelter will also be analysed in an effort to detect variation through time as this was the site with the longest recorded Aboriginal occupation in the Coonabarabran/Warrumbungle Region. Chapter Five will present the results of the analysis from the Crazyman Shelter and the relationship of each of the four phases to each other. It will tabulate the inferences of human behaviour that would or would not have been missed if the quartz portion of the assemblage had not been analysed in each phase. It will also document the first appearance of backed artefacts in the assemblage. Possible uses of the site in the period of each phase will then be discussed.

Chapter Six will present the results of the analysis from the five sites and the variability, or lack of it, found in each site and relationships, if any, to other sites. It will tabulate the aspects of human behaviour that would or would not have been missed if only the fine grained portion in the assemblage had been analysed. It also discusses possible types of occupation for each site.

Chapter Seven will discuss the overall results of the analyses and what conclusions can be gained from the results. Problems and the potential of analysing quartz in assemblages will be discussed together with future research questions.

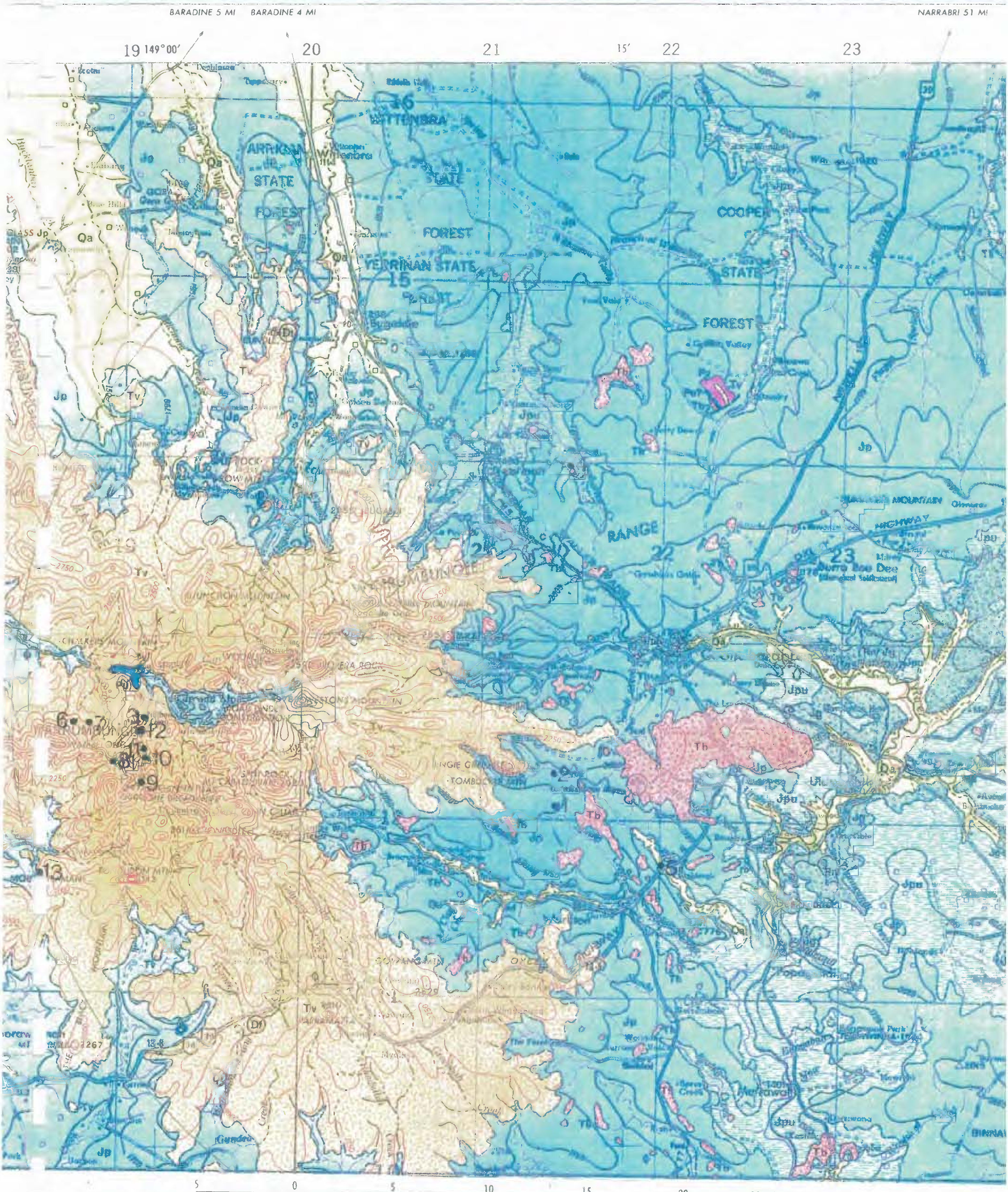
1.6 CONCLUSION

The aim of this thesis will be to use a technological analysis of stone artefact assemblages from five Coonabarabran/Warrumbungle sites to gain a greater understanding of the role of quartz in the life of the Aboriginal people using this area across time and space. Once the role of quartz has been identified, it will be possible to determine which aspects of human behaviour would have been missed if the quartz portion of the assemblage had been ignored.

EXTRACT FROM GILGANDRA

1:250,000 GEOLOGICAL SERIES SHEET SH 55-16

FIRST EDITION, 1968.



MAP 1.3

LOCAL SITE AREA AND GEOLOGICAL BACKGROUND

GEOLOGICAL AND SITE LEGEND P.15

FIRST EDITION, 1968.

Reference

CAINOZOIC	QUATERNARY		Alluvium, gravel, sand, silt, clay (Qa)
			Sand, silty sand (Qs)
	TERTIARY		Largely volcanics; trachyte, basalt, dolerite, andesite phonolite, with tuff, breccia, and diatomite (Tv)
			Basalt, dolerite (Tb)
MESOZOIC	JURASSIC	Pilliga Sandstone	Quartz sandstone; conglomerate, claystone (Jp)
		Purlawaugh Beds	Lithic sandstone, shale, claystone, conglomerate, lignite (Jpu) Includes Comiala Shale (Jc)
		Garrawilla Volcanics	Dolerite, basalt, trachyte, tuff, breccia (Jg)
			Alkaline intrusives, phonolite, trachyte (p)
		Ballimore Beds	Claystone, shale, sandstone, ironstone, conglomerate, coal (R-Jb)
	TRIASSIC	Narrabeen Group	Conglomerate, quartz sandstone, claystone (Rn)
PALAEOZOIC	PERMIAN		Shale, sandstone, conglomerate, coal
		Liamena Rhyolite	Rhyolite (Pl)
	CARBONIFEROUS	Gulgong Granite	Granite, granodiorite, diorite (Cgg)
	SILURO-DEVONIAN ?	Tucklan Beds	Quartzite, phyllite, andesite, dacite, tuff (S-Dt)
	UNDIFFERENTIATED		Schist, phyllite, slate, tuff

Geological Boundaries

- *Established boundary-position approximate*
- *Inferred or probable boundary*

Faults

- *Established fault-position approximate*
- *Probable or inferred fault*

Strike and Dip of Strata

- *Inclined*
- *Inclined, showing prevailing dip*

Mineral Localities

- (Dt) *Diatomite*
- (Cu) *Copper*

Fossil Locality

- *General*
- *Plant*

SITE LEGEND

1. THE CRAZYMAN SHELTER
2. KAWAMBARI CAVE
3. CAMP PINCHAM
4. UKERBARLEY HAYSHED SITE
5. JACK HALLS CREEK CAMP SITE
6. BURBIE CAMP
7. BURBIE SPRING
8. OGMA SADDLE
9. DOWS LOOKOUT
10. STRENG BOSS
11. WILSONS REST
12. SPIREY CREEK JUNCTION
13. MOUNT NAMAN

CHAPTER TWO

QUARTZ: PAST ANALYSES AND MODELS

2.1 INTRODUCTION

This chapter will examine quartz in assemblages, and the previous archaeological research, geology, soils, vegetation and climate of the Coonabarabran/Warrumbungle region. Relevant archaeology and the background to the region will be used to formulate a model of past Aboriginal Land use in the region. This model will blend aspects of stone technology with past climatic periods.

2.2 PREVIOUS TECHNOLOGICAL STUDIES OF QUARTZ IN ASSEMBLAGES

Despite quartz being found in assemblages throughout the world, technological analyses of quartz artefacts are very rare. One of the few accessible studies is Flenniken (1981:1-129). Flenniken endeavoured to replicate the quartz stone artefacts found at a fish processing site at the mouth of the Hoka river in the State of Washington USA. No other raw material except quartz was found in the site. In an attempt to understand the technology found in the site, Flenniken used the bipolar method to reduce the cobbles that were sourced from the river. He also stated that the quartz artefacts found in the site, and also those replicated by himself, required low maintenance, adding to the efficiency of the whole quartz technology. He found that the bipolar method was the most simple but an efficient method for the reduction of stone at the site (Flenniken 1981: 113-114).

Some attempts have been made in Australia, to come to terms with the analysis of quartz artefacts. Some used replicative experiments in order to better understand the flaking characteristics of quartz and then compared their results with artefacts from assemblages (for example Dickson 1977, Perham 1985, Knight 1991). Others used mostly technological attributes in their analyses but supplemented these with some typological categories such as Backed blades, (for example Lampert 1981, Hiscock 1982, Anderson 1984, Bowdler 1984, Gaynor 1987, Flood, David, Magree and English 1987, Allen, Marshall and Ranson 1989, Pearson 1990, Witter 1992, Wall 1993, Purcell 1994, Morwood and L'Oste-Brown 1995). Some of these studies are now considered.

Dickson (1977:97-103), carried out experiments on quartz to assess its working qualities and the ability to produce specific sized flakes from it. He also tested its suitability for making Bondi points. From his experiments on a variety of the raw material from NSW and the ACT, Dickson concluded that :

1. Cores lighter than 60 grams had to be worked by the bipolar method in order to produce more flakes.
2. Working qualities improved with increasing translucence of the raw material. The more lustrous the material, the better the flaking quality.
3. Clear Crystal quartz made good artefacts but the material was very rare on the landscape and was seldom found in sites.
4. The quality of finished Bondi points depended on the quality of the raw material.
5. When lightly struck, fired quartz was reduced to crumbs.

Hiscock (1982:43) analysed ten assemblages containing quartz from Mumbulla Creek near Bega on the South Coast of NSW (see map 2.1). Quartz accounted for 80% of the raw material in these assemblages. He found that, although there appeared to be evidence to suggest that quartz was flaked more than other raw materials, in his opinion, the quartz flakes were not subject to as much use as the artefacts manufactured from fine grained material. This assumption was based on an examination of artefact edge damage. This has implications for the actual importance of quartz. Was quartz actually knapped more because it was a local resource, as Hiscock has suggested? From personal experience quartz (because of its flaking qualities) is more difficult to fashion into formal tool types such as backed blades than the fine grained material, but its importance may have been because of its ability to maintain an edge far longer than other raw material. Although Hiscock included six whole assemblages in his analysis, the main thrust of his research was directed towards the technological problems of quartz knapping. These, he listed, as the variable knapping quality of the raw material, the presence of stress lines and incipient fracture planes. Hiscock (1982:43) also suggested that the use of the bipolar flaking method may point to the assemblages being of recent origin. This recent origin theory has also been supported by other archaeologists (e.g. Lampert 1971, Flood 1980). Hiscock (1982:40) also disputed Dickson's findings on freehand/bipolar core threshold weight and suggested that instead of the 60 grams limit suggested by Dickson (1977:99), it was more like 5 to 7 grams, but this threshold depended more on shape than on weight of the core.

Perham (1985) conducted a number of replicative experiments to gain an understanding of the flaking characteristics of reef quartz. He found the pebble quartz he experimented with, to be very inferior in quality in comparison to the reef quartz, and he did not pursue this line of experimentation beyond saying in contrast to reef quartz, it "usually produced amorphous blocks that were riddled with minute cracks" (Perham 1985:67). Perham applied the knowledge he gained from flaking the reef quartz to establish a reduction sequence that was similar to that used by the Aborigines in tool making at Mudgegonga Rockshelter (situated about 50 km south of Wodonga in NE Victoria - see map 1.1). Perham concluded that there was a degree of variability between quartz industries and it was necessary to consider each site on its merits. He concluded that quartz industries can not be classified as "batter and shatter affairs" (Perham 1985:110).

Perham (1985:111) stated that :

> *although quartz has not been considered particularly valuable from an archaeological perspective, it does offer the opportunity for an analysis of far greater depth than so far has been demonstrated by Australian archaeology.*

Knight (1991:37) also carried out replicative experiments in order to describe the diagnostic features of worked and unworked vein quartz. Knight found that quartz was a brittle material that produced many fragments when worked, and these fragments were difficult to interpret. He was of the opinion that archaeologists in Australia had a low regard for quartz as a knapping medium, but prehistoric knappers had a much higher opinion, judging from the number of assemblages in Australia that were dominated by quartz (Knight 1991:47).

Witter has described quartz knapping in Southeastern Australia as "an adaption of the core and flake tool industry" but with the difference, that use was made of existing fracture lines in the stone to reduce the raw material. Witter (1992:43) described this method as the fracture line acceleration technique (Witter's preference) but stresses that Kamminga called it the crack or flaw propagation technique (Witter 1992:43). The problem encountered with this method , however, is that it is virtually impossible to tell if a pebble has been divided by the fracture line method or it has fractured naturally, if there are no signs of the pebble being struck by a hammerstone.

Witter analysed quartz assemblages found in numerous workshops around the Boorowa area in Southwestern NSW (see map 1.1) and found by experimentation that the method used was the fracture line acceleration technique. In other areas, the bipolar method of reduction was used if the raw material was in pebble form, or that there was a limited supply of reef quartz available. Witter stresses that the core and flake tool industry is not the same as the "core tool and scraper tradition" as defined in O'Connell and White

(1982). The "core tool and scraper tradition" according to Witter (1992:28) has typological and other characteristics that are linked to a certain chronology which is not implied in the industry described by Witter. Witter (1992:29) stresses that the "core and flake tool industry" is present throughout the whole of the Australian prehistoric sequence and is not connected with any issues of chronology or ethnicity. Witter (1992:28), describes the core and flake tool industry as comprising :

> *the most simple and unspecialised form of stone working technology. The chief function of this industry is to provide edged tools for a variety of cutting and chopping tasks. Although multi-functional, it has a major role in the manufacture and maintenance of wooden implements.*

Two types of artefacts that are commonly associated with quartz pebbles are bipolar cores and flakes. In the bipolar method of knapping, the raw material is placed on an anvil and struck with a hammerstone to produce flakes. Gaynor (1987:138) found up to 50% of artefacts had been knapped by the bipolar method in sections of Kawambarai cave (KACA).

Jeske (1992:467-481) investigated the use of bipolar knapping as a mechanism for energy saving in a population under stress from other factors (such as social constraints and adverse environmental conditions). Jeske suggested that the amount of time spent on lithic raw material selection and artefact manufacture was a measure of energy stress on that culture as a whole. According to Jeske, bipolar production can be used for a number of reasons. These include an inability to obtain raw material in large cobbles or of flaking quality, an increase in sedentism, a testing of cobbles for fractures and an attempt to economise on raw material. Jeske (1992:480-481) stated that bipolar knapping has one major drawback and that is the lack of precise control over the raw material when knapping.

Bipolar knapping also produces large amounts of useless blocky fragments, shattered pieces, and dust. A distinctive debitage assemblage is produced with characteristic lozenge, wedge or pillow shaped cores. Flakes have no, or diffuse bulbs of percussion, but with multiple edges with crushing and pronounced rings of percussion. Jeske stated that where time and energy were in demand because of social issues (including warfare), lithic technology was one area where groups could conserve energy as long as the basic functional requirements for stone tools were being met. Bipolar reduction does produce an unattractive tool kit, but it is a successful one that does conserve energy. The presence of artefacts made by the bipolar method in a site may be instrumental in conveying to the researcher, stresses not otherwise apparent in past occupations of the site (Jeske 1992:480-481). The failure to analyse the quartz section of an assemblage could mean that this important indicator of changed human behaviour would be missed.

In conclusion, previous technological research on Australian quartz assemblages has concentrated on vein, rather than pebble quartz and in a reiterating the difficulties of quartz flaking and the differences between quartz and other raw materials. This thesis intends to take a more positive and inclusive view of quartz artefacts.

2.3 PREVIOUS STUDIES OF QUARTZ IN THE STUDY REGION

In the early 1980's, Richard Wright, his colleagues and students from the University of Sydney, carried out some relevant research near this region. They investigated two swamp sites, Trinkey and Lime Springs which are situated near Spring Ridge (see map 1.1). These sites are approximately 80 km to the east of Coonabarabran. These sites were situated very close to soils derived from Pilliga sandstone and basalt, which are similar to those soils found around the Coonabarabran sites. The majority of artefacts from these two sites, which are approximately 3 km apart, occurred in the time period before 6000 BP, with many of the stone artefacts being associated with megafaunal teeth and bones (burnt and unburnt) (Gorecki, Horton, Stern, and Wright, 1984:117-119; Wright 1986:4-9). One uncalibrated radiocarbon date of 19300 ± 500 BP from a depth of 1 metre was obtained from Lime Springs. The only data published to date on stone artefacts from these sites, is for the Lime Springs site (see Gorecki et al. 1984:117-119). The raw materials recovered from this site, were described as chert, quartz, quartzite and "quarried tabular tuff". No comparisons can be made between this site and the Coonabarabran /Warrumbungle assemblages in relation to the importance of quartz in the assemblage, because percentages of raw materials and other technological details were not published.

The Coonabarabran/Warrumbungle region has been the subject of concentrated ongoing archaeological research since 1986. In that year, an analysis of stone artefacts from several locations (see map 1.3) in and around the Warrumbungle National Park, was carried out by staff and students from the Department of Archaeology and Palaeoanthropology, University of New England, under the guidance of Dr. Dan Witter,who was, at the time, the archaeologist in the local office of the National Parks and Wildlife Service. He was familiar with the surface stone assemblages in the area and had put forward a series of in-house manuscripts as guides for the analysis of the assemblages (see

Witter 1986a,b,c,d,e,f), including a model of land-use from pre-5000 to 200 BP (Witter 1986b).

Sixteen surface sites previously located by Witter, were selected for the project on the grounds of accessibility. Information on the stone artefacts was recorded and collated by students. The basic aim of the 1986 research was to list and measure artefacts and with these measurements, construct a reduction chart for each site (see Witter 1987, Dibble 1985 for examples of reduction charts). According to Witter (1987:7), the purpose of the Reduction Chart was to give an interpretation of how a piece of stone was reduced from its unflaked state to the recovered artefact. The measurements of the artefacts found in a site formed the data for the Reduction Chart. In constructing this chart, Witter stated that the thickness of an artefact is never greater than the width and the width is never greater than the length (this necessitates a maximum measurement approach to measuring artefacts, see Chapter 3). Witter's method was to plot the square root of (length by width) against thickness on a scattergram, plotting each material separately.

Witter claims that reduction charts provide a consistent way to classify cores by shape, size and degree of reduction. Reduction charts will be used in this analysis as one method to differentiate sizes of cores of the three raw material groups through time and space. It is important to differentiate sizes of cores in the three raw material groups as this is one way in determining different reduction methods.

Gaynor (1987) re-analysed the data for ten of the 16 assemblages analysed by Witter in 1986 to obtain information on raw materials percentages. This analysis revealed that quartz was the dominant raw material in all assemblages. Quartz percentages in these assemblages ranged from 68 -100% (see table 2.1). No excavations were carried out by Witter in 1986 and the ages of the sites are unknown (Gaynor 1987:247-285).

For a further comparison of raw material percentages, Gaynor (1987:172) examined the 417 stone artefacts collected by staff and students of the Department of Anthropology, University of Sydney in 1986 from a transect in a paddock adjacent to Ulungra Springs which is about 45 km to the south of Coonabarabran (see map 1.1). No measurements were taken during the examination, but raw material percentages were recorded. The percentages were quartz - 71.1%, fine grained 19.5%, coarse grained (mainly quartzite) 9.4%. This placed the percentage of quartz in the assemblage near the lower end of those in table 2.1. This was important because it showed that quartz was dominant in the southeastern part of the Warrumbungles (Ulungra Springs) as well as from the central and western areas of the Warrumbungles (see table 2.1 and map 1.3).

1986 COONABARABRAN/WARRUMBUNGLE SURFACE SITES

SITE	QUARTZ	%	FG.	%	CG	%
WEST SPIREY CR.	34	68.0	16	32	-	-
BURBIE SPRINGS	53	77.9	12	17.7	3	4.4
UKERBARLEY	217	86.1	21	8.3	14	5.6
SPIREY CR.	19	95.0	1	5.0	-	-
WILSONS REST	17	94.4	1	5.6	-	-
WEST SPIREY CR. JR.	21	87.5	3	12.5	-	-
OGMA SADDLE	32	100	-	-	-	-
STRENG BOSS	23	100	-	-	-	-
DOWS LOOKOUT	31	96.9	1	3.1	-	-
MT.NAMAN 1	24	72.7	4	12.9	5	15.2

Key

FG = Fine grained, for example chert, jasper, chalcedony.

CG = Coarse grained, for example quartzite.

TABLE 2.1

(Adapted from Gaynor 1987: 246-285).

Gaynor's (1987) analysis of the artefact assemblage from the excavated site of KACA revealed that :

1. From 1940 BP to c.1800 BP quartz was dominant (all these dates are uncalibrated).
2. From c.1800 BP to c.1000 BP, fine grained raw materials (such as chert, jasper and chalcedony) were dominant.
3. From c.1000 BP to contact, quartz artefacts were dominant.
4. The three excavated samples contained percentages of microdebitage (artefacts that measured less than 5 mm in maximum length) of up to 57% in quartz, 53% in Fine grained (FG).

A general decrease in the number of stone artefacts per excavated unit in the top units of KACA, suggested that the cave was used only sparingly in this time period or that there was a greater reliance on other types of technology (such as nets for hunting animals instead of stone tipped spears - several types of cordage was found in the excavation) (Gaynor 1987:20,183, 188). Hiscock (1981:33) has suggested that a technological change to a more efficient tool kit or more reliance on wood, bone and shell, or a change in the availability of raw material would possibly not show in artefact numbers even though there was an increase in population numbers.

Wall (1993) carried out a technological analysis of stone artefacts in the Coonabarabran/Warrumbungle region but instead of targeting a chronological sequence, he researched the quartz portion of assemblages from surface sites. Wall's main objective was to test whether attributes found on quartz artefacts displayed rationing effects due to the distance from the source. Rationing effects on chert and greywacke artefacts had been documented by Hiscock (1984:178-190) at Lawn Hill in Northern Queensland (see map 1.2) but no one had previously attempted to see if rationing effects could be detected on quartz artefacts (Wall 1993:19).

Wall found that the quartz percentages of the assemblages analysed, varied from 72% to 89% with the smallest percentage recorded at the Pilliga site, about 10 km from the nearest raw material source of quartz (Wall 1993:26-27). He stated that by using some of the parameters outlined by Hiscock, he was able to find signs of rationing of the quartz. Wall (1993:101) claimed that he was able to find rationing effects on the following attributes:

1. The percentage of flakes and cores retaining cortex. This percentage became lower on cores as the distance from the raw material source increased (average cortex on flakes ranged from 25% (close source) to 8 % (furthest source), and cores 55% - 20 % (Wall 1993:65-66). This trend, however, did not occur in the bipolar cores at Pilliga.
2. The percentage of flakes with cortex present in all sites followed the same pattern as for cores but with the Pilliga site again being the exception.
3. The number of fracture planes present in the cores (the least number was present at the site furthest away from the source (minimum distance from a raw material source at Pilliga was 10 km) (Wall 1993:26-27,144-146).
4. Flake length, width and thickness which decreased as the distance from the raw material source increased (Wall 1993:49).
5. Core weight decreased as the distance from the raw material source increased (Wall 1993:54).
6. Core rotation increased as the distance from the raw material source increased (Wall 1993:58).
7. The proportion of quartz artefacts per assemblage decreased as the distance from the raw material source increased (closest site to the raw material source -88%, furthest site from source - 70% (Wall 1993:63).

Wall found that only cores present at Dubbo Creek, Pilliga, the site furthest from the source of the quartz raw material were bipolar(Wall 1993:57). He suggested that as knappers were only using small pebbles, inertia problems were being encountered with freehand knapping, and the bipolar method was overcoming this problem. Wall also found that the bipolar cores analysed at Pilliga appeared to be of the best quality quartz (there were no or few fracture lines present). As Pilliga was about 10 km from a raw material source, Wall suggested that only the best quality quartz was being transported and this was being reduced to its fullest extent by the bipolar method (Wall 1993:27, 52, 95).

Wall's research was problem orientated and very highly focussed, but his findings are of value to this thesis as his research was carried out on quartz in the same study region. What is of further importance to this research, was that the length and width of flakes and cores (produced by the freehand method) did not show signs of rationing unless the raw material source was at least 2 km away Further to this overhang removal and platform preparation were only detected on 2 quartz artefacts in all the assemblages analysed. This last point is important because overhang removal and platform preparation are two attributes that can be used to assess the technological skills of the knappers of fine grained material(see Hiscock 1986:43). Because these two attributes are rarely found on quartz artefacts, they cannot be used to compare quartz with fine grained artefacts that commonly do exhibit these attributes.

Following Wall's analysis, Purcell (1994) carried out an technological analysis of stone artefacts to test whether residues on small flakes were indicators of resharpened stone artefacts. The artefacts he used for his analysis were from layer three of five excavated squares from KACA (Purcell 1994:42). Layer three in one of the squares (H31) returned a radiocarbon date of 600 calibrated (2 sigma) BP (Gaynor 1987:35). Purcell found that the largest numbers of residues occurred on flaked pieces and microdebitage (artefacts less than 5 mm in maximum length) with 72.6% of the residues occurring on quartz artefacts. From his research and experimental work, Purcell found that residues appear to adhere more readily to rougher surfaces, so that quartz artefacts, which naturally have a rough surface, were more likely to retain residues than artefacts manufactured from fine grained material, such as chert (Purcell 1994:66,87). Purcell's results suggested that many of the residues on the quartz and fine grained debitage could have resulted from the resharpening of artefacts. Purcell's analysis also revealed that the percentages of quartz artefacts per total assemblages were consistent with those from the 3 squares analysed by Gaynor (53%) (Purcell 1994:58).

In conclusion, the previous work on quartz in the study region has focussed on recent assemblages of the last 2000 years. Only limited technological studies have been carried out. This thesis aims to investigate quartz technology over the last 20,000 years in detail.

A summary of previous work shows that quartz has flaking characteristics that are different to fine grained artefacts. These flaking characteristics present special problems for the analyst, but these have been addressed to some degree by a few analysts. The widespread use of quartz as a raw material for stone artefacts in much of Southeastern Australia, and in many other parts of the world, makes it imperative that researchers address these problems if all inferences contained in a stone assemblage are to be explored. However, in order to understand the role of quartz in the study region over time, it is necessary to examine the wider issue of land use and how it relates to quartz technologies.

2.4 LAND USE MODEL IN THE COONABARABRAN REGION

This section will first review the climate history of the region and Witter's (1986) model of land use, before presenting a revised model which incorporates information from research done between 1987 to 1996.

2.4.1. Pleistocene

On the southeastern side of the Warrumbungles, Dodson and Wright (1989:182-192) carried out an analysis of pollen from Ulungra Springs (about 40 km to the south of KACA - see map 1.1) which has direct implications for past climatic conditions for the Coonabarabran/Warrumbungle region. The Ulungra Springs area is geologically much the same as the rest of the Warrumbungles with a mixture of black, red and sandy soils present(personal observations). An radiocarbon date of 29440 ± 60 BP was obtained from the pollen core at a depth of 5.5 metres while a depth of 2.3 metres yielded a date of 22790 ±140 BP (all dates from Ulungra Springs are uncalibrated).

Dodson and Wright (1989:186) divided their analysis according to the 5 samples taken from an excavation in the swamp. The authors used Pits 1 to 5 to identify their samples. These were :

PIT 1. This sample returned an age older than 27300 BP and was possibly beyond the boundaries of successful radiocarbon dating techniques. The analysis of Pit 1 indicated that the landscape was dominated by *Eucalyptus, Angophora, Poaceae, Asteraceae, Plantago, Leptospermum/Baeckea, Bossiaca, Dodonaea, and Lomandra/Xanthorrhoea.* The authors' interpretation of this period based on this data, was an open woodland with a grassy/heath understorey.

PIT 2 . This sample was indeterminate n age but was less than 27000 BP. The pollen in this sample was found to return unreliab e statistics and was not used.
PIT 3. This sample covered a period greater than 29000 BP to C. 1000. The analysis of Pit 3 detailed changes during the late Pleistocene (18000 - 10000 BP) with *Eucalyptus pollen values falling to a value consistent with only a fringe of trees around the adjacent creek line. Chenopodiaceae, Plantago, Tubuliflorae and Liguliflorae* dominated the pollen record with a small portion of heath type plants and probably a grass component (which is common in Chenopod shrubland today in semi-arid Southern Australia). This postulated landscape, according to Dodson and Wright (1989:186-188), was similar to the Chenopod shrubland found today in the semi-arid area of Australia. This implies that less rainfall was present at Ulungra Springs during the late Pleistocene (18000 - 10000 BP), than in the period before 27000 BP (Dodson and Wright 1989:186-188).

2.4.2 Holocene

According to Dodson, Fullagar and Head (1989:118), synthesising results from the wooded regions of SE Australia, maximum rainfall and warming occurred between 8000 BP and 6000 BP in the Holocene, with rainfall up to 10% higher and temperatures up to 2° C higher than at present. Linacre and Hobbs (1977:191-192) stated that a general warming of climate occurred in the Holocene Period culminating in a *Climatic Optimum* at c.5000 BP. This was followed by a colder and more arid period at c.3000 BP. The climate became increasingly warmer after this period, except for a cold spell at c.1750 BP. A *Secondary Climatic Optimum* occurred between 1150-750 BP. Three centuries of climatic instability then followed with alternating floods and droughts.

Further information as to Holocene climate is indicated from the pollen analysis from Ulungra Springs by Dodson and Wright (1989:182-192).
PIT 4. This sample covered a period from 10500 BP to mid Holocene. *Eucalyptus* pollen values rose substantially in the Holocene, indicating, according to the Dodson and Wright (1989:186), a return to climatic conditions similar to pre 27000 BP.
PIT 5. This sample was taken between a depth of 1.1 cm and the surface, but the pollen was too degraded to give a reliable analysis. The loss of a suitable pollen sample from the last half of the Holocene indicated that continuous waterlogged conditions did not occur for long enough periods to preserve the pollen.
In the absence of pollen data from Ulungra Springs from c.6000 BP to the present, it

seemed necessary to find data in areas as close as to the Coonabarabran/Warrumbungle region as possible so that some idea of climatic changes may be postulated during this period. Wasson (1983:118-119) found evidence to suggest that sand dunes became mobile between 3500 BP and 2500 BP at Belarabon, which is situated about 90 km SW of Cobar NSW and about 433 km SW of Coonabarabran - see map 1.1). This dune building is thought to have been a direct response to a lower vegetative cover caused by increased evaporation and/or lower rainfall.

The Coonabarabran/Warrumbungle region is situated on the boundary of the Northwest slopes and Northwest plains and the Central west slopes and Central west plains and as such would have been affected by a reduction in effective rainfall. The reduction, however, may not have been as severe as at Belarabon which is a semi-arid area today.

Pollen samples from Lake Frome covering the period 7000 BP to present, were analysed by Singh (1981:118), (Lake Frome is situated approximately 130 km northwest of Broken Hill - see map 1.2). The pollen analysis indicated that summer monsoon incursions were more frequent in the period 7000-4000 BP in Southeastern Australia than from 4000 BP to the present. In the latter period, both the summer and the annual rainfall declined markedly (Singh 1981:118). Lake Frome is situated in a much more arid area than around Coonabarabran, however, personal observations of the recent prolonged drought (1992-1996), point to an absence or a very marked reduction of monsoon rains in the northwest of NSW. This drought, according to historical records, was more severe than any previously experienced in the region and may be used to indicate the boundary conditions of more arid periods. The Lake Frome pollen analysis must have some value for postulating changes in the climatic conditions in that period for the Coonabarabran region as the latest drought (1992-96) enveloped all the area between Lake Frome and Coonabarabran.

Other personal observations (during the 1992-96 drought) of the Northwest slopes (in which Coonabarabran is situated) have made it clear that this drought extends the range of variability of climate as recorded in the region since 1830. During the 1992-96 drought, waterholes and springs that had never run dry in recorded history, and were considered permanent by landholders, had either dried up or the flow of water from them had been reduced considerably. Dramatic variations in climatic conditions were probably a regular, if infrequent, feature in the region from the middle Holocene to the present. At Ulungra Springs, on the banks of the Yarragrin Creek, there is a layer of about 15 cm of black silt on top of the Pilliga Sandstone (personal observations). Farmers in the area stated that the largest recorded flood in the area was only level with the creek bank, so that implies that at one time in prehistory, a flood of larger proportions than the 1955 flood must have carried the black silt from areas of black soil further up the valley to be deposited on the creek bank. The personal experience gained from living in the Northwest of the state for the past 50 years suggest that the extremes of climatic conditions have continued on past the c.450 BP which was the limit of the evidence from Linacre and Hobbs (1977:191-192). The most extreme conditions such as the 1992-96 drought may have occurred every 200 years or so as the drought had no equal in the Northwest since climatic were first recorded in the 1930s. Davidson (1990:54) has stated that in prehistoric times, these extremes of climate, would have led to local extinctions of Aboriginal groups.

During dry times, the black soil slopes and plains of the Northwest have very poor water capillary action compared to the sandy soils around Coonabarabran (Jensen 1912:130). However, the sandy country, though much lower in plant nutrients than the black soils (Jensen 1912:130), would be more attractive for the Aborigines in dry times, as less risk (as far as food and water were concerned) was present in this country. From personal observation, waterholes on the sandy soils usually have a solid sandstone base ensuring a smaller loss of water from drainage through the bottom of the waterhole than from those on black soils. This suggests that the environment, and in particular water resources, could be a major factor in determining where Aboriginal sites would be located in these dry and or/drought periods.

The location of Holocene Aboriginal sites around favoured waterholes in Northwest NSW seems to be widespread as surveys conducted by Jan Wilson and myself around the Tamworth region (which is situated about two hundred and fifty kilometres to the east of Coonabarabran - see map 1.1) have found that where there have been permanent water holes during this drought (1992-96), Aboriginal sites have invariably been found nearby (see Gaynor and Wilson 1994, 1995). This seems to suggest that water may have become more accessible around CMS at between 6000 and 7000 BP when evidence for increased use of the site first becomes evident. The present landscape has a very swampy area about 200 metres north of the site. If this was present at 6000 BP, it would probably have supplied a reasonable source of water but probably not during the more arid Pleistocene period.

The pollen analysis from Ulungra Springs has given some insights into climatic conditions covering the period of Aboriginal occupation in this region. Spring/swamp sites such as

Trinkey and Lime Springs show much evidence of intense Aboriginal occupation from before 19000 BP till 6000 BP, when the springs dried up (Wright 1986:8). It is important to note here, that the main occupation at CMS seems to have commenced at c.6000 BP. This may have occurred as a results of the same climatic incident that ended the continuous swamp conditions at Ulungra Springs, Lime Springs and Trinkey.

The palaeoclimate of the region can be summarised as :

PLEISTOCENE

Conditions and vegetation were much the same before 27,000 BP as the present climate, with Eucalypt pollen dominating the pollen record. It became progressively colder from that period until about 18000 BP when Chenopods dominated the pollen record. This indicated a shrubland much the same as the semi-arid area of Australia today, with trees found along watercourses.

HOLOCENE

Conditions became progressively warmer and wetter until about 4000 BP. Annual rainfall and monsoonal conditions declined after 4000 BP with a very dry period between 3500 and 2500 BP. Conditions since then have been much the same as the present with wide variations of wet and dry periods.

2.5 WITTER'S MODEL

Witter (1986b:1-7) presented three phases of a model based on his knowledge of surface stone artefacts and environments in the region. Witter divided the region into the following landscape zones:

1. The Warrumbungle Ranges.
2. The Sandstone Plateau.
3. The Black Soil Plains.
4. The Castlereagh River Valley.

Witter stated that the Ranges and the Sandstone Plateau today are mixed Eucalypt type woodlands, while it was generally thought that the Black Soil Plains were probably grasslands in prehistoric times. These Plains today, contain small tree-lined watercourses which flow towards the west and eventually empty their contents into the Castlereagh River. The Castlereagh River supports a Riverine woodland which also extends into its chief tributaries.

Witter's model covers the period from pre-5000 BP till 200 BP. This model was based on the amount of archaeological information available at that particular time. This evidence was slight with no regional evidence available from excavated sites with radiocarbon dates.

Much of this model then was based on assumptions about typology.

The phases of Witter's model were :

1. The Early Prehistoric Period (pre-5000 BP) see map 3.1.
2. The Microblade Period (5000-2000 BP) see map 3.2.
3. The Post Microblade Period (2000-200 BP) see map 3.3.

Witter suggested that camps in the Early Prehistoric Period would be situated in optimal areas. These areas would be:

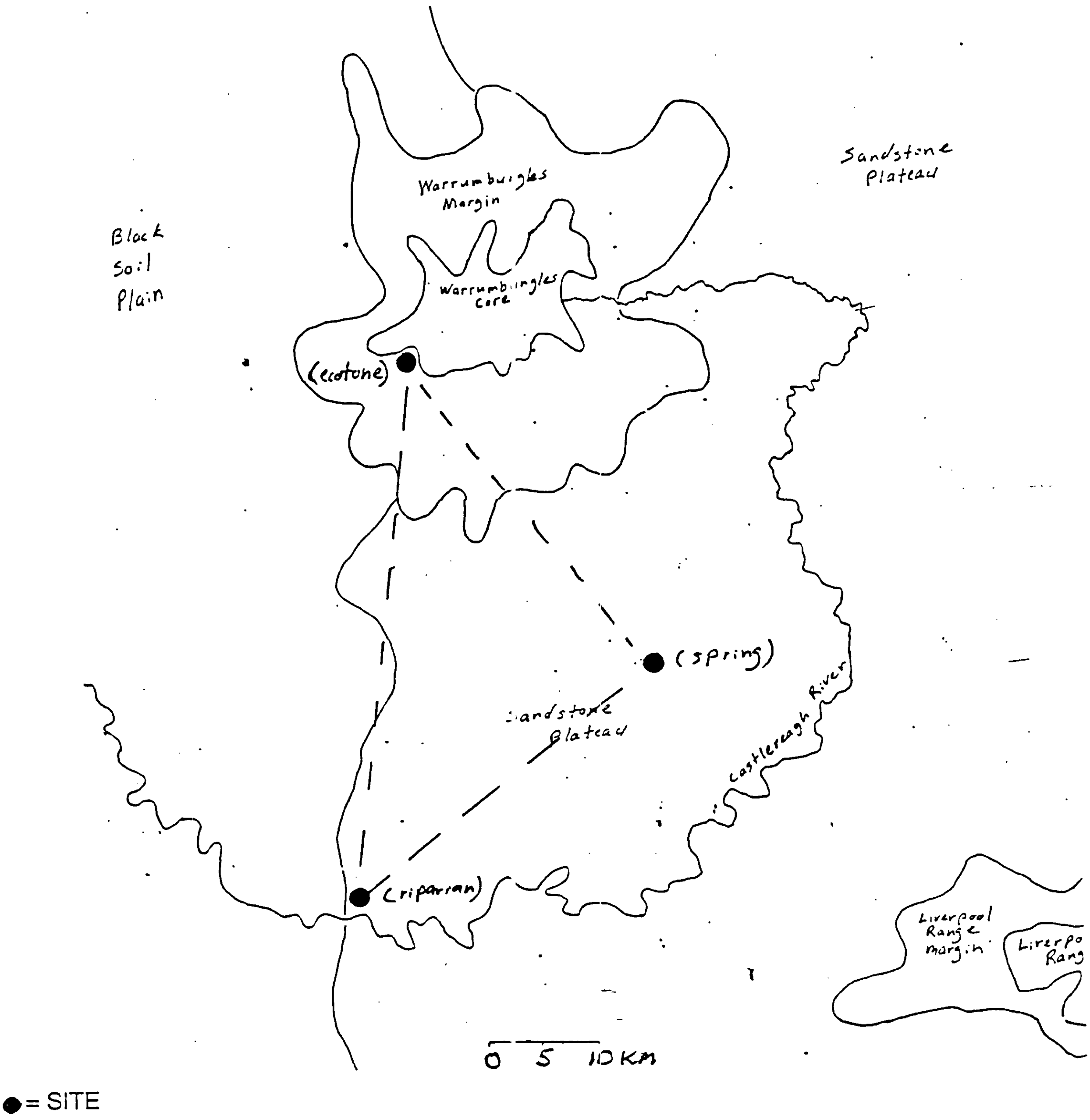
1. In the margins of the Ranges.
2. Around the springs in the sandstone country.
3. In the highly diversified areas along the Castlereagh River.

In the period before 5000 BP, Witter has indicated that sites would be sparse and would be located in areas of optimal diversity.

The Microblade period according to Witter, had base camps located around the margins of the Warrumbungle ranges and the Castlereagh River. Satellite camps were situated close to these base camps. Some camps were located in areas that had supplies of fine grained raw material stone sources (such as chert, jasper and chalcedony). The Post Microblade period had a diversity of camps that were occupied seasonally. The Sandstone Plateau was used chiefly for hunting kangaroos as they came to waterholes and springs for water (there was the possibility that nets were used to catch some of these animals). Small mammals and lizards were also hunted. Because of the high fertility of the black soil plains today, Witter suggested these plains contained big camps that were occupied on a seasonal basis, with the Aborigines gathering large quantities of root foods in the spring. According to Witter, these Plains would have supported a large population of Aborigines. He also suggested that the Aborigines processed grass seeds in the autumn in that area with the resources of the Castlereagh River possibly only being used in drought times. Small groups would have gathered a variety of fruit from the Warrumbungle mountains in mid summer with *Macrozamia* nuts used as a staple food in the margin of the ranges (Witter 1986b:37).

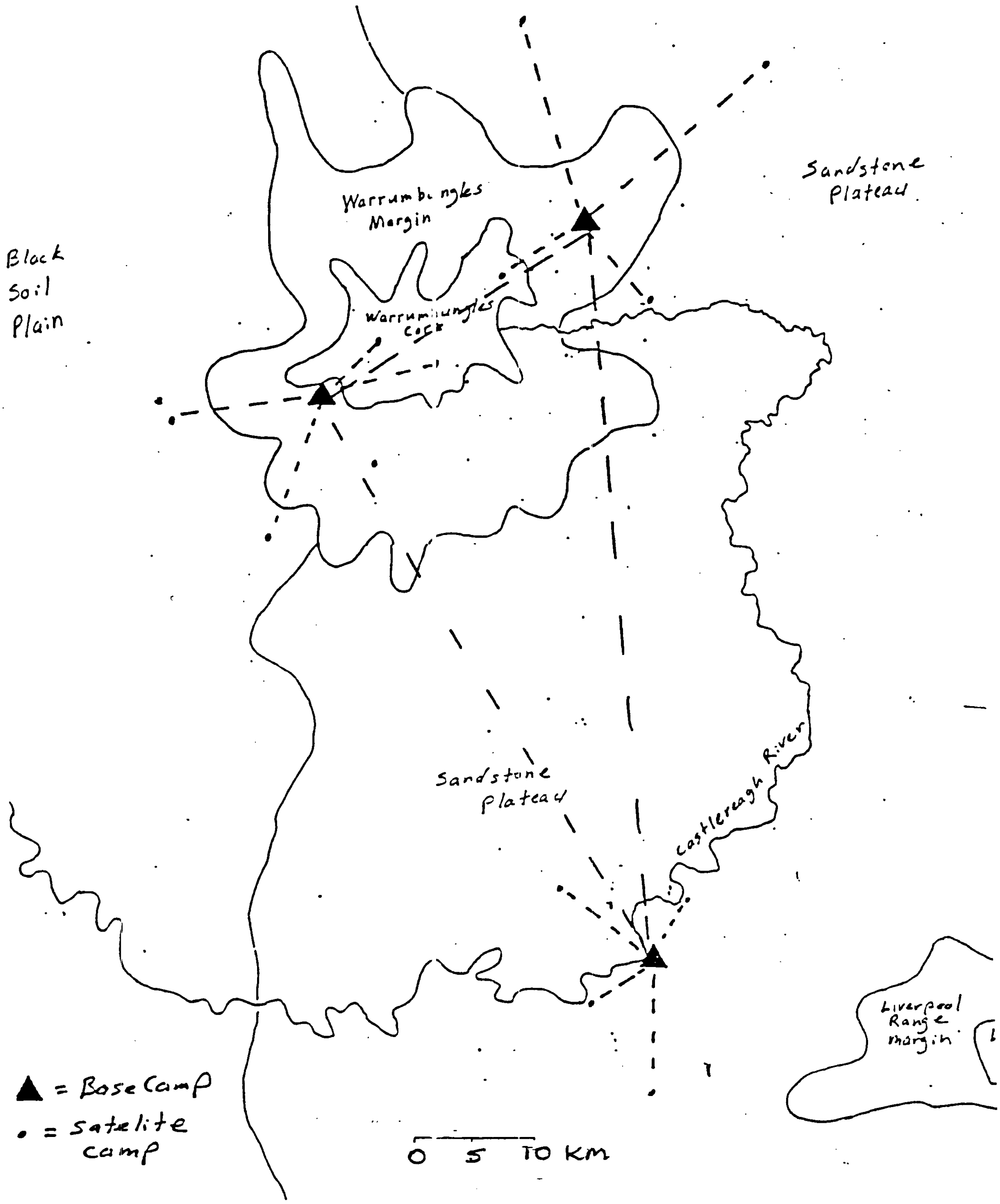
From personal observations, Macrozamia plants grow on most sandy soils in the Coonabarabran/Warrumbungle region. The fruiting of the Macrozamia plant, however, seems to be a haphazard affair with many years between fruiting of plants (personal observations). According to Beck (personal communication) *Macrozamia* sp. probably have a six year fruiting cycle, which is the same as many other Cycads. Although there is some evidence to suggest that burning may encourage fruiting (Beaton 1982:59-67),

WITTER'S MODEL (PHASE 1)



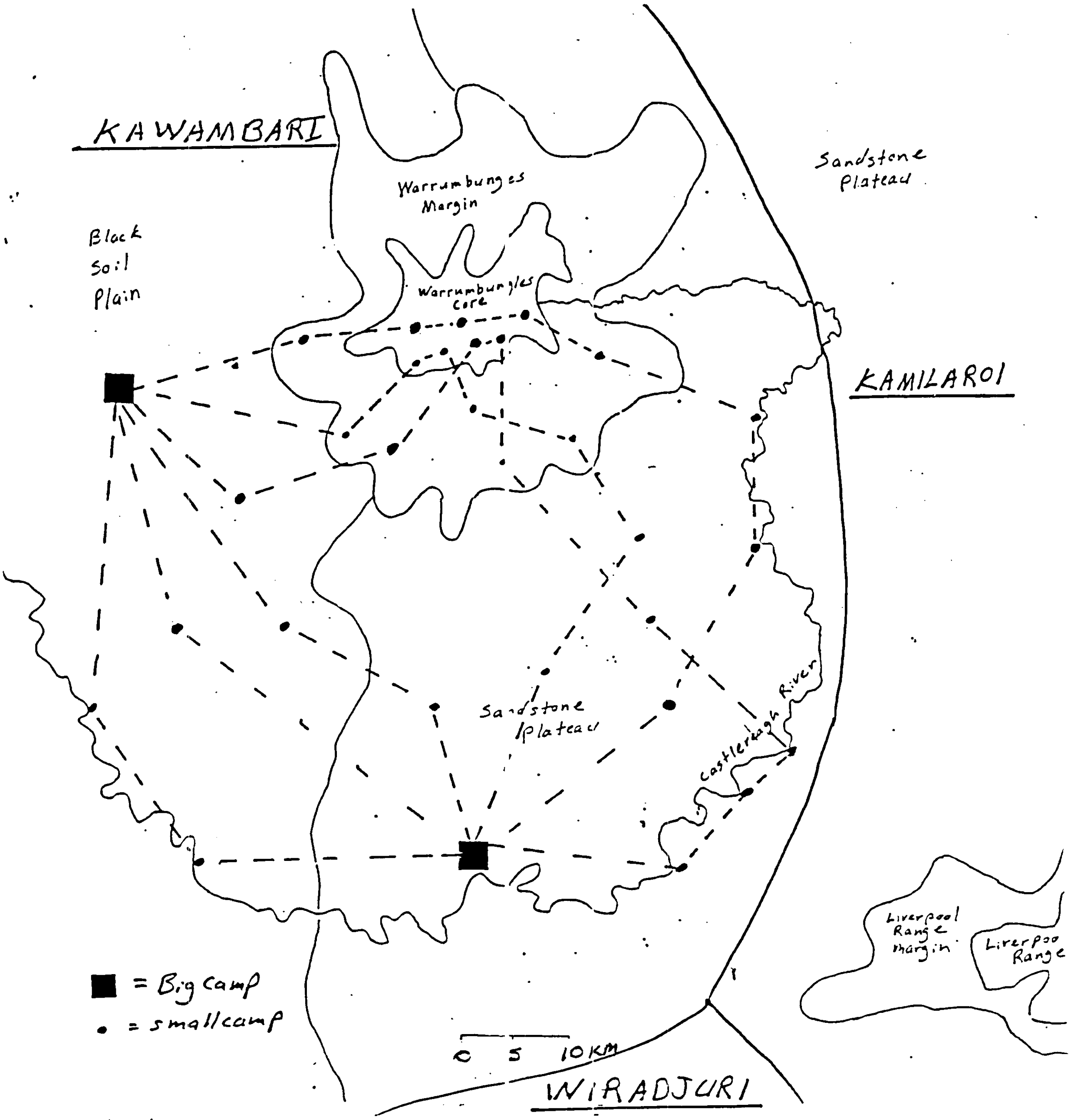
EARLY PREHISTORIC PERIOD (PRE 5000 BP)
SITES LOCATED IN AREAS OF OPTIMAL DIVERSITY
(adapted after Witter 1986b:1-7)

WITTER'S MODEL (PHASE 2)



MICROBLADE PERIOD (5000 - 2000 BP)
BASE CAMPS LOCATED IN FINE GRAINED PATCHY ENVIRONMENTS.
SATELLITE CAMPS ASSOCIATED WITH THE BASE CAMPS
(adapted after Witter 1986b:1-7)

WITTER'S MODEL (PHASE 3)



POST MICROBLADE PERIOD (2000 - 200 BP)
BIG CAMPS LOCATED IN MAJOR HIGH PRODUCTIVITY AREAS.
SMALL CAMPS USED WHILE DISPERSED OVER REGION.
AGGREGATION TAKES PLACE AGAIN IN ANOTHER BIG CAMP
TRIBAL BOUNDARIES FROM TINDALE (1974)
(adapted after Witter 1986b:1-7)

my observations from the Warrumbungles in areas that have been fired, seems to imply that fruiting may not take place for up to 3 years after the area has been burnt. Purcell's (1994) research was directed towards residues on artefacts from the Coonabarabran region but it was not specific enough to ascertain whether quartz artefacts have been used in the harvesting and processing of Macrozamia nuts.

Witter's phases of his model depicting camp sizes and types in the different periods, all have information that will be important in formulating models of past Aboriginal activity and in turn in quantifying the importance of quartz in the region. However, Witter did not deal specifically with technological aspects of artefacts in the phases of his model.

Ross (1985:84-87) has argued that the increase in the number of sites occupied in the Victorian Mallee after 4000 BP was a general theme that had occurred throughout Southeastern Australia and this theme signifies population increase. This increase in site numbers in Southeastern Australia has important implications for any proposed model of the Coonabarabran/Warrumbungle region.

Witter based the phases of his model on the impressions gained from studying the surface stone artefact scatters in the Warrumbungle Mountains area while he was the NPWS Regional archaeologist for the area and also on his general understanding of the reduction sequence of stone artefacts of Western N.S.W. (see Witter 1985:519). All the assemblages Witter inspected in Coonabarabran/Warrumbungle region were surface scatters (as the first excavation did not take place until 1987). He defined these assemblages as "Post-microblade in age". He recognised at the time, that special attention should be given to datable deposits to help clarify the chronological sequence he had postulated (Witter 1986b:5-7). This has now been carried out with excavations at four of the sites selected for this research.

From the results of the technological analysis of a portion of the stone assemblage from the excavation of KACA that I carried out in 1987, I was able to suggest a revision of some of the dates put forward by Witter for the duration of the age of some of the phases of his model. On the available evidence at the time from KACA, it appeared that the "Microblade Period" (signified by the large scale manufacture of backed artefacts) ended no later than c.1000 BP. This is younger than the 2000 BP date as suggested by Witter. This revision of dates would place the "Post Microblade Period" of Witter's in the period c.1000-c.200 BP (these are uncalibrated dates). These dates also have implications as to the age of the surface scatters in the Warrumbungle National Park that were recorded prior to 1987 (see Gaynor 1987:247-286, for some o these). If these artefact scatters were less than c.1000 BP in age, then this could imply that the Warrumbungles Mountains were not frequented to any great extent before this time, or alternatively that the earlier assemblages containing high percentages of fine grained material (if they were ever present) are now buried. Those sites analysed in 1986, which had percentages of fine grained material above 12%, may in fact, have been part of these older sites (Burbie Springs could be such a site : see table 2.1).

2.6 GAYNOR'S PREDICTIVE MODEL

The phases of this model have been formulated to take advantage of information from Gorecki et al. (1984), Moore (1970) (raw material preference); Witter (1989a,b,c,d,e,f), Gaynor(1987) and Wall (1993) (Coonabarabran stone technology); Wasson (1983), Singh (1983), Dodsor and Wright (1989) Linacre and Hobbs (1977) Dodson et al. (climatic considerations) Beck (1989) and Beaton (1982) (Macrozamia information). The phases of the model are then used to guide the analysis of the excavated sequences at the Crazyman Shelter.

2.6.1 Phase 4

20,000 BP to 8000 BP (Late Pleistocene/Early Holocene)

The phase has been constructed using data from :

1. The Lime Springs site (which has an uncalibrated date of 19300 ± 500 - Gorecki et al. 1984).
2. The Bobadeen site (which has a base uncalibrated radiocarbon date of 7750 ± 120 BP - Moore 1970).
3. The Ulungra Springs site (Dodson and Wright 1989) which contained pollen data on late Pleistocene/early Holocene climate
4. Witter's pre 5000 BP phase.

It has been suggested that the Aboriginal population in some areas in Australia during the Pleistocene, was generally smaller than in the Holocene (for arguments for and against this position, see O'Connor, Veth and Hubbard 1993:95-105). Therefore in the Late Pleistocene/Early Holocene, small groups, as postulated by Witter in the pre 5000 BP period in the Coonabarabran/Warrumbungle region, should have had little restriction as far as access to resources was concerned. This scenario, however, would leave limited archaeological evidence across the landscape and any artefacts recovered from these sites

would show signs of only the basic reduction of raw materials and little rationing (i.e cortex would be present on many artefacts, the percentage of rotated cores in an assemblage would be small, the percentage of microdebitage would be small).
Local raw materials (such as quartz and quartzite) would be used more than exotic raw materials as the need to carry raw material around for later reduction would be minimal due to good access to raw materials sources within extensive tracts of land. Knapping skills would not need to be high, as economic use/rationing of raw materials would not be warranted due to a plentiful supply of raw materials in all areas.

At the larger well watered sites such as the spring fed swamp site at Lime Springs, evidence for more economic use of raw material could be more evident as resources around these sites would have been subjected to more pressure on them than other sites that were only sparingly used. This scenario should see much use of local quartz and little use of exotic material. Exotic material if present, however, should show less evidence of rationing than post 5000 BP. As there is evidence for Aboriginal presence at Lime Springs (about 80 km to the east of Coonabarabran) a 19300 ± 500 BP (Gorecki, Horton, Stern, and Wright, 1984:118), it is assumed that Aborigines were occupying the Coonabarabran/Warrumbungle region as well.

2.6.2 Phase 3 (8000 BP to 5000 BP)

The phase has been constructed using data from :

1. The Trinkey site (from which Wright (1989) has stated that the swamps dried up at approximately 6000 BP).
2. The Bobadeen site (which has a base uncalibrated radiocarbon date of 7750 ± 120 BP - Moore 1970).
3. The Ulungra Springs site (Dodson and Wright 1989) which contained pollen data on late Pleistocene/early Holocene climate
4. Witter's pre 5000 BP phase.
5. Climatic information from Dodson <u>et al.</u> (1989) Wasson 1983), Singh (1983)

In this period, stone artefact assemblages would initially not show any appreciable difference to those from the Late Pleistocene/Early Holocene but as the climate became warmer and rainfall increased (c.6000 BP), food resources may become more plentiful (a greater quantity of food plants, more animals and possibly more people owing to a better and more plentiful diet). Although organic resources would increase in this period, stone resources would not, and with increased population pressures, stone artefacts from this period would show signs of more thrifty use of raw material (this should be evident by the presence of more rotated cores, a lower percentage of cortex on flakes and cores, a larger percentages of microdebitage from increased reduction). An increase in knapping ability would be evident. Quartz should still be the dominant material, but skills in knapping the quartz should be improving due to a greater pressure on this local resource. Sites would still be sparse across the landscape except for a few large residential types situated close to a permanent water supply.

2.6.3 Phase 2

Revised Microblade Period (5000 BP - 1000 BP)

The phase has been constructed using data from :

1. The Kawambarai Cave site which has a base uncalibrated date of 1980 ± 140 BP (Gaynor 1987:35)
2. The Bobadeen site (which has information on backed blades - Moore 1970).
3. The Graman site (which has information on backed blades - McBryde 1977).
4. Witter's Microblade phase.
5. Climatic information from Wasson (1983), Singh (1983).

According to Witter's model, this period began at c.5000 BP. There should an increased use of fine grained material to coincide with backed blade technology and this should produce a larger percentage of microdebitage and flaked pieces (as debris from the backing operation) and a greater reduction of cores. McBryde (1977:243) cites the use of on-site quartzite for making backed blades at Graman on the northern slopes of NSW, although the local cherts and chalcedonies were better suited to the task. Using this as an analogy, quartz being available on site may be used to make backed blades even though cherts and chalcedonies are better suited to the task.

Generally, as greater pressures were exerted on raw material sources, cores and flakes will have less cortex, and fewer whole flakes will be left on site as these will be utilised off-site. The core percentage per assemblage should be lower than in the previous period, as the cores would be reduced more. Percentages of flaked pieces (see definition - 3.3) should show increases due to a greater reduction of cores and the backing of artefacts. There should be an increase of the percentage of rotated cores without cortex present over the last phase, due to a maximum effort to get the most out of cores. Base camps could be located close to areas that have supplies of fine grained material. Climatic conditions will be inclined to be dry between 4000 BP and 3000 BP, but should improve after this time. As greater pressure is put on food resources, Macrozamia nuts should be utilised and their remains found in excavated shelters.

2.6.4 Phase 1 The Post Microblade Period (1000 BP - 200 BP)

This phase has been constructed using data from :

1. The Kawambarai Cave site (Gaynor 1987:35).
2. Wall (1993) on quartz artefacts.
3. Beck (1989), Beaton (1982) on *Macrozamia* information.
4. Witter's Post-microblade phase.

(Witter (1986b:5-7) stated that most of the surface assemblages he had inspected in the Coonabarabran region were "Post Microblade" in age (i.e they did not have backed artefacts present). Given that information, the five sites selected for analysis for this research, (all surface scatters or the surface units of excavated sites) are most likely to be "Post Microblade" in age.

Using the evidence from Gaynor (1987) and Wall (1993), these assemblages should show a smaller percentage of flaked pieces than the previous period, a larger percentage of whole flakes (caused by more opportunistic knapping) and a larger percentage of cores than the "Microblade" period. Bipolar knapping of quartz cores should increase as this is the easiest and quickest way to reduce a core. Furthermore as there seemed to be a decline in artefact density at KACA in the "Post- Microblade" period (Gaynor 1987:197), this trend should also be present at other excavated sites.

According to Witter, as there were few or no backed artefacts found from the "Post-Microblade" period, there should be less dependence on fine grained material in assemblages from this time as those raw materials seemed to have been favoured for the "Microblade" technology. Wall (1993:63) supported Witter's supposition, as he found that fine grained material accounted for less than 10% in the six surface assemblages he researched.

Camps will be scattered across all landscapes but these sites may have been used only spasmodically as food resources became available in each area (this could be directly connected with climatic variation such as drought). Sites with good access to stone resources may be residential types as there would be an incentive to camp close by. Another factor that appears to have influenced assemblages is preference for raw material.

2.7 CONCLUSION

The model uses the Coonabarabran region as an example of the potential of how quartz technology may be analysed to answer questions of land use. Artefact attributes that could be used to test this model will be discussed in the next chapter. I have reviewed the archaeology of the study region, the past climatic conditions and the previous studies of quartz technology. All these factors supply information either directly (archaeology) or indirectly (climate) that would have affected the way quartz was used in the past.