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The Function, Design and Distribution of
New Zealand Adzes

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A thesis submitted
in partial fulfilment of
the requirements for the degree of
Doctor of Philosophy
in
Anthropology

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ABSTRACT

The main objective of this thesis was to understand the function, design and distribution of New Zealand adzes, aspects little studied in Polynesia as a whole. Methodology involved functional and manufacturing replication experiments and comparisons of these results with statistics derived from the analysis of almost 12,000 archaeological adzes. Methodology was guided by technological organization theory which states that technological strategies reflect human behaviours and that artefacts like adzes are physical manifestations of the strategies employed by people to overcome problems posed by environmental and resource conditions.

Variability in adze morphology was discovered to be the outcome of ongoing technological adjustments to a range of conditions that were constrained by a set of functionally defined parameters. The nature of the raw material, both for the adzes themselves and to make them, had a major influence on adze technology and morphology within these functional parameters. Four basic functional adze types were identified from distinct and consistent combinations of design attributes not previously recognized explicitly in previous adze typologies. It was found that design attributes previously considered significant like cross-section shape and butt reduction were more heavily influenced by raw material quality than functional specifications.

It was also important to recognize that form and function changed over time with use, and because adzes were so valuable due to manufacturing costs, they were intensively curated. The majority of archaeological specimens studied for this thesis had seen major morphological and functional change. This dynamic was included in a typology based on 'adze state' as findings suggested (1) that extending adze use-life and optimizing reworking potential was incorporated in initial design strategies, (2) that intensive curation may have played a major role in changes in adze morphology over time, and (3) that it had a major influence on distribution and discard patterns in the archaeological record.

Having identified these influences on adze discard and distribution, two complex production and distribution networks were observed for the North Island based around Tahanga basalt and Nelson/Marlborough argillite. Each was complimentary to the other and involved other major and minor products and materials. Influential factors in the roles different settlements played in distribution included where people and raw materials were in relation to one another and the mode of transportation. The coastal location of early period settlements and important stone sources was an important aspect of these networks.
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CHAPTER ONE: INTRODUCTION

The study of adzes has long been a focus of archaeological research in Polynesia but their potential value for providing information on human behaviour, while recognized, has not been realized. Furthermore, the preoccupation with adzes as 'type fossils' and 'markers of culture historic patterns' (Issac 1977) continues as archaeologists persist in the use of formal adze typologies (e.g., Duff 1977) which were designed to address a limited range of questions.

Archaeologists are aware of the inadequacies of current methodologies employed to study adzes and this has resulted in new approaches (Cleghorn 1984). The similarities shared by adze types throughout Polynesia have identified close cultural historic relationships (Duff 1977; Green 1971; Skinner 1974). A clear chronological sequence of development and change among and within different island groups, however, particularly in East Polynesia, remains elusive.

Formal typologies provided a description of the standardized morphological adze forms present in Polynesia, where they are present or absent, and in what frequency, but do not adequately explain these observed patterns. Previous statistical analyses (Green and Desaint 1978; Green and Purcell 1961; Groube and Chappell 1973; Law 1995; Park 1972), while establishing certain significant dimensional correlations, ultimately failed to explain their significance. In recent years it has, as a consequence of these failures, become apparent that explanation may need to be sought in other areas relevant to the people who originally produced these artefacts, namely function and technology. While certain progress has been made concerning the manufacture and production of adzes (Cleghorn 1982; Jones 1984; Leach and Leach 1980; Leach and Witter 1987, 1990; Turner 1992; Turner and Bonica 1994; Witter 1985), the results of technological studies (for example, the influence of raw material quality on final adze form) have yet to be fully incorporated into the analysis of finished adzes. Apart from S. Best's small but significant study on adze function (1975), the function and use of adzes has received scant attention from archaeologists. Due to a primary concern with the adze as an 'archaeological tool' for defining cultural relationships through time and space, the implications of the adze as an 'actual tool' have been almost completely neglected.

Methodological analyses have focused on the classification of a restricted number of features into discrete categories without consideration of the influences they reflected. In Europe, reassessment of Bordes’ (1961) classification of stone tools demonstrated that many of these
formal morphological types were not discrete categories but rather the outcome of '...continuous morphological change due to continuous use and rejuvenation' and that 'continuous remodification was the key factor in accounting for tool variability in the archaeological record' (Rolland and Dibble 1990). In Polynesian adze studies this insight has yet to make an impact. Duff's typology implicitly treats adzes as though they were in a pristine unused state; that they may have been used, and undergone extensive morphological modification as a consequence, is ignored.

The probable influence of use on tool morphology has seen the introduction of new ways of observing the role of stone tools in archaeological research and a greatly expanded perspective on the types of questions stone tool studies can address. The concept of 'Technological Organisation' describes this approach and the best summary of this work to date can be found in Nelson (1991). The basic premise of technological organization theory is that 'Technology facilitates, and perhaps constrains, much human activity, particularly human relations to the natural environment' (Nelson 1991:88). Stone tools and their byproducts are material manifestations of behavioral strategies designed to overcome problems posed by environmental and resource conditions. Problems include '...time stress, risk management, activity scheduling, mobility requirements, energy costs, raw material availability and social aggregation requirements' (1991:60). Thus strategies developed to deal with these problems apply from the tools inception, namely with the problem of procuring the necessary raw materials for the types of tools required, until their discard, loss or abandonment - the point at which they enter the archaeological record.

Three technological strategies for dealing with these problems are identified by Nelson - curation, expediency and opportunistic behaviour. Artefact form, distribution and assemblage composition are therefore '...the consequences of different ways of implementing...' these technological strategies. (1991:62).

Curation is a strategy that involves preparing tool kits well in advance of use. This preparation can involve special expeditions to procure raw material, prolonged and staged manufacturing sequences, repair and recycling of damaged tools, and storage of tools before and after use. Expediency, in contrast, is a strategy employed where tools are manufactured when needed, and discarded shortly after. The major difference between these two strategies is that curation is a response to conditions where raw materials and manufacturing time are not available at the place of use. A well known example of a highly curated technology is detailed in Binford's ethnographic study of the Nunamiut. Because they captured almost 70% of their subsistence
needs during one month of the year (a consequence of migratory herds), it was essential that hunting gear be well prepared in advance (Binford 1979). Expedient strategies anticipate raw material availability and generally short tool manufacturing times at the place of use (Nelson 1991:63,64). Portable cores, where flakes are struck off and used when required, are a prime example of this strategy. In New Zealand, adzes may be viewed as an example of a curated technology, while obsidian flakes and cores probably represent an expedient technology. As asserted by Nelson (1991:63), these strategies are not mutually exclusive. Nor do they exclude taking advantage of unforeseen circumstances - opportunistic behaviour (1991:65).

Important to these strategies are 'design variables' (Nelson 1991:66). Curated tool kits need to be reliable, that is, they must be designed to carry out the task efficiently and to last the distance. To ensure these conditions, reliable tool designs are often 'overdesigned', that is, bigger and stronger than they need to be, of high quality raw materials, frequently comprised of composite parts with a backup supply to enable quick replacement, and with features that facilitate repair (Bleed 1986:739). While reliable tool designs are '...suitable for maximizing tool-use time, considerable downtime for manufacture and maintenance is needed both before and after tool use' (Nelson 1991:67,68). Thus both the costs and the benefits of a reliable tool design are high.

Expedient tools are generally 'maintainable' designs - light, portable, quickly made and easily replaced (Bleed 1986:740). They may also be 'flexible', for example, the edge of a flake can be used variously for scraping and cutting or can be retouched to form a range of other tools, or 'versatile', a tool that can be employed for a range of uses (Nelson 1991:70).

Bleed uses ethnographic examples to correlate these different strategies and designs with differences in subsistence practises and settlement patterns. Nomadic hunting and gathering groups like the !Kung and Yanomamo have expedient, maintainable tool technologies, whereas more sedentary groups like the Nunamiut, who operate from semi-permanent residential bases with very short hunting periods, have highly curated reliable tool kits (1986:740-43). Shott (1986), drawing on similar ethnographic data, stresses this point further by stating that recognition of these different types of tool technologies would enable reconstruction of settlement 'mobility' (1986:20). He adds that the degree of mobility, whether 'residential mobility' like the !Kung, or 'logistical mobility' like the Nunamiut, will be a major influence on the type of tool kit in use. Kelly (1988) and Odell (1994) provide cases using both ethnographic and archaeological data where increased sedentarism over time was accompanied by a change from expedient to more curated and reliable tool kits.

Amid considerable debate, raw material availability is most commonly cited as the primary
factor in changes from an expedient to a curated technology, or in the choice of one over another. A high level of mobility meant that people regularly moved through areas where raw materials needed for tools were available, and that the procurement of these could be 'embedded' in other activities, thus no extra time or energy was wasted. People constantly on the move needed to minimize excess baggage thus small, flexible and expendable tools were desired, and this type of technology was rendered feasible by the certainty that raw material would be available at the next destination when tools would be required again. More sedentary societies, those practising 'logistical mobility', in contrast, were faced with an extra task when preparing tool kits - special trips had to be made as raw material was no longer so readily available or expendable. The development of conservation strategies was a response to this problem. Strategies included the use of more reliable designs that entailed more efficient use of the raw material and enhanced its durability. Tools were no longer discarded directly after use and/or damage. Edges could be rejuvenated and broken tools remodelled to fulfill some other function. By this process, tools became highly curated, and the degree of curation evident in any given tool assemblage is taken by some authors as a measure of the degree of raw material availability/scarcity. (Bamforth 1986,1990; Beck and Jones 1990; Hayden 1989; Kelly 1988; Morrow and Jefferies 1989).

Other scholars (Kuhn 1991; Nelson 1991; Torrence 1983,1994), however, caution that curated technologies are not simply a response to raw material being in short supply. Production and function requirements may result in reliable curated tool kits regardless of settlement mobility. Broken and damaged tools may be '...brought back to residences to be maintained and reworked in order to recover the cost, in manufacturing time, of portable design' (Nelson 1991:78). Torrence (1983) suggests that 'time stress' may be an important factor regarding technological behaviour. Curated technologies imply considerable 'downtime' spent at residences preparing tool kits to maximize the success of brief hunting periods. Time invested in production paid off in time invested in use (1983:12).

In a later paper, however, Torrence asserts that function may be the major influence on tool variability. She states that '...the key variable (for a tool to hunt bison) would have been the characteristics of the prey (i.e., the nature of the task) not the (availability of the) raw material.'(1994:127), and that selection of raw materials is guided by functional requirements, not the other way around.

Additionally, sedentarism need not engender an immediate problem with raw material availability. Base residences may be located close to important raw materials (Nelson 1991:79), or alternatively procurement of raw materials for tools may be embedded in other activities such
as hunting expeditions. This latter situation was the case, according to Binford (1979), with the Nunamiut who collected raw materials en route to their hunting grounds, stockpiling them at strategic locations for collection at a later and more convenient date as required. Their highly curated tool kits were a response to a different set of problems, ones that did not include raw material availability. Nelson concludes that various technological problems ‘...must be weighed against one another with respect to different contexts' (1991:60).

Different technological strategies will result in different patterns of tool discard being reflected in the archaeological record. Tools resulting from expedient technologies are likely to be manufactured, used and discarded in the same context and within a short space of time. Highly curated tools on the other hand are rarely discarded in a context of use. Even damaged and broken tools were brought back from hunting trips by the Nunamiut for future reworking and repair (Binford 1977). Nelson states:

‘Those [residences] occupied during seasons of low productivity, sometimes described as downtime, should have the highest proportion of tool manufacture and repair debris because the greatest amount of time is available for these activities’ (1991:79).

Storage or 'stockpiling' or 'caching' of tools is also most likely to occur at base residences, especially for those not in constant use and where 'items are too complex or heavy to be moved from place to place' (Nelson 1991:82).

Nelson further asserts that 'The artefact or artefact class' becomes 'the analytic unit of comparison. Distributional expectations refer to regional patterning of artifact classes, not the characteristics of different places' (1991:86).

Studies of technological organization therefore incorporate the production, function and design elements of tools and relate to these within the contexts of subsistence and settlement practices. The potential of stone tools to inform on many aspects of cultural behaviour in Polynesia may now be more effectively explored. Polynesian cultures are but one example where both curated (adzes) and expedient technologies (flake tools) were used in response to different tool requirements.

Traditionally adzes have been studied from a very narrow perspective; archaeologists have rarely looked beyond the artefact to ask questions that relate to site function and context. For example, what does the presence of adze caches and evidence of adze manufacture and reworking at a site tell us about settlement duration and function? Can we really accept
Anderson's (1989) interpretation that the Waitaki River Mouth site was merely a temporary moa cooking and preparation staging post without explaining what very large numbers of highly curated, very valuable, specialized wood working tools (see Figure 3.62 and 3.63) were doing in a context not related to moa cooking?

Additionally, identification of the technological strategies represented by stone tools in sites also has the potential to define relationships and communication networks among people occupying these sites. It may be possible to go beyond merely identifying links among regional groups from the range of imported materials found, to explaining the behavioural strategies that resulted in the deposition of these materials.

For many early sites in New Zealand, little evidence generally remains but large artefact assemblages, among which stone tools often dominate. As such they represent a largely untapped source of information that could have a significant impact on our understanding of early Maori culture.

The study of stone adzes in New Zealand has previously been hindered by an impoverished ethnographic record. By the time Elsdon Best conducted his ethnographic study on stone implements (1912), none of his informants were still using stone tools, nor had they done so for several generations. Additionally, what information they could provide only related to late period technology and the types of adzes in use at that time. European explorers, however, did note the uncommon skill with which Maori and other Polynesian groups could wield an adze and shape wood, a skill that apparently surpassed that of European experts (Brigham 1902:408-410). That skill has all but disappeared in modern times. Mechanical experiments such as those carried out by S. Best (1975) failed to incorporate the fundamentally important role of the adze-user. For example, Cleghorn (1984), in criticising Best's test for 'angle of attack', stated that Best did not consider that this could be strongly influenced by the wood-worker '...modifying his motor patterns when using the adze' (1984:413). In his axe replication experiments Dickson rejected the use of a 'mechanical chopping device' because

'...the experimental conditions would be too artificial to have much relevance for the operation of a tool designed for a human user. The human arm is not a rigid structure and it would be exceedingly difficult to simulate...' (1981:123-124).

It was therefore my fortune to observe the use of stone adzes by Dante Bonica who has gained proficiency in the use of both steel and stone adzes over a period of many years which involved working on canoe building and restoration projects on the Turangawaewae Marae in
Ngaruawahia, New Zealand.

The aim of this thesis is therefore to apply technological organization theory to the study of Polynesian adzes. Defining the technological strategies imported from East Polynesia and how these may have developed and changed over time is a major focus of this research.

Of all the islands settled by the Polynesians, New Zealand must have presented the most alien landscape, being larger than all the Polynesian islands put together, with a cooler climate, and possessing a much greater range of resources. The identification of technological strategies may provide insight into how the first settlers responded to such a dramatic change in environmental and resource conditions, and how East Polynesian culture may have changed as a consequence.

The early East Polynesian adze-making technology brought to New Zealand was primarily based on the flaking of fine-grained tough volcanic rocks (like basalt) reflecting the geologically limited range of rocks available on home islands. Operational parts of the adze like the bevel and cutting edge were ground as was the rest of the adze to varying degrees with the technique of bruising the surface, or hammerdressing, occasionally employed in the finishing process.

By the time East Polynesian immigrants settled New Zealand a variety of adze forms had developed (Cleghorn 1984; Duff 1977; Green 1971). There was variability in size and cross-section shape, specially designed distinctive forms like the side-hafted adze and the 'hogback' (a large narrow-bladed gouge), and very large tanged quadrangular adzes that may have had a ceremonial function. Hafting security was provided by modifying or reducing the butt of the adze and they were usually lashed to one-piece flat-soled wooden hafts (Keyes 1971a; Wallace 1982).

In New Zealand, tough fine-grained flakeable materials suitable for adze manufacture had an uneven distribution. Manufacture was based at source locations or quarries where large parent forms like outcrops were worked and preforms flaked out. As seen also in tropical Polynesia, for example, Hawaii (Cleghorn 1984) and Samoa (Leach and Witter 1987,1990), abundant and extensive by-product assemblages were left behind in the archaeological record at quarries. Many regions in New Zealand relied on imported adzes from these quarries. Some adzes from major quarries like Tahanga on the Coromandel Peninsula and those of Nelson/Marlborough were distributed over hundreds or even thousands of kilometres (Best 1977; Keyes 1975; Moore 1976; Prickett 1989).

It has been assumed that these major 'exporting' quarries were controlled by specialists (H. Leach 1993; Witter 1985). Throughout Polynesia, according to Helen Leach, major quarries emerged contemporaneously to represent the '...organised production of large high-value adzes
for export, over the period from A.D. 1100-1500.' (Leach 1993:39). Leach further states:

'I find it difficult to accept that the concept of large high-status, high-value adzes of standardized morphology, which inspired the growth of these major quarries and enriched the communities which produced them, evolved independently but contemporaneously in Samoa, Hawaii, New Zealand, the Marquesas and Pitcairn. The concept may have arisen by association with the ancient Polynesian category of the expert, but this fails to explain why the large adzes and major quarries did not appear much earlier in the archaeological record, especially in the west. I am left with the proposition that the large adze constituted a new and desirable fashion and that the demand for it by tohunga or by chiefly families spread from central Polynesia...as far as Hawaii, Pitcairn and New Zealand early in the second millennium A.D.' (Leach 1993:41).

In New Zealand this adze technology was in place from initial settlement (at present a hotly debated issue but, based on radio-carbon dates from the earliest sites thus far discovered, not much earlier than A.D. 1200 - Anderson 1991) to some 300 years later (A.D. 1500), a time span known as the 'Archaic' (Golson 1959a) or 'Early period of Maori culture'.

Adze assemblages from sites dating between the 16th and 18th centuries, a period known as the 'Classic' (Golson 1959a), revealed that radical changes in almost every aspect of adze technology and morphology had occurred. This included changes in raw material, from fine-grained flakeable materials to coarse-grained rocks like greywacke and others like nephrite, and changes in manufacturing techniques with the flaking method replaced by hammerdressing and grinding for coarse-grained rocks and sawing for pounamu or nephrite (H. Leach 1990). There were changes in the location of manufacture with a decline in the exploitation of major quarries and a switch to domestic production. Adze distribution networks contracted and people increased exploitation of local materials. Changes in adze morphology were marked by a decrease in the range of cross-section shapes and standardization in size. The tang or hafting device was transferred to the wooden haft which may have had a recessed sole or extra parts like sockets into which the adze was slotted (Wallace 1982). In the North Island, a small to medium sized tangless rounded quadrangular form with a steep bevel, commonly rendered in greywacke and gabbro and known as Duff Type 2B, became the predominant form. The superior functional properties and aesthetic appearance of pounamu, found only in South Island west coast rivers and lakes, became dominant in South Island adze assemblages, and was the only adze-stone to be distributed throughout New Zealand in the Classic period.

These changes took place in a background of far reaching changes in subsistence and settlement patterns, increasing conflict and competition for dwindling resources which included mega-fauna.
extirpations and extinctions, contractions in communication networks, and changes in many other aspects of material culture. From this emerged the 'Classic Maori Culture' which was fully established by the time European explorer Captain Cook and his crew arrived in 1769. It is, therefore, unlikely that the causes of change in adze technology and morphology were unrelated. Little is known about the rate of change or if it was stimulated in some regions sooner than others. There is some evidence for the retention of 'archaic' elements for some regions with adzes assuming an important role in this evidence, for example, the Hauraki Gulf, Coromandel Peninsula and Marlborough, where adzes reflect the continued use of early materials like Tahanga basalt, Motutapu greywacke and Nelson/Marlborough argillite (Brothers and Golson 1959; Davidson 1981,1984:111, Keyes 1975; Prickett 1989).

A number of theories have been advanced to explain changes in adze morphology, generally within the context of overall culture change. Only one considers change in function as a primary factor. From the results of a series of mechanical tests relating to adze shape and raw material properties, Simon Best (1975,1977) suggested that the variability seen in early Archaic adze types was geared to the complex design of early narrow hulled canoes which were, in turn, related to significant coastal movement and interaction. Later woodworking focussed on chopping tools to clear land for gardening and for palisades in pa (fortification) building. Best also asserted that the coarse-grained 2B adze was a technological improvement on earlier designs - '...the stronger rock was used in the stronger shape' (1975:330).

In a review of adze quarry studies, Helen Leach (1990) drew attention to the relative costs and benefits of Archaic and Classic adze technology as an explanation for change. The early technology was expensive involving high risks, high skill levels and long periods spent at the quarries. As such, adze production was controlled by specialists who passed costs onto consumers. The hammerdressing and grinding of coarse-grained rocks, however, while more laborious and time-consuming, required less skill and were much safer techniques hence production could take place in the domestic context (1990:388-389). Over time the Archaic technology saw '...increasing costs (which) included transportation from the quarries to evermore distant locations as the country was settled, and the diminishing accessibility of the high quality rock in the quarry areas' (1994:248). The response to these problems was a change from '...highly flakeable sorts vulnerable to transverse fracture during manufacture, to materials that were harder to shape but more robust and long-wearing;...a change from the diversified Archaic kit to the Duff Type 2B' (1994:248).

Jones (1984), Keyes (1975), and Witter (1985) place an emphasis on the loss of flaking skill in
regions beyond major quarry areas. Adze specialists alone had the skills required to deal with the most difficult aspects of adze manufacture. Thus when problems in the availability of imported adzes became critical, people were forced to utilize local materials and to develop new techniques for working the stone (hammerdressing and sawing). Over time a total loss of flaking skill occurred even in quarry centres as lack of demand for their products saw a decline in the specialist adze-makers.

From extensive replication experimentation in adze manufacture and an examination of flake and preform assemblages at the Tahanga basalt quarry and other sites where Tahanga basalt assemblages were recovered, I proposed (1992) that the reworking of adzes rendered in increasingly rare imported materials lead to technological adjustments like the increased use of hammerdressing and grinding to conserve materials and the transferral of the hafting device from the butt of the stone adze to the wooden haft in order to accommodate drastically foreshortened reworked forms. Both the techniques and haft adjustments provided solutions to problems confronted by working more widely available coarse-grained rocks. I concluded that:

‘The modifications to the adze and possibly to the haft shape and design that came about as a consequence of reworking broken adzes may have provided a means by which local previously under-utilized, unflakeable rocks could be rendered into simpler untanged forms.’ (Turner 1992:276,277).

In 1994 Helen Leach came to a similar conclusion after comparing the poll treatment of Archaic adzes with that of Classic 2B adzes (Leach 1994).

The major problem with most of these theories is that they are based on assumption rather than empirical data. A large disparity exists between prevailing hypotheses on early adze technology and how this changed over time, and the amount of archaeological research that has actually been undertaken to test their validity. An example is the significant role of the adze-specialist in the theories of change postulated by Leach (1990, 1993) and Witter (1985) yet at the time of these publications little archaeological investigation had been undertaken to determine who actually had access to adze quarries. The existence of adze specialists in Archaic adze production has yet to be demonstrated archaeologically let alone accepted as a primary causal factor for changes in adze technology and morphology over time. Barbara Lass, in a recent study (1994) which attempted to determine the role of specialists in Hawaiian adze technology, failed to define this archaeologically. Most theories are also concerned with the relative costs involved in adze production and distribution, for example, time, risk, skill, and energy, but, apart from my
1992 study, little quantification of these costs have been provided. For example, the assumption has been made that hammerdressing was a more time-consuming method than flaking with no actual demonstration that this was, indeed, the case. Likewise assumptions that accessibility to valuable raw materials and products decreased over time, that the distribution of imported adzes increased over time, and that people were forced to use local rocks as a consequence, balance unsteadily on a dearth of archaeological evidence.

Apart from Simon Best's study, very little attention has been given to what may have been the guiding principle behind choices made about adze morphology and technology - function. It is difficult to explain change until conditions prior to change are established. To do this it is necessary to understand the interaction of function, raw material and manufacture and the behavioural strategies that guided early adze technology in New Zealand.

In particular, a study of New Zealand adzes has the potential for understanding how people who came from geologically impoverished environments where variability in stone quality was limited responded to a new environment where a much wider range of raw materials was available. If raw material quality and availability played an important role in adze production strategies, then changes in adze technology and morphology after initial settlement may have been quite rapid.

Chapter Two presents a model as a framework for approaching the technological organization of adzes in New Zealand. Aspects of the model, and the methods employed in this thesis to examine them, are described and discussed.

Chapter Three presents the results of functional experiments carried out with Dante Bonica, a functional typology based on these results, and validation of this by comparison with a large archaeological adze sample.

Chapter Four examines what happens to adzes as a consequence of use, repair and re-use, and how this influenced adze morphology and function over time.

Chapter Five looks at the context and distribution of New Zealand adzes employing a large sample of almost 12,000 archaeological specimens.

Chapter Six examines the nature of trade and exchange in early New Zealand prehistory as demonstrated by the North Island adze data. Questions such as who had access to adze quarries and who was responsible for distributing adzes from source areas to remote regions and what this can tell us about the communication networks and exchange mechanisms in operation during the early period of New Zealand prehistory are addressed.
CHAPTER TWO: METHOD AND THEORY

Introduction

I agree with Nelson (1991), Sheppard (1987), and Torrence (1994) that the type of task the tool is required for is a key influence on the types of tools produced. The degree to which the ideal tool for the job can be actualized depends on the conditions and resources available and the technological strategies developed to make this possible. These strategies become part of established cultural practices that are effective in achieving desired results. When different or adverse conditions arise, technological strategies can be expected to change in response. They may also change over time as improved methods of achieving better results develop.

Ground stone tools are the outcome of a long history of stone tool experimentation and innovation. Grinding the edge of a stone tool increased the efficiency and sharpness of the cutting edge while extending its use life considerably (Dickson 1981:40). It also allowed effective rejuvenation of the tool edge with minimum waste of raw material. Hafting was another innovation that improved tool efficiency, control and longevity (Hayden 1989). These were all technological developments that were increasingly labour intensive and time consuming. But the tools themselves resulted in major cultural advances that thereafter became essential to meet the everyday requirements of life.

In Polynesia adzes were primarily wood working tools (E.Best 1974; Buck 1987). In societies where wooden watercraft played a fundamental role in transportation, communication and the provision of subsistence needs, these tools were a necessity. In New Zealand particularly, wood was a major medium in material culture. The double-hulled canoe, which enabled the colonisation of the remotest islands in Polynesia, was a sophisticated and effective design - an achievement of construction made possible by the employment of an equally sophisticated and efficient tool kit. Such a tool kit was, thus, only likely to disappear from a cultural inventory when the task it was required for was no longer undertaken, or was undertaken by different methods. While a tool, or set of tools, remained essential to cultural well-being, survival and advancement, technological strategies were likely to be in place to ensure these tools remained
available. Problems with raw material scarcity, for example, may have been overcome by maintaining trade and exchange relationships with people who were located close to desired raw material sources.

Variability in adze morphology may thus be conceptualized as the outcome of ongoing technological adjustments to a range of conditions that were constrained by a set of functionally defined parameters. It is, therefore, important to identify these technological adjustments, the conditions they were responsive to, the functional requirements that constrained them, and how these factors interrelated to produce the artefact assemblages evident in the archaeological record.

**Adze Model**

In a study to investigate variation in stone tool form in the Capsian of North Africa, Sheppard formulated a `Decision Model' which proposed that tool design and variability reflect decisions made to solve problems (1987:3,4). For example, some stone tools were designed to solve food procurement and processing problems while adzes were tools designed primarily to solve wood-working problems. These problems constrained tool design (`Constraints' in Sheppard’s model) and may have been solved in various ways depending on environmental and social conditions (or 'Means' and 'Laws' in Sheppard’s model) such as the quality and availability of raw materials and the technological repertoire in place to work them. Decisions were made and 'strategies' (Nelson 1991) were likely in place to provide the required tools under the given conditions in a manner that organised time, energy and risk efficiently.

In this study a model based on that designed by Sheppard (1987:7) is applied to the technological organisation of stone adzes in New Zealand (see Figure 2.1).

1. **The Problem**

Variability in Adze morphology = Solutions to wood-working problems and requirements.

**A. Constraints or Design Requirements** (Nelson 1991:66-76):

i). *Reliability/Durability*. Dependable tools that work when required without breaking
unpredictably, and will last the time it takes to complete task/s.

ii). Efficiency. Good benefits gained in terms of the time/effort saved in wood-working, and in the
Figure 2.1: Adze Model
Figure 2.1: Adze Model

quality and range of the work accomplished.

iii). *Flexibility*. Adzes are probably an example of 'design flexibility', that is, they are able to be remodelled into other tools or re-used in what has been described as 'sequential reduction' or 'serial design' which '...anticipates the order of various future tasks, changing form in a sequence...' (Nelson 1991:70).

B. **Design or Functional Attributes:**

i). Size (length and weight).

ii). Cross-section shape and thickness.

iii). Blade width and curvature.

iv). Bevel or edge angle and length.

v). Hafting device.

vi). Symmetry of finish.

2. **Solving the Problem**

A. **Environmental Conditions**

i). *Raw Material Quality*. Important are the form, size and properties desired for manufacture and use. This includes both the raw material for the tool itself and the raw material for the tools used to produce it, for example, for adze-making, workability, toughness and hardness are important qualities.

ii). *Raw Material Conditions*. Important factors are distribution, accessibility, abundance, density, and transportability. These factors should also be considered for manufacturing tools.
B. Social Conditions
These include the technological repertoire of a culture, the techniques and strategies that have been developed in the past to produce desired tools in response to existing environmental conditions:

i). Raw material/product procurement (settlement mobility, trade and exchange mechanisms).

ii). Manufacturing techniques (flaking, hammerdressing, grinding).

C. Strategies
How technological behaviour is organised to solve the problem of providing the required tool or tool kit under given conditions. Probable Costs include:

i). Time.

ii). Effort.

iii). Risk.

iv). Skill.

Discussion of the Model
That adzes were solutions to wood-working problems is undoubted. But while wood may have been the primary and possibly only medium worked by adzes, other authors have suggested their use on sea mammal bone (Leach and Leach 1979:263; Taylor 1984:95-96,165) and for breaking ground in preparation for cultivation and pit and pa construction (Barber 1984:430,444-446; E.Best 1974:140; Challis 1978:66).

Bone is, however, considerably stronger and more resistant than most woods. Dante Bonica once attempted to chop fresh whale bone with a pounamu (known variously in English as greenstone, nephrite or jade) adze. The blade chipped almost immediately, the result being that Bonica was extremely reluctant to continue further with similar experiments. He suggests from experimentation, that large spalls, which can be extremely sharp when freshly split and which have very smooth low-angled cutting edges, are more efficient and left damage on the bone
consistent to that described by Taylor (Bonica pers.comm.). Additionally spalls can be quickly made and are far more expendable than adzes would have been. It is therefore unlikely, from these results, that adzes would have been subjected to such a risky process.

The use of ground finished adzes for earth-working is also improbable. Earth-working would not require the time-consuming process of grinding a cutting edge which would invariably become badly damaged in stony ground. Barber (1994) suggests that the chunky steep-angled heavily hammerdressed but unground adzes characteristic of later Nelson and Tasman Bay sites were designed expressly as 'agricultural tools' for earth-working. What Barber failed to understand, however, is that the features he interpreted as indicative of this activity, including '...irregular and generally massive blade end damage...' and 'humpback' or 'deep rounded bevels' (1994:444) are typical of preforms predominantly shaped by hammerdressing. On like specimens I observed from the area in the Nelson Museum, including those from the late period layer at Rotokura, this 'massive damage' is actually the original rough flaking of the blade edge. From experimental results, hammerdressing too close to the blade is best avoided as deep chips can be removed as a consequence. The care taken to avoid this problem is evident on archaeological adzes where hammerdressing stops short about 10mm from the blade. This, in turn, results in the steep rounded bevels common to these preforms.

It is also difficult to explain why so much time and effort would be invested in hammerdressing the entire adze if they were only intended to dig earth. In addition, numerous finished adzes seen in Museum adze collections that were derived from similar preforms, while often roughly formed, had finely ground blades denoting their status as wood-working tools. From ethnographic records, one-piece wooden tools like Ko and timo were usually employed for preparing ground for cultivation (Buck 1987:90,91; Keyes 1971a:93).

It is possible that some badly damaged adzes and rejected rough preforms were re-used as gardening implements but archaeological evidence for this is inconclusive, being difficult to identify from other forms of edge damage or manufacturing processes.

**Design Requirements**

Polynesian wood-working called for a wide range of operations on both a large (houses and canoes) and small (bowls, tool/implement handles and shafts) scale. Almost all this work was
accomplished by one basic tool - the adze. The range of operations required from adzes may have included shaving, gouging, chiselling, splitting, chopping, scarfing, carving and excavating in confined spaces. Variability in adze design may reflect these different actions.

The time consuming and complex nature of many of these wood-working tasks, particularly the manufacture of large items like house and canoes, called for a reliable tool kit made well in advance. From what we know of adzes to date, they conform to a reliable design. They are composite tools, always hafted when in use, and in addition, have ground blades to enhance tool durability, efficiency and rejuvenation. The 'overdesign' aspect (Nelson 1991:66-68) of New Zealand adzes has been frequently observed by previous authors (for example H.Leach 'mega-adzes' 1990:382) with some being much larger and more finely finished than seems necessary to meet functional requirements. Many East Polynesian adzes had butt modification illustrating another feature common to reliable designs, secure fittings (Nelson 1991:69), and the foot of the wooden haft may have been standardized to enable different types of adzes to fit (Keyes 1971a; Wallace 1982).

Wood is a hard medium and an outcome of hafting is an increase in the force that can be applied. Adzes would, therefore, need to be made of particularly tough materials, stone types that could be depended on not to break on impact and that could withstand sustained stress for a predictable period without irreparable damage occurring.

From previous experimental research on adze production (Turner 1992; Turner and Bonica 1994), we know that East Polynesian adzes conform to other aspects characteristic of a reliable design - complex and lengthy manufacturing stages and selection for high quality fine-grained tough raw materials that were often unequally distributed in the landscape.

It is thus probable that adzes had long use-lives and that adze design incorporated elements geared to enhancing this longevity in order to offset the costs involved in the procurement of relatively scarce raw materials and adze manufacture. Adzes may, therefore, have been highly curated tools, subject to ongoing episodes of rejuvenation and re-cycling or 'sequential reduction' (Nelson 1991:70). By the time they enter the archaeological record some adze forms or types may be solely the outcome of curation strategies.

Regrettably, due largely to an impoverished ethnographic record, the attributes of adzes that were constrained by functional requirements or influenced by curation strategies have not been
defined. The criteria employed by the current typology (Duff 1977) to distinguish different adze forms (presence/absence of a tang and cross-section shape) may not be explicitly functional. Aside from butt modification (tanging) and cross-section shape, other features important to adze function may have been the width and shape of the cutting edge, the edge angle, size (length and weight), and cross-section thickness. These features (and combinations thereof) may have varied according to the tasks different adze forms were intended to perform. For example we may expect an adze designed for heavy rough work to be different in fundamental ways from an adze designed for fine shaping work. A major objective of this thesis, therefore, is to identify those attributes most directly related to adze performance, the degree that they influenced adze morphology and variability and how adze form changed over time as a consequence of use and repair.

The means by which functional criteria were achieved may have been constrained by the raw materials available and the technological repertoire in place to work them. Within functional parameters, adze variability may reflect limitations imposed by raw material quality and production methods.

The change in adze technology over time in New Zealand indicates that there may have been different ways of achieving the same result or tool for the task. Such changes may reflect innovations and improvements or a response to changes in the physical or social environment, for example a decrease in raw material availability due to over-exploitation, or restricted access imposed by a local group.

The influence of manufacture and raw material quality on adze morphology has been the subject of previous research (Turner 1992), and from replication experiments the costs of adze production in terms of time, effort, skill and risk were defined. Production rates were found to be slow, and skill, effort and risk levels high. Thus we may expect benefits in terms of functional performance to be correspondingly high. Once functional parameters are defined, the relationship between production costs and functional benefits can be clarified. Both may have constrained adze morphology to a significant degree.

A further factor that may influence adze design is what Sheppard calls '...social constraints...factors creating formal variability which deviates from the requirements of use and economy' (1987:11). Social constraints may be particularly important regarding certain adze
forms that may never have been intended for use. In his ethnological study of Maori stone implements, Elsdon Best documents a ceremonial adze form known as Toki Pou Tangata, a thin pounamu adze blade, sometimes notched and/or perforated, which was inserted into a highly decorated and carved haft. It was used '...more as an insignia of rank...than as a weapon or tool' (1974:134). He adds 'It is probable that highly prized adzes were tapu, and were not used for any common work...' (1974:150). He includes in this category very large adzes, such as the 570mm long black argillite Duff type 1A adze from Horowhenua, described as '...ceremonial implements...not used as tools' (1974:246). There remains in the present day, assumptions that some adzes were too large and too finely finished to be used, and that:

'These adzes may have served to mark the rank of their owners or to signify the superior status of the craftsmen who used them, possibly ceremoniously, at the commencement of a major project' (H. Leach 1993:39).

Again, the importance of symmetry and size in regard to functional performance needs to be addressed before considering elements of adze design that may pertain wholly to social identification or symbolic and ceremonial use.

**Solving the Problem**

In tropical Polynesia, a restricted variety of rocks was suitable for the manufacture of adzes (Green 1971,1974:142). These were commonly of volcanic origin, namely fine-grained and tough basalts. Probably as a consequence of the properties of these rocks, principally a fine-grain, flaking developed as the primary method for shaping adzes.

The technique of flaking has advantages in being a relatively rapid and flexible method of reduction and may have been responsible for an increase in the elaboration and size of adzes in East Polynesia, notably the trend toward modifying the butt of the adze, possibly to improve hafting security. The disadvantages of flaking, however, were high skill requirements, high waste of material and a high risk of breakage.

Hammerdressing was a finishing technique employed frequently on some Polynesian islands (Easter Island, New Zealand) and rarely on others (for example, Hawaii - Cleghorn 1982). The basic function of this technique was to reduce the high points left by flaking thereby reducing the
time and effort otherwise spent in grinding. Grinding was the final manufacturing stage essential for forming the cutting edge.

Both hammerdressing and grinding were low-risk, low-skill techniques but, depending on raw material quality, could be laborious and time-consuming to undertake.

This then was the cultural repertoire in place to manufacture adzes at the time New Zealand was settled by East Polynesian immigrants. It is evident that they rapidly sought out the types of fine-grained rocks they were familiar with (Davidson 1984:195). But New Zealand had a much greater range of rocks and there was considerable variability even among fine-grained materials (Turner 1992). Changes in adze morphology may have occurred quite quickly as East Polynesian settlers adapted their old technology to new materials.

Included here are rocks used for manufacturing tools, for example, hammerstones. The reason why some Polynesian island groups hammerdressed their adzes and others did not may reflect the presence/absence of suitable hammerdressing material.

Alternatively decisions regarding the selection or emphasis of one technique over another may reflect the quality of the adze stone. It is possible that qualities valued for adze function caused problems in adze manufacture. For example, toughness (resistance to breakage) may have been desirable for tool reliability and durability but may have decreased the flakability of the stone. Likewise, hardness (resistance to abrasion - see Turner 1992:58-62 for a full description of these properties) may have enhanced edge-keeping and cutting properties but increased resistance to indentation and abrasion. This would have prolonged the time and effort required in hammerdressing and grinding.

It is therefore important to identify the relevant properties of the raw materials used and how these may have influenced selection and manufacturing strategies. A stone that could be easily worked yet was both tough and hard was likely to be preferred over materials of lesser quality.

The obtaining of desirable raw materials may have been tempered by availability and accessibility. High quality materials might be rare and extremely localized thereby adding extra procurement costs for those who lived some distance away. In New Zealand, suitably fine-grained and tough rocks for adzes were unequally distributed in the landscape. Yet adzes from some sources, for example, Nelson/Marlborough metasomatised argillite and Tahanga basalt from east coast Coromandel, were distributed to sites hundreds of kilometres distant (S.Best
settlement mobility is relevant here in that the costs of procuring raw materials could be considerably reduced if this was undertaken during seasonal movements or while collecting other resources.

Some sources might also be difficult to access. For example the high altitude adze quarry at Mauna Kea, Hawaii (Cleghorn 1982) and many of the Nelson/Marlborough argillite quarries would have required special trips to reach.

The size of the parent material and methods of extraction may also have imposed extra costs in terms of time and effort. An extreme case is the Tungei people of the Waghi Valley in the Papua New Guinea highlands who extracted their axe stone by '...digging down and then going "inside" or "underneath" the unusable stone...' via a `...network of galleries like mineshafts' (Burton 1984:237-239).

Additionally, once at the source, considerable time may have been invested in seeking out homogenous material that was free of flaws and suitably shaped, particularly after long periods of exploitation. At the Tahanga basalt quarry, stone quality was highly variable and much time had to be spent in searching for and testing raw material (Turner 1992:213-214).

The abundance and density of high quality material at a source will also affect time and energy expenditure. A number of west Auckland rivers contain fine-grained high quality basalt but long stretches of these rivers have to be searched to find it. Evidence for working this material in local sites is almost non-existent suggesting that the source was never plentiful and that the costs involved in searching were too high to make exploitation viable. This situation contrasts with the availability, accessibility and abundance of the Motutapu greywacke source area in the nearby Hauraki Gulf.

Another problem to be solved in raw material procurement was transportation to and from sources and the weight and bulk of the load removed from source areas. Coastal and navigable river sources were advantageous in that watercraft could be employed to carry loads and to reduce travelling time and effort. The amount of material required by the technology is also influential here, as are social requirements, i.e., whether trips to source areas were to acquire raw materials for local needs only or for trade and exchange.

Different technologies probably had different raw material requirements. In simple or expedient New Zealand flake technologies, tools were often small. Portable cores could, therefore,
represent a large number of tools, and may have been the basic unit removed from source areas, for example, obsidian cores from Mayor Island, and distributed via trade and exchange mechanisms.

Larger tools like adzes posed different transportation problems. In adze manufacturing experiments (Turner 1992:Appendix B), 50-80% (depending on adze size and blank form) of the original blank weight was removed during the initial roughing out stage. Large adzes with a final weight of 1-2kg were derived from blanks weighing 10-20kgs. The high rate of preform rejection due to problems with flaws and unpredictable breakage also increased the amount of material that was discarded during early manufacturing stages. Adze makers, therefore, did not usually remove unmodified material from sources because the amount of material required to make even a small number of successful adzes far surpassed carrying capacity. The solution was to spend lengthy periods at the source so that much of the reduction could be undertaken in-situ and only viable preforms removed.

Another consideration was the need to collect suitable manufacturing tools. Hammerstones of varying sizes were required at adze rock sources to work outcrops, break up boulders and rough out blanks. Depending on the size of the parent material, quarrying hammers could be very large and heavy, and had to be of tough materials to be effective. Adze-makers working the Nelson/Marlborough argillite quarries had first to collect hammers from the Nelson grano-diorite boulder bank, and then transport these up to high altitude quarries. Some of the largest quarrying hammers weighed between 25-50kgs (Duff 1946; Keyes 1975). Each adze maker would have needed several of these plus a selection of smaller ones for roughing out, and would probably need to replenish this supply with each trip. In replication experiments, large hammers (including those of grano-diorite) used to break up parent material had quite short use-lives, and at the Tahanga quarry, the majority of broken hammers observed had little use-wear (Turner 1992:153,170,172). Split and broken hammers are common at other quarry sites indicating that a back-up supply was necessary. Hence visits to adze quarries may have also entailed special trips to gather hammerstones and extra effort in their transportation to the source.

All these factors would have influenced the time and energy invested in adze production. The costs of working a raw material that was abundant and accessible, and of manageable size and homogeneous quality would be much lower than working one where such optimal conditions did
not exist. Adze-makers may, however, have exploited sources despite the difficulties and problems they presented because the raw material may have been of such high quality that benefits in use far outweighed the costs incurred in manufacture.

Raw material procurement and manufacturing costs may also affect what happens to adzes during use-life. It is highly likely that adzes were reworked after damage and breakage as much to recoup manufacturing costs as to conserve raw material. It is therefore important to understand the nature of raw material sources used for tools and those used to make them, and how the characteristics of these raw materials interacted with manufacturing techniques to produce the tool required for the task.

**Technological Strategies**

Strategies provide solutions to problems in order to achieve desired results, in this case, wood working tools. Raw material procurement and adze manufacture entailed costs that needed to be managed in a sensible way. Adze-makers, for example, did not remove unmodified material from quarries because this would have been an extreme waste of time and energy with very little beneficial outcome (Turner and Bonica 1994). For a technological system to function effectively, i.e., to supply the number and types of tools required on an on-going basis, maintaining a balance between costs and benefits was probably crucial. It is likely that the higher the costs, the greater the need for strategies aimed at keeping these at a manageable level.

Both Sheppard (1987:12) and Nelson (1991:61) caution about making assumptions that tool designs necessarily reflect optimal solutions. Rather they should be perceived as solutions that allowed time and energy to be used efficiently and economically so that a successful outcome was accomplished. Where costs are particularly high, strategies may be aimed at minimizing these as a crucial element of technological organization. Thus it is important to identify, and where possible, quantify these costs in terms of time, effort and risk to understand how they were managed.

Strategies guiding adze production, distribution, use and repair were probably tightly linked but to date only strategies relating to adze production have been defined.

Previous research (Turner 1992; Turner and Bonica 1994) employed an extensive replication experimentation programme to assist in the interpretation of archaeological material found at the
Tahanga basalt quarry and nearby domestic residences, and to provide data on the raw material procurement and manufacturing costs involved in Tahanga basalt adze production. The following costs were identified:

1. High searching and testing time - one/two hours were generally required to locate enough high quality material to make blanks for one days flaking.
2. High time and energy for parent material reduction - several hours were needed to break up a large (100-200kg) boulder into between 20-30 blanks, of which a number (about 1/3 in experiments) would not be used due to flaws and poor shape.
3. Fast roughing out during which 70% of the original stone weight was removed. 15-20 minutes were needed on average to rough out medium (flake) blanks (150-200mm long) but closer to an hour for larger blanks.
4. High risk of transverse fracture at all flaking stages. There was a 60-80% failure rate depending on size, manufacturing stage and material quality.
5. The advanced flaking stage of fine trimming carried the highest risk of breakage particularly during bevel formation, and was a much slower process than roughing out. This risk increased as length became disproportionate to thickness.
6. Large preforms, particularly quadrangular preforms, involved markedly higher costs. The greatest effort was involved because more reduction and larger blanks were required. They also required the longest flaking time and the highest skill (as high angled quadrilateral flaking was often required), and the greatest risk of breakage. Complete flaking out of a medium sized flake blank (140-200mm long) took 30-60 minutes compared to 2-3 hours to flake a large quadrangular preform (250-300mm long).
7. Reworking of broken preforms was a viable option for making smaller adzes if specimens were at least 200mm long when complete.
8. Reworking had a higher success rate than preform manufacture (50%), and took less time (10-15 minutes flaking) especially for bevel portions where the blade and bevel was already formed.
9. Skill was required for all manufacturing stages including the breaking up of parent material. Implicit in this skill was the need for a thorough knowledge of the properties of the stone being worked. Despite his experience in making adzes, Bonica achieved a much greater success rate
once he had gained a familiarity with Tahanga basalt, and this involved knowing what to look for at the quarry.

Aided by these experimental results, comparisons made of debitage and reject preforms at the quarry with those found at domestic residences nearby revealed strategies that were in place to deal with the high costs involved in adze production (Turner and Bonica 1994). A major strategy at the quarry was to make preforms as large as possible and, despite the high risk of breakage, to remove them before flaking was completed, saving most of the time consuming fine trimming until after their return to domestic residences. In this way, adze-makers were able to make better use of their time at the quarry - maximising both raw material availability and the number of blanks that could be produced and successfully roughed out. This strategy ensured that even though a large number might break after removal from the quarry, enough large adzes would survive the fine trimming process to meet supply needs. Furthermore, the considerable time and energy invested in preforms that eventually broke was recaptured by the strategy of reworking them into smaller adzes (Turner and Bonica 1994). The costs of manufacturing large adzes remained high but time, effort and risk were managed in such a way as to ensure that a successful outcome resulted.

Additionally, the strategies employed in Tahanga basalt manufacture produced different artefact distributions at different places. Debitage from raw material testing, blank reduction and roughing out were observed at the quarry, while at east coast Coromandel residences flakes from advanced stages of manufacture, together with reworking flakes and broken preforms (much reduced in size due to failed reworking attempts) characterized adze manufacturing debris. Tahanga basalt debitage in sites outside this area related to finished adze repair and reworking only (Turner and Bonica 1994).

That adze production strategies at these sites were interconnected suggests that only the east coast Coromandel residents had direct access to the quarry. Finished Tahanga basalt adzes, however, have a much wider distribution, thus the east coast Coromandel people may have been suppliers as well as producers of Tahanga basalt adzes. For people outside the area with no suitable local adze material, strategies may have been geared not to adze production but adze distribution via trade and exchange mechanisms. The high costs involved in adze production
may have been passed on to consumers, thus adzes were probably expensive items to acquire. In this way production strategies probably impacted on distribution strategies and very likely on strategies of use and repair.

The strategy of curation was a likely response to high production costs involving rare raw materials. As documented above, even people at settlements close to Tahanga were reworking broken preforms despite the availability of the stone. This curation reflects the recouping of considerable time and energy investment at the quarry. The finishing techniques of hammerdressing and grinding were also very time consuming adding to the high value of adzes. We might, therefore, expect a high degree of curation among finished adzes.

**Research Objectives**

Given the apparent complexity of their history, design, production, distribution and use-life, adzes have great potential for understanding the behaviour that guided technological organization in New Zealand. Furthermore, adzes endure in the archaeological record. Excavations rarely fail to recover at least one or two specimens, and among museum and private collections large numbers exist thus providing the opportunity to study a very large sample.

Research objectives are organised in the following manner:

**A. Function and Design** (Chapter Three)

i). Identification of functional attributes that constrain adze design and how these relate to woodworking performance.

ii). Examination of existing adze typologies to determine if the standardized adze forms or 'types' classified are functional realities.

iii). Examination of how raw material quality and manufacturing techniques interact with functional constraints to influence variability in adze morphology. How different materials performed in use and how this may have influenced raw material selection and distribution.
iv). Identification of stylistic attributes and whether some adze designs fulfilled non-utilitarian or ceremonial roles.

B. Use-life (Curation) (Chapter Four)

i). Identification of the degree to which adzes were curated and what forms this curation took, i.e., identification of attributes related to adze repair and reworking - the definition of adze 'states' or stages of 'sequential reduction', and how change in adze morphology was brought about by these processes.

ii). Examination of design elements that may have enhanced adze durability, longevity and repairability.

iii). Investigation of whether some raw materials were more durable and easier to repair than others and if these qualities influenced selection processes.

iv). Examination of the types of damage incurred in adze use, how often these occurred, the problems they posed for repair, how repair problems were solved, and the costs involved in adze repair and rejuvenation.

v). How on-going repair and reworking may have constrained adze function/performance.

C. Distribution (Within and between sites and site areas)

Within sites (Chapter 5):

i). Examination of the contexts in which adzes at different stages of their use-life are discarded, lost or abandoned.

ii). Examination of what the presence of adzes and by-products indicate regarding site function and occupation duration.

Between sites/site areas (Chapter 6):

i). Examination of how settlement mobility may have affected distribution mechanisms.

ii). Identification of the distances over which adzes of different materials were found and how this relates to raw material quality, accessibility and abundance.

iii). Identification of distribution mechanisms and interaction/communication patterns between regions and sites.
But how are archaeologists able to access this information? There are two forms of evidence:

1. Attributes of finished and unfinished stone tools, the raw materials they were made of, the by-products of manufacture, use and repair, and the tools used in their manufacture and repair.
2. The spatial patterning of both inter and intra-site, and the contexts in which tools and their by-products are found.

While significant progress has been made in understanding the strategies underpinning raw material access and procurement and adze manufacture (Turner 1992; Turner and Bonica 1994), knowledge of adze function and use-life has been poorly understood.

In previous research (Turner 1992; Turner and Bonica 1994) concerning the identification of adze manufacturing strategies, replication experimentation proved an effective method by which to interpret the archaeological data found at adze quarry sites and secondary production centres. A similar replication programme was undertaken for the present research with skilled adze maker and user, Dante Bonica, to gain insight into the operational dynamics of adze use in order to investigate the problems outlined above. In conjunction with the experimental project, close to 12,000 New Zealand adzes were examined and entered into a data base for statistical analysis, so that:

1. Experimental results could be tested and compared.
2. Archaeological evidence could be interpreted with reference to the model outlined above.

Previous research on early (or 'Archaic') adze technology and the sources of stone exploited (Best 1975; Bristow, Gillies and Gumbley 1985; Davidson 1981; Duff 1946; Huffadine 1978; Jones 1984; Keyes 1975; Kronqvist 1991; B.F Leach 1969; Leach and Leach 1980; Moore 1975,1976,1982; K.Prickett 1975; Turner 1992; Walls 1974; Witter 1985) has provided valuable information on some of the conditions that had to be met in order to procure and manufacture adzes in New Zealand. Replication experimentation in the manufacture of adzes has, additionally, provided insights into the 'workability' of many of the raw materials used; that is,

But while that research focussed on the flaking processes involved in adze manufacture, the present research involved the finishing of a large number of adzes by Dante Bonica in preparation for experiments in adze use. I also made and finished ten adzes made from a variety of raw materials in order to understand the time, effort, risk and skill involved in rendering an adze operational. Knowledge gained from these experiments is incorporated into the discussion below. Present research has also provided further information on source characteristics including a geological survey of Motutapu Island in the Hauraki Gulf, the major source area of Motutapu greywacke. The environmental conditions of raw material availability and quality and the technology developed in response to these conditions are also summarized below. From this information we can:

1. Determine probable influences of raw material and technology on variability in adze morphology.
2. Make predictions about how these materials would have operated in use.
3. Outline the problems encountered in making the required tools and how these were solved.

Below is a summary of information regarding the raw materials and technology used in adze manufacture in New Zealand.

1. **Influences of Raw Material Quality and Manufacturing Methods**

   A. **Properties important for hafted ground-edge wood-working tools:**


      Advantages:

      i). Can be used with greater force thereby faster more efficient wood displacement.

      ii). Lower risk of breakage and longer use-life.
Disadvantages:

i). Manufacturing difficulties - flaking tough rocks requires greater skill and force than brittle rocks.

2. **Hardness**: Resistance to abrasion.

Advantages:

i). Edge keeping - decreases resharpening time and increases resistance to edge damage.

ii). Sharp fine edge for clean wood penetration and cutting.

Disadvantages:

i). Very labour intensive and time consuming to grind and hammerdress.

**B. Properties important for manufacturing hafted ground-edge wood-working tools:**

1. **Workability** (Sheppard 1987): Grain size and Homogeneity.

Grain-size is related to flakability, that is, the finer the grain the greater the ability to shape a tool by flaking (Cotterell and Kamminga 1987:678-680; Dickson 1981:31,32). Coarse-grained rocks like most greywackes generally have very limited flaking properties and tools made from these materials require alternative shaping techniques like hammerdressing and grinding. Adze stone also needs to be homogeneous. Material flaws create shaping problems during manufacture and cause weaknesses in the stone that would likely prove fatal during use.

**C. Characteristics of manufacturing methods:**

*Flaking* (shaping by conchoidal fracture):

Advantages:

1. A rapid method of reduction.

2. A flexible method - allows considerable control over shape.

3. Allows for effective and quick rejuvenation and reshaping.
Disadvantages:
1. High risk of unpredictable breakage (transverse fracture) generally at the mid-section of the adze.
2. High skill requirement to achieve maximum shaping control.
3. Wasteful of raw material.
4. High energy investment at quarry and early production stages.

Hammerdressing (shaping by bruising or indenting/pecking):

Advantages:
1. Low risk method.
2. Conserves raw material.
3. Low skill requirement.

Disadvantages:
1. A slow gradual method of reduction.
2. Restricts shaping and reshaping options.
3. Not high energy but repetitive - RSI?

Grinding (shaping by abrasion):

Advantages:
1. Very low risk method.
2. Conserves raw material.
3. Low skill requirement.

Disadvantages:
1. An extremely slow method of reduction.
2. High energy requirements.
3. Restricts shaping options (see below).
D. Influences of manufacturing methods on morphological variability:

The main shaping methods in New Zealand were flaking, hammerdressing and grinding. Relative to hammerdressing, grinding is an extremely slow method of reduction. High points and irregularities left by flake scars, for example, can be more effectively reduced by hammerdressing. But in replication experiments where material quality restricted fine flaking, and where extensive hammerdressing was required to correct shaping problems, brief periods of grinding were employed intermittently between longer periods of hammerdressing for two reasons:

1. To check the evenness of the surface. Grinding the surface will immediately define any imbalance in thickness or width.
2. A smooth surface is easier to indent and enables more efficient removal of material than one already roughened by previous hammerdressing.

The outcome of this process is an adze that will be more fully ground than adzes where no hammerdressing was applied or required.

Where flaking is the primary shaping method, angular contours are produced. Thus adzes shaped by flaking are likely to have sharp steep angles and intersections including angular profiles and offset butts. Depending on flaking quality, larger sizes and greater variability in shape is possible. The flaking technique is also an effective method of reshaping after bad damage or breakage has occurred during use, thus we may expect some variability in adze morphology to reflect reshaping outcomes. Where hammerdressing is the primary shaping method, more rounded contours are produced. When hammerdressing, sharp angles are difficult to produce and there is a need to avoid edges, including the cutting edge, due to the danger of causing deep chips. Hammerdressing is a slow and gradual reductive process that would have limited shaping and reshaping options. There was probably a need to choose material forms close to the adze size and shape desired or to adjust adze design to the forms available. This may be relative to the quality of the hammerdressing stone which would have to be as hard or harder.
than the material being hammerdressed in order to be effective.

**E. Influence of raw material qualities on manufacture and design attributes:**

Because of their resistance to indentation and abrasion, hard rocks are very difficult to hammerdress and grind and these processes can be very long and energy intensive. Fine-grained materials are generally very hard due to their tightly bonded matrix hence flaking provides a technique that reduces the need for hammerdressing and grinding and enables large parent material forms to be reduced to more manageable and suitable sizes. Coarse-grained rocks, in contrast, due to a more loosely bonded matrix, are often softer than fine-grained rocks and can be more easily and quickly reduced by hammerdressing and grinding. This has been tested in replication experiments. For example, two roughly flaked out preforms made by the author, one of coarse-grained greywacke from Te Miro River, Waikato, and one of metasomatised argillite from the Maitai River, Nelson, both of approximate shape and dimensions (180mm long), were primarily shaped and finished by extensive hammerdressing and overall grinding. The softer greywacke adze took approximately five hours to finish, while the extremely hard and dense argillite adze took 45 hours to complete. Don Millar records a similar finding from experiments where replication of the hammerdressed spirals found on Hawke's Bay greywacke adzes took only 15 minutes to execute (Millar 1995:200-201). With hard fine-grained materials, therefore, there is an impetus to achieve the final shape of the adze by flaking as much as possible in order to reduce the time and labour that would otherwise need to be spent hammerdressing and grinding it to shape. For softer coarse-grained materials, hammerdressing and grinding are markedly less time-consuming and laborious methods, and it is highly likely that the late period 'Classic' coarse-grained greywacke Duff 2B adzes were much easier and quicker to make than the early 'Archaic' forms rendered in fine-grained hard materials.

The amount of grinding on an adze may reflect several influences. Grinding would have been essential to finish the bevel and cutting edge. According to Dickson (1981:99), a smooth fully ground bevel results in less wood-cutting resistance than a rough uneven one. In replication experiments, grinding the lower portion of the bevel and the cutting edge, particularly the blade corners, was difficult and required considerable care and concentration. An effective method in
the initial stage was to square off the blade thereby providing an even edge and some protection against inadvertent over-grinding during lower bevel formation. Gradually the correct edge angle can be achieved by grinding down toward, but not including, the blade. Relatively coarse sandstone can be used, albeit with care, in this procedure but for the process of sharpening the cutting edge, finer sandstone must be used. Undue pressure during this procedure, even when using the finest sandstone, can cause small chips to the edge and corners. This will often mean squaring off the blade once more and beginning the process of sharpening anew. This risk and difficulty increases when a fine low angled cutting edge is required and where blades are wide and flared. Raw material quality may have set limits on the degree to which an edge angle could be lowered and on blade width, particularly regarding softer, weaker materials.

As the working part of the adze we might expect that bevels and blades would need to be symmetrical and well-balanced. Indeed, Bonica often returned newly finished adzes to the hoanga for further honing after initial trials in use, not being satisfied that they balanced correctly in the haft (Bonica, pers.comm.).

For hard, fine-grained materials, therefore, achieving symmetry of blade and bevel by flaking was a primary goal because it reduced markedly the time and effort that was required later in grinding. Grinding blades and bevels on adzes made of coarse-grained materials, in contrast, was a faster and less difficult process.

Grinding of the other parts of an adze was less essential. Full grinding in the butt area would have been a disadvantage in making the grip too slippery in the haft except where the butt was slotted into a socketed or recessed foot. In replication experiments, hammerdressing was the most efficient method for butt modification and reduction, removing sharp flaked edges that could damage the lashing during use, and providing a roughened surface to increase lashing adhesion.

We might also expect adzes of softer coarse-grained materials to exhibit much more grinding than adzes of harder materials. But again the flaking quality of the stone may be influential here. If flaking quality does not permit fine shaping, more hammerdressing and grinding might be needed. With a finely flaked adze, grinding and hammerdressing might be minimal so as not to disguise the high level of flaking skill represented. When flaking has been less than successful, hammerdressing and grinding are effective remedies to cover a 'multitude of sins'.

In some cases overall grinding might be applied to enhance the symmetry and appearance of the adze, particularly where extensive hammerdressing was required in the shaping process. In the latter case, overall grinding would not require undue extra effort as surfaces would already be relatively flat and smooth from hammerdressing.

The degree of symmetry and attention to adze finish may vary according to adze function. A well-balanced tool might be more crucial for some tasks than others. A symmetrical form may additionally be less vulnerable to breakage and edge damage. Symmetry in the butt area might be necessary to ensure a secure fit to the wooden haft. This might especially be the case with adzes designed to slot into a recessed or socketed helve. It might also be likely that adzes intended as gifts or for trade and exchange would be more finely finished than those produced for local needs.

Generally, the tougher the rock the greater the force necessary to initiate fracture, hence toughness can cause shaping difficulties, especially with the flaking technique. Tough rocks can also withstand heavier hammerdressing and be more resilient to chipping during blade sharpening. Manufacturing costs are, however, likely to be relative to benefits incurred in use. We might expect that the blades of adzes made from soft coarse-grained materials would be more vulnerable to crushing and abrading than blades rendered in hard fine-grained materials, and become blunt more rapidly. The blades of hard fine-grained materials would retain a sharper edge for longer but might be prone to chipping and spalling rather than crushing and abrasion.

Different costs may have been experienced during repair and resharpening of blade damage. We might expect that:

1. Adze blades of soft coarse-grained materials would require more frequent resharpening and repair than hard fine-grained materials.
2. Adze blades of soft coarse-grained materials would be faster to repair and resharpen than blades of hard fine-grained materials.
3. Repair of blades made from hard fine-grained materials could entail high risks if damage was major (large and/or deep chips and corner snapping) and required blade reflaking. Reflaking of an asymmetrical edge caused by deep chips to the blade edge and corners might pose an even greater risk of transverse fracture occurring than was present during manufacture. Hammerdressing close to the cutting edge would be equally dangerous given the degree of force
required to indent hard materials. Likewise only very fine sandstone or *hoanga* can be used to sharpen and resharpen the cutting edge.

Being faster and easier to abrade, damaged blades of soft coarse-grained materials could be readily repaired by grinding alone. If this damage was severe, however, for example, corner snapping, viable reshaping options might have been few. Repair would usually involve trimming back the whole damaged side from poll to blade, or alternately reshaping the whole blade and/or bevel. Both types of repair would entail considerable reduction, reduction that could be readily accomplished by flaking for fine-grained materials but would be very difficult to achieve by hammerdressing and grinding for coarse-grained materials. Adzes of fine-grained materials may, therefore, have had longer use-lives than adzes of coarse-grained materials due to the process of sequential reduction made possible by the flexibility of the flaking method. Success in reshaping and repairing adzes might be enhanced with high quality flaking materials that may have had greater modification potential. As a consequence, they probably had longer use-lives than poorer quality materials.

The identification of different types of blade damage and repair co-related with the state of the adze could be significant in determining the degree to which adze repair caused adze breakage. The condition of the blade may also provide information on the degree of use it has received. Use wear in the form of polish and striations can provide evidence of use but, as with haft polish, the amount of use required before this type of evidence is visible is unknown. Identification of this evidence may also be complicated by the practice of frequent regrinding and resharpening which would obliterate evidence of previous use.

That the flaking technique remained important in the repair of blade damage and reshaping suggests that people who used adzes were also required to gain some proficiency in this technique even if they did not actually make the adzes themselves. Indeed, repair of particularly severe damage like blade corner snapping might have required a flaking skill equal to that required in primary manufacture, certainly more than that required for working brittle materials like obsidian and chert. Implicit in this skill would have been knowledge of the manufacturing properties of the materials their adzes were made of. This should be borne in mind when considering theories like those of Witter (1985) who assert that only specialists living close to major quarries had this level of flaking skill. From my analysis of adze flake assemblages from
sites close to the Tahanga basalt quarry and remote (Turner and Bonica 1994) no differences in flaking skill could be discerned.

**Characteristics of Adze Stone Sources.**

One of the advantages of distributional adze studies in New Zealand is that the major sources of adze rock exploited during the early period are geologically and macroscopically distinctive. In North Island adze collections, Tahanga basalt, Nelson/Marlborough metasomatised argillite and Motutapu greywacke are the most commonly observed materials. In the South Island, Nelson/Marlborough argillite, East coast basalt and Southland argillite and meta-volcanics were major sources represented in adze collections.

This contrasts with the situation in the rest of Polynesia where, having crossed the Andesite Line (Green 1974:142), a much more limited and geologically similar suite of rocks for adze manufacture was found. Barbara Lass (1994), in a distributional study of Hawaiian adzes, found that sourcing adzes by hand specimen to different quarries was very difficult and ultimately unreliable due to the similarity of the stone used.

Additionally, in New Zealand, considerable research has been undertaken in the sourcing of adze rock and the identification of quarries (S.Best 1975; Felgate 1993; Keyes 1975; Moore 1975,1976; K.Prickett 1975; Walls 1974). My familiarity with these sources, both as freshly worked raw material and in finished form, enabled source rock identification of the majority of adzes observed with a high degree of confidence. Hours spent grinding and closely inspecting the slow progress during adze manufacture, particularly during blade formation, results in a discerning eye for distinguishing subtle differences. Identification was assisted by the use of a magnet and a magnifying glass. A magnet was useful especially in distinguishing Tahanga basalt from Nelson/Marlborough meta-somatised argillites of a similar colour. Due to the amount of iron present in Tahanga basalt, it is strongly magnetic. But Nelson/Marlborough argillite, given its sedimentary origins, is never magnetic. The geological conditions under which Nelson/Marlborough argillite was formed resulted in an exceedingly fine-grained rock with distinct characteristics that are very obvious once the adze has been ground. For example, apart
from pounamu, no other adze material in New Zealand takes such a high polish. It is also very resistant to weathering. Motutapu greywacke can sometimes be mistaken for Nelson/Marlborough argillite, but also has distinct though subtle features that distinguish it. High quality fine-grained Motutapu greywacke is almost always dark green in colour, and has a distinctive marbled surface patterning most noticeable when ground. Again due to its sedimentary origin it is never magnetic, and when ground, rarely acquires a glossy surface.

Potentially the most problematic source to identify reliably was Tahanga basalt. Other sources of fine-grained basalt have been located in the North Island but very few show evidence of adze working. This evidence must be compared with the extensive quarrying evidence at the very localised Tahanga source above Opito Bay on the east coast of the Coromandel. Lack of quarrying evidence, however, can not be used to confirm that a source was not exploited, and such evidence could well be as yet undiscovered. Nevertheless, the petrographical work of Best and Moore on a sample of adzes from a variety of different regions and sites confirmed macroscopic identifications of Tahanga basalt (S.Best 1975,1977; Moore 1975,1976). Felgate's (1993) geochemical analysis has provided further support for these results. Other relatively fine-grained basalts examined by Felgate (Great Barrier, Waikato, Northland, Auckland) proved to be geochemically, as well as macroscopically, different to Tahanga basalt. One of the qualities of Tahanga basalt, one that was so highly prized by the early adze makers, was its fine grain. Other North Island basalts observed by myself and Dante Bonica during the course of this and previous research (1992), rarely approached Tahanga basalt in this respect. Basalt weathers quite rapidly and grain-size appears, from the large archaeological adze sample examined, to have some influence on the manner by which an adze weathers in the ground or on the surface exposed to wind and sun. Large grains break down and form small rusted pits. Such a feature is rarely a characteristic of weathered Tahanga basalt (as observed during the analysis of hundreds of flakes and preforms exposed on the surface at the quarry itself - Turner 1992) which generally presents a dense, smooth appearance when ground, though a high gloss is not common.

Field trips to examine museum adze collections served a dual purpose in incorporating geological exploration of local environments. The adze collections themselves were indications of what suitable raw materials may have been available. Even in the early period, most regions utilized local sources in some minor capacity for making adzes. Some of these sources have been
previously investigated; others remain, until now, unrecorded. All the stone sources referred to in this thesis are listed below (along with the abbreviations used in Tables and Figures).

**North Island Major Sources** (see Figure 2.2 for locations of sources).

**Tahanga basalt** (TB)

*Location and Availability:* Tahanga basalt is restricted to one volcanic hill that rises 210m above Opito Bay on Kuaotunu Peninsula, east coast Coromandel (Best 1975:13).
Figure 2.2: Map showing Locations of Adze Stone Sources
Figure 2.2: Map showing Locations of Adze Stone Sources

Accessibility: Canoes would have been able to haul ashore at Opito Bay almost at the foot of Tahanga, with a 100-200m climb to reach the source from the shore. Moderate costs were involved in transporting hammerstones up to quarry and preforms down. Removing excess blank weight was a likely motivation to reduce the load given that each preform removed was likely to weigh between 1-2kg.

Abundance and Density: Boulder screes and outcroppings cover an area of 40 hectares, from the upper to lower flanks of Tahanga and a small adjacent hill. But deposits of high quality raw material are found in greater density at higher altitudes. Little good quality material was in evidence during field work in 1991 with experimental samples derived from sub-surface deposits exposed by modern quarrying, ditch digging and road cuttings. Variable quality was experienced during experiments and was observable in the working floors at Tahanga, ranging from very flawed and quite coarse-grained to very homogeneous and fine-grained. It is likely that considerable searching time was needed to test for material quality which could be visually deceptive and could only be determined by working the stone. This problem would have provided an extra incentive to partially form the adze at the quarry. Differences were observed between working floors in different areas that reflected intensive exploitation. Some areas consisted of vast carpets of flaking debris with little unworked material in evidence. Other working floors around the smaller hill adjacent to Tahanga were characterised
by flakes and reject preforms with a high frequency of flaws suggesting the adze-makers were forced to work poorer sources due to decreasing availability in higher quality areas or restricted access to these. So the costs involved in searching and testing raw material may have been high.

**Form:** Outcrop pieces, angular boulders and ideally shaped tabular blocks were found in replication experiments to be consistently flawed and flow layered. Thick rounded irregular shaped boulders and cobbles proved more consistently homogeneous and fine-grained, but posed extra flaking difficulties due to their difficult shapes. The selection of these cobbles for large quadrangular adzes was demonstrated in the archaeological record, both among reject preforms at the quarry and among complete preforms removed from the quarry (for example, personal observation of two caches from Opito Bay and Mercury Bay). All had cortical remnants with irregular contours, commonly on two or more faces. It is clear, then, that the Tahanga adze-makers had to select material quality over suitable form.

Breaking up large boulders and testing and roughing out cobbles would, therefore, have been quite costly in terms of time and effort, as well as skill. The thick weathered cortex that characterizes Tahanga basalt also caused difficulties when breaking up boulders and splitting cobbles by cushioning hammer blows and impeding the force of impact.

**Manufacturing Tools:** Both the irregular form and the thick weathered cortex made Tahanga basalt generally unsuitable for hammerstone material. But suitable smooth round stones were available at each end of the three kilometre stretch of Opito Bay. Large spalling hammers up to 30kgs in weight were mainly of water-rolled basalt and andesite with smaller ones of the same materials for roughing out. Some effort was involved in hauling these up to the quarry, particularly as a back-up supply was necessary. From replication experiments, impact damage builds up quite rapidly on big spalling hammers and they have short use-lives, being prone to splitting. In support of this, many of the broken spalling hammers examined at the quarry had only minor damage evident.

High quality 'soft' trimming hammers for the advanced stage of manufacture, a red andesite from the eastern end of Opito Bay, were probably removed with the preforms, and are rare at the quarry, though found occasionally in other east coast Coromandel sites with other adze debitage.
There was also an abundance of local chert for use as hammerdressing stones. Though adequate for the purpose, in replication experiments they had a tendency to bruise rather than to indent the surface.

**Stone Quality:** Colour ranges from medium grey to dark-grey when fresh but weathers to light grey, grey-blue and grey-brown (Munsell colour chart). This weathering can be fairly rapid. Already experimental Tahanga basalt preforms manufactured five years ago are lighter in colour than when first made.

In manufacturing experiments, difficulties were imposed by the toughness of the stone. This impeded flakability and compounded the problems imposed by the irregular rounded shapes of cobbles and boulders. A high degree of force was needed to remove flakes, even during high angled fine trimming, which increased the risk of transverse fracture and limited flaking control. These manufacturing difficulties are likely to have imposed size and shaping limits on adzes.

Tahanga basalt was found to be moderately hard and hammerdressing and grinding were prolonged processes. For example a Tahanga basalt adze made by the author of similar size and shape to the Waikato greywacke adze (5 hours) and the Maitai River argillite adze (45 hours) took 30 hours to hammerdress and grind. The toughness of Tahanga basalt was very likely the most valuable asset for adze performance, however, particularly in heavy duty wood-working tasks.

**Motutapu greywacke (MGW)**

*Location and Availability:* Adze quality Motutapu greywacke, part of the Waipapa group of basement sedimentary rocks of the Waitemata harbour, Tamaki, is found around the coastal margins of a number of Hauraki Gulf islands (Davidson 1981:111). Evidence of working is found on Rakino and Motutapu Islands (and possibly Motuihe Island - S.Best pers.comm.), with Motutapu Island probably being the major source. The greywacke can also be found on the mainland, commonly as water-rolled cobbles on coastal beaches and in rivers from Orere Point to Kaiaua. Field observation of, and replication experiments with, the mainland greywacke demonstrated that fine-grained material was quite rare, the majority being relatively coarse-
grained and of poor flaking quality. No evidence of working in-situ deposits has been found at any of the mainland sources.

Accessibility: The stone is very accessible at a number of locations on both sides of Motutapu Island (see Figure 2.3), commonly in the inter-tidal zone. The largest source is almost continuous from Administration Bay to West Point Bay, a distance of 2.5km. It may not have been a coincidence that the earliest sites thus far known on Motutapu, Pig Bay (R10/22) and Sunde (R10/25) (Davidson 1978), both having evidence of large scale adze manufacture, were situated in close proximity to this source. Transportation costs would have been low. Even for visitors from other areas of the island or from the mainland, access was easy and in some places, for instance, Emu Bay, viable blanks or preforms could have been loaded directly into canoes for removal. This may be why no large concentrations of flaking debris characteristic of the Tahanga basalt and Nelson/Marlborough argillite quarries have been found on Motutapu Island. Those quarries were some distance from settlement areas but on Motutapu were literally a stone’s throw away.

Nevertheless, analysis of adze manufacturing debitage from the Pig Bay site showed a similar
Figure 2.3: Map of Motutapu Island showing the Motutapu Greywacke Distribution
Figure 2.3: Map of Motutapu Island showing the Motutapu Greywacke Distribution

pattern to that seen in the adze debitage from east coast Coromandel sites. Flakes from advanced stages of manufacture and from the reworking of broken preforms dominated in the Pig Bay assemblage (see Appendix A) indicating that the breaking up of the parent material and initial roughing out took place elsewhere, probably at the source. The reason that little manufacturing evidence remains at these inter-tidal sources is due to on-going tidal action and the continuous erosion of outcrops. Debitage has either been washed out to sea or has been crushed and covered by fresh layers of broken up and eroded stone. The Motutapu evidence provides additional support for the findings at Tahanga; that despite very close proximity to the source, reworking broken preforms was a response to the time and effort invested in manufacture.

Inland deposits may also have been available but the majority observed by the author were poor quality and coarse-grained. Modern quarrying for road metal of hitherto subterranean deposits behind Home Bay has revealed adze quality fine-grained boulders but whether such deposits were visible for exploitation in the pre-European past is unknown. Given the coastal orientation
of early settlements on Motutapu and the accessibility, density and abundance of inter-tidal deposits, it is likely that these were favoured.

**Abundance and Density:** Good quality Motutapu greywacke is also very abundant, densely concentrated in some areas and easy to find. While the greywacke ranges from very fine-grained to relatively coarse-grained, high quality material is readily available. Searching time is thus likely to have been low. Flaws were quite common however, particularly among water-rolled cobbles, but often this could be identified by surface features such as cracks, without having to test the material by breaking it open.

**Form:** The parent material is available in a great variety of forms in close proximity. Water-rolled material from small smooth round pebbles and cobbles to large boulders hundreds of kilograms in weight cover a number of beaches (see Figure 2.3). The small cobbles can be readily split by the bipolar technique or by hurling onto a reasonably flat faced boulder to create two suitably shaped blanks for adzes small to medium in size (100-200mm length). Adjacent outcrops, either on the beach (Administration Bay) or just above it (Otahuhu Point) commonly have a distinctive orange cortex. Due to the rather fractured nature of the outcrops and to rigorous tidal action, pieces of a tabular nature are continuously splitting off along cleavage planes, providing suitably sized and shaped blocks for larger adzes. Due to continuous erosion, evidence of worked outcrop faces is difficult to discern but probably did occur given the favourable shape of the pieces and the ease of removal. Additionally outcrop pieces had a lower incidence of flaws than water-rolled cobbles. Analysis of the Pig Bay flake and preform assemblage (Appendix A) confirmed the practice of selecting tabular blocks for the manufacture of large quadrangular and triangular adzes, while smaller split water-rolled cobbles were employed for the manufacture of smaller, thinner adzes.

The manufacture of adze blanks on Motutapu Island would, thus, entail considerably less time and effort than was required at Tahanga.

**Manufacturing Tools:** Round water-rolled cobbles also served a dual purpose as hammerstones of various sizes, from larger ones for breaking up boulders to smaller roughing out hammers.
Water-rolled rounded cobbles of eroded Waitemata sandstone also proved very effective in experiments as soft fine-trimming hammers though they abraded quickly and had very short use-lives. Their relative abundance, however, would have made their high rate of attrition a minor problem. The local sandstone would also have been used for grinding though a low quartz content renders it relatively ineffective. The addition of sand or crushed stone fragments to the surface of the hoanga would have increased its abrasive quality. Water-rolled pebbles of locally occurring red or green chert were likely employed as hammerdressing stones, and have been found in most of the sites excavated on Motutapu (Davidson 1981:116; personal observation) including Pig Bay and Sunde. In experimentation, these chert hammers proved to be of limited effectiveness, bruising rather than indenting the adze surface.

All these materials can be found today in abundant supply among boulders, cobbles and outcrops of Motutapu greywacke. The adze-makers who worked the stone therefore had a great advantage in finding all the manufacturing tools they needed available at the source. There was no need to make special trips elsewhere to procure them or any extra effort involved in transporting them to the source.

**Quality:** Motutapu greywacke is a very fine-grained predominantly dark green metamorphosed sedimentary rock. The flaking quality is quite high, the material flaking readily and with none of the problems like flow layering that characterised Tahanga basalt. This may be directly related to the brittle nature of the stone. It does not require the degree of force to remove flakes that was required with Tahanga basalt. Rather care must be taken to moderate the amount of force used in order to avoid transverse fracture, particularly during fine trimming.

But while the lack of toughness may have improved the flakability of Motutapu greywacke, it was probably a disadvantage for adze performance, particularly for tasks requiring heavy forceful use.

Motutapu greywacke is also very hard, harder than Tahanga basalt, which would have had benefits in use for producing a sharp resistant cutting edge. Extreme hardness resulted in extra difficulties in manufacture, however, providing a strong motivation to flake Motutapu greywacke adzes as close to the desired shape as possible. The time-consuming and arduous nature of hammerdressing and grinding was compounded by the relative weakness of the stone so that the
degree of force required to effectively indent the surface carried high risks of breakage. This occurred while hammerdressing the tang on an almost completed large 1A adze made by Bonica (Turner 1992:219, Figure 5.21,266-268) and no successful Motutapu greywacke adzes over 200mm in length have been completed due to a high frequency of transverse fracture during both flaking and hammerdressing stages.

We might, therefore, expect to see relatively low frequencies of large Motutapu greywacke adzes in the archaeological record, due both to manufacturing difficulties and the brittle nature of the stone. Significantly, in my own experiments, a Motutapu greywacke preform of similar proportions to the specimens of Waikato greywacke, Nelson/Marlborough argillite and Tahanga basalt mentioned above was never finished due to the problems involved in hammerdressing and grinding such a hard yet brittle material. Thus we might also expect archaeological specimens to present the minimum amount of hammerdressing and grinding required and that butt reduction, a very dangerous undertaking, will be minor.

**North Island Minor Sources**

Less is known of sources that appear to have been exploited for local needs only. Most are derived from river or inter-tidal coastal margins and little or no evidence now exists to inform on extraction and manufacturing practises.

**Northland Altered basalt (NBA)**

No quarries of this raw material have been discovered to date. According to Northland geologist Fred Brooke, Northland basalt derives from the Tangihua suite of volcanic rocks, which includes gabbro (Best 1975), and is quite widely distributed in the Northland area. The stone is present in the North Cape/Cape Reinga region but does not re-emerge until south of the Aupouri Peninsula where it extends down as far as Dargaville (Fred Brooke, pers.comm, DoC Northland).

From Doubtless Bay to the Bay of Islands, rivers and beaches contain boulders and cobbles of this stone. Similar deposits are to be found on the west coast. Working floors have been recorded from a number of the beaches on the east coast: Manganui, Hihi Beach, Whangaroa, Tapou Bay,
Takou Bay, and Te Tii and Purerua in the southern Bay of Islands (New Zealand Archaeological Association site record files, DoC, Northland). Stone identified as Northland basalt by Fred Brooke is quite variable, ranging in colour from light green to green-grey, and from fine-grained to relatively coarse-grained. Predominant in adze collections from the area is a fine-grained green-grey stone that is distinguished by a network of white veins.

No manufacturing experiments have been conducted with this material largely due to the difficulties of finding suitable samples. Several sources in the Doubtless Bay area were examined and sampled but almost all the stone proved to be very flawed and of poor flaking quality.

**Waikato basalt (WBA)**

A fine-grained basalt, distinctive from Tahanga basalt, was exploited in coastal Waikato. While no worked source has been found, evidence of basalt adze production is abundant in the coastal middens around Whaingaroa (Raglan), Aotea and Kawhia harbours (personal observation, New Zealand site record files and reports, DoC Waikato).

Dante Bonica has located a source of adze quality angular basalt boulders in the inner Whaingaroa harbour, and similar basalt boulders and cobbles were observed in rivers around the harbours of Aotea and Kawhia.

Experimentation with this basalt indicated that the quality was variable. Generally the basalt was coarser than Tahanga basalt and not as flakable. It was relatively tough, however, though not as tough as Tahanga, but with a similar hardness factor.

Other valuable stone materials were found in the Waikato harbour area including high quality sandstone suitable for hoanga and hard water-rolled quartz pebbles and a high quality chert both of which made effective hammerdressing stones.

**Taranaki Argillite (TARG)**

This fine-grained, light green argillaceous stone is found as water-rolled pebbles and cobbles in a number of rivers throughout the Taranaki region. Worked sources have been located along the Waitara River (Keyes 1971b), and in tributaries branching from the Patea river (Hooker 1971).

In replication experiments stone from the Purangi source near the Waitara river proved to be very hard and tough but of poor flakability. Shaping by fine flaking was very limited and it is
likely that extensive hammerdressing would have been required to finish adzes. Given the hardness factor, this could have been a time-consuming and laborious task.

**Silicified Limestone (SL)**

This light grey fine-grained rock weathers rapidly to a dirty chalky colour. A worked source of this material was recorded by Simcox (Notes collated by D.Millar 1993) in the Wairarapa region at the Aohanga river mouth. Smaller sources have been located at other river mouths near Aohanga, for example, Akitio (K.Prickett 1979). From personal observation at Aohanga, high quality material is not abundant and is scattered over a considerable distance along coastal margins on each side of the river. Much of the material is in the form of small cobbles and pebbles that may have limited adze size. Alternatively most suitably shaped and sized material may have been used up in the past.

Experiments conducted with silicified limestone indicated that it was both hard and very flakable but also very brittle, certainly more brittle than Motutapu greywacke, and this would have limited both adze size and the range of tasks these adzes could perform.

**Miscellaneous**

In addition to the rock types above, other less localised materials were occasionally exploited for the manufacture of early or 'Archaic' forms of adzes. This included quite coarse-grained basalts and other volcanic rocks (Mid-north, Tamaki, Great Barrier, Bay of Plenty), argillicious rocks (Northland - i.e., Mt Camel, West coast Coromandel from a source at the mouth of the Waiaro river), and coarse-grained sedimentary rocks including greywacke, particularly in the southern half of the North Island. Confirmation of the local availability of these rocks was generally made by field survey or by comparison with museum geological samples from natural deposits.

**South Island Major Sources**

**Nelson/Marlborough metasomatised argillite (NMA)**
Location and Availability: About forty isolated quarries of this highly altered and very fine-grained stone have been found along the Nelson mineral belt which stretches for 130kms from D'Urville Island in the Marlborough region to Red Hills in the Nelson district (K.Prickett 1975:58,59; Walls 1974:38). Descriptions of these quarries can be found in Walls (1974) and Keyes (1975). Other quarries may yet remain to be found in the rugged, precipitous and forested ranges of the Nelson/Marlborough area. Rivers below outcrop areas like the Pelorous, Maitai, Lee and Motueka also contained water-rolled boulders and cobbles of adze quality argillite.

Accessibility: Most of these quarries are at high altitudes, commonly between 300-650m above sea level, and thus require fairly steep ascents to access. For example, it takes over an hour on the Maungatapu track to reach the Rushpool quarry above Nelson. Additionally, almost all the high altitude quarries on the mainland are some distance from the coast (5-15km) and the rocky shallow nature of the rivers may have impeded easier access by canoe. Most of the D'Urville Island quarries are at high altitudes also, particularly the important and extensively exploited Mt Ears quarry. At 430m above sea level, the quickest access to this quarry from the coast involves an almost vertical climb. River deposits and beach deposits on D'Urville Island were more accessible but form and raw material quality may have favoured high altitude sources. Accessibility, therefore, may have been difficult and considerable time and effort was probably required to reach quarries that were remote and distant from coastal habitation areas.

Abundance and Density: There does not appear to have been a problem with abundance, though outcrops were scattered over a wide area. High altitude quarries comprise mainly isolated outcrops which Jones describes as '...inclusions [which] can range in size from quite small blocks to masses as large as a house or a town hall' (Jones 1984:252), as well as boulder scatters. Quarries and debitage concentrations rarely cover more than one hectare in extent except on D'Urville where evidence of adze manufacture at the most extensively exploited source of Mt Ears is scattered over several hundred acres (Prickett 1989:143; Walls 1974:41).

Nevertheless, locating the outcrops was probably not difficult. This may have been due to the outer soft serpentine of outcrops weathering and causing the surrounding vegetation to be stunted (Jones 1984:254-255). Any break in the vegetation was likely to signify a potentially good
source of adze-quality argillite. Thus less time may have been spent in searching for good quality material than in extracting and reducing it.

_Form:_ While the raw material may have been abundant, obtaining adze blanks from the large bodies of stone represented by the argillite outcrops could have entailed quite heavy duty extraction processes. Removal of an outer weathered poor quality zone of material may have been necessary in some cases (Jones 1984:254), and in others much of the good quality argillite may have been subterranean. For example, at Hebberds quarry above the Whangamoa River, a trench had been dug to gain access to good quality argillite. The extraction process involved hurling 50kg hammerstones from the top of a large adjacent boulder down on to the argillite bench below in order to shear off large tabular pieces (Duff 1946:120,121). Due to the nature of its formation, the layering of which can be seen in the outcrops today, the effort invested in working outcrops paid off in that the argillite probably split along cleavage planes into angular pieces or 'tabular' blocks, well shaped for conversion into adzes by flaking (Jones 1984:253). River boulders on the mainland and beach boulders on D'Urville Island were of less ideal shapes having rounded contours as a result of water-rolling. In experiments, these proved very difficult to break into and many grano-diorite hammers were fractured in the process.

_Manufacturing Tools:_ Given the heavy-duty extraction processes involved, large spalling hammers of considerable weight (up to 50kgs) and toughness were required. Rounded grano-diorite boulders from the Nelson boulder bank and Cable Bay proved suitable for the task but considerable time and effort would have been invested in collecting these and transporting them up to high altitude quarries.

Other important materials for manufacturing tools were found in the Nelson/Marlborough rivers including flaking hammers of sandstone and greywacke, and of particular importance, hydrogrossular garnet for hammerdressing. This very tough, fibrous, hard material (with a hardness value on Moh's scale of 6.5-7.0) was the hammerdressing stone par excellence in New Zealand, eclipsed only by the more homogeneous, more suitably shaped water-rolled pebbles of the same material from the Southland area. The Nelson/Marlborough hydrogrossular garnet is most frequently found in large chunks, often with serpentine inclusions, and considerable effort
is required to break them up into more suitably sized pieces. In replication experiments this
garnet proved to be the only hammerdressing material that could effectively indent the surfaces
of very hard materials like Nelson/Marlborough argillite, Motutapu greywacke, Southland
argillite and Taranaki argillite. While it proved too dangerous for use on the brittle Motutapu
greywacke and silicified limestone, it decreased hammerdressing time for other materials by a
marked degree. Hydrogrossular or 'lime garnet' hammerstones are very common in South Island
sites and they have also been found in a number of North Island sites including Horowhenua,
Taranaki (including fragments from Kaupokanui), Hawke's Bay, Raglan Harbour, Coromandel
(personal observations of museum and private collections), probably imported along with
Nelson/Marlborough argillite adzes.
The possession of such an effective manufacturing tool may have had a major influence on
choices made about manufacturing techniques, and possibly on the raw materials available that
could be worked.

**Nelson/Marlborough Argillite Source Characteristics**

Nelson/Marlborough argillite is found in a range of colours and surface textures, though few
can be sourced to particular quarries. Adzes were identified by colour with reference to the
Munsell colour chart. Unfortunately adzes were rarely observed under the best conditions of
natural light, and occasionally artificial light created difficulties in distinguishing between very
dark colours, for example, dark green, dark grey and black.

Data on colour and surface patterning were recorded, and argillite adzes were classified by
colour, and where possible, by source area, and are listed below. The information was gained by
personal observations made at a number of the quarries on D'Urville Island (Ohana Bay, Mt Ears, Black Beach) and the mainland (Samson Bay and Falls Creek quarries, Heberds Quarry, Rushpool Quarry, Pelorous, Maitai, Motueka Rivers) and with reference to a comparative
collection of argillite samples in the Nelson Museum from most of the known sources.

**D'Urville Island Argillite (DUA)**

*Ohana Argillite (OA):* This is probably the most distinctive of the Nelson/Marlborough argillites.
Outcrops and detrital material are found on and above Ohana Beach on D'Urville Island. This quarry is one of the smallest on the island (0.115ha - Leach 1993:36), and may have had a limited production capacity. The scarcity of Ohana argillite in the upper layers of some mainland sites, for example, Tahunanui, may indicate that, through over-exploitation, good quality material had become depleted (Millar 1971).

The colour ranges from light-grey to light-green and light-blue, commonly but not always, with black veining and has not, to my knowledge, been found at any other known argillite quarry.

**Black Argillite (BLA):** Jet black argillite with fine veining is also sourced to D'Urville Island from the extensive quarries of Mt Ears. This argillite, along with Ohana, has been considered of the highest quality (Prickett 1989), and manufacturing experiments have confirmed this.

**Dark Green-grey Argillite (DGGNA):** This argillite may also be sourced to D'Urville Island though possibly not from one particular quarry. The variable surface patterning of this argillite ranges from a patchwork effect to fine veining very similar and of equal quality to the Mt Ears argillite. Samples from the quarry of Attempt Hill on D'Urville Island, while of other colours, also had some of this stone in evidence. Flake samples from the small Starvell Quarry above the Lee River in Nelson are also dark green but with no veining or other surface features. Adzes matching samples from the Starvell quarry were poorly represented among archaeological collections.

A small number of preforms provenanced to D'Urville Island, and several argillite adzes seen in museum collections (for example, Figure 4.6c), were made from blanks that displayed bands of either two or all three of the following colours - 'Ohana', black and dark green-grey, including a broken preform from D'Urville Island, suggesting that these sources had a close association.

**Mainland and D'Urville Island Argillite**

**Dark-grey (DGA), medium-grey (MGA) and light-grey argillite (LGA):** These argillites are common both on D'Urville Island and the mainland quarries. At present it is not possible to source adzes in this colour range to more specific sources with any reliability until extensive
source characterisation studies are undertaken. A variety of surface patterns are seen among the grey argillites including veining, streaking and mottling. Argillite found at outcrop quarries and in rivers on the mainland fall predominantly within this colour range. Medium and light grey colours are particularly common to river sources.

*Light-blue grey (LBGA), Light green (LGNA) and cream (CRMA) argillite*: These colours are rare in archaeological adze assemblages and may reflect a variety of sources, some of which may not have been discovered. Light blue-grey argillite may derive from the Toi Creek quarry, also near the Lee River, but some adzes of this colour with fine black veins may also have come from the Ohana quarry on D'Urville Island. Similarly, some light green argillite adzes may also derive from Ohana though both colour and surface patterns differ from Ohana quarry preform and flake samples in the Nelson Museum and from what was observed at the quarry itself. The source may be elsewhere on D'Urville, for like dark green-grey argillite, rough broken preforms and adze production flakes of this stone have been collected from occupation sites on the island. This assumes that there would be little reason to import mainland argillite sources to an island where the argillite was of a generally superior quality and where the state of both the preforms and flakes indicate early manufacturing stages.

*Material Quality*: Among the sources of Nelson/Marlborough argillite some variability exists. Replication experiments have involved argillite from Ohana, Mt Ears and Black Beach on D'Urville Island, Falls creek from Croisilles Harbour, Whangamoia near Hebberds quarry in Marlborough and from the Pelorous, Motueka and Maitai rivers. Apart from the river sources, argillite samples were taken from disturbed areas where stone had been exposed as a result of road cuttings and modern quarrying.

All the argillite samples were impressively tough and hard but flaking quality proved to be variable. D'Urville Island argillite had the most superior flaking qualities while the river sources were most inferior. The frequency of flaws was also high for the river sources but low for the black argillite from Mt Ears.

For all the argillite sources the toughness of the rock required extreme force to be used when striking off flakes, but unlike Tahanga basalt, much finer flakes could be removed enhancing
flaking control and enabling most argillite adzes to be flaked very finely to shape. This was most
certainly the case with D'Urville Island argillite particularly regarding the black argillite from Mt
Ears where flaking quality and homogeneity was more constant than for other sources.
But toughness caused problems for some other argillite sources, and it would appear that
mainland sources were more variable in quality. Flaking problems caused by toughness was
experienced most consistently with the river samples. Cobbles were rarely suitable for blanks
being generally of very irregular rounded shapes. The combination of toughness and rounded
contours also made large boulders difficult to break up. Experimental adzes from the Maitai,
Motueka and Pelorous Rivers could rarely be flaked finely to shape and had to be finished with
liberal applications of lime garnet hammerdressing.

Southland Sources

The region south of Marlborough has a wide range of adze-quality rock sources that were
extensively exploited in the past.

Southland Argillite (SA): A number of argillite quarries have been recorded and studied in the
Southland area. This includes the light green argillite which is found as both outcrops and
cobbles on the beach at Riverton (Leach and Leach 1980), and Bluff Harbour argillite which is
predominantly dark green in colour. Major quarries of Bluff harbour argillite are found on Tikore
and Colyers Island where outcrops and boulders of various sizes were exploited in the inter-tidal
zone. Unlike Motutapu Island, tidal action is gentle over large areas of mudflats on these islands
and much of the flaking and quarrying evidence remains intact (Huffadine 1978, Bristow, Gillies
and Gumbley 1985). Like Motutapu greywacke, the stone was very accessible and easily reached
by canoes able to be hauled up close by.
Little information is available concerning selection and extraction processes and material
variability to inform on the costs involved in searching and extracting good quality material. It
appears that at Riverton, similar to the Nelson/Marlborough argillite (to which it is related
geo logically), tabular blocks could be split along fracture planes from outcrops while from
boulders flake blanks were extracted and 'elongated' beach cobbles split in the manner employed
for Motutapu greywacke cobbles (Leach and Leach 1980:117,120).

Hammerstones for adze flaking could be selected from water-rolled argillite beach pebbles but special trips had to be made to collect large spalling hammers of tough gabbronorite from Bluff hill beaches some eight kilometres away by sea from Colyers Island (Bristow, Gillies and Gumbley 1985:145,149).

Replication experiments with light-green Riverton argillite and dark green Bluff Harbour argillite were undertaken and both proved impressively tough and hard but very difficult to flake, on par with the Nelson/Marlborough river sources. Extreme force was required to detach flakes, and while shaping by fine flaking was possible, much time and perseverance was required with an attending high risk of breakage. Supplied with water-rolled pebbles of hydrogrossular garnet from local beaches and rivers, it may have been a more economic practise to limit flaking and accomplish shaping by more extensive hammerdressing. While the hardness of the stone may have been a limiting factor in this option, the toughness and hardness of the garnet was greater so that hammerdressing, or more precisely in this case, pecking, could be applied with unrestrained and effective vigour with little risk of breakage. If the flaking difficulties experienced during experiments with Southland argillite was also shared by early east Polynesian adze-makers then we might expect to see greater advantage being made of the hydrogrossular garnet expressed in the morphology and finish of Southland argillite adzes.

**Southland Volcanic rocks (SV):** Adzes of magnetic dark blue-green volcanic rock were also observed to be quite common in Southland adze collections. Russell Beck, director of the Southland Museum, refers to this stone as 'meta-tuff' or 'meta-basalt'. Very little is known about the sources of this stone except that they appear to have a similar distribution to the Southland argillites, and with this suite of rocks, form part of the Greenhills group of rocks comprising '...intrusive igneous dykes, fine- and coarse-rudite breccia and argillite' (Bristow, Gillies and Gumbley 1985:144; R.Beck, pers.comm.).

No experiments were conducted with this stone to inform on material quality.

**Southland basalt (SB):** A number of beaches on the Southland east coast have deposits of adze quality fine-grained basalt. A worked source was recorded by Haast (1880) at Brighton beach,
south of Dunedin, of which little evidence remains. High quality basalt, available in great quantity and in a range of sizes and forms, from a boulder beach at Seaclliff, north of Dunedin, was used in manufacturing and functional experiments during the course of this research. Quality at this source was comparable to Tahanga basalt in terms of toughness, hardness and flakability. During an excavation of adze working floors at Kakanui, North Otago, the basalt source of the excavated material was observed in the adjacent inter-tidal zone (Weisler and Sommerville-Ryan 1996).

Miscellaneous sources

While pounamu adzes were generally excluded from the data, some pounamu adzes were included if they formed part of an adze cache or if they were rendered in early 'Archaic' forms. The majority of pounamu sources derive from the west coast of the South Island (Hooker 1986). No attempt was made to identify the specific sources of pounamu adzes.

Fine-grained basalt, probably from a number of sources found on Bank's Peninsula (Hutton 1898; Jacombe, pers.comm.), was popular in the Canterbury region for adzes but little information is available as to their distribution, form, variability, and quality.

Experimentation with basalt from a boulder beach at Little Akaroa was of good flaking quality but seemed to be brittle. No successful preforms were produced to test the nature of this stone further.

Coarse-grained sedimentary rocks were also occasionally exploited, most notably in the Southland area to make the distinctive Duff type 1D and 1C adzes, but were also rendered into other early 'Archaic' forms.

Table 2:1. Relative Costs of Raw Material quality and manufacture for major Sources and benefits gained in function.

<table>
<thead>
<tr>
<th>Costs</th>
<th>Tahanga Basalt</th>
<th>Motutapu Greywacke</th>
<th>D'urville Argillite</th>
<th>Nelson/Marlborough Argillite</th>
<th>Southland Argillite</th>
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</thead>
<tbody>
<tr>
<td>Costs</td>
<td>Tahanga Basalt</td>
<td>Motutapu Greywacke</td>
<td>D'urville Argillite</td>
<td>Nelson/Marlborough Argillite</td>
<td>Southland Argillite</td>
</tr>
<tr>
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<td>High</td>
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**Benefits**

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<tr>
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<td>Fair</td>
<td>High</td>
<td>Fair</td>
<td>??</td>
</tr>
</tbody>
</table>

Grade: Low, Fair, Moderate, High, Very high.

**Summary**

The various costs and benefits of the major rocks used for adzes during the early period of New Zealand’s prehistory is summarized in Table 2.1. D’Urville Island argillite emerges as requiring the highest investment in procurement and extraction costs but is likely to yield the highest benefits in terms of adze performance and flexibility. Possibly some of the high altitude outcrop quarries on the mainland such as Rushpool and Hebberds, could be included here. While outcrop material was unable to be tested in replication experiments, the efforts invested in reaching and extracting the stone indicates that benefits in terms of high quality material might be expected. Mt Ears argillite combined the attributes most favoured for manufacture and probably use. The manufacturing quality was such that ideals set for adze designs could be readily achieved. Performance in use is also likely to be high. It is, therefore, not unreasonable to suggest that D’Urville Island adzes (especially those from Ohana and Mt Ears sources) may well represent the standardized adze designs most desired by early East Polynesian settlers against which all adzes of other materials may be compared. In contrast, the costs involved in procuring and working Motutapu greywacke were low, but so also were the benefits relative to other materials. Tahanga
basalt, Nelson/Marborough river argillite and Southland argillite probably had similar cost:benefit ratios.

The distribution of adzes beyond source areas is also likely to reflect the relative value of different stone materials. From what has been published to date on adze distribution (Best 1975; Davidson 1981,1984; Keyes 1975; Moore 1976; K.Prickett 1979, N.Prickett 1989), distribution patterns are consistent with the results above. D'Urville Island argillite adzes are found in sites from one end of the country to the other, while Motutapu greywacke adzes have the most limited distribution of all the major sources.

Nelson/Marlborough argillite sources also have the advantage of centrality, particularly D'Urville Island which is as close to the North Island as it is to the South Island. It is also more accessible by sea than other Nelson/Marlborough sources, especially for the people on the southern west coast of the North Island.

On the northern east coast of the North Island, the value and distribution of Motutapu greywacke adzes was probably reduced by the close proximity of the superior Tahanga basalt source.

**Influences of Raw Material Quality on Adze Design and Performance**

We might now consider what precisely the ideals of adze design were, particularly in regard to functional concerns, and how the properties of raw materials, toughness and hardness may have
Figure 2.4a and b: Features of Adzes and Hafts.
**Figure 2.4a and b: Features of Adzes and Hafts.**

interacted to constrain design.

**Edge Angle** (see Figure 2.4a for adze terminology - after Davidson 1961:7).

The majority of New Zealand adzes have what are called 'biased' bevels, that is, the 'angle of intersection' or 'cutting edge angle' is much more pronounced on the back of the adze than the front (Dickson 1981:77). Very few adzes examined in this research could be described as truly 'symmetrical' or equal-bevelled adzes, and none were in primary condition. Late period adzes with this type of bevel have been recorded, however, sparking a lengthy debate as to whether they were hafted and used as axes rather than adzes (see E.Best 1974).

According to Dickson (1981:39), who has carried out extensive practical experimentation in the operational dynamics of Australian stone hatchets and other stone tools including adzes, low edge angles and long bevels result in fine blades that cut cleanly and effectively into the wood. They are, however, more vulnerable to damage than blades with steep or obtuse edge angles. The latter are more '...robust and not susceptible to plastic deformation under load because it is
supported by the solid material behind it' (Dickson 1981:73).

Dickson also discusses the problems involved in preserving an effective edge angle during repair:

'One is tempted to confine...[ honing]...to the part of the bevel close to the edge for a quick repair but, after this has been done a few times, the effective edge angle is increased enough to make the blade too obtuse for good penetration. It is then necessary to extend the operation over a greater area of the bevel' (1981:42).

While it may be argued that the edge angle is important in fundamentally different ways for stone hatchets compared with stone adzes, the need to retain a fine edge (and a long bevel to carry it) to effectively penetrate timber, be it from a horizontal (adze) or vertical (axes, hatchets) plane, may hold true for both types of tools.

What is pertinent to this discussion is that the edge angle is valuable for informing on how adzes were used. Edge angles were not measured for all the adzes examined during this research. Common problems such as edge damage meant a significant number could not be measured reliably, a problem Dickson also encountered (1981:76). Thus only a sample of adzes with undamaged and finished blades were selected for measurement employing a goniometer.

We might expect that planing strokes at low angles of attack would be effective in cleaning down planks of timber and fine shaping. For this task a low edge angle and a long bevel for effective follow through may be necessary to make a long clean shaving stroke. It is also probable that shaving and dressing timber was not as rigorous as chopping where there would be greater wood resistance and greater force required. In contrast, adzes used for heavy duty tasks such as tree felling and excess wood removal might need to be used at a higher angle of attack and with more force, and therefore need more robust edge angles.

Regarding raw material, and within functional parameters, we might expect adzes made of weaker, softer raw materials to have more robust edge angles than adzes made of harder more resistant materials in order to increase resistance to damage.

Another related variable, the position of the cutting edge with respect to the axis of the tool, may also have functional significance (S.Best pers.comm.). Due to practical difficulties, data were not collected to measure this variable. General observations made, however, suggest that, where
observable differences did exist, it was between early and late adze forms. Future studies, especially those comparing distinctions between adzes from early and late sites, are well advised to include this variable in their analysis.

**Blade Curvature**

With regard to the ground edge curvature of Australian stone hatchets and his experimentation in the use of them, Dickson states that some curvature of the blade is important in that:

'...the rounded contour is a good protection against fracture. In wood chopping, whether by mis-hitting or by intent, the heel or toe of the blade often takes most of the impact rather than the middle. If the edge is straight there is a definite corner at each end which is particularly liable to fracture especially if there is any twisting of the blade on impact. In a steel hatchet the curved edge reduces the tendency of the blade to stick fast in a deep cut into hard wood.' (Dickson 1981:45).

These findings may also be relevant to the use of adzes. In replication experiments, obtaining the right degree of curvature was one of the more difficult tasks involved in grinding adze blades, but it may have been crucial to the operation of the adze, and in the avoidance of blade damage. It is possible that the degree of blade curvature could reflect material quality. For weaker, softer materials we could expect a greater degree of curvature to ensure blade corner protection. Adzes used with greater force and at higher angles of attack might also have more marked blade curvature.

Blade curvature might also relate to the nature of the task. For example, adzing of concave and curved surfaces might require a curved blade to create and fit contours. Making deep grooves (e.g., for a lashing grip) may also require a round bladed tool.

**Blade Width**

Blade width probably relates to the size of task and the type of task. For excess removal of wood and for dressing timber, wide blades would cover a greater area and aid in keeping flat surfaces even, thereby reducing time and effort.

For many tasks blade width is likely to exceed poll and haft-foot width so a solution for maximizing blade width would be to increase tool width toward the blade so that the cutting edge
flares outward.
This feature may also prove advantageous in repairing blade corner damage. Blade corner snapping on straight-sided forms would necessitate more extensive retrimming of the damaged side. But where a blade is flared, side retrimming could be confined to the bevel area. Hence flaring of the blade not only maximizes blade width but extends the use-life of the blade, aids damage control, preserves symmetry, and reduces the risk, time and effort involved in repair. Disadvantages could include an increase in blade corner vulnerability because of the greater projection beyond the median plane of the adze (Dickson 1981:109). Solutions to this problem may be to select the hardest toughest materials. Alternatively, acute or convex bevel sides will strengthen blade corners as will making the bevel face wider than the front (though the latter has the effect of reducing blade width), also increasing blade curvature. Predictions for tasks where wide blade width is desirable include:

1. Adzes of highest quality materials will have the widest blades relative to length.
2. Softer, weaker materials will exhibit more compensatory devices, i.e., back-wider-than-front, blade corners curving inward, more blade curvature and generally narrower blades.
3. For tools required to make grooves or scarf lines, narrow blades will be desirable and may be expected to be more robust and resistant to damage than wider-bladed forms due to contrivances designed to minimize rather than maximize blade width. For example, as above - making the back wider than front and blade corners curving inward rather than flaring out. Blade corners may still be vulnerable, however, which can be minimized by increasing blade curvature.

The Hafting Device
Attaching the adze securely to the wooden helve was a major functional consideration. Any undue movement of the stone blade during use could not only render the adze less efficient but might result in a mis-aimed blow that could cause blade damage or even adze breakage. Ensuring a secure 'fit' between stone blade and wooden helve would have been a high priority. There were generally two methods of providing a secure fit between stone adze and haft. Either the butt of the stone adze could be modified to fit the haft, or the foot of the haft could be modified to fit the stone adze (see Figure 2.4b for examples after Wallace 1982:180). Because
they only endure in the archaeological record under unusual conditions, wooden hafts are rare, and it is mainly to the stone blades that archaeologists must look for information on how adzes were hafted. Certainly, in New Zealand, changes in adze design over time was accompanied by changes in haft design. In the early period it was mostly the stone adze butt that was modified, but in the later period the fully ground and unmodified butts of the majority of adzes suggest that the hafting attachment device was transferred to the wooden component of the adze (Keyes 1971a:92). This modification may have taken the form of a recessed foot or the attachment of a wooden socket; the latter known from archaeological New Zealand examples as a composite haft (Keyes 1971a; Wallace 1982). Precisely what caused this transferral to take place is poorly understood. It may have been prompted by an increasing need to conserve raw materials. By transferring the hafting device to the wooden haft, the size of the stone blade could be reduced. Alternatively it may have been a development that lessened the time and energy invested in manufacturing adzes by simplifying the form (Wallace 1982:181). This development could have arisen as a consequence of reworking. Small truncated broken pieces may have frequently been too short to allow any kind of effective grip to be made on the stone piece, thus alternative methods of achieving this had to be found (Keyes 1971a:93; Turner 1992:276,277). How butt treatment changed through the use-life of an adze can be observed by comparing this feature with the use-life state of the adze.

The size and weight of the adze may also be significant in the degree and type of butt modification applied. As Duff noted, lugs were most often seen on the tangs of large, heavy quadrangular adzes where they provided an additional 'lashing grip' (1977:149). Such robust adzes may have been used with much greater force than more delicate types, and thus required attachment to the haft that could survive the jarring effect of immense impact. On Australian stone hatchets Dickson noted a relationship between weight and 'grooving' of the butt:

'As a matter of mechanics, grooving is the more secure way of mounting a handle to any head but it is especially valuable for heavy heads, where, due to inertia, manipulations involving sudden changes of speed or direction impose great stresses on the junction between the head and the handle' (1981:116).

At the Archaic site (A.D. 850-1100 - Sinoto 1982:169) of Huahine in the Society Islands,
excavation of swamp deposits revealed a large number of hafts, including one with the stone adze still in place (Sinoto 1982:173, Fig.3). Eight hafts were finished, all one-piece, and three different foot attachments were identified. Three had the flat foot (as illustrated by Wallace 1982:180), two were recessed but open-ended and three were recessed but closed off at the heel so that the adze could slot into the haft (Sinoto 1982:174-6). From observations made of the hafted stone adze, Sinoto stated that:

‘The handle is smaller than I would have expected judging from the size of the adze and ethnological collections. However, the size of the handle may have depended on the type of cutting work required. In this case, the heavy head may have been easier to use with the relatively short handle.’ (1982:174).

Similar haft designs were probably brought to New Zealand by the early East Polynesian settlers. The poll is the upper extremity or termination of the adze butt (see Figure 2.4a). This feature can also inform on the manner by which an adze was hafted. For adzes designed to slot into a recessed or socketed sole, the poll was often hammerdressed and/or ground flat to fit more securely. With use this surface often acquired a 'gloss' known as haft polish as a result of the contact between wood and stone. Adzes with butt modification or tangs were designed to be lashed on to the sole of the haft. Many may not have needed any poll treatment because the polls of these adzes did not come into contact with the haft.

In a study of the Shag River Mouth adze assemblage, Smith and Leach (1996:145), with reference to the haft designs from Huahine, suggested that the location of haft polish might indicate the method of haft attachment:

1. Gloss on back = flat sole.
2. Gloss on poll and back = flat sole with a stepped heel.
3. Gloss on sides and back = open recessed sole.
4. Gloss on poll, sides and back = closed recess or composite haft with a socket.

The majority of Shag River adzes had haft polish on the back only while a few also had haft polish on the back and sides. Hence the most common form of haft at Shag River was the flat
sole (Smith and Leach 1996:145-146).

It is not known, however, how long an adze needed to be used before haft polish became visible. Sinoto noted of the hafted adze at Huahine:

'It seems a fibrous strip from the base of a coconut leaf was wrapped around the butt of the adze before lashing to keep the lashing from slipping' (1982:174).

This practice may have delayed or even prevented the development of haft polish. The type of hafting device employed is likely to have had some influence on adze design. When hafting security is accomplished by modifying the stone blade, the effect may have been to:

1. Increase length. Up to one-third of the adze length needs to be reserved for the sole of the haft with sufficient length remaining to carry the bevel and to prevent the lashed adze butt making contact with the wood during a follow-through stroke.

In recessed soles only a small part of butt end needs to be slotted into the cavity, while socketed or composite hafts actually extend the length of the stone blade. For example, sockets listed by Keyes (1971a:88-90) are all between 200-300mm long. While one third of this length attaches to the foot of the haft, this leaves 130-200mm projecting from the foot, of which only a small portion needs to be taken up by the adze butt. This, in effect, provides the stone blade of small Classic 2B adzes (100-150mm long) with a length equal to some of the largest Archaic forms. Additionally sockets were made from very hard strong heavy woods (Wallace 1982:183) thereby providing weight as well as length to the tool. The use of a composite haft, however, may have placed restrictions on adze use. According to Keyes, the added length imparted to a stone blade when set into a socketed helve would increase the 'reach' of the adze (i.e., its ability to gain unimpeded access in deep confined spaces like canoe hulls) but '...reduce the effective swing of the adze in use' (1971a:93). Because the rim of the socket rested quite close to the adze blade, a follow through action was difficult to achieve, restricting adze use to 'short strokes' (Keyes 1971a:93).
2. Increase manufacturing effort. Types of butt modification seen on East Polynesian adzes include frontal reduction, offsetting/angulation of the butt, lateral reduction or 'spade shouldering', rounding of all the butt area, or actual reduction of all surfaces. Sharp corners and flake scars can abrade the lashing (even when covered by fibrous material) so there is a need to remove these either by grinding or hammerdressing. Hammerdressing is advantageous in that it roughens the surface to create a better grip than a smooth ground surface.

Substantial time and effort was also required to produce the haft. Searching for branches at the correct angle to the trunk is a time consuming task today, and may have been the case in the past, though undoubtedly to a lesser degree. Tree branches could also have been trained to grow at the correct angle. Based on replication experiments, extraction from the trunk and manufacture could take several days (Bonica, pers.comm.). Twenty-eight of the 36 adze handles found at Huahine were ‘...unfinished handles in various stages of manufacture' (Sinoto 1982:171) indicating that they were not quickly made. Making lashing cords is also a time-consuming task.

From the information above, we might predict:

1. That large adzes used for heavy duty wood working tasks will have either more devices ensuring secure hafting (i.e., reduction of butt area with lugs or grooves) or more pronounced butt reduction in terms of depth and the number of sides reduced, or have the butt offset at a more pronounced angle. Thus the larger and heavier the adze the more pronounced the butt modification could be. Smaller, lighter adzes used for lighter tasks will have less butt modification.

2. That the type of butt modification applied may reflect raw material and manufacturing influences. For example, some danger of breakage exists when flaking and hammerdressing tangs on adzes made from more brittle materials, for example, the Motutapu greywacke experimental adze mentioned earlier.

3. That different manufacturing techniques may produce different types of butt modification, especially where the stone is tough and the hammerstone material of high quality like lime
garnet. In the latter case, we might expect more rounded or grooved and deeper tangs. Where butt modification is created by flaking only, adzes may be more frequently angulated with offset rather than reduced butts.

4. That the shape of adze, particularly the depth of the cross-section, could influence the type of tang applied and the degree of butt modification. Butt modification, either by frontal reduction or offsetting, might be more dangerous on shallow bodied forms. Creating a tang may be easier to accomplish for some forms than others. An alternative for shallow bodied forms might be lateral reduction which could be readily accomplished during flaking or hammerdressing.

**Size/Dimensions**

Adze size is likely to be highly constrained by task performance requirements and probably varied accordingly. Large scale wood-working tasks like canoe building would require robust heavy adzes, especially in the early stages of tree felling and roughing out. Such tools would need to be thick relative to width in order to withstand the stress of forceful use, would probably be matched to robust edge angles to bear the weight of impact and be of sufficient length to allow for butt modification and a balanced distribution of mass. Maximizing weight for these adzes may have been a major goal, with limitations probably imposed by raw material quality, manufacturing difficulties and the strength of the wood-worker.

Tasks involving the fine dressing of timber would likely require a different combination. We might expect that the size of adzes used for cleaning timber may relate to the surface area being dressed and we could expect some size variability among adzes designed for such work. As mentioned above, low edge angles and wide blades would be important considerations here, possibly dictating other dimensions such as thickness and length. Length and blade width were possibly more important than weight for these types of adzes in that the longer the adze and the wider the blade the longer and wider the adze stroke speeding up the task and contributing to an even impression on the wood, particularly on flat surfaces like boards. A robust cross-section and heavy weight were probably not necessary due to the less forceful nature of the work. For finer precision tasks, heavy adzes would be a disadvantage, possibly causing unwanted splits in the wood or with the danger of cutting too deeply. A fine shallow cross-section would also be
advantageous for follow-through strokes, in allowing low edge angles, and for creating a lighter tool without undue reduction in length.

From measurements taken on 450 Australian stone hatchets, Dickson found a significant correlation between edge angle and thickness with thickness increasing with edge angle (1981:106). Green and Purcell examined 293 adzes from seven island groups in Central East Polynesia:

'...to assess the relationships between three measurements taken on adze heads: total length, width and thickness...to demonstrate that, whereas the length of an adze head is closely related both to its width and its thickness at the shoulder or central portions of the adze, the width and thickness themselves are less directly related to each other' (1961:451).

A positive correlation between length and thickness was found. Green and Purcell noted that this '...may be a function of a certain thickness deemed necessary to insure the structural strength of a stone adze head' (1961:457-458). A similar relationship was found between length and width though this was not as marked (1961:459). The result for thickness:width ratios (referred to as the 'shoulder index') was much more variable and, according to Green and Purcell:

'...differentially associated with various geographical localities and the nature of the material used, and is positively associated with various formal features of adzes whether or not these are employed in the present classifications of adze heads.' (1961:465).

In Green and Purcell's study, however, width and thickness measurements were taken at the same place on the adze, either at the shoulder, or at the mid-point of the adze if no shoulder was evident. As they duly noted:

'In general it has been agreed that the total length, the width at the shoulder or central portion of the adze head, and the thickness at the same point, are important measurements. But the reasons for taking such measurements have rested more often in obviousness, convention, and ad hoc faith in their eventual importance, than in any demonstration of their actual significance.' (Green and Purcell 1961:451).
But with regard to adze function it is likely to be length and thickness relative to blade width, not shoulder width, that is significant for understanding how weight is distributed behind the part of the adze that makes direct contact with the wood. For example, two adze forms might have similar shoulder/mid-section width:thickness ratios yet have very different blade widths. A thick cross-section and a narrow blade can be expected to function in a different way to a thick cross-section coupled with a wide blade. A narrow blade concentrates energy into one small area, and is likely to penetrate deeper with a gouge-like effect whereas with wide bladed adzes, the force of impact is dissipated over a much wider surface area. The distribution of weight and thickness and length, therefore, is likely to be organised in direct relation to blade width and edge angle.

It is also likely that variability in the thickness:blade width ratio will be even more pronounced than seen for the 'shoulder Index'. We could expect that variable thickness:blade width ratios might relate to functional differences like those outlined above with thin wide adzes designed for dressing timber, and thick more narrow bladed adzes designed for excess wood removal.

Raw material quality and manufacturing techniques might also be influential. Green and Purcell noted an overlap in thickness:width ratios between tridacna shell adzes and stone adzes from Pitcairn and explained this as possibly being due to the 'thin tabular nature' of the Pitcairn adze stone which was similar to the thin pieces of tridacna shell (1961:460).

The variability evident among adze materials exploited in New Zealand is likely to exert some influence on variability among adze dimensions within functional parameters. This variability may manifest as the selection of higher quality materials for some adze designs that require particularly hard and/or tough materials, or where the design is a difficult one to manufacture. For example, in replication experiments, large (over 200mm length) quadrangular and rectangular adzes proved markedly more costly to produce due to high time, effort, risk and skill levels. We might, therefore, expect the largest adzes to be made of the best quality materials especially large quadrangular and rectangular adzes.

**Cross-section Shape**

Cross-section shape has long been considered of fundamental importance when attempting to describe and define adze variation, and is one of the primary criteria of existing adze typologies (Duff 1977; Emory 1968; Green and Davidson 1969; Simmons 1973; Skinner 1974; Suggs
Green and Purcell (1961:458 and Figure 4:460), however, found that when correlating length to thickness:width ratio's by geometric cross-section shape for 47 Southern Cook Island adzes, three distinct clusters were apparent. These consisted of wide-bladed triangular adzes with the apex to the back, narrow-bladed triangular adze with the apex to the front, and rectangular adzes (where 'sides are shorter than the face'). Notably the one quadrangular adze ('face shorter than sides') clustered with the narrow-bladed triangular forms. From this patterning Green and Purcell concluded:

'...that the formal shape of quadrangular, triangular and "inverted triangular" cross-sections and the ratio between the maximum thickness and width that can be measured on a cross-section of any shape are closely related features, although there is no geometric reason why this should be so. It may be suggested, however, that there are structural reasons in respect to the total area contained in any cross-section at this point in the adze which may be operating to give rise to this association' (Green and Purcell 1961:460).

These 'structural reasons' are undoubtedly connected to functional requirements, yet it is not so much the geometric shape that is standardized but rather the configuration and orientation of cross-section dimensions. Green and Purcell's adze sample mainly consisted of three and four sided adzes as do many of the larger adze assemblages documented by the aforementioned authors (e.g., Duff 1977; Green and Davidson 1969). For example, in the Green and Purcell sample the triangular sectioned adzes form two distinct clusters primarily because one cluster comprises adzes that are very narrow relative to thickness while the other comprises adzes that are thin relative to width. Had Green and Purcell measured blade width instead of shoulder width the real difference may have been more apparent (that is, related to different task requirements as examined above).

Similarly there are marked distinctions between the four-sided adzes in Green and Purcell's study which may relate to function; the relatively thin rectangular wide-bladed form designed for dressing timber, and the one thick quadrangular specimen for heavier woodwork (note that in this thesis the term ‘quadrangular’ is used more specifically to describe adzes that are close to
square in shape). The cross-section shape is not different just orientated in a different manner. Again, this may indicate that the cross-section thickness:blade width ratio may be of greatest significance for understanding adze function, not the shape of the cross-section or the width at the shoulder or mid-section.

Factor analysis conducted by Stuart Park on some 200 New Zealand adzes also highlighted the importance of 'the nature of the cross-section' (1972:102). The variables employed, however, related to length, thickness and cutting edge width, again variables that relate to cross-section dimensions not necessarily shape.

The problem of most existing adze typologies in failing to recognize the likely importance of thickness relative to blade width can be seen in the lack of distinction made between quadrangular adzes (where the depth of the cross-section is more than half the width), and rectangular adzes (where section thickness is less than half the width). Most authors use either 'rectangular' or 'quadrangular' indiscriminately to describe four-sided adzes (for example, Barber 1994; Cleghorn 1982,1992; Lass 1994). Skinner was one scholar who did make this distinction and incorporated it into his typology of four sided adzes, possibly because the cross-section difference between the relatively thin-sectioned metasomatised argillite and pounamu adzes was marked compared to the thick square-sectioned greywacke Southland adzes. Skinner astutely related this difference to the manufacturing and functional properties of the different stone materials used (1943:66,67). Duff, however, in dealing with an adze assemblage principally of one material, Nelson/Marlborough argillite, whose flaking properties and toughness may have commonly resulted in four-sided adzes with particularly thin or rectangular cross-sections, failed to note the technological significance of this difference and combined Skinner's Type 1A ('adze thick from front to back' 1974:103) and Type 1B ('adze thin from front to back' 1974:104) into his Type 1A.

It is likely, however, that a functional as well as a morphological distinction may be found between the thick massive quadrangular 1A type and the thinner and generally less robust rectangular form. A pertinent observation made by Duff regarding the presence of lugs is that they are most often seen on 'massive thick types' - the type of adze that might especially require an extra facility of this kind to ensure secure hafting (1977:148). Skinner notes that his thin Type 1B has 'Lugs never present.' (1974:104). It is logical to expect that rectangular forms would
require more careful handling and may have been set aside for cleaning down wide planks of timber, while the more robust thick quadrangular form would have been ideal for heavy rough work. This is a functional distinction recognised by Skinner but not by Duff.

The emphasis that Duff places on cross-section shape and presence/absence of a tang as the primary criteria for distinguishing type, also inclines him to assume that these features may also have functional significance. An example is his Type 4A, a predominantly triangular back-wider-than-front thick narrow-bladed gouge form. Duff notes that while the form does appear to be designed for a particular purpose, it does not seem to have been an essential tool because many island groups in East Polynesia, for example Hawaii, got by without it (Duff 1977:178). Other adze forms, however, could easily have assumed the same function. For example, in Hawaii, narrow bladed, deep-bodied quadrangular adzes with steep edge angles are found that probably served the same deep gouging function as Duff's Type 4A. In profile particularly they resemble their triangular counterparts in New Zealand. Likewise, in Central Polynesia, the triangular 3A adze may have performed tasks accomplished elsewhere by Type 1A. The shape of the adze may have had more to do with the quality of the raw material used and the manufacturing techniques applied. The preference for one cross-section shape, for example, triangular in Central East Polynesia, over others may be the result of experimenting with different raw materials or developing more efficient manufacturing techniques. Very little research in the technological strategies guiding adze production has been undertaken in the Central Polynesian region to inform on this matter.

Nevertheless, the focus on cross-section shape has lead to the downgrading of function as an important influence on adze form by some authors:

'In addition, it should not be forgotten that different East Polynesian groups concentrated on the production of different adze shapes often to the exclusion of others. This fact should be remembered by those hoping to correlate a specific activity with a particular type of adze.' (Leach 1981:168).

Cross-section shape may be standardized for various types, functional or otherwise, but it might not be indicative of specific function. Rather it may represent adjustments constrained by more directly functional attributes. For example, wide-bladed adzes for timber dressing would
probably need to be of adequate length, have low edge angles, an even distribution of mass, and relatively steep sides, especially in the bevel area to protect blade corners and to maximize blade width. A shallow rectangular cross-section would be suited to this arrangement though it may impose greater manufacturing difficulties particularly for long adzes in terms of high risks of breakage, and for flakeable materials, difficult high angled quadrilateral flaking. Similarly for wide bladed adzes suited to heavy roughing out work, a thick equal-sided quadrangular cross-section might be ideal, especially in providing protection from breakage during forceful use and for a very balanced distribution of mass which may have been crucial under such stressful conditions.

The distinction made between rectangular/quadrangular adzes with the front wider than the back (Duff Type 2A) or with the back wider than the front (2C) might also reflect differences in material quality in terms of solving both manufacturing and functional problems. For example, as discussed above, making the back wider than the front may have been a device to strengthen blade corners. Type 2C is the dominant standardized form in Samoa, comprising '...over ninety percent of all adzes recorded from Samoa' and thus has become known as the 'Samoan Type' (Duff 1977:168; Skinner 1974:107). Outside the immediate area of Samoa its occurrence is rare. This might indicate that the basalt used in Samoa was rather soft, and may reflect constraints imposed by the form and workability of the stone (Leach and Witter 1990).

**Symmetry/Finish**

One final feature that emerges from the discussion of other attributes above is the probable importance of symmetrical form. Some of the larger adzes in New Zealand are spectacular examples of craftsmanship, and their aesthetic appeal has long made them an attractive artefact for collectors and scholars alike. This artistry has lead some archaeologists and scholars to question whether such adzes were ever used as tools at all, and to the assumption that the finish of some finely rendered specimens far exceeded functional requirements. Instead they had a ritual or ceremonial role and were considered prestige items for display only (Duff 1977:148; Leach 1990:382,1993:39-41; Skinner 1974:103-104).

Dickson noted, however, that symmetry and an even distribution of mass were important for effective tool operation, hafting security, and avoidance of damage and breakage (1981:112).
We might expect that for some adze forms, symmetry was more important, i.e., large heavy adzes used for chopping, splitting and gouging would need to be well balanced to prevent twisting during the stroke and to absorb the shock from the impact evenly. Breakage was likely to occur more readily where a weakness or imbalance existed. The same could apply, possibly even more strongly, to large rectangular wide-bladed adzes where length was markedly disproportionate to thickness, particularly where an even shaving stroke was the desired effect.

Having defined the nature of the raw materials and methods used in adze manufacture, and having considered the aspects of adze design that may be most relevant to function, the methods employed to analyze adzes in previous studies and in the present research can now be discussed.

**Methods of Analysis**

A major problem with previous analyses of adze collections (Park 1972; Simmons 1973; Skinner 1974) was the highly selective nature of the samples used. In an ambitious statistical project (at a time when the advantages of computerization were just beginning to be realized), Park attempted to test the quantitative significance of Duff's adze types. He selected for analysis, however, ‘...only adzes which were more or less finished and unbroken...’ (1972:79), and ‘...which appeared to have morphological or functional significance...’ and ‘...which could be considered representative of the spatial distribution of adzes in New Zealand' (1972:78). Whether 200 adzes (1979:Table 9:128-132) can be considered a representative sample is open to serious debate, and the failure to qualify what constitutes 'morphological and functional significance' renders Parks sample a decidedly biased one. While Park later states that 'The archaeologist must examine the relationships between artefacts in order to analyse the relationships between sites.' (1972:100), the omission of unfinished and broken adzes from his sample means that the representation of some site types like quarries and domestic working areas will be completely inadequate.

A study of South Island adzes by Simmons (1973), while comprising a larger sample of some 2000 adzes, suffers from a similar selection bias with incomplete adzes excluded from his data.
Both these studies exposed a major problem with the existing (Duff) typology employed to analyze adzes - that too many adzes were rendered 'non-diagnostic' by its application. Indeed Duff himself was equally selective in his study of the Wairau Bar adze assemblage that was pivotal to the formulation of his typology. He included only ‘...reasonably perfect and classifiable adzes...' in his table of adzes found at Wairau (1977:140). Clearly explanation of the presence of unfinished, broken and otherwise ‘non-diagnostic' adzes, which can often be abundant (for example, east coast Coromandel midden assemblages - Boileau 1980; Davidson 1975; Furey 1990), requires explanation - and alternative methods of analysis. Their exclusion from samples can introduce serious bias into adze analysis, particularly when attempting to understand how and in what contexts adzes enter the archaeological record, and when calculating distributional frequencies of adze ‘types'. Archaeologists cannot answer questions about the spatial distribution of New Zealand adzes if some forms, and some of the states (i.e., broken) that resulted in the discard of adzes, are overlooked. For example, the spatial distribution of unfinished adzes may provide information on how adzes were distributed from source areas. Broken adzes may reveal insights into the use-life of adzes and the degree to which the raw materials they were made of were conserved or curated. In addition, while the inadequacies of Duff’s typology are recognised, this has not been demonstrated statistically.

A large practical problem has confronted researchers in the past; namely the processing of large samples. This is steadily being overcome by rapid technological advances in computerization. Computer programmes are now available which allow the processing and analysis of very large samples in very little time. Such a programme (SPSS) was utilized in the analysis of the large adze sample generated in this research.

This thesis focuses on the raw materials, manufacturing techniques, typology, function and distribution of early period 'Archaic' adzes. Therefore, for the North Island, only Duff type 2B adzes made from coarse-grained rocks and pounamu were excluded from analysis. The 'Classic' (or late period) 2B adze represents a situation where change had already taken place. While a similar examination of late period adze technology is certainly required, it was beyond the scope of the present research. Because preforms found at quarries were the subject of previous research (Turner 1992), they are also omitted from the present data.

Originally it was intended to examine both North and South Island Museum adze collections.
But while data processing technology has improved markedly, data collection remains a time consuming and expensive undertaking. After two years of collecting data on almost 10,000 North Island adzes, a decision was made to restrict the analysis of adze distribution to this island only. Typological studies on New Zealand adzes, however (Duff 1977; Skinner 1974), have developed almost exclusively with reference to South Island adze collections. For example, the Otago Museum collections provided Skinner with the adze sample that lead to the formulation of his adze typology which, in turn, was modified by Duff into the one in current use in New Zealand today. The latter was heavily influenced by the large assemblage from the 'Moa-hunting' site at Wairau Bar near Blenheim in the Marlborough region. Because re-examination of the current adze typology plays an integral role in the present research, it was considered necessary to view first hand the adzes that influenced both Skinner's and Duff's typologies. These typologies have proved particularly inadequate for the analysis of North Island assemblages, especially the ubiquitous '2B' type; the one both Skinner and Duff were least familiar with, and, as a consequence, the type most poorly defined. It is notable also that both the Canterbury Museum where Duff spent much of his professional life as director, and the Otago Museum where Skinner fulfilled a similar role, have small North Island adze collections dominated by the late 2B form (personal observation). The impression gained by Skinner and Duff from these collections may be responsible for the still accepted idea that the 2B was the prevailing North Island adze type, Duff going so far as to state that the 2B type '...probably covers 80 percent of all adzes in North Island collections', a statement often repeated by subsequent researchers (S.Best 1975:307; Duff 1977:141; Golson 1959a:48). This may prove to be so, but will remain an untested assumption until statistically demonstrated via the use of large non-biased samples. Hence a small sample of South Island adzes has been included in this research.

Where possible excavated adze assemblages were included. But due to problems of regional and contextual bias, they were insufficient to provide the information sought in this research. Therefore adze collections from 34 Museums were examined, 26 from the North Island and eight from the South Island. To address problems relating to regional distribution, eight large North Island private collections plus sundry smaller ones were also included (see Appendix B for lists and details of all these collections).

A data collection procedure was developed which maximized the amount of information
obtained while minimizing the time taken. A coding system was employed toward this end, supplemented by 'one minute' outline drawings for approximately 70% of all adzes observed (a number of which are included in Chapter Three and Four). Due to time limitations the usual convention of drawing the cross-section was omitted. A slide rule that could safely accommodate both very large and very small adzes was used to take measurements and a portable battery operated electronic scale was used to record weights accurate to within five grams. Some display adzes were unable to be weighed because they were permanently fixed in place. Accurate weight was unable to be recorded for a few adzes because they exceeded the weight limit of the scale (5750gms). Each adze took approximately five minutes to process but they were generally examined in 'batches'; usually about twenty at a time. Data collection was staggered so that each adze was examined separately at least three times. First the adzes were drawn, then measurements and weight were recorded followed by the taking of descriptive details. Each step allowed different aspects of the adze to be noted and permitted re-assessment and the recording of details that may have initially escaped observation. Dante Bonica was present during much of this analysis and provided a valuable second opinion, particularly from a practitioner’s perspective.

Approximately 11,886 adzes were examined during the course of this research. 9711 adzes were provenanced to the North Island (total sample) and 2175 to the South Island. The South Island sample included all the adzes from Wairau Bar (619), Rotokura (260), and Waitaki River mouth (560). All primary adzes (adzes that had seen little or no use) and well-formed complete preforms were recorded. In addition, all adzes recovered from burial contexts and those found in caches were included in the data (see Appendix B).

The next chapter presents the results of experiments in the use of stone adzes. The knowledge gained from these results is then employed to examine archaeological adze samples within the framework of a functional typology.
CHAPTER THREE: FUNCTION AND DESIGN.

Introduction

The European term 'adze' may be responsible for introducing some confusion regarding how stone adzes were used. It has generally been assumed, particularly for early forms, that adzes were used at a low angle of attack with a shaving stroke that carried through rather than coming to rest in the wood in the manner of axes (S.Best 1975:135,315; Dickson 1981:88; Richards 1990:139). Preliminary experiments in the use of adzes, however, suggested that their wood working repertoire extended beyond this one type of motion. The haft procurement exercise outlined in Turner (1992:11-13) demonstrated that one medium-sized rectangular Duff 2A adze was quite flexible in the range of tasks it was assigned, though it was not the most suitably shaped or sized adze for all of these. The adze was used first to detach a secondary limb from a manuka tree, then to remove excess wood and bark from the haft 'blank' before refining the haft shape. The low edge angle of what was essentially a trimming adze was too fine for the initial chopping task and the blade chipped all along the cutting edge with each successive blow. This resulted in a more suitable robust edge angle. Nevertheless there was never any concern that the adze would break when being used for chopping and, despite the chipped edge, it was used for the full 50 minutes that it took to complete the roughing out and trimming of the haft.

In Dickson's study of Australian archaeological stone tools, he saw none that could be conclusively defined as an adze, though some specimens had slightly biased bevels. Dickson pertinently noted, however, that 'It is the shape, not the method of hafting that distinguishes the adze from the axe' (1981:89). The chief distinguishing feature of this 'shape' is the biased cutting edge. From his own functional experiments, Dickson concluded that an axe (mounted with the blade aligned with the handle) was very difficult to use when the blade edge was biased by more than 15 degrees. None of the archaeological specimens seen in Australian museums had a blade bias that exceeded this, leading Dickson to conclude that the Australian aborigines did not use adzes (1981:89). Axes (wielded with two hands) or stone hatchets (wielded with one hand) though efficient chopping tools, could not be used in the skimming follow through stroke of adzes (Dickson 1981:88). Ethnographic studies of Papua New Guinea 'axes' (Strathern 1965;
Toth, Clark and Ligue 1992), however, report that axes and adzes were distinguished by the manner they were hafted. It is interesting to note, therefore, the words of Toth et al.’s Papua New Guinea informants - that their low edge angled equal-biased tools were hafted in the manner of an axe or an adze depending on task requirements (1992:66).

In a study of Western Samoan adzes, Richards states:

'Only a few could have been hafted and used with an adze-like, planing, follow-through stroke. In fact, from their shape and from what is known of their hafting, most to'i ma'a were used hardly at all as adzes but more as hafted choppers.'(1990:137).

It is possible that the European term 'adze' was conceptually different from Polynesian terms like *toki* and *to'i ma'a*. For example, in the European sense, the term 'adze' generally refers to a tool used for dressing timber while the term 'axe' describes a tool used for wood chopping. The Maori term *'toki'* very likely included tools that performed both these functions.

Possibly no other wood-working task required such a varied adze kit than the construction of a *waka* (canoe), particularly a large ocean-going canoe of the kind used to colonise New Zealand. The hull design that imparted the crucial features of stability and speed represent certain advancements in wood-working technology. From the few archaeological examples recovered in New Zealand (Barrow and Keyes 1966), these hulls, also characteristic of smaller fishing canoes or outriggers, were very narrow and deep with a transverse convexity of the sides between the base and top surface. If ever specialized tools were needed, it would have been for the purpose of excavating such hulls as these. Longitudinal curvature on these canoes terminates in a sharp apex at both bow and prow.

Two New Zealand archaeological examples of this type of hull are known; a 4.7m long unfinished totara specimen from a Horowhenua dune swamp, and a larger (6.6m long) finished but poorly preserved specimen from South Taieri in Southland (known as the Henley canoe, Barrow and Keyes 1966:279). The longitudinal curvature of the Southland canoe is particularly pronounced and the opening at the top of the hull correspondingly narrow (40cm across), though not as narrow as the Horowhenua example (30cm). Both had similar depths (Henley = 42.5cm, Horowhenua = 37.5cm), (Barrow and Keyes 1966:282). An outrigger float found in the same vicinity as the Horowhenua hull was probably lashed to a similar canoe (Adkin 1962). A decorative canoe prow (Duff 1961) from Waitara, North Taranaki, and a notched bow cover from Waitore, South
Taranaki (Cassels:1979), both fit very narrow hulls. Apart from these examples and the outrigger float from Monck's Cave, Canterbury (Skinner 1924a), few other archaeological specimens of this type of canoe have been recovered in Polynesia.

Observations made by early European explorers of the types of watercraft still extant in New Zealand at the time reveal that narrow double-hulled canoes and outriggers, while occasionally seen, had largely been replaced by wide shallow-hulled vessels, often, as in the large waka taua or war canoe, with added side strakes (Adkin 1962; Barrow and Keyes 1966; Bathgate 1969; Walter 1988). This change in canoe design has been implicated in arguments explaining changes in adze form, especially the disappearance of the side-hafted adze (Best 1975:333; Moore, Keyes and Orchiston 1979).

The pristine native forest of the New Zealand environment presented the early settlers with extensive and accessible stands of mature and large trees. Some species proved especially ideal for wood-working. Totara was probably the preferred wood for canoe making due both to its seaworthy properties (buoyancy, strength and resistance to rotting) and wood-working properties (straight grain, few knots, clean cutting).

In a study of six Fiordland sites where an unusual abundance of wooden cultural material was found, totara and rimu were the most frequently identified timbers (Coutts 1977:67). Green or wet wood was favoured over dry wood because it was far easier to work with. This was experienced by Coutts during experiments with stone adzes:

'Green timber was used after it was found that stone tools would not cut dry or semi-dry totara or rimu' (1977:67).

This may explain the discovery of the unfinished Horowhenua canoe in a swamp. The significant number of wooden artefacts found in swamps suggests they were an ideal repository for the safe discard of broken tapu objects (i.e, the combs at Kauri Point - Shawcross 1976), for the safe storage of valuable carvings and other goods during times of political uncertainty, and additionally would have been an ideal way of preventing the wood of both finished and unfinished items from drying out and cracking. Preference for heart wood over the outer sap wood (which is very spongy, difficult to work and also rots much faster than heart wood), meant that even a small outrigger may .
have required a fairly sizeable tree to be felled.

This consideration introduces another major challenge in wood-working technology, the manner by which large trees were cut down, a seemingly daunting task with stone tools. No demonstrably feasible method has thus far been put forward to explain how this was accomplished. The use of ‘battering-ram’ devices by which an adze is hafted in line to a large pole and swung at the tree trunk is mechanically unsound for adzes with biased cutting edges (E.Best 1974:129; Dickson 1981; Hiroa 1987:187; Richards 1990:138) and would have resulted in almost immediate and tremendous damage. All the Samoan types observed in Richards' study had biased edges as did those observed in the present study. Another suggestion given by Skinner (1974:108) and Richards (1990) may be more accurate. Richards states:

'The most effective felling would have begun with small deep initial cuts requiring nearly horizontal blows from a tool with a narrow front to penetrate as deeply as possible through the outer soft wood into the interior hard wood. With such a tool it would be more efficient to make two scarfs, more or less horizontally across the standing tree trunk, and then to chip out the space between them, preferably using a chopping tool.’ (1990:138).

An alternative method, that of kindling fires in the cut grooves (E.Best 1974:135-136), may have been difficult when the wood was damp, and dangerous when it was dry. Another possibility - one that may have been more suited to the use of adzes - was to undermine the roots on one side of the tree and then wait for a strong wind to complete the felling task. Initially, when populations were small, there may have been an adequate and accessible supply of already felled trees as a natural consequence of storms. The climatic periods outlined by Grant certainly suggest that forests destroyed by wind-throw were common during warm periods like the Pre-Kaharoa Period (A.D. 950-1000) and the Waihirere Period A.D. 1180/1270-1350) (1994:166-168).

Regrettably, functional experiments in felling large trees were unable to be undertaken for this research. It is no longer possible to stroll in to a forest, select the fine totara of your choice and then begin hacking it about. Also for one person to attempt this task alone would be a very lengthy process, and as yet there is no one who is sufficiently skilled in the use of stone adzes to assist Bonica in such an undertaking.

In considering functional experimentation with stone adzes it was seen as necessary to choose an actual item for manufacture so that adze use, and the use of certain types of adzes, would arise from task requirements, not from preconceived archaeological assumptions about how types of .
adzes were used. The manufacture of a small outrigger was considered suitable in that it would likely require the greatest range of adzes involving the greatest variety of wood working actions, as well as being a very important artefact for which archaeological examples exist.

An adze tool kit was prepared well in advance of the experiment, and this took far longer to achieve than anticipated. All the adzes were painstakingly made and finished employing traditional methods by Bonica over a two year period. More adzes were made than were probably required in order to prepare for all possible eventualities, and to represent a range of raw materials. Eventualities might include a higher breakage rate than expected thus a back-up supply was seen as sensible, and, given the experimental nature of the project, ensuring that a range of tools (in terms of size and form) were available in case they were required. Thus the task was able to dictate the type of adze used in order to identify adzes most suited to the task rather than those that had to be used to 'make do'.

The aims of the project are outlined below, followed by a description of the project itself, and the problems encountered.

**Aims of the Functional Experiment**

The project was designed to address the questions of function and use-life outlined in Chapter Two.

1. Can adze forms be matched to specific or specialized tasks?, i.e., what characterizes the "...performance of adze types in various tasks" (Leach 1981:168).
2. How were certain tasks accomplished? Was there flexibility in terms of the range of wood-working functions - shaving, gouging, cutting/chopping? What features contribute to function - how? - i.e., angle of attack, edge angle, edge curvature, blade width, cross-section, length.
3. How efficient were adzes in terms of strength and durability? How much force could be used? What are the problems encountered in terms of the types and causes of damage? How long could adzes last in primary condition? How often did they need resharpening and how long did this take?
4. Evidence of use-wear (haft polish, blade striations) - how long does this take to build up and after how much use?
5. How much time and effort is involved in wood working projects?

6. What is the nature and amount of debitage resulting from use – i.e., adze chips and wood shavings?.

7. What are the relative values of the different raw materials and the values of the properties - hardness, toughness - and how do these manifest in operation?

8. Do the existing adze typologies employed to analyze adzes in New Zealand (Duff 1977; Skinner 1974) describe different functional types? These typologies were originally designed to answer questions related to '...tracing the temporal development of adze forms within island groups...and...postulating cultural-historical relationships between island groups' (Cleghorn 1984:403). The influences of manufacture and function, while occasionally recognized, were subsumed by the larger questions above with Duff asserting that:

'...the peculiarities in the distribution of adze types over the scattered island groups of Polynesia are due less to the nature or needs of the environment than to the successive growth, diffusion and replacement of cultural patterns (1977:143).

An additional objective of the present research, then, is to test Duff's assumption given that my major hypothesis is that adze 'peculiarities' or variability may be adequately explained by variability in raw material and manufacturing techniques within functional parameters.

Because scholars in Polynesia, particularly New Zealand, are most familiar with the adze typology as defined by Duff, it is used in the text below with reference to the experimental adzes used in the functional experiment. These are illustrated in Figure 3.1-3.3, and their dimensions are given in Table 3.1.

**Description of the Functional Experiment**

**A. Initial Roughing out**

A Kauri log was kindly donated by Joan Lawrence and had already been cut down. It was 5.7m long with a width of 1.4m and was estimated to be about 110 years old (see Figure 3.4).
By the time the adzes were ready the log had dried out considerably despite efforts to keep it
Figure 3.1: Experimental Type 1 and Type 2 Adzes
Figure 3.2: Experimental Type 4 Adzes
Figure 3.3: Experimental Type 3 and 5 Adzes
Table 3.1: Experimental Adzes used in the Functional Test

<table>
<thead>
<tr>
<th>Stone</th>
<th>Adze No.</th>
<th>Duff Type</th>
<th>Length mm</th>
<th>Blade Width mm</th>
<th>Edge Angle</th>
<th>Maximum Thickness minus haft</th>
<th>Weight gm with haft</th>
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</thead>
<tbody>
<tr>
<td>Tahanga Bas</td>
<td>1 4A</td>
<td>315</td>
<td>15</td>
<td>60</td>
<td>81</td>
<td>2655</td>
<td>3480</td>
</tr>
<tr>
<td>Seacliff Bas</td>
<td>2 4A</td>
<td>270</td>
<td>17</td>
<td>62</td>
<td>61</td>
<td>1640</td>
<td>2270</td>
</tr>
<tr>
<td>Light-grey Arg</td>
<td>3 4A</td>
<td>231</td>
<td>20</td>
<td>65</td>
<td>62</td>
<td>1265</td>
<td>1905</td>
</tr>
<tr>
<td>Dark-grey Arg</td>
<td>4 4B</td>
<td>235</td>
<td>42</td>
<td>42</td>
<td>52</td>
<td>1070</td>
<td>1710</td>
</tr>
<tr>
<td>Tahanga Bas</td>
<td>5 1A</td>
<td>313</td>
<td>87</td>
<td>50</td>
<td>62</td>
<td>3025</td>
<td>3850</td>
</tr>
<tr>
<td>Dark-grey Arg</td>
<td>10 1A</td>
<td>315</td>
<td>97</td>
<td>37</td>
<td>36</td>
<td>2130</td>
<td>2955</td>
</tr>
<tr>
<td>Ohana Arg</td>
<td>11 Alugs</td>
<td>208</td>
<td>92</td>
<td>37</td>
<td>33</td>
<td>1035</td>
<td>1700</td>
</tr>
<tr>
<td>Tahanga Bas</td>
<td>12 1A</td>
<td>183</td>
<td>72</td>
<td>49</td>
<td>35</td>
<td>705</td>
<td>1345</td>
</tr>
<tr>
<td>Tahanga Bas</td>
<td>8 1A</td>
<td>199</td>
<td>80</td>
<td>51</td>
<td>47</td>
<td>1335</td>
<td>1830</td>
</tr>
<tr>
<td>Tahanga Bas</td>
<td>9 1A</td>
<td>205</td>
<td>88</td>
<td>42</td>
<td>35</td>
<td>1080</td>
<td>1720</td>
</tr>
<tr>
<td>Tahanga Bas</td>
<td>7 3B</td>
<td>212</td>
<td>65</td>
<td>36</td>
<td>26</td>
<td>540</td>
<td>1155</td>
</tr>
<tr>
<td>Tahanga Bas</td>
<td>13 3B</td>
<td>192</td>
<td>57</td>
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<td>32</td>
<td>475</td>
<td>970</td>
</tr>
<tr>
<td>Tahanga Bas</td>
<td>14 5A</td>
<td>210</td>
<td>84</td>
<td>40</td>
<td>36</td>
<td>940</td>
<td>1765</td>
</tr>
<tr>
<td>Tahanga Bas</td>
<td>15 5A</td>
<td>156</td>
<td>69</td>
<td>39</td>
<td>32</td>
<td>435</td>
<td>1050</td>
</tr>
</tbody>
</table>

No 11 is from the Ohana Source, D'Urville Island
No 10 is from Croisilles Harbour, Marlborough
No 3 and 4 are from Maitai River, Nelson
Seacliff basalt source from North Dunedin

damp. Also too much sap wood was present comprising two thirds of the logs thickness. Kauri does not cut as cleanly as totara and rots more rapidly. Such a log would probably have been rejected in the past when better timber was available. However, attempts to procure a more ideal totara log had failed so a decision was made to proceed with what we had.

Prior to use the adzes immediately required were hafted. All experimental adzes were hafted to one-piece flat-soled hafts. To provide extra hafting security, all adze butts were wrapped in fibre or canvas before being lashed to the haft. For large adzes (e.g., the No.5 1A and the No.1 4A) this took approximately 15 minutes, the smaller ones less. The hafted adze heads were then soaked in water to tighten the lashing. This was done periodically when the lashing began to dry out and loosen (see Fig 3.5 showing newly hafted 1A adzes). Shaft lengths ranged between 40-50cms, the larger adzes hafted to the longer hafts.

Problems were experienced almost immediately when attempting to remove the bark using the
Figure 3.4 - Top: Kauri Log used in Functional Experiment
Figure 3.5 – Bottom: Hafted Experimental Type 1 Adzes
large Tahanga basalt 4A (No.1) and the large Tahanga basalt 1A (No.5) adzes. The aim was to make transverse scarfs across the top of the log with the 4A adze, and then chop out the wood between these with the 1A adze. This attempt was a total failure. Though Bonica used the adzes with maximum force the adzes could make little impact on the wood. They literally bounced off. A shallow chip spalled off the 1A blade at one front corner. The chip snapped in several pieces and one fragment was recovered 10m away from the log. This damage was quickly repaired by re-grinding.

When it became clear that the wood was just too spongy and dried out, a decision was made to use a steel adze. This was also ineffective and its use was ceased when the handle snapped in two. A steel axe also failed to make an impact and suffered a minor chip to the blade. Finally only a chain saw proved a match for this task, and it was used to remove the outer bark and to saw a flat surface across the top of the log. This was not an encouraging start!

**B. Reducing the top surface**

The reduction of the top surface was accomplished in three steps:

1. Making a series of transverse scarfs approximately 15cm apart with the No.1 4A adze.
2. Removing the wood between these scarfs with the No.5 1A adze.
3. Cleaning down the rough surface remaining with first the large 1A adze then shaving this surface to an even level with a smaller Ohana argillite adze (No. 11).

By using it to smash through the wood fibres (see Figure 3.6 showing transverse scarfs), the 4A adze was capable of penetrating the wood up to 4cm depth. It was used with a high angle of attack with a chopping motion that impacted with tremendous force, pulping and splintering the wood. (See Figure 3.7). The resulting wood chips resembled nothing that would normally be associated with an adze (see Figure 3.8). The 1A adze was used to split out the sections between the scarfs. This was generally accomplished by one well-directed blow with the force of impact resulting in a clean split in the wood from one scarf to the next (see Figure 3.9 and 3.10). The large chunks it removed were 3.5cm thick and approximately 18cm x 10cm matching the width between the scarfs and the 1A blade width respectively (see Figure 3.11a and b). The No.5 1A adze was then used to clean up the rough surface remaining before the process of reduction was repeated. This
action was important to keep the surface even and in proportion and to avoid mis-aimed blows that could result from an uneven surface (see Figure 3.12). When the surface had been reduced to its approximate final level the Ohana argillite rectangular adze was used with a true low angled adzing stroke to produce a smooth very even surface. The large rectangular Croisilles Harbour argillite adze (No.10) was used briefly for the same task but only for observation purposes. This adze, characterised by a thin cross-section and a low cutting edge angle, was designed for fine trimming work, not rough shaping. The log was considered too small for the effective use of such a large adze, nor did the quality of the wood do it justice. It would have proved its value in cleaning down much longer and wider flat surfaces as might be required in the manufacture of larger canoes or in the dressing of large planks for house boards. Extra effort and time had to be invested in these procedures as they all involved removing dried out sap wood. Wood workers in pre-European times would doubtless not have had such difficult material to work with, nor would their adzes have been under such stress. Nevertheless none of the adzes were damaged or chipped during these steps.

C. Trimming the outer sides

The hull was able to be tilted, laid on its side or turned over to rest on the flat surface for the initial removal of excess wood. The outer shape was roughly formed prior to the reduction of the upper surface with finer shaping taking place after this. The large No.5 1A adze and the smaller quadrangular No.8 1A adze, both Tahanga basalt, were used for the roughing out work then cleaned down by the No.11 Ohana argillite adze and the rectangular No.9 Tahanga basalt adze.

It was during this activity that other serious problems emerged. The upper half of the log had a number of large knots that became an increasing difficulty as reduction progressed. Also the log was found to be riddled with 10cm long nails which must have been hammered into the tree when it was a young ricker. A very small chip was removed from the Ohana argillite blade edge to the back as a consequence of striking one of these nails. This damage was repaired by regrinding, a process that took ten minutes.

The solution to these problems was twofold. Bonica decided that the log was no longer suitable for the making of a small canoe. Instead he proposed to make a kumete (bowl) of the type traditionally used for making fibre dyes (see Figure 3.13 showing the manufacture of a red dye from Tanekaha
bark). The fundamental design remained the same except that the apex at the base had to be trimmed flat so that it could rest evenly on the ground. This was achieved by using the same methods and adzes (with the addition of the Seacliff basalt 4A adze) employed to reduce the top surface. During this procedure, a small chip to the blade corner on the back of the 1A adze occurred but took only five minutes to repair by grinding.

Additionally the length of the hull had to be drastically shortened. The upper portion was cut away with a chain saw and the length of the hull reduced to 2.5m.

Forming the outer transverse and longitudinal curvature was accomplished by both chopping and adzing most frequently across the grain (Figure 3.14 -3.16). First the sides were reduced down to their approximate final width, then the narrowing of both ends was undertaken. A cluster of nails at one end meant further reduction of the *kumete* to 2m in length.

The final shape of the outer surface was cleaned down with the Ohana argillite adze before hollowing out of the *kumete* commenced. Minor use was made of the smaller side-hafted adze in trimming the curved ends (Figure 3.17).

At this point work had been in progress for four weeks with Bonica working for approximately 60 hours a week. Because of the various problems encountered, this can not be taken as a reliable estimate for such an undertaking under normal circumstances comparable with the pre-European situation. On one hand progress was impeded by the poor quality of the wood but on the other it was accelerated by the use of modern tools.

The dimensions of the *kumete* at this stage were 1.9m length, 35cm depth, and 35cm maximum width (see Figure 3.18).

**D. Hollowing out**

Medium sized adzes were used for the initial hollowing out procedure. The use of large heavy adzes would run the risk of causing splits in the wood too close to the edge. The first objective was to make a longitudinal V shaped groove. The two 4B adzes (No.4 and No.6) were used for this purpose in the manner shown in Figures 3.19 and 3.20. The No.12 1A adze then cleaned down the rough apex that remained. The 4B adzes acted as a compromise between the very narrow bladed 4A and the wide bladed 1A. The back wider than front feature results in stronger blade corners and a better gouging effect than wide-bladed front wider than back forms. These adze types can also remove more surface wood than the 4A adzes. These adzes were also used in a chopping action,
both with and across the grain. While undertaking this task, the No.4 adze struck and sheared through a nail without suffering any damage. Nails continued to be a problem throughout the hollowing out process and much time was wasted extracting them by means of a steel chisel and the claws of a steel hammer.

As excavation proceeded and the width of the base decreased, the 1A adze was replaced by 4A adzes (No.2 and No.3). These adzes were also employed to shape the inner longitudinal curvature and apex at each end of the kumete.

At a depth of 15-20cm (see Figure 3.21), side shaping became difficult to accomplish using ordinarily hafted adzes, particularly when trying to gain access to the deeper reaches. Either the adze blade would strike at a distance too far away from the sides or the butt of the adze would knock against the side preventing the blade from making contact with the wood.

From this point on the side-hafted adzes (see Figure 3.22) were commandeered to do most of the side trimming work in a manner best imparted by Figure 3.23. The 4A and 4B adzes continued to be used at intervals to clean down the base. The 5A adzes were efficient for trimming the sides but where they curved quite sharply toward the apex at each end of the kumete, the 5A blades proved too wide. The leading blade corner tended to 'dig in' at an awkward angle, and this caused a small chip to be removed on the left-sided 5A adze. The sharp angles curving around and up toward the apex at each end of the kumete called for a different set of adzes. This is where the Type 3 adzes were valuable. The relatively narrow curved blades and the convexity of the front was well suited to trimming curved surfaces (See Figure 3.24). Length was also important so that the blade could reach the lower depths. The frontal convexity of the 5A adzes also produced marked concavity of the sides. This feature, seen also on archaeological specimens of Type 3 and 5, has a 'scooping' or spoon-like effect. The Type 3 adzes were also important for shaping the upper edges or rim of the kumete, a task requiring care to avoid causing splits in the wood at this narrow junction (see Figure 3.25). The intersection at the apex itself was cleaned down by the Tahanga basalt 4B adze which also had a rounded convex front. For sharp corners like this a long slender 4A gouge would have been ideal. On a later project one of these adzes was used and proved very suitable for this purpose (Bonica, pers.comm.).

The final dimensions of the kumete were 1.9m length, 35cm maximum outer width and 29cm maximum inner width, 35cm outer depth and 29cm inner depth (see Figure 3.26). Just prior to completion all surfaces were rubbed smooth with pumice and water. The hollowing out process took ten days.
Figure 3.6: Transverse Scarfs made by Type 4 Adze.
Figure 3.7 – Top: Type 4 Adze being Used.

Figure 3.8 – Bottom: Wood Shavings made by Type 4 Adze.
Figure 3.9 – Top: Type 1 Adze splitting out Wood between Scarfs.
Figure 3.10 – Bottom: Wood chunk split out by Type 1 Adze.
Figure 3.11a and b: Wood Chunks split out by Type 1 Adze.
Figure 3.12 – Top: Type 1 Adze cleaning down Rough Surface.
Figure 3.13 – Bottom: Kumete being used to Dye Fibre.
Figure 3.14: Smaller Type 1 Adze cleaning Surface
Figure 3.15 – Top: Type 2 Adze trimming Surface.
Figure 3.16 – Bottom: Type 2 Adze trimming Surface.
Figure 3.17 – Top: Type 5 Adze trimming Outer Edge.
Figure 3.18 – Bottom: Kumete prior to Hollowing Out.
Figure 3.19 – Top: Type 4B Adze making V-shaped Groove.
Figure 3.20 – Bottom: Type 4B Adze making V-shaped Groove.
Discussion of Results

1. Performance

The functional experiments conducted during the present research demonstrated that adzes were far more flexible tools than axes and that their function was not restricted to adzing. By adjusting length and blade width, curvature and edge angle, and by varying cross-section thickness, an adze 'tool kit' could shape wood in a variety of ways.

While the *kumete* project was in progress, a somewhat colloquial functional classification was developed to refer to the adzes used. The large heavy thick sectioned deep bodied adzes used to remove excess wood became known as 'thumpers' or 'choppers' (No.5 Tahanga basalt 1A and No.1 Tahanga basalt 4A) while the finer sectioned rectangular adzes (Tahanga basalt No 9, Croisilles Harbour argillite No.10, and Ohana argillite No 11) were referred to as 'cleaners'.

The heavy 4A adze was used to smash into the wood with enough force to tear apart the fibres. This enabled the wide bladed 1A adze to split and lever out large chunks of wood with one heavy blow. Neither was used with a 'true' adzing or shaving stroke that had a smooth follow-through, though both were worked with the grain. Both adzes were used with high angles of attack - the 4A adze at approximately 65 degrees, the 1A adze somewhat lower at 50 degrees. The angle of attack used in the haft procurement exercise to cut down the upright limb was approximately that used with the 1A adze - 50 degrees. Both the 4A and 1A adzes had relatively robust edge angles (60 and 50 degrees respectively) and minor blade curvature to prevent blade damage during vigorous use.

There may well be a significant correlation between angle of attack and edge angle. The true adzing stroke calls for a low angle of attack by which the blade makes gradual entry into the wood in the direction of least resistance - with the grain. A fine low angled blade edge lessens that resistance even further as it limits the amount of compression the wood must undergo when the blade enters. Thus a sharp blade can cut cleanly and smoothly through the wood fibres without excessive force being used. As a consequence there is less stress placed on blade corners and on the mid-section of the adze. These functional features are well adapted to the fine trimming, shaping and shaving of wood. The thin-sectioned rectangular 'cleaners' were used with an angle of attack around 20-30 degrees and all had fine low angled edge angles of approximately 36-40 degrees. The 1A adze used in S.Best’s strength and stress tests was of this fine rectangular type.

Best asserted from the results of these tests that 1A adzes were only suitable for a skimming
shaving stroke with a low angle of attack. This has not been substantiated by the functional experiment results outlined above.

The width of the blade is a valued functional feature for these adzes. The wider the blade the greater the surface area that can be cleaned down in one stroke. Also the longer the adze, the longer the stroke and this has a similar beneficial outcome. But the wider the blade the longer the bevel and butt must be to allow effective follow through. If the bevel is too short it will steepen the edge angle thereby causing too much friction against the wood. If the butt is too short it will make contact with the wood during the stroke thereby preventing the adze from carrying through.

But in order to remove excess wood quickly and efficiently a different set of actions was needed requiring quite a different sort of adze. The large 4A and quadrangular 1A adzes were used at higher angles of attack with far greater force in order to penetrate more deeply and to chop out large chunks of wood quickly. These adzes needed to be heavy with a thick cross-section supported behind high angled bevels in order to prevent adze breakage and blade damage and to overcome the greater resistance of the wood. Dickson also found that higher angles of attack and more obtuse blade angles combine to result in a greater displacement of wood (1981:91 - see Figure 11). The different blade widths also have a different effect. The 4A adze penetrated more deeply because it had its weight concentrated behind a narrow blade edge that could impact on a smaller surface area. The scarfs made by the 4A adze then allowed the wide bladed quadrangular 1A adze more effective access to split out the block of wood between them.

In summary, edge angle coupled with features such as length, weight, cross-section thickness and blade width emerge as significant for understanding how an adze functioned and the types of tasks it was best suited to. This does not mean that any of these adzes could not be used in other ways by adjusting the angle of attack and the amount of force used. For example, an adze with a fine thin cross-section and a low edge angle may not generally have been used for heavy duty chopping and roughing out work. But, as demonstrated by the haft procurement exercise, it is not impossible, just less efficient. The task would take more time and effort to accomplish and a higher risk of adze damage and breakage would be present, consequently it would have to be used with far greater caution. Likewise the 1A and 4A adzes could be used in a shaving stroke but the result would not be as fine and smooth, and in the case of the 4A adze, very time consuming. Also the size of the adze is likely to be relative to the size of the task. Large heavy adzes would be of limited value for tasks requiring delicate precision shaping or cleaning. Neither the large No.5 1A adze or the No.1 4A adze were used in the initial hollowing out process for fear that they would cause splits in the
wood close to the edge. All could be and were, at different times, used across the grain.
The hollowing out tools, 'the gougers and scoopers' (Type 4B, 5A and 3 adzes), also have
distinctive functional features that relate to the tasks they were designed for. All had rounded
convex fronts and curved blades so that they performed in the manner of a scoop or spoon when
used at very low angles of attack, leaving concave depressions in the wood. All had low edge
angles reflecting the less vigorous tasks they were involved in. The No.4 4B adze was a somewhat
different design with a more obtuse edge angle, very little blade curvature and a more robust cross-
section, representing a compromise on a smaller scale in terms of function, between the action of
the wide bladed quadrangular adze and the narrow-bladed 4A adze. These adzes were quite large,
all but one over 20cm long, and this was considered important to allow the adze stroke to reach as
deep as possible into the excavation. The smallest adze at 15.6cm long was the left-sided side-
hafted adze. Bonica felt this was somewhat smaller than ideal and expected the larger right-sided
5A adze to be more efficient. However, despite perseverance and some adjustments to the leading
blade corner on the right-sided 5A adze, Bonica displayed a distinct preference for the left-sided
5A adze for both sides of the kumete. In the final analysis this could only be explained by the fact
that Bonica is left-handed.

In summary, these primary adzes proved to have functions that they were optimally suited for. Yet
adzes appear to have displayed considerable flexibility. They could be used variously to adze,
chop, scoop, gouge and split timber. This could be accomplished by altering the angle of attack
and adjusting the amount of force used. Some adze designs were more flexible than others. Type 5
and Type 3 emerge as the most specialized forms and this may explain their rarity in the
archaeological record.

The features identified as having the greatest influence on how an adze functions can be
summarized as follows (in no particular order of importance):

1. Length and weight = size.
2. Edge angle.
3. Edge curvature.
5. Thickness relative to length and blade width.
2. Durability, Efficiency, Damage and Resharpening

All the adzes used in the construction of the *kumete* proved highly efficient and reliable despite the poor quality of the timber used. The inability of the stone to work the outer surface of the log was shared by the steel tools also. The most significant outcome of this failure was to demonstrate the strength of the stone adzes. Both Tahanga basalt 1A and 4A adzes showed a remarkable capacity for absorbing the shock of impacting an intractable material with immense force. Adzes in the past would rarely have received such punishment but this experiment is evidence that they were certainly equal to it in the hands of a skilled wood worker and tool user. The ability of the Maitai River argillite 4B adze to shear through an iron nail (which had not been weakened by rust) without suffering any damage is also testimony to the durability and efficiency of stone adzes. This evidence also suggests that adze breakage did not occur frequently. Bonica, who at times was using all the strength he could muster, was confident that the adzes were never in any danger of snapping during use and finds it difficult to imagine what could cause such damage, except in unskilled hands (Bonica pers.comm.). The damage sustained by the adzes during the *kumete* experiment was restricted to a few minor and easily repaired blade chips. Bonica has recently completed a second *kumete* using the same adzes, this time on more suitable timber - green totara. The only damage sustained was the transverse fracture of a very thin small flake adze used to chisel off high ridges in the final smoothing process.

The evidence gained from these functional experiments suggests that, with care and correct handling, adzes were very durable and reliable tools and may have had long use-lives, even in a primary state. Preventative strategies were likely in place to extend this use-life to the maximum, and to minimize the time and energy wasted in repair. An important condition in preventing blade damage was ensuring that the cutting edge does not become blunt. Even blades in perfect condition and seemingly sharp need some re-honing immediately prior to use as an efficient blade needs to be freshly sharp. During the *kumete* experiment, adzes needed resharpening after approximately eight hours of use and this generally did not take more than five minutes. Even though the blade used in the haft experiment was chipped across its complete width, the broken edge was freshly sharp - and would have been sharper than the original ground edge. The benefits of a ground edge relate more to its edge keeping ability than to imparting an improved sharpness. A fresh unground edge will be very sharp but will not retain this sharpness for long and is much less resistant to damage. Another advantage of ground edge.
Figure 3.21 – Top: V-shaped Groove at point where Type 5 Adzes needed.

Figure 3.22 – Bottom: Type 5 Adze Hafted.
Figure 3.23: Type 5 Adze being Used in Hollowing Out.
Figure 3.24 – Bottom: Type 3 Adze being Used.
Figure 3.25 – Top: Type 3 Adze being Used.
Figure 3.26: Finished Kumete.
Figure 3.27 Top: Wood Shavings from Steel Adze.
Figure 3.27 Middle: Wood Shavings from Pounamu Adze.
Figure 3.27 Bottom: Wood Shavings from Ohana Argillite Adze.
and bevel is that the friction of entering the wood is lessened and penetration is increased (Dickson 1981:99).

These aspects may explain the different results obtained from Coutts' experiments. All the stone adze blades used in his experiments were damaged (both edge and corner chipping) after two hours use on green totara, and none would cut dry or even semi-dry totara. The eight archaeological specimens all had blades that were already damaged, and despite their apparent sharpness would not, after very long periods of disuse, have been sharp enough to be efficient. The modern stone replica was made from serpentine, not a material represented among the archaeological examples, and as such, may not have been of a quality suited to adze making in the past (1977:67,68,71). It also suffered greater damage than the other experimental adzes including bad blade corner snapping (see Coutts 1977:70, Figure 1 and 2). Of possibly greater significance is the skill factor. Coutts states:

'Each tool was used for approximately two hours and the wood chips were not cut until some expertise had been developed in handling the adzes.' (1977:67).

The 'special skill' (Dickson 1981:88; Bonica pers.comm.) required to wield adzes, especially stone adzes, with any degree of aptitude is not one that can be picked up in a few hours or even a few days. Implicit in this skill is an extensive knowledge of the strengths and weaknesses of the raw materials adzes are made of, and knowing the full range of their technological capabilities. This skill also extends to knowing when an adze blade needs resharpening and how to resharpen it correctly. Specialised tasks particularly require perfectly honed tools. Awareness of these vital factors is clearly lacking in Coutts' experiments and this is demonstrated by the total inability to cut dry or semi-dry totara with the stone adzes. What these experiments actually show is that you cannot cut wood efficiently with blunt and ineptly handled tools, or make reliable comparisons with the archaeological evidence.

Additionally, as the haft procurement exercise demonstrated, once a blade has chipped, continuous use will result in further chipping. On the few occasions when the blade chipped during the kumete project Bonica ceased working immediately in order to prevent further damage. As discussed earlier, the repair of blade damage can be a protracted and risky undertaking thus a strong motivation would have existed to avoid and minimize it.

Some adze forms may have been more durable and resistant to damage than others, though this may be relative to the types of tasks they were designed for. The most robust form is the 4A adze.
where thickness often equals or exceeds maximum width. The greatest thickness and width generally occurs close to the mid-point of the adze, the area normally most vulnerable to transverse fracture during use and manufacture. Also the narrow blade is well protected by the weight concentrated behind it, and there are no vulnerable blade corners. Even adzes of inferior materials would be less likely to break in this form.

3. Use-wear

Even after the second kumete had been made, haft polish on the experimental adzes could not be detected with the human eye. Similarly while the cutting edge would gain a sheen from high pressure contact against freshly crushed wood fibres, this ‘gloss’ was temporary and could be easily rubbed or washed off. The fibre padding placed between lashing and sole may have had a similar effect. Striations or fine scratches were also macroscopically invisible. This evidence suggests that adzes had to undergo quite extensive periods of use before use-wear developed. Additionally, it implies that we cannot assume that the lack of these features on archaeological specimens means they were not ever used.

4. Time and Effort

In terms of the time and effort expended in an undertaking using stone adzes the results were less reliable than hoped for. Assisted by the use of a chain saw but slowed down by the poor quality of the wood, the kumete took approximately six weeks constant work by one person to complete. Of note was the time required to prepare the tool kit for such a project. This can not be seen as comparable to the pre-European situation where stored tool kits would have been commandeered. Sooner or later, however, replacements would have been needed. A project such as a canoe would require the use of large adzes. Almost all the adze forms used in the kumete experiment could not be replaced by reworked adzes, chiefly because the vital factors of length and weight would not be present. Thus preparation of replacement parts would require either a visit to the necessary raw material sources to make new adzes, or arrangements made to procure these via trade, gifting or exchange. If they were acquired in a flaked out state but unground, considerable periods of time would be needed to finish them.

The amount of time expended on any one adze would depend on the raw material properties and
the size of the adze. Bonica spent several months hammerdressing and grinding the No.10 large Croisilles Harbour argillite rectangular adze, which was by far the longest period of time spent on any adze made for these experiments. Nelson/Marlborough argillite is a very hard material and consequently very resistant to abrasion and indentation. The adze blank was a particularly tough ill-shaped cobb that did not allow fine shaping by flaking, thus the final form of the adze was achieved largely by the more laborious and time-consuming methods of hammerdressing and grinding. The final form and finish of this adze gives the appearance of exceeding functional requirements but Bonica begged to differ. This was one of the adzes that had to be tested in use and returned to the hoanga several times before Bonica was satisfied that it could be used efficiently. Adjustments included some regrinding and hammerdressing of the butt as well as the cutting edge and bevel. The symmetry of such adzes may well reflect the need for the adze to be well-balanced, that is, for the mass to be distributed very equally and accurately to enable well directed blows and to ensure that the force of impact is absorbed evenly so that undue stress is not inflicted on vulnerable areas like the mid-section and blade corners (Bonica pers.comm.). With regard to Australian stone hatchets, Dickson found that a balanced distribution of mass was an important operational feature for stone hatchets (1981:112). This balance is especially crucial for large adzes where the length is markedly disproportionate to cross-section thickness and where the blade is more likely to twist as it enters the wood.

Additionally the need for well balanced symmetrical tools is relative to the types of tasks they were designed for. Tasks requiring precision trimming and difficult shaping would demand tools with a high quality even finish.

It is likely, therefore, that major projects like the construction of a large ocean-going double hulled canoe required extensive toolkit preparation well in advance of use. It is even possible that the preparation of this tool kit took as much time as the construction itself.

5. Debitage

The very low incidence of adze damage and the total lack of adze breakage resulted in a very minute sample of the type of debitage that would be the outcome of adze use. From this we might infer that at sites where adzes were used very little debitage (apart from wood chips and shavings), would be recoverable unless the same area was used for very long periods of time. For large projects it is probable that much of the work was done in-situ at the place where the tree was
felled, for, except where there was immediate proximity to a water course, a large felled log could not have been moved until much reduction and roughing out had taken place.

The few chips that broke off the experimental adzes during use were very small. Apart from the chip that broke into several pieces, chips were only a few millimetres in size and had been pulverized into the wood fibre. The larger chip that snapped in several pieces scattered over a wide distance up to 10m away from the log and it took over half an hour to locate and retrieve them.

6. Value of different Raw Materials

All the adze materials used in the kumete experiment showed impressive toughness in operation, and under less than suitable conditions. In general the raw materials responded much as predicted from the manufacturing results summarised in Chapter Two.

The quality of toughness was found to be the most valuable asset of Tahanga basalt. This could be used to best advantage in the 'thumper' class where the property of toughness is most valued. Nelson/Marlborough argillite emerges as the most flexible adze material, being both impressively tough and hard. In all classes and for all tasks it was probably the most effective adze to use.

The choice of adzes used in the kumete project reflected both the accessibility and availability of raw materials and manufacturing success. Ideally, in order to directly compare the performance of different adze materials, replicas of each adze type should have been made for each of the different raw materials. In practice this was not possible due to the limited availability of some raw materials and to the extremely time consuming nature of the production process.

All attempts to make large Motutapu greywacke adzes failed but a number of smaller rectangular adzes were finished successfully. None were selected for use during the kumete experiment. The main reason for this is that the stone was considered too brittle for working such a difficult medium. The dried out sap wood was very difficult to cut cleanly thus more stress was placed on even these (cleaning) adzes than would normally be the case. The Motutapu greywacke adzes would need to used carefully to prevent breakage and blade damage and thus work would proceed at a much slower rate. Functionally, adzes of Motutapu greywacke are best suited to the class of 'cleaners' where excessive force is not usually required and where the quality of hardness is of greatest value by imparting a clean cut to the wood.

The major problem with Nelson/Marlborough argillite was the inordinate time they took to hammerdress and grind thus only a few could be completed for the project. Due to the extensive
replication experimentation programme with Tahanga basalt (Turner 1992) a large number of
preforms of a variety of types and sizes were available. Additionally they took half the time to
finish compared to Nelson/Marlborough argillite adzes and those of Motutapu greywacke.
In cleaning down operations Bonica showed a distinct preference for the Ohana argillite adze over
equivalents in Tahanga basalt because the adze material was tough enough to withstand the extra
stress and the superior cutting edge made a cleaner cut. In the initial hollowing out process the
Maitai River 4B was also preferred over the Tahanga basalt adze of the same type. The merits of
Tahanga basalt were fully realized in the challenging roughing out process, but Tahanga basalt
adzes also proved effective in the shaping work required in the hollowing out of the kumete.
While the blades of Tahanga basalt adzes needed more frequent resharpening than those of
Nelson/Marlborough argillite, repair and resharpening took less time. Motutapu greywacke might
hold its edge for longer than Tahanga basalt but it would be more vulnerable to blade damage,
suffer more severe blade damage and repair and resharpening would take longer.
These different properties may also influence the use-life of an adze. Because they are the most
resistant to breakage and have superior edge holding qualities, Nelson/Marlborough argillite adzes
might be expected to last longer than adzes of Tahanga basalt, and Tahanga basalt adzes to outlast
those of Motutapu greywacke. They are also more likely to retain their original or primary forms
for a longer period of time.
A separate experiment was undertaken to address how adzes in these raw materials compared with
similar adzes in pounamu, probably the most superior adze stone used by pre-European Maori, and
steel. It has been assumed that steel tools were vastly superior to those of stone. The fact that the
latter were so quickly and readily abandoned in favour of the former after European contact
appears to support this case (E.Best 1974). Equally, Nelson/Marlborough argillite adzes may have
fallen out of favour once a new technology was in place to effectively produce adzes from the
more superior pounamu. But how much more superior? and in what way or ways? Preference
might reflect manufacturing advantages more so than functional ones. Functional superiority might
rest on greater durability and resistance to breakage than on any marked improvement in wood
working performance (Coutts 1977:82).
Additionally Coutts, from observations of experimental wood chips cut with both steel and stone
adzes, states that:

'...the sharper the tool the smoother the cut wood surface; the marks on the
surfaces of the timbers are mirrors of the edge damage on the tools that produced them; the marks left by stone tools tended to be broad, fairly irregular, ill-defined and in relief; marks left by steel tools were often very fine, regular, well defined, close together and incised as well as in relief...' (1977:69).

Wood chips and shavings should also reflect these differences thus Coutts maintains that those deriving from steel and stone tools can be distinguished in archaeological assemblages (1977:71). Setting aside the obvious problem that adzes were probably not used in a damaged or blunt state as was the case for the archaeological specimens used in Coutts' experiments, the opportunity was nevertheless available with the present research to test whether a difference could be discerned between stone and steel adze work on wood and whether the wood shavings would reflect this difference.

The Ohana argillite adze was selected to be used against a rectangular pounamu adze made of high quality nephrite from Westland, and a steel adze, primarily because it was of a similar form, weight, edge angle and size. All were used with a true adzing stroke with the grain at a low angle of attack on a green totara plank. No difference could be discerned in the marks left on the wood; all made clean well defined regular impressions in the wood and produced fine smooth shavings that were also indistinguishable (see Figure 3.27).

One problem with practical experiments like these is that it is very difficult to give a precise measure of the degree to which one material is better or more effective than another. Bonica, who gained proficiency in using steel adzes before those of stone, was surprised at how efficient stone adzes proved to be, certainly more than he had anticipated (Bonica pers.comm.).

In relation to the use of stone adzes in Hawaii, Brigham comments:

'...I have seen them used and sharpened, and have been astonished at the dexterity of the man and the efficiency of the tool. In watching the shaping of a canoe I have seen the old canoe-maker use for the rough shaping and excavating an ordinary foreign steel adze, but for the finishing touches, he dropped the foreign tool and returned to the adze of his ancestors, and the blunt looking stone cut off a delicate shaving from the very hard koa wood and never seemed to take too much wood as the foreign tool was wont to do.' (1902:408-410).

Pounamu is both tougher and harder than Nelson/Marlborough argillite but not enough to make a marked difference in the finish that results. Bonica considers the superior edge holding ability of a pounamu blade and its greater resistance to damage to be of greatest significance. The steel adze was superior again for the same reasons. Translated into technological advantages, pounamu and
steel adzes reduce time and energy expenditure - probably to a significant degree - and could be expected to have longer use lives, but may have had a less marked effect on the quality of the work produced. The problem is basically one of having to grade different degrees of excellence.

Summary

The findings of the kumete project can be summarized as follows:

1. **Function**: Five features were identified as being of functional significance - cutting edge angle and curvature, cross-section thickness relative to length and blade width and size (length and weight). Large heavy adzes with robust cross-sections and edge angles could be used with high angles of attack and immense force to chop and split wood. In contrast adze with low edge angles and thin cross-sections were better suited to low angled wood shaving strokes. Length was important for the even distribution of mass, secure hafting, longer strokes and to enable deep excavation. Blade width was important in either concentrating energy into a narrower and deeper stroke (as in the case of Type 4 adzes) or for covering a larger surface area (1A and 2A adzes). Adzes with marked edge curvature (Type 3 and Type 5) were more suited to the shaping of curved surfaces. Identification of these features on archaeological adzes may therefore enable archaeologists to make informed judgements on how these adzes were used.

2. **Use-life and Use-wear**: Adzes may have seen a long period of use even in primary condition, and extended periods of use before any signs of use-wear appeared on the adze. In the kumete project, stone adzes proved to be very efficient, reliable and durable tools. Despite rigorous use, no major damage was experienced and the few minor edge chips were able to be quickly repaired by grinding. We could expect, therefore, that debitage concentrations would take a long time to build up in areas specifically related to wood working and adze use.

   After the construction of two kumete, none of the experimental adzes showed any signs of use (haft polish, blade edge striations), and would, in an archaeological assemblage, be classified as primary adzes.

3. **Raw Material Value**: All the raw materials used in the kumete experiment performed well under difficult conditions. The substandard quality of the kauri used placed great stress on the
adzes but with no adverse effect. Only adzes made from very tough materials were employed, however, and a choice was made by Bonica not to use adzes made of more brittle materials like Motutapu greywacke for fear that they would suffer bad damage, or would have to be used so carefully that wood working procedures would be slowed down considerably.

Raw material qualities may have a played a major role in matching adze form to different wood-working tasks. For tasks involving the excess removal of bulk wood, the property of toughness was of prime importance, particularly for large adzes with a thin cross-section relative to length. It is therefore possible that tough materials like Nelson/Marlborough argillite and Tahanga basalt were favoured for the manufacture of these adzes, and that some materials like silicified limestone and Motutapu greywacke may have been too brittle to fulfil this role. In contrast even brittle materials may have been commandeered to manufacture Type 4A adzes due to a very thick cross-section which would have imparted considerable strength and resistance to breakage to the most vulnerable area of the adze - the mid-section - regardless of the raw material used. The property of hardness, on the other hand, was most valued for wood cleaning and shaving tasks, tasks that generally did not require excessive force to be applied. Thus brittle but hard rocks like Motutapu greywacke may have been more commonly used to make timber dressing adzes.

Raw materials in operation performed to expectations obtained from extensive manufacturing experimentation. Tahanga basalt was most valued for its toughness, while for Motutapu greywacke, hardness was a valuable asset. Nelson/Marlborough argillite emerged as being of superior hardness and toughness to all other flakeable adze rocks tested in manufacturing and functional experiments, its performance in use eclipsed only by pounamu adzes. Nelson/Marlborough argillite, therefore, was probably the most versatile adze rock available, and this would have contributed to its desirability.

Pounamu and steel adzes could be used with greater force and retained a sharper edge for a longer period but no differences could be discerned between Nelson/Marlborough argillite, pounamu and steel adzes in terms of their ability to clean down wood and in the shavings that resulted.

In conclusion, experiments in adze function, while conducted under less than ideal conditions, nevertheless provided valuable information on the relationship between adze design and performance, on morphological features that are functionally specific and on the durability and effectiveness of different adze materials in use.

From these results a functional typology is presented below together with an evaluation of the archaeological data for verification that these functional types were a reality in the early East.
Polynesian period of New Zealand prehistory.

Because adzes were tools made to be used, rarely are they preserved in the archaeological record as they were originally designed. Of 11,886 adzes examined in this research, only 783 (6.6%) were identified as unbroken primary adzes (see Table 3.2), that is, adzes that had seen little or no use; in essence, original designs frozen in time by loss, interment as burial goods, the heirloom effect or unclaimed storage. In order to test the functional model based on the experimental results above, therefore, only the primary adze sample was considered (except where stated otherwise). A significant proportion of the archaeological adze sample had undergone considerable morphological change as a consequence of use, subsequent repair and reworking which often obliterated original form and function. These adzes are examined in Chapter Four.

Significant differences between quantitative variables (T-tests) have been established at the 0.01 level unless otherwise stated.

**Functional Types**

**Type 1**

**Task/Problem:** Heavy roughing out work to remove excess timber and for tree felling.

**Solution:** Type 1. A large wide-bladed, thick, heavy tool with a robust edge angle for chopping and splitting out timber between scarfs.

**Operations:** Chopping, splitting.

**Action:** High angle of attack, high force of impact.

**Functional Requirements:**

1. Large size (long and heavy) for maximum impact.
2. Thick cross-section to prevent breakage and to allow maximum force to be used.
3. Robust edge angle to carry weight for penetration and protection but not so steep as to impede penetration - around 50 degrees.
4. Wide blade to maximize size of wood chunks removed, some blade curvature and steep sides to protect blade corners.
5. Very secure hafting to prevent movement during use and to accommodate the jarring effect of impact.

6. Symmetry of form for even distribution of mass to promote hafting security, prevent twisting of the blade during the stroke, prevent breakage and damage, and for ease and efficiency in use.

**Conditions:**

1. Raw material requirements: Selection for toughness, with some materials possibly not tough enough. It is likely that the toughest materials would be more frequently represented in this class and to dominate larger size classes.

2. Manufacturing requirements: High. Requirement for large size and symmetry. High angled quadrilateral flaking. In replication experiments, these adzes were markedly more difficult to produce than any other form. There were constraints on the size and form of the parent material. Flake blanks are generally not of adequate length or thickness. Tabular blocks would be ideal. Extra effort and time are also required in providing a secure hafting facility and in blade and bevel formation.

**Skinner Type:** 1A, 1E, 1D, 5.

**Duff Type:** quadrangular 1A, 1D, quadrangular 1C.

Duff's description of his Type 1A is as follows:

(This is the type broad-bladed, quadrangular in section, and with a marked 'tang' or 'grip', thick and massive...all faces intersecting sharply, the width of the front and back are often approximately equal, but the back never exceeds the width of the front and is frequently exceeded by it' (1977:146,148,151).

The basic difference Duff makes between 1A and 1C adzes relates to the nature of the tang. He states that the 1C adze '...is tanged not only by reducing the butt below the level of the blade, but by lateral reduction as well' (1977:158). Only three examples were known to Duff in 1950, all from the South Island.

Of his Type 1E (Duff's Type 1D) Skinner notes the similarity to his Type 1A, the major difference being that the 1E blade is very narrow, and that these adzes commonly have raised chin ridges (1974:105,106). Skinner's Type 5 is again similar to Type 1 except for the rounded cross-section. Of this type Skinner says 'It is probable that rocks which can be bruised and pecked into shape are
preferred' (1974:110). It is, however, highly probable that the shape or 'type' is the result of raw material and manufacturing techniques adapted to suit, not the other way round as interpreted by Skinner. Duff later combined Skinner's IE, ID and V into his Type 1D.

**Discussion of Archaeological Data** (see Figures 3.28-3.36).

Data results are consistent with expectations derived from both manufacturing and functional experiments regarding raw material suitability for Type 1 adzes. While Tahanga basalt and Nelson/Marlborough argillite make up 76.3% of all the North Island adzes listed in Table 3.3, they are notably dominant among Type 1 adzes accounting for 91.5% of the sample. It was predicted that Type 1 adzes would require the best quality materials; stone that would enable manufacture of such a technologically challenging form yet also be possessed of a superior toughness. It is thus not surprising that Tahanga basalt and Nelson/Marlborough argillite prevail in the North Island while Motutapu Greywacke and other local materials are poorly represented in this form.

Only four finished Motutapu greywacke Type 1 adzes were observed during this research. Three were broken pieces and the one complete adze had seen considerable blade modification and foreshortening. Additionally, only 1 complete well-formed preform was recorded (Figure 3.28b). A number (N=24) of large quadrangular broken preforms found at the Pig Bay and Sunde sites on Motutapu Island, however, suggests that attempts were made to make them. Advantages of form (tabular blocks) and material quality (good flakability) existed but there may have been functional constraints. Motutapu greywacke was likely not of sufficient toughness for heavy use. The Pig Bay and Sunde evidence may represent a period of initial experimentation before the realisation that production costs were too high and functional benefits too low to persist. The proximity to Tahanga basalt may have provided a more viable alternative for the supply of large Type 1 adzes. Likewise Waikato basalt, Wairarapa silicified limestone and Taranaki argillite were rarely used for Type 1 adzes (the one in Figure 3.28c being the largest and most well made example observed for Taranaki argillite). The brittle nature of the rock in the former case and the manufacturing limitations of the latter rendered these materials unsuitable. The proximity of Taranaki to D'Urville Island (and Waikato to Taranaki) probably meant that the need for large adzes was readily met by Nelson/Marlborough argillite. Manufacturing difficulties may also be the reason why large primary Tahanga basalt adzes were generally not as large as their Nelson/Marlborough argillite counterparts.
D'Urville Island argillite (Ohana, Mt Ears) adzes dominate among Nelson/Marlborough Type 1 adzes, both in the South Island and North Island (Table 3.3 and 3.4), and there was an obvious preference for these particular argillite sources over others in the Nelson/Marlborough region. It should be noted, however, that a number of these sources could also have come from D'Urville Island as much as from the mainland. But this evidence highlights the superiority of the identified D'Urville sources.

**Size/Dimensions/Edge Angle**

The average Type 1 adze had a length of 280mm, a cross-section thickness of 49mm, a blade width of 75mm and a weight close to 2000gms. Some Type 1 adzes, however, reached lengths of over 400mm, weights over 5000gms and blade widths close to 130mm (Tables 3.5-3.8). They also had consistently robust edge angles averaging 50 degrees (Table 3.9).

Almost 93% of primary Type 1 adzes were over 200mm in length (Table 3.10) and they make up 89.1% of all adzes recorded over 300mm in length. They are significantly longer, thicker, heavier and have wider blades than all other forms except for large Type 2 forms (rectangular Duff 1A and 'chin-ridge' form for length, weight and blade width, and Type 5 for blade width).

While Duff emphasises the large size of 1A adzes in his description of the type, he does not make this large size a criteria even though the description calls for 'thick and massive' (1977:147,148). In the functional experiment above, however, size emerged as an important functional attribute of this type of adze. Statistical data for primary Type 1 adzes also support this case.

D'Urville Island argillite adzes are significantly longer and have wider blades than quadrangular Type 1 adzes of other materials, including Nelson/Marlborough argillite adzes from sources other than those identified from D'Urville Island. But they are not significantly thicker or heavier. A probable reason for this is that the superior toughness and flaking qualities of the argillite allowed finer cross-sections on longer adzes with wider blades. The longest and heaviest Nelson/Marlborough argillite Type 1 adze recorded in this research is a finely flaked preform from Mangahuri, Southern Hawke's Bay, made of black D'Urville Island argillite with a length of 492mm and weighing over 6000gms. The largest finished specimen is a black argillite adze from Whakatane with a length of 430mm (the weight is unknown. This adze was dug up on a farm and photographed and measured by the late Anton van der Wouden previously of the Whakatane Museum before being reburied by the farm owners).
Tahanga basalt adzes, in contrast, are significantly shorter and thicker and have more robust edge angles than those of D'Urville Island argillite reflecting the superior hardness and toughness of the latter raw material. Tahanga basalt adzes do, however, have blade widths, weights and lengths comparable with Southland argillite and Nelson/Marlborough argillite other than D'Urville Island argillite. The largest Tahanga basalt Type 1 adze, a back-wider-than-front form from Russell, Bay of Islands, is 363mm long and 3320gm in weight. A well-formed preform from Waiwera, North Auckland, has a length of 354mm and weighs 2740gms.

Probably as a consequence of the higher frequency of D'Urville Island adzes in the South Island data, South Island Type 1 adzes are longer and blades are significantly wider than those of the North Island (T-test at the 0.05 level).

**Duff Type 1D - the 'Southland' adze, and quadrangular 1C**

The distinctive 1D form (Figure 3.29), commonly rendered in coarse-grained materials like greywacke, is significantly longer, thicker, and heavier than the Duff quadrangular 1A form, but have significantly narrower blades. Duff 1D adzes also have robust edge angles which are very similar to quadrangular 1A adzes. Thus, though morphologically distinctive, the dimensions of 1D adzes place them in the Type 1 class as tools that would have proved very effective in the chopping and splitting of timber.

The 1D form is a likely outcome of the stone materials used and the technology in place to work them; a technology that developed as a result of the availability of hydrogrossular garnet and its effectiveness as a hammerdressing material. An interesting observation in Southland adze collections was the not uncommon occurrence of 1D adzes rendered in fine-grained Southland argillite (for example Figure 3.29b), as well as hybrid forms displaying features of both Duff 1A and 1D forms (Figure 3.30b). All Southland adzes demonstrated the importance of lime garnet hammerdressing in the shaping process.
The 1C adze form is the product of similar raw materials (lime garnet) and manufacturing techniques but is generally smaller with a wider blade (such as Figure 3.30a, also of Southland argillite).

**Lugged or 'horned' Duff 1A adzes** (see Appendix F for list of recorded specimens).

A small number of Type 1 adzes were recorded where butt reduction has left two 'horns' or 'knobs' at or near each corner of the poll to the front surface (though one rare example in D'Urville Island argillite from Turangi has an extra knob in the centre). Both Duff (1977) Skinner (1974) observed that the feature (see Figure 3.31 and 3.32) was most often seen on exceptionally large heavy adzes to provide additional hafting security. The present research provides statistical confirmation of this observation. Lugged Duff 1A adzes were significantly longer, heavier and had wider blades than unlugged Type 1 adzes (Table 3.5-3.8). But, contrary to expectations, they were not significantly thicker. This may be related to the dominance of adzes of Nelson/Marlborough argillite, particularly of D'Urville Island argillite, among lugged adzes (52.7%), though, in the South Island, a number of Southland argillite and basalt adzes have lugs. Among North Island raw materials, only two Tahanga basalt adzes have well defined lugs, and the majority of lugged Type 1 adzes came from the South Island. Thus the greater thickness of Tahanga basalt adzes raises the mean for thickness in the unlugged quadrangular adze sample. Again, the quality of D'Urville Island argillite allowed the length and blade width of Type 1 adzes to be enhanced without the need to increase the thickness of the cross-section unduly.

Only adzes with well-defined lugs were included in the sample (see Figure 3.32). A similar number had incipient or less prominent lugs, generally present as sharp projections left in relief at poll corners rather than well-defined hammerdressed 'knobs'. Greater variability in adze size and cross-section thickness was exhibited among adzes with incipient lugs and no correlation between adze weight and thickness and the presence of lugs could be made for this group. But while this evidence may confirm that well defined lugs were generally featured on particularly large heavy quadrangular adzes in order to provide extra hafting security, the decision to add them appears to be somewhat arbitrary. Type 1 adzes with well-defined lugs are rare as evidenced by the small sample size (N=34, 6 of which were broken). Adzes of similar length and weight are far more frequent without lugs. Additionally, a small number of adzes with well-defined lugs are not
of the heavy quadrangular type. Among these are two rectangular lugged *pounamu* adzes from the Lower Portobello Cache figured by Duff (1977:Plate 32), and a relatively small (244mm length, 675gm weight, 23mm thickness) Southland argillite adze from the Taieri Plains. On these adzes the lug feature appears to be more stylistic than utilitarian.

The two largest lugged adzes recorded are also rectangular forms - the Ohana argillite adze from Burial 5 at Wairau Bar which is 450mm long, 137mm blade width, and 5405gm in weight (figured in Duff 1977:Plate 26), and the basalt adze from Makihikihi, South Canterbury, much admired by Skinner who used it as his type specimen (described and figured by Skinner 1974:104), 440mm long, 135mm blade width with a weight of 4765gm. Both are remarkably similar in design, finish and dimension.

**Differences between Duff 1A rectangular and quadrangular adzes**

In experiments, a functional difference was noted between quadrangular and rectangular Duff 1A adzes to the extent that in the functional typology presented here, they are considered as separate and different types of tools. Examination of archaeological adze assemblages also indicates that a functional difference exists between these two forms, and that rectangular 1A adzes rightfully belong with the timber dressing class of adzes designated in this thesis as Type 2.

The majority of Duff 1A adzes had quadrangular sections; rectangular 1A adzes were far less common. There was probably a greater demand for large quadrangular adzes. Smaller adzes like Type 2 adzes could be used to clean down flat surfaces but large quadrangular adzes would have been essential for large projects involving the bulk removal of timber.

Rectangular Duff 1A adzes are significantly thinner and longer with wider blades and markedly lower edge angles confirming that Duff's rectangular 1A is a very different tool than the quadrangular form. They form a continuum with Duff type 2A/2C adzes, the only difference being that larger Type 2 have more marked butt modification for hafting security (tangs), hence Duff's classification of these adzes as Type 1A.

Due to their greater length and wider blades, rectangular 1A adzes are somewhat heavier than quadrangular Type 1A adzes but no significant difference exists (Table 3.5-3.8). This relates to a different distribution of mass. For quadrangular 1A adzes weight and mass are centred on a robust cross-section for maximum impact and to protect the adze from breakage during heavy use. In rectangular 1A adzes, this weight is spread out over a larger surface area to provide a wider blade.
and a longer follow through stroke.

**Shape**

The majority of Type 1 adzes had very steep sides where the difference in width between front and back was minimal (Table 3.11). See, for example, the cross-sections from two large broken Type 2 D'Urville Island argillite adzes, one from Grovetown, Marlborough in Figure 3.45b and the other from Pouto, Kaipara Head, in Figure 3.44a; quadrangular sections have similar steep angles. This characteristic is likely to relate to the need for steep sides to enhance blade width and protect blade corners, but is also one that reflects the flakability of the raw material.

From the sample of unfinished Type 1 adzes, it is evident that side steepening takes place at an advanced stage of flaking where difficult high-angled quadrilateral flaking is applied (Turner 1992). Where the flaking quality of the stone was limited, other options were required. Thus it is not surprising that almost all D'Urville Island argillite Type 1 adzes had very steep sides while adzes of tough poorer flaking quality Southland materials had high frequencies of front-wider-than-back forms (compare the Southland argillite adze in Figure 3.33b with the D'Urville Island argillite adze in Figure 3.34b). This is marked among Duff 1D and 1C adzes rendered in coarse-grained materials that could not be flaked. While hammerdressing was a viable shaping method it restricted the degree to which sides could be steepened. These manufacturing constraints can also be seen when comparing the significantly wider flared blades on Nelson/Marlborough argillite adzes to the narrow curved-in blades on Duff 1D adzes. Type 1 adzes of poorer flaking quality mainland Nelson/Marlborough argillite occasionally exhibit notably wider fronts (Figure 3.28a) and they are generally heavily hammerdressed and well ground.

The flaking difficulties experienced by Tahanga basalt adze makers were solved in another way by making the back notably wider than the front (Figure 3.35a). Among Tahanga basalt adzes a standardized primary Type 1 form with the back wider than the front is common. That it was an intentional design is well illustrated by the Mercury Bay Cache of twelve large unfinished adzes where all the 1A adzes had the back notably wider than the front. Had they been finished they would have resembled Figure 3.35a. Thus Duff's qualification that for 1A adzes 'the back never exceeds the width of the front' (1977:151) is contradicted in this case. Such a feature has the effect of '...decreas[ing] the width of the blade, but increas[ing] its entering capacity' (Duff 1977:168). It also provides additional protection to blade corners. These adzes are generally thick deep-bodied.
quadrangular forms with quite steep edge angles. These features serve to make the form ideal for heavy roughing out work. While it could be said that this is a distinctive northern North Island 1A form, the more significant factor here is the raw material. Almost all primary Type 1 specimens with the back wider than the front are rendered in Tahanga basalt (90.4% - Table 3.11) where the form reflects the thick cobbly nature of the raw material, the variable flaking quality of the stone and possibly its inferior hardness compared to the very hard South Island argillites. No primary Nelson/Marlborough argillite Type 1 adze had the back wider than the front but several Southland adzes had this feature.

The majority of primary Type 1 adzes had flared blades to maximise blade width (Table 3.12 and Figures 3.33-3.36). In contrast 1D adzes were characterised by sides that curve in toward the blade instead of flaring out, a feature also shared by a number of quadrangular 1A and 1C adzes in Southland materials. The high frequency of Tahanga basalt blades that curve inward is a reflection of the back-wider-than-front form.

Angulated profiles characterize Type 1 adzes and also reflects the main method of shaping (Table 3.13). From the preform data it appears that angulation was achieved mainly by flaking at an advanced stage of manufacture - only 10.8% of rough preforms (prior to fine trimming) were angulated compared to 51.6% of primary preforms where the flaking stage was completed.

Angulated profiles are, however, almost non-existent for 1D and 1C adzes. The rounded shape of these adzes are characteristic of adzes that have been extensively hammerdressed while extensive flaking tends to produce sharp angled profiles and cross-sections. The majority of 1A adzes in Southland materials have no angulation either again reflecting the dominant shaping method - hammerdressing (Figure 3.33b).

Quadrangular adzes display more angularity than their rectangular counterparts. Angulation increases hafting security which would have been especially vital for large heavy quadrangular adzes.

**Blade Curvature** (Table 3.14).

Type 1 adzes characteristically have blades with only minor curvature. Exceptions are the South Island quadrangular 1C/1D adzes where curved blades were predominant reflecting the soft nature of the coarse-grained materials these adzes were made of (as discussed in Chapter 2). Predictably the hardest toughest materials had the lowest frequencies of blade curvature.
Chin (Table 3.15).

Placement of a chin on Type 1 adzes was an arbitrary decision. Again the influence of hammerdressing and lime garnet resulted in a higher frequency of chins, and a more distinctive rendering of them among South Island adzes. The Southland 1D and 1C adzes had a predominance of raised chins; a feature difficult to achieve by flaking but readily formed by hammerdressing (Figure 3.29). These were often elaborately rendered and prominently defined. Again, like the deep tangs on these adzes, lime garnet hammerdressing has been used to good effect in chin formation. Where chins were seen on other Type 1 adzes they were generally an outcome of angulation rather than a separately applied feature (for example, the preform in Figure 3.34b). Predictably Type 1 adzes rendered in coarse-grained Southland materials had a markedly higher frequency of raised chins than other stone materials.

Hollow-ground bevels

This feature was present on 27.6% of primary quadrangular adzes. Functionally it serves to decrease resistance when the blade enters the wood. From examination of archaeological adzes, it is apparent that hammerdressing was the main method by which this feature was formed with grinding being applied as a final finish. Thus it is not surprising that hollow ground bevels on Type 1 adzes are more frequent in the South Island and relatively uncommon on North Island adzes, for example, those made of Tahanga basalt.

Hafting (Table 3.16).

Almost all large four-sided adzes had some form of butt modification to facilitate hafting and all primary Type 1 adzes had some type of tang. Providing a grip by reducing the front and rounding front and back corners was the most common form of butt modification for Type 1 adzes. Type 1 adzes made of Southland materials, including pounamu, characteristically had very pronounced and deep tangs (see Figures 3.29a, 3.30c, 3.33a). These tangs often exhibited lateral as well as frontal reduction (Figure 3.30a), and sometimes reduction of all butt surfaces reflecting liberal application of lime garnet hammerdressing. The use of lime garnet hammerstones is
particularly noticeable in the pronounced and sometimes elaborately grooved tangs characteristic of Southland adzes (for example, Figure 3.37c; for other examples see Skinner 1943:80,81). The majority of these adzes were rendered in coarse-grained materials which, being softer and easier to indent than fine-grained rocks, took much less time and effort to hammerdress, especially with lime garnet hammers. Lime garnet was also used to advantage to provide a reduced grip on Nelson/Marlborough argillite adzes. Typically these tangs were well-defined by hammerdressing which served both to erase sharp flake scars and increase lashing adhesion.

Offset butts were generally found on adzes with angulated profiles and where flaking had been the primary method of shaping (Figure 3.34b and 3.36b). Hence angulated profiles and offset butts were rarely seen on adzes where hammerdressing was the predominant shaping method. Offsetting the butt was most common on Tahanga basalt adzes which may also be related to the lack of an effective hammerdressing material to bring about marked reduction. D'Urville Island argillite adzes characteristically had both offset and reduced butts to maximize hafting security.

Well-defined tangs were not a feature of Motutapu greywacke adzes. They tended to have minor butt modification either by offsetting or by minor frontal reduction (Figure 3.28b). This may reflect the risks involved in hammerdressing Motutapu greywacke, particularly in the butt area. Additionally Motutapu greywacke adzes were rarely large or heavy enough to require a well-defined grip.

*Hafting on Lugged Adzes* (see Appendix F)

As observed above, well-defined lugs were most commonly found on large heavy adzes thus confirming that it was a feature employed to aid hafting security. It was by no means an essential feature for large heavy adzes, however, and is quite rare. Only 14.1% of primary quadrangular 1A adzes had well defined lugs while 5.0% had incipient projections.

Lime garnet was probably responsible for the presence of lugs on both Nelson/Marlborough argillite and Southland adzes. Of the 34 quadrangular 1A adzes with well-defined lugs or 'knobs', 34 (73.5%) were found in the South Island. Additionally, all but two North Island adzes with well-defined lugs were rendered in Nelson/Marlborough argillite. The well-defined knobs on these adzes were created by hammerdressing, and bear the deep pitting characteristic of lime garnet. In the North Island no such high quality hammerdressing stone existed and thus, rather than knobs, Tahanga basalt adzes have incipient lugs present in the form of projections left in relief after flaking.
**Poll Treatment**

Almost all primary Type 1 adzes had polls that have been left untreated, even to the extent that some retained the original cortical surface of the parent rock. None had haft polish on the poll. This is consistent with the manner by which these adzes were hafted where the poll projected from the heel of the foot and did not come into contact with either wood or lashing. A similar observation was made for the Shag River Mouth adze assemblage (Smith and Leach 1996).

Only a small number had evidence of haft polish (25%), and this was largely confined to the back of the adze. This cannot be taken to mean that adzes without haft polish were never used. Rather, functional experiments suggest that such use-wear developed only after extensive periods of use, particularly if wooden pegs (as seen in the hafted Type 1 adze from Huahine) or fibre padding (as seen also at Huahine and employed by Dante Bonica in the hafting of his adzes) was placed between the haft and stone adze head. Additionally post-depositional processes like weathering and water-rolling may have obscured such evidence on a number of adzes. Chris Jacombe's examination of the Motukarara cache of 31 adzes revealed a similar frequency of haft polish on finished adzes (29.4% - Chris Jacombe pers.comm.).

**Manufacture and Symmetry**

In the preform sample where blank form origin could be discerned, thick cobbles (for Tahanga basalt) and tabular blocks (Nelson/Marlborough argillite and Motutapu greywacke) were selected to make these large adzes. No flake blanks were identified confirming that flakes were rarely of adequate length or thickness for this form.

Primary Type 1 adzes were well finished and shaped mainly by skilled high angled quadrilateral flaking (Table 3.17). Hammerdressing was chiefly applied to the butt area to provide a secure grip and/or to remove sharp edges that could damage the lashing when the adze was hafted (Table 3.18).

Notable exceptions are Southland adzes. Consistent with predictions made from replication experiments, adze-makers in the past found that even the fine-grained Southland argillites had limited flaking qualities. A solution was at hand in the form of lime garnet. Data results are, therefore, not surprising in suggesting that hammerdressing was the principle method by which the...
The majority of Southland adzes were shaped after some rough flaking. While surfaces were often fully ground in the final finishing process, this was not applied extensively enough to obscure remnants of the deep pitting left by lime garnet hammerdressing. Lime garnet hammers were also effective on pounamu (for example, Figure 3.37d) and probably made it possible on a small scale to wrest 'Archaic' adze forms from such an intractable material.

The adze-makers in the Nelson/Marlborough region had the greatest opportunities to realise tool design ideals. They had the highest quality raw materials and the widest range of manufacturing choices. The data reflect the options available. The highest quality adze material, D'Urville Island argillite, and the most effective hammerdressing material, lime garnet, were both found in this region and used to advantage.

Over half the D'Urville Island argillite adzes had been finely flaked to shape. Hammerdressing was seen on most of these adzes but for the main this was concentrated in the butt area to provide a secure grip. Additionally lime garnet hammers could be employed at very little cost in terms of extra effort to enhance the symmetry of well-flaked adzes. They proved valuable in pulverizing high points left by flake scars in order to reduce the considerable time and labour involved in grinding the very hard Nelson/Marlborough argillites. Most D'Urville Island adzes were evenly ground (Table 3.19) but not enough to obscure flaking evidence which indicated that most were shaped primarily by fine flaking (for example, see Figure 3.38, an example of the flakability of D'Urville Island argillite. Note the small patch of hammerdressing showing the deep indentations characteristic of lime garnet hammers).

For adzes made from other Nelson/Marlborough argillite sources, flaking quality was not as high. This problem was effectively remedied by lime garnet hammerdressing and these adzes often reflect features commonly associated with hammerdressing, for example, the adze in Figure 3.28a which has a raised chin and where the front is notably wider than the back.

The influence on lime garnet on adze manufacture is marked when a comparison is made between the North and South Island adze samples. In the North Island the frequency and degree of hammerdressing is low for Type 1 adzes. For example, the overall finish of Tahanga basalt adzes was quite high but not of the standard seen on D'Urville argillite adzes. Much less hammerdressing was seen on Tahanga basalt adzes compared with Nelson/Marlborough and Southland argillite adzes and a considerable number had no hammerdressing at all. An outcome of this was seen above with the tendency of Tahanga basalt Type 1 adzes to have less well-defined tangs than their South Island argillite counterparts. This data confirms field observations that the North Island...
adze-makers had no hammerdressing material of a calibre that remotely equalled hydrogrossular garnet. In addition, few North Island adze materials were tough enough to withstand the force of hammerdressing with lime garnet. In experiments, it proved far too risky to use on Motutapu greywacke, and had to be employed with care on Tahanga basalt and other basalt adzes. Thus, the Tahanga basalt adze-makers had fewer solutions to shaping problems relating to the flaking quality of the stone. Unlike adze-makers in the South Island, they had no lime garnet to enhance symmetry and remove flaking errors. Tahanga basalt adze-makers also had to persist with flaking as a primary shaping technique, adding to manufacturing costs possibly not experienced by
Figure 3.28: Type 1 Primary Adzes
Figure 3.29: Southland 1D Adzes.
Figure 3.30: Southland Type 1 Adzes.
Figure 3.31: Lugged Type 1 Adzes.
Figure 3.32: Basalt Lugged Adze from Ellesmere Spit (Canterbury Museum).
Figure 3.33: Southland Type 1 Adzes.
Figure 3.34: Type 1 Primary Preforms.
Figure 3.35: Tahanga Basalt Type 1 Primary Adzes.
Figure 3.36: Tahanga Basalt Type 1 Primary Adzes.
South Island adze-makers. Southland argillite and some of the Nelson/Marlborough argillites are of similar, if not better, flaking quality to Tahanga basalt, yet it is apparent that the adze-makers working the argillite selected the easier more efficient option of hammerdressing because of the availability of lime garnet. South Island east coast basalt adzes are more heavily hammerdressed and more fully ground compared with basalt adzes from the North Island, and tangs demonstrate greater definition and reduction including the presence of lugs. Hence, Tahanga basalt adzes are generally more roughly finished and more cursorily ground than argillite adzes and others made in South Island materials.

In summary it can be seen from the results given above that, within functional parameters, considerable morphological variability is evident among Type 1 adzes which primarily relates to raw material qualities and the manufacturing techniques developed to solve the problems they presented. In the South Island, the availability of a very effective hammerdressing stone had an important impact on adze morphology, and this may have increased over time. The presence of lugs, deeply grooved and heavily reduced tangs, chin and shoulder ridges, hollow-ground bevels, rounded rather than angulated profiles and front-wider-than-back cross-sections are all features of adzes where hammerdressing plays a major role in manufacture, and are otherwise difficult to execute by any other method. In Southland particularly, many of these features are rendered in a very elaborate manner demonstrating the relative ease by which they could be brought about when in possession of lime garnet. One Southland form represents an extreme example of manufacture by hammerdressing, the very narrow, long, thick and rounded 'shark-shaped' Duff 1D adze. Being usually rendered in softer coarse-grained materials, elaboration of hammerdressing features was taken to new heights. The Duff type 1C adze is another example of a 'hammerdressed' form and tangs on these adzes sometimes display double or even triple transverse grooves.

In the Nelson/Marlborough region, lime garnet hammers were also used to advantage though with more restraint given the high flaking quality of the dominant adze materials exploited. Flaking provided benefits in speed and flexibility and in maximizing length and blade width while hammerdressing could be employed to increase hafting security and enhance symmetry. Tahanga basalt adzes have features more characteristic of adzes primarily formed by flaking, notably angulated profiles and offset butts (Figure 3.36).

Large Type 1 and 2 adzes exhibited the highest levels of symmetry of all adze forms. They were also one of the most impressive adze forms in terms of size and craftsmanship. This can be related to several factors:
1. The degree of symmetry is, from the experimental evidence presented above, likely to be related to the operational dynamics of the adze. Large heavy long wide-bladed adzes were probably the most difficult to wield and to make operational. A even distribution of mass was necessary in order to prevent the adze from twisting during the stroke, to ensure a secure fit to the wooden haft, and to prevent breakage and blade damage that could result from a mis-hit.

2. Due to design requirements, the highest costs in terms of time, effort and (especially) skill were involved in making these adzes. This was particularly the case for large adzes finely flaked to shape. In contrast, while often of spectacular size and with elaborately rendered features, the main techniques employed to make Southland 1D and 1C adzes (hammerdressing and grinding) did not demand the level of skill or entail the degree of risk involved in adzes shaped primarily by flaking. In addition, equipped with lime garnet, they may not have taken as much time to make.

D'Urville Island adzes were the finest and largest adzes made and represent design ideals. Adzes from other Nelson/Marlborough argillite sources were, in contrast, less finely flaked and more frequently finished by generous applications of hammerdressing and grinding. This demonstrates the relatively inferior flaking quality of these argillites compared with D'Urville sources. Tahanga basalt adzes were also less well flaked and finely finished compared with D'Urville Island adzes, although they were of a standard akin to those from other Nelson/Marlborough argillite sources. The highest quality parent rock at Tahanga was commonly irregular and rounded, and the toughness of the stone made it difficult to flake. Additionally there was no hammerdressing material available with the effectiveness of lime garnet that could have been used to further refine the shape of Tahanga basalt adzes.

Type 2

Task/Problem: Fine timber shaping and dressing:

Solution: Type 2. Shallow sectioned, wide bladed and low edge angled tools. Size depends on the size of surface area to be adzed.

Operations: Follow through adzing stroke.
**Action**: Low angle of attack, Low force of impact.

**Functional Requirements:**
1. Shallow section to allow a low edge angle (for low resistance and ease of entry into wood) and a follow through stroke.
2. Sufficient length for a follow through stroke.
3. Wide blade to maximize contact area.
4. Less need for butt modification for hafting security - not used with as much force or with a jarring action - dependent on size - expect more butt modification on larger heavier adzes of this kind but probably not to the extent of Type 1.
5. Needs to be well balanced for an even true stroke so expect a degree of symmetry. Expect this also to increase with size.
6. Relatively (see Chapter Two) straight blade.

**Conditions:**
1. Raw material requirements: Emphasis on hardness for efficient smooth cutting and minimum resistance (including low edge angle) so preference for hard rocks. Size dependent - large long adzes would also need to be tough due to the stress on the mid-section as a result of disproportionate length to thickness - would expect only high quality materials to be selected for large adzes of this kind. But, apart from this exception, expect a variable range of rock types in this form.
2. Manufacturing requirements: Size dependent - for large (200mm+) adzes, probably more skill, risk, time and effort was involved than for Type 1, requiring high angled quadrilateral flaking. A very difficult form to manufacture with a high risk of breakage due to a thin cross-section relative to length and width. Especially at an advanced stage of manufacture, extreme care was required to avoid transverse fracture or end-shock that would have increased time costs. Butt modification and bevel shaping also carried high risks. We might expect less butt modification than for Type 1 given that Type 2 adzes would not be used as forcefully and that the risks of breakage during hammerdressing would be higher. Bevel and blade finishing are also likely to be very time-consuming. There would be high constraints on blank form as well. Flake blanks would most certainly be too small but thin tabular slabs would be ideal.

For smaller forms, less risk, skill, time and effort would be required. In replication experiments,
medium sized (100-200mm long) rectangular adzes could be made readily from flake blanks where less blank reduction was required. With well-shaped flake blanks, adzes can be shaped by bilateral flaking only. Some risk of breakage exists due to their thin cross-sections. Due to their smaller size and their use with a lower force of impact, butt modification need only be minor to ensure hafting security.

**Skinner Type:** Types 1B, 2A, 2B, 3.

**Duff Type:** Rectangular 1A, 2C, 2A, rectangular 1C.

**Duff/Skinner Type 2A and Skinner Type 3/Duff 2C:**

The major distinction made between these two rectangular tangless forms is that Type 2A has the front wider than the back, while the other, Type 2C, has the back wider than the front. This difference does have some historical relevance. The 2C is the dominant standardized form in Samoa (see Figure 3.39b), comprising '...over ninety percent of all adzes recorded from Samoa...' and has thus become known as the 'Samoan Type' (Duff 1977:168; Skinner 1974:107). According to Duff and Skinner, outside the immediate area of Samoa the occurrence of 2C is uncommon. Of Type 2A, Duff writes that it:

'...is essentially an offshoot of variety A of Type 1, that is only its size prevents it from having a `grip' or tang, which indeed is often incipient, either in the tendency for the butt area to be left unground, or for the butt...to taper off and occasionally to recurve in the manner reminiscent of the angle-shouldered Type 1A. The cross-section is rectangular, occasionally irregular or sub-triangular, and the front is always wider than the back. The specimens are characteristically small, and thin between front and back.'(1977:161).

Challis (1978) has also classed as 2A a distinctive standardized rectangular adze form seen most frequently in Nelson/Marlborough argillite and common to that region. It has been associated stratigraphically with late rather than early occupation from at least one site in the area (Rotokura). Challis distinguishes this type as '2Aii' and suggests that it developed from the earlier 1A form. The 2Aii adzes differ in being '...much shallower in cross-section...broader bladed, and (with) no grip' (Challis 1978:70). Skinner included this adze form with his Type 2B (1974:107). The most distinctive feature of this type of adze is a raised chin-ridge (see Figure 3.42). The nature of the...
cross-section and edge angle, however, firmly places this form of adze in the functional category of timber dressing adzes and probably developed from the rectangular 1A form rather than the quadrangular. In this research the decision has simply been to identify these adzes by their key distinctive feature - the chin ridge (CR).

Of his Type 1, Variety B, Skinner states that the

'Cutting edge (is) broad. Grip is always present but is always lightly cut. Adze thin from front to back. Lugs never present.' (1974:105).

He also notes that the angulation common to the more robust quadrangular 1A is rare for Variety B. Duff, however, failed to make this distinction between Variety A and B and combined them into his Type 1A. In the present research, examination of the Type 1 adze data and experimental evidence indicates that rectangular 1A adzes are a very different functional type to quadrangular 1A adzes, and were undoubtedly used to dress rather than chop and split wood. They are, therefore, classed here as Type 2.

Among those classified as 2A by Duff at Wairau Bar are what I have alternatively identified as small flake adzes (SFA), a distinctive form that had a very different technological history and function (discussed in Chapter 4). They bear almost no morphological resemblance to primary well crafted rectangular tangless specimens. These small flake adzes were, however, common in the Wairau Bar assemblage. Duff's assertion that Type 2A '...were the most numerous single group found...' (1977:161) may thus be an over-estimation of the dominance of this type.

**Discussion of Archaeological Data** (see Figures 3.39-3.46).

Type 2 adzes do emerge as being the most common adze form. But for the North Island this occurs only where the functional typology is applied (Table 3.3). Duff would have included the sample of large tanged rectangular adzes with his 1A type. When Duff types are considered, therefore, Type 1A adzes emerge as the most frequently recorded adze type in the North Island. At Wairau Bar and Waitaki River Mouth (Table 4.2), Type 2 adzes prevail.

Among the medium-sized forms, Duff type 2A and 2C, a greater variety of materials are utilized than for Type 1 and the large-sized Type 2. For example, Motutapu greywacke adzes are more frequent among these smaller lighter forms (Table 3.3). This is probably due to lower production and use constraints.
There are, however, marked differences in raw materials between the two Duff types (2A - Figure 3.39, and 2C - Figure 3.40). In the North Island, Tahanga basalt is poorly represented among 2A adzes but overwhelmingly dominant among 2C adzes (Table 3.3). Other basalts, both in the North and South Island, also have a strong showing among 2C adzes (Table 3.3 and 3.4). The reverse is the case for Nelson/Marlborough argillite where Type 2C is rare. Because Nelson/Marlborough argillite is the most commonly utilized adze material overall, this might explain why 2A adzes are more common than 2C, particularly in sites like Wairau Bar where 80% of the adzes are Nelson/Marlborough argillite. It is interesting to speculate, therefore, that had fine-grained basalt been the dominant or only stone material available in New Zealand, 2C adzes may have emerged as the most common rectangular form reflecting the situation in Samoa.

Nelson/Marlborough argillites, particularly the D'Urville Island sources, clearly dominate among the large rectangular Type 2 adzes (Table 3.3 and 3.4, Figures 3.43-3.45), both for the North and the South Island.

Chin-ridge adzes were also predominantly made of Nelson/Marlborough argillite though specimens rendered in pounamu, Taranaki argillite, Southland argillite and greywacke were recorded. In addition, for only this form were adzes of D'Urville Island argillite overshadowed by other Nelson/Marlborough argillite sources (Table 3.3 and 3.4). This is in contrast to the dominance of D'Urville Island argillite for other functional types. Cortical remnants on chin-ridge adzes were commonly water-rolled suggesting the use of river or inter-tidal sources.

**Size/Dimensions/Edge Angle** (Tables 3.5-3.10).

There was considerable variability in size for Type 2 adzes, more so than for any other functional type. Large forms have hitherto been classified by Duff as Type 1A due to the presence of a tang. The presence of tangs on these large forms, however, reflect the need for larger adzes to have a more secure hafting device. The tangless forms, Duff types 2A and 2C, in contrast, are more commonly under 200mm in length (Table 3.10), thus hafting security is not so critical.

All the largest adzes (with the exception of the 680mm long chin-ridge pounamu adze from Claudelands, Waikato) thus far recovered are rectangular and are made of D'Urville Island argillite including the longest and probably the finest specimen of the type - the black argillite Horowhenua adze (570mm long, 132mm cutting edge width and 5450gm weight). Also over 500mm long is a finely flaked preform from Wanganui East (507mm long with 123mm wide cutting edge) and the
Patea adze (518mm long and cutting edge width of 130mm) which has a badly damaged blade under repair (see Figure 3.45a). The Wanganui D’Urville Island argillite preform weighed 5375gms and the Patea adze was over 6000gms (the weight of this adze was well in excess of the scale limit of 5750gms). Curiously, no adzes over 500mm long were observed from the South Island, the largest being the very angulated rectangular preform (Duff's 1A type specimen, 1977:150 - Figure 31) from Wairau (471mm long, 117mm cutting edge, 4320gm weight). However, the broken 1A adze mentioned by Duff (1977:154) from Grovetown near Wairau (The Pritchard adze now in the Canterbury Museum), was originally larger than the Wairau adze. This black D’Urville argillite bevel section (NOT a butt section as described by Duff- see Figure 3.45b), has a blade width of 150mm, the widest recorded of all finished adzes observed in this research for both islands, certainly exceeding that of the Horowhenua adze. The existing weight is close to 5kgs and the present length is over 300mm long. With at least a third missing it is likely to have been over 6kgs in weight and over 500mm long when complete. Of interest was the faint haft polish on, and minor chipping around, the broken surface which suggests that it was re-used with only very minor modification after breakage. The blade has received further damage and was under repair with a squared-off blade when it entered the archaeological record. Both the Grovetown and Patea adzes provide evidence that adzes of this great length and weight could be, and were, used.

The largest recorded Tahanga basalt adze is a Type 2 adze (415mm long, 98mm blade width, weight 3950gm) and is quite a remarkable achievement in this stone (See Figure 3.43b). Regrettably its provenance within the North Island is unknown though it may have come from the Coromandel area (Bob Murdoch, pers.comm.). Similarly only one Type 2 adze rendered in Southland argillite was over 400mm long (from Waimataua, with a length of 422mm, a blade width of 71mm and weighing 2290gm). Generally large Type 2 adzes were uncommon in Southland materials (see Figure 3.46a for a typical example) but specimens made of pounamu (for example, Figure 3.46b) were not unusual.

Large tanged rectangular adzes are significantly longer than other Type 2 and Type 1 forms with the exception of lugged Type 1 and 1D adzes. This may relate to the more delicate use of the rectangular form compared to the quadrangular form, but the extra length serves to place an even greater stress on the thin mid-sections of these adzes. They were an average 320mm in length, weighed 2000gms, were 37mm thick and had blade widths approaching 90mm. They were also among the heaviest adzes and had the widest blades, equalled only by lugged Type 1 adzes and the
chin-ridge form. Chin-ridge forms were also frequently large adzes, equal in length to Type 1 adzes but significantly shorter than the large tanged rectangular adzes.

There are no differences in length between South and North Island large Type 2 adzes. This reflects the dominance of D'Urville Island argillite in both South and North Island collections. It is clear that few materials had the necessary flakability and toughness required for the successful manufacture and use of these long thin rectangular forms.

Duff types 2A and 2C were among the smallest, lightest and thinnest adze forms, with none exceeding 250mm in length and with the majority between 170-180mm long and 400-500gms in weight. As noted above with Type 1 adzes, 2A adzes of D'Urville Island argillite tended to have wider blades and were longer and thinner than those of other materials, though in this case, the difference was not significant. Motutapu greywacke 2A adzes were, however, significantly smaller than those rendered in other materials (compare, for example, Figure 3.39b and c of D'Urville Island argillite with 3.39a of Motutapu greywacke and Figure 3.39d of Tahanga basalt).

All Type 2 forms shared low edge angles which were significantly less robust in comparison to Type 1, and in keeping with the timber dressing tasks they would have been assigned to. The only difference between 2A and 2C adzes was the significantly higher edge angle of the latter. This reflects the difference in stone type, not a functional difference. Nelson/Marlborough argillite had a very low representation among 2C adzes but dominated among 2A, chin-ridge and large tanged forms. In contrast, Tahanga basalt made up over half of the 2C adze sample, the remainder comprising mainly other basalts. For both 2A and 2C, and as also seen with Type 1, Tahanga basalt 2A adzes had significantly more robust edge angles than Nelson/Marlborough argillite. This probably relates to the inferior hardness of the basalts. Motutapu greywacke 2A and 2C adzes also had edge angles comparable to Tahanga basalt, but in this case, the need for a more robust edge angles reflects the weakness of the stone. Thus the significance in edge angle between 2A and 2C is indicative of raw material quality not adze type. The majority of 2C adzes would, therefore, appear to fulfil similar functions to 2A. The decision to make the front or the back wider may have been influenced more by the properties and shapes of the raw materials concerned then by any specific difference in the tasks they were required for.

Shape

From Table 3.11 it is clear that the majority of primary Type 2 adzes are steep sided, and for
most the front of the adze was rarely obviously wider or narrower than the back. As with Type 1 adzes, steep-sidedness was favoured, probably to provide greater blade corner protection on wide flared blades and to aid hafting. The significance of the Duff 2A and 2C distinction is less one to do with style than in solving raw material and manufacturing problems. Nor is it a distinction that, in practice, is easy to make.

Comparing my own analysis of the Wairau Bar assemblage with that of Duff's, several problems in the practical application of his typology become apparent. For Duff the Type 2A classification appeared to have served as a 'catch-all' for adzes that did not fit any other of his type descriptions. It is interesting to note that with the Wairau assemblage particularly, it is very difficult to discern whether the front is wider than back or vice versa - the difference is often less than several millimetres. This is a characteristic of the Nelson/Marlborough argillite adzes which make up 80% of the Wairau adze assemblage. The faces and sides of quadrangular and rectangular argillite adzes generally intersect at sharp well defined right angles so that the back and front of the adzes are approximately the same width (as seen in the Type 2 adze from Pouto in Figure 3.44a). Therefore, trying to determine whether an adze is a 2C or a 2A on the basis of this feature is a time-wasting and ultimately fruitless exercise, at least for Nelson/Marlborough argillite adzes. Obviously, because Duff had the Samoan 2C type to use as a model (Figure 3.41b), he classified as 2C only those adzes approximating this shape and distinctive 'style'. All other tangless and four-sided adzes were lumped in the with the 2A variety even though very few of these adzes have the front noticeably, or even marginally, wider than the back.

In summary, in the Wairau Bar assemblage and others where Nelson/Marlborough argillite dominates, the distinction between 2A and 2C can not, given Duff's criteria, be made. The approximation to the 'Samoan Type' for adzes to qualify as 2C needs to be made more explicit. In this research, only adzes where the back was noticeably wider than the front were classified as Type 2C. The reason for retaining this distinction is largely due to the observation that while rare in Nelson/Marlborough argillite, Type 2C is a notably common primary form in Tahanga basalt and other basalts though they are often morphologically distinct from the Samoan type (see Figure 3.40 for New Zealand examples). This might be significant if it were not for the observation that adzes of the 2A type had fronts clearly wider than their backs for these stone types also. It is evident from replication experimentation and from confirmation in the archaeological record that Tahanga basalt and most other raw materials did not allow for the finely controlled flaking that enabled the sharp angles on Nelson/Marlborough argillite adzes. The 'generally crude
workmanship' (Duff 1977:170) of the Samoan 2C adzes may indicate that the basalt used there also imposed technological limitations that influenced final adze form. Interestingly, the 2C Type specimen from Wairau and illustrated by Duff (Figure 37:169) is made of basalt - possibly even Tahanga basalt - and Skinner stated from his study of Otago Museum adzes that 'All examples observed are of basalt' (1974:107). Most of the adzes identified as 2C in the Wairau assemblage were also made of basalt.

Type 2 adzes characteristically have wide flared blades (Table 3.12). This is particularly marked for large forms and chin-ridge adzes demonstrating the importance of blade width in the functioning of these forms.

Large Type 2 adzes were less angulated than Type 1 adzes (Table 3.13). The risks involved in flaking long thin rectangular adzes may have restricted the degree of angulation applied. Nevertheless, angulation is more commonly observed on these adzes than on the smaller Type 2 forms that required less hafting security.

Chin-ridge adzes (see Figure 3.42 for examples), in contrast, are notably lacking in angulation and are generally very straight in profile. This is likely to be the result of a change in manufacturing and hafting techniques (see below).

**Chin and Hollow-ground bevels**

The smaller Type 2 forms have a very low incidence of chins and hollow-ground bevels (Table 3.15). As with Type 1, where chins were present they were generally the outcome of angulation. Larger forms had a higher frequency of what may be considered design 'extras' given that, for Type 1 and 2 at least, chins and hollow-ground bevels feature sporadically and thus appear not to be essential to the functioning of the adze. Rather raw material quality and manufacturing techniques may have guided choices on whether to add a chin or to hollow-grind the bevel. Additionally where hammerdressing is the principle shaping technique, leaving a raised ridge to indicate where the bevel is to start assists in keeping the shape in proportion during hammerdressing. Removing it when the adze is shaped to its final form would actually increase, not decrease, time and effort costs. This probably explains the prominent raised chin on the chin-ridge form which was shaped primarily by hammerdressing. Evidence of the process of leaving this ridge to demarcate the bevel during surface reduction can commonly be seen on chin-ridge preforms in the Nelson/Marlborough area otherwise known as 'humpback' (for illustrations see .

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Blade curvature

Like Type 1, relatively straight blades with minor curvature were characteristic of Type 2 adzes. An exception was the chin-ridge form (75.5%) where blades with more marked curvature predominated (Table 3.14).

One of the outcomes of increasing blade curvature is to impart greater strength to blade corners which are the weakest points of the cutting edge. This explanation can not be used to explain the result for chin-ridge adzes, however, which are commonly made from Nelson/Marlborough argillite (82.5%), and marked blade curvature was not a feature shared by their tanged counterparts.

The observation that chin-ridge adzes had significantly wider blades than large tanged forms may be pertinent here. The wider and more flared the blade, the more vulnerable the corners, and on chin-ridge adzes both of these features were exaggerated, more so than with other Type 2 adzes. Hence the blade curvature on chin-ridge adzes may have also functioned to provide added protection to blade corners.

Hafting (Table 3.16).

The chin-ridge form was characterised by very little butt modification but a significant number had hammerdressed polls, some with evidence of haft polish. This evidence signifies that a change in haft design had taken place with the hafting device transferred from the stone blade to the wooden helve. This explains the lack of butt modification and angulation on these adzes.

The related and earlier large tanged form, while generally exhibiting some butt modification, had less pronounced tangs than Type 1 forms. The large rectangular Type 2 adzes would have been used with considerably less force than the more robust quadrangular forms and thus would not require such secure hafting. Also, because of a thin cross-section relative to length, butt reduction would have needed to be applied very carefully to avoid transverse fracture or end-shock.

The smaller lighter Duff type 2A and 2C forms required even less hafting security and the majority had no butt modification; where it was present it was minor. These forms, however, are an example of another difficulty when employing the Duff typology which places such an
emphasis on the presence or absence of a tang. This is the principle difference between Duff types 1A and 2A.

As experienced in this research, determining the presence or absence of a 'grip' or 'tang' is quite frequently not a clear-cut matter. Because the presence or absence of a tang carries some interpretative weight in existing typologies (see above) this is a problem. Most adzes examined in this research had some form of butt modification; the difficulty lay in deciding if it was sufficient to qualify as a tang. For example, a number of large Type 1 adzes lacked well-defined tangs, be it either by angulation or reduction. This has forced at least one author to classify such an adze as Type 2A when it is so obviously of the thick and massive quadrangular 1A type (a Tahanga basalt adze from Matatauhu, Manukau Harbour illustrated by Prickett 1987:11- Figure 13) with much greater affinity both in form and function to a Type 1 adze. The Type 1 Tahanga basalt adzes in Figure 3.35 are similar examples that also lack actual butt reduction.

From comparisons between my own analysis of the Wairau bar assemblage and Duff's, it is apparent that Duff did not adhere strictly to his own type definitions, and had similar problems in defining when a tang was not a tang. The distinction between his Type 1A and Type 2A proved to be particularly problematic. Ten adzes and preforms classified by me as Type 2A were classified as 1A by Duff. Almost without exception these adzes were medium sized (under 200mm in length), with thin rectangular cross-sections and varying degrees of angulation (though not marked in any case) with no specimens exhibiting actual tang reduction. The difference may be explained by the emphasis I placed on size, cross-section thickness and edge angle as functional criteria while Duff placed a major emphasis on butt reduction or angulation regardless of how well defined it was.

In a similar pattern to that seen with Type 1 adzes, Type 2 adzes rendered in Southland materials, even when relatively small in size, commonly had well defined tangs. Southland adze-makers took advantage of the fine cross-sections on Type 2 adzes to reduce by lime garnet hammerdressing not only the front of the adze but usually the sides as well (see the examples in Figure 3.37). Again tang reduction sometimes took the form of grooving (Figure 3.37c), a feature readily accomplished by hammerdressing.

**Manufacture and Symmetry** (Table 3.17-3.19).
There were some notable differences in finish between large and small Type 2 adzes. Despite the greater surface area, large rectangular adzes were more finely flaked and fully ground than smaller forms and generally more so than Type 1 adzes. This may reflect the need for greater symmetry and the higher investment of time and effort for large adzes. Smaller forms like Duff 2A and 2C were generally less well flaked and finished. The need to be well balanced was not so crucial with these smaller forms and they also required far less time, skill and effort to manufacture. Among the preform sample where blank origin could be discerned it is apparent that thin four-sided medium sized adzes
Figure 3.39: Primary Type 2 Adzes (Duff 2A)
Figure 3.40: Primary Type 2 Adzes (Duff 2C).
Figure 3.41: Tropical East Polynesian Adzes
Figure 3.42: Chin-Ridge Type 2 Adzes.
Figure 3.43: Large Type 2 Adzes.
Figure 3.44: Large Type 2 Adzes.
Figure 3.45: Very Large Type 2 Adzes.
Figure 3.46: Large Southland Type 2 Adzes.
could be made from flake blanks which presented few technological challenges compared with larger forms like cobbles. Shaping requirements were less demanding and sometimes, for well-shaped flake blanks, bilateral flaking will suffice. Additionally there are not the extra costs and risks that were involved in the manufacture of large adzes; for example, no tang formation was required.

Nevertheless, the majority of 2A and 2C were quadrilaterally flaked to quite a high standard with generally only minor amounts of hammerdressing and grinding applied.

Primary chin-ridge adzes were usually well finished but lacked the fine flaking of most large Type 1 and Type 2 adzes. As with 1C and 1D adzes, hammerdressing with lime garnet was the primary manufacturing technique employed, often followed by extensive grinding, thus a lower skill and risk level was involved. This evidence of the increased use of lime garnet was probably a response to the increased exploitation of tough low flaking quality mainland river sources.

Large Type 2 adzes were consistently finished to a very high standard and represent the highest technological achievement in adze manufacture. The skill, time and effort requirements would have surpassed even those for large quadrangular forms, and due to the very thin cross-section relative to length, risk of breakage during the advanced flaking stage must have been exceedingly high. It is probably not farfetched to suggest that the successful manufacture of the 570mm long Horowhenua adze was a momentous occasion. That the majority were rendered in D'Urville Island argillite is testimony to the high constraints on raw material and manufacture that this form imposed. This could also be viewed from the opposite angle; that the presence of very high quality materials allowed such a form to be made.

Type 3

Task/Problem: Shaping curved (concave) surfaces, edge trimming and other precision wood shaping tasks (corners, apex):

Solution: Type 3 Rounded shallow sectioned tools with curved blades.

Operations: Follow-through adzing stroke.

Action: Low angle of attack, low force of impact.

Functional Requirements:

1. Some length for the follow-through stroke and for reaching some difficult areas (hollowing out
canoes/bowls).
2. Frontal convexity, marked blade curvature and low edge angles (minimum resistance, sharper edge).
3. Blade width relative to curvature of area being adzed, for example, corners would require a very curved and narrow blade.
4. Size relative to area being adzed. Wide-bladed forms probably larger and more robust than narrow-bladed forms.
5. Degree of butt modification for hafting security will probably reflect size - longer forms need more secure hafting.
6. Symmetry was probably important for the types of precision tasks for which these adzes were used.

**Conditions:**
1. Raw Material requirements: Selection for hardness as per Type Two.
2. Manufacturing Requirements: Larger forms impose more constraints on blank form. In replication experiments, flake blanks were suitable for medium sized forms (under 200mm). Due to shallow cross-sections it is possible, particularly with thin flake blanks, to shape these forms by low angled bifacial bilateral flaking which requires the lowest skill level. Care is needed when/if modifying the butt as the thin cross-section makes the form vulnerable to transverse fracture. Convexity of the front was achieved by grinding. It is likely that considerable attention was required to form and finish the bevel and blade area in order to attain the correct blade curvature, frontal convexity and low edge angle, and where achieving symmetry and balance would be important.

**Skinner Type:** Type 1C (Duff type 3A), 7 (Duff type 3C), 8 (Duff type 3B).

**Duff Type:** Type 3: Varieties A,B,C,D.

These adzes are described by Duff as being of:

'Triangular or Sub-triangular section (apex downwards)....may be regarded as a natural transition from adzes of quadrangular section. Thus in most Polynesian quadrangular adzes, the front is wider than the back, the sides sloping downwards and inwards toward the base. Increase this tendency so that the back
becomes narrower and narrower [until], finally a median ridge [is] formed by the sides meeting and the result is...[type 3]. The type par excellence of the Society, Cook and upper Austral Islands, and its emergence may be regarded as the last great fashion change of adzes that took place in Polynesia.' (1977:170).

Duff also suggests that '...the New Zealand examples...are ancestral forms or prototypes' (1977:170). That is, the form was incipient at the time of migration to New Zealand and thereafter developed in Central Polynesia in a more elaborate form (1977:170) such as the adze in Figure 3.47a. Skinner also noted the resemblance of his type 1C - thick rounded hammerdressed Southland forms - to what he called the 'Cook Island type' (1974:104-5).

Duff does note some morphological differences between the New Zealand and Central Polynesian forms, however, in that:

'[...the blades are thinner...[and the section]...is often represented by the intersection of two lines only, the back absorbing the sides to take the form of a continuous convex or concave line...often thus sub-triangular.' (1977:172).

Varieties A (Figure 3.48a, Figure 3.50a,b and c, Figure 3.51a) and B (Figure 3.48b and c, Figure 3.51c) are wide bladed forms, the major difference being that Type 3A has a laterally reduced tang while Variety B has no such 'grip'. Varieties C (Figure 3.49b,c and d, Figure 3.51d) and D (Figure 3.49a and Figure 3.50e) are narrow-bladed 'coffin shaped' forms, again the former having a 'spade-shouldered grip' the latter not (Duff 1977:172-176).

Confusion arises in that Duff obviously includes as Type 3D both adzes (with the stone bit set at a right angle to the wooden helve as demonstrated by the illustrated type specimen from Sumner, Canterbury: 1977:175, Figure 40), and round gouges (where the stone piece is hafted in line with the helve and applied to the wood by pounding with a mallet) represented by the other two type specimens illustrated (Figure 40:175). The latter two gouges (distinguished from chisels by the curved blade edge) are functionally and morphologically so similar to Duff's Type 6 that I have chosen to relegate such gouges to that category, and reserve Type 3D for adzes with narrow blades but with no distinct lateral shoulder. The distinctive coffin shaped adze may well be a form influenced by the quality of the raw material used, thus the distinction was considered viable, and particularly relevant when comparing North Island forms with those from the South Island. Type 3D as defined in this thesis may well be a cruder rendering of Type 3C reflecting the technological limitations of the raw materials available.
The very rare examples observed of Type 3E, both in the South and the North Island (N=3), are indeed 'accidental products' (Duff 1977:176), and none can be regarded as primary adzes. This is in marked contrast with the elaborate forms more frequently found in Pitcairn Island, Tubuai and Easter Island for which only a very tenuous resemblance can be noted. The very small New Zealand sample, including the one small unfinished sample from Wairau, have been reworked from the blade portions of large rectangular adzes.

**Discussion of Archaeological Data** (Figure 3.48-3.51).

Type 3 adzes are quite rare compared to Type 1 and 2 reflecting the relatively specialised tasks they performed. Type 3C and 3D adzes are even rarer than side-hafted adzes, especially in the North Island (see Table 3.3 and 3.4).

South Island materials dominate the tanged varieties 3A and 3C while Tahanga basalt makes up a large percentage of the 3B sample (Figure 3.48b - regarded by Simcox as the finest adze in his collection - and c). The frequency of D'Urville Island argillite Type 3 adzes is much higher than for other Nelson/Marlborough argillite sources (85.1% D'Urville and 14.8% other Nelson/Marlborough argillite), especially among 3A and 3C adzes.

Motutapu greywacke Type 3 adzes (Figure 3.49a and Figure 3.50b) are not unusual reflecting the value of hardness for this form and the relatively low levels of force used with these adzes.

**Size/Dimensions/Edge Angle** (Table 3.5-3.9).

Among 3A and 3B adzes are a number of very large (over 300mm length) specimens (for example, Figure 3.48a) which may have been used in the construction of particularly large canoe hulls. All are either D'Urville Island argillite or Southland argillite. Type 3 adzes are generally long with shallow cross-sections. The length serves to increase the length of the adze stroke and to enable a better reach into the lower recesses of a canoe hull.

There are clear differences between the varieties of Type 3. The wide-bladed 3A and 3B are significantly thicker, heavier, longer and overall generally more robust than the narrow-bladed 3C and 3D. The tanged form 3A is significantly thicker than 3B (T-tests at the 0.05 level) thus there was a greater need for more hafting security. Likewise the 3C form was significantly longer than Type 3D. Robust Type 3 adzes are particularly common when rendered in Southland materials.
(see, for example, Figure 3.51b).

The wider bladed forms were designed for greater surface impact and wood displacement along the sides of canoes while their more fragile form and the narrow cutting edge suggests Type 3C and 3D adzes may have been reserved for more delicate operations such as forming the apex at each end of bowls and canoes, and for shaping rims and edges.

The sample size for edge angle was too small for different varieties but there were few observable differences; all but several robust forms (like Figure 3.50a) had low angled bevels comparable to other timber dressing adzes used at low angles of attack (i.e., Type 2).

Shape

From my examination of a large number of Type 3 adzes in both the North and South Islands, I would assert that the differences between New Zealand and Central Polynesia Type 3 adzes are so marked as to suggest that the ancestral relationship postulated by Duff (1977:1970) is tenuous. In functional terms, the Central Polynesian Type 3A, with its commonly thick cross-section and robust edge angle (see Duff 1974:129-135 and Figueroa and Sanchez 1965:Figures 65-71), is more directly comparable with Type 1, and while the transition from quadrangular to triangular cross-sections can perhaps be accepted for these Central Polynesian 3A types, the same cannot be said for the New Zealand Type 3, nor is the idea that they represent a 'prototype'. While a very small number of D'Urville Island argillite and Southland 3A adzes are robust tools with thick cross-sections (see, for example, Figure 3.50a), by far the greater majority of New Zealand forms are thin-sectioned more fragile tools morphologically similar to Type 3 forms found in other marginal East Polynesian Islands, for example, Hawaii, Marquesas and Pitcairn (see Figure 3.41a).

For both the South Island and North Island forms, rarely can the section be called triangular or even sub-triangular, rather the cross-section of primary Type 3 adzes is most commonly lenticular (83.6% - see Figure 4.21 for a typical Type 3 cross-section).

The majority of New Zealand Type 3 adzes are functionally different from the sturdy heavy Central Polynesian types also. Characteristic and consistent features of primary New Zealand Type 3 adzes are shallow rounded cross-sections with marked blade curvature and convexity of the front and back, while the bevel is low angled and often hollow ground (38.7% - Table 3.9 and 3.15).

The marked blade curvature characteristic of Type 3 adzes (Table 3.14) is directly related to the function of the adze. This feature was generally combined with marked frontal convexity and

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resulted in a scooping action designed for use on concave and curved surfaces such as the inner hull of a canoe. On a small number of these adzes frontal convexity was so exaggerated as to result in a scooped cutting edge that was more concave than convex.

Type 3 was also one of the few primary adze forms that consistently had chins (Table 3.15) where the triangular bevel and chin formed part of the overall design and probably related to the high incidence of hollow ground bevels.

**Hafting** (Table 3.16).

The distinction Duff made between his type 3A and 3B, and 3C and 3D was chiefly one of the presence/absence of a tang. The tanged forms were somewhat larger than the untanged forms but generally size does not appear to have influenced the decision to modify the butt. Again the influence of stone type may be implicated here, with the smaller Tahanga basalt adzes dominating the tangless 3B sample and Nelson/Marlborough argillite and Southland materials most strongly represented among the larger, more robust tanged 3A adzes.

Butt modification for primary Type 3 adzes was, however, rarely extensive and would not have involved the time and effort invested in the tangs seen on Type 1 adzes. Tangs were formed by lateral reduction, commonly by flaking, during the shaping process of the adze. On larger adzes, particularly in the case of Southland adzes, reduction was accomplished and/or completed by hammerdressing. On Southland adzes, tang reduction was often marked and generally included reduction of both sides and front (see Figure 3.51a and b).

Again the problem of deciding when a tang is or is not a tang is a practical difficulty when attempting to sort Type 3 adzes according to Duff’s classification. It was observed that even on tangless forms, a small amount of hammerdressing was sometimes applied to prevent sharp flaked edges from abrading the haft lashing, though no reduction or definite shoulder was present.

It might be assumed that the often rounded contours of Type 3 adzes would lend them some instability if set onto a flat soled haft. At Huahine, a number of haft soles were recessed and grooved and would have been ideal for triangular, plano-convex or lenticular adzes (Sinoto 1982:176). Bonica preferred to set his Type 3 adzes onto a flat open sole if only to avoid having to modify a haft specifically for an adze form that would not be used as often as others like Type 1 and 2, thereby restricting the use of the haft to that form. Wrapping the adze head in fibre padding provided adequate hafting security for Type 3 adzes where the amount of force used was not severe. **Manufacture and Symmetry** (Table 3.17-3.19).
Figure 3.47: Tropical East Polynesian Adzes
Figure 3.48: Primary Type 3 Adzes.
Figure 3.49: Primary Type 3 Adzes and Preforms
Figure 3.50: Primary Type 3 Adzes.
Figure 3.51: Southland Type 3 Adzes
The majority of Type 3 adzes were shaped by low angled bilateral or trilateral flaking, generally much easier and faster to achieve than quadrilateral high angled flaking. Observations of archaeological preforms, together with replication experimentation results (Turner 1992), also suggests that flake blanks were ideal for smaller forms. Apart from Southland adzes, hammerdressing was rarely applied except to form tangs on 3A adzes. Particularly for the thin-sectioned narrow-bladed forms, hammerdressing was probably too dangerous. Again, large 3A and 3B forms tended to have more hammerdressing and to be more fully ground than smaller forms. The high frequency of 3B with no hammerdressing reflects the dominance of Tahanga basalt adzes and the lack, in the North Island, of an effective hammerdressing material. Southland Type 3 adzes (most commonly rendered into the 3A form), in contrast, were almost all hammerdressed and well-ground with well-defined tangs and chins. Additionally hollow ground bevels were especially common (87.5%). The rounded contours on Type 3 adzes were accomplished during the finishing process of grinding.

3A and 3C adzes were generally more finely formed and finished than 3B and 3D adzes. The 3A result partially reflects the dominance of D'Urville Island argillite and the larger size of 3A compared with 3B adzes more commonly rendered in Tahanga basalt. It is clear that 3D adzes were just smaller less finely formed versions of 3C. Functionally they would have performed in a similar way.

**Type 4**

**Task/Problem:** Making deep V-shaped cuts in wood to allow wider bladed tools like Type 1 access to split and chop out large chunks of timber.

**Solution:** Type 4 Thick, heavy, large narrow-bladed tool with robust edge angle.

**Operations:**
1. Scarfing, gouging, splitting - work in tandem with Type 1 for rapid wood displacement.
2. Initial hollowing out of canoes with a wider bladed tool in order to cover a wider surface area but with deeper penetration than Type 2 and with less risk of timber splitting than could result with Type 1.

**Action:** High angle of attack, high force of impact.

**Functional Requirements:**
1. Large size (length, and especially weight) for maximum impact.
2. Thick cross-section to withstand force of impact without breaking and to increase force used.
3. Robust edge angle to absorb impact and overcome wood resistance.
4. Narrow blade for maximum penetration.
5. Secure hafting device to reduce movement in use.

Conditions:
1. Raw Material Requirements: The Type 4 design is a robust one with a very thick cross-section and a steep edge angle. The weakest point on an adze is the mid-section but with Type 4 thickness is equal or greater than width at this point. There is also not a great need for hardness, rather blade edge strength is required to withstand heavy impact. This is again imparted by the adze design in the manner by which the sides curve into a narrow blade well protected by a robust edge angle. We might, therefore, expect a selection for tough materials if they are available but a greater range of materials in this form might be predicted compared with Type 1.
2. Manufacturing requirements: In replication experiments, Type 4 adzes were not difficult to manufacture. Shaping can generally be accomplished by low angled trilateral flaking. Type 4 proved an adaptable form when problems roughing out blanks for Type 1 adzes occurred. Because of their narrow form, asymmetrical blanks could be readily reshaped into Type 4 adzes. A similar situation resulted during reworking experiments. Figure 4.1 shows a medium sized Type 4 adze reworked from the bevel portion of a large Type 1 preform. There were some size constraints in that flake blanks were often not thick or large enough. The risk of transverse fracture is also lower due to a more or less equal thickness to width ratio. Blade and bevel finishing require less time and effort than wide bladed forms.

Skinner Type: Type 4 (=Duff 4A), Type 9 (=Duff 4B).
Duff Type: Type 4A and 4B.

Of Type 4 Duff states:

'The genesis of this type has been referred to in discussing Type 2, Variety C, where variation on the theme of the normal quadrangular adze produced the narrow-fronted 'Samoan' adze with sub-rectangular section. By pursuing this modification to its extreme, that is by increasing the slope and height of the sides, so that the front becomes virtually a ridge, terminating in the narrowest cutting edge, Type 4 was produced. The functional object would be to decrease
the width of the cutting edge, but to increase its entering power....reflects obviously a specialized purpose, although its distribution cannot be explained in terms of that purpose....its distribution within Eastern Polynesia is mainly marginal......first developed at an early date...with the other early types, namely 1A and Type 2A.'(1977:176).

Again, in his classification of Type four, Duff's preoccupation with cross-section led him to include varieties of small gouges (Type 4C and 4D though the latter was later incorporated into the Type 6A class), which were probably more commonly used in conjunction with a mallet. In practise the extensive variability of cross-section shape among small chisels and gouges made the application of Duff's typology difficult and ultimately irrelevant for this class of adze. This was particularly the case when field observation revealed that the majority were the outcome of reworking. All these small chisel (straight blade) and gouge (curved blade) forms have been assigned here to Type 6 (see below).

The major difference between varieties 4A and 4B is the width of the blade. Type 4A has a narrow blade, usually the narrowest part of the adze (see Figures 3.52 and 3.54), while 4B adze blades are considerably wider (Figure 3.53b).

Blade width is emphasized in the current research, more so than in Duff's original description, the reason being that the nature of the blade, and to some extent, the bevel, are the most functionally significant features of Type 4. Hence, where the blade equals or exceeds maximum body width, it is classified as 4B.

Both Skinner (1974:108) and Duff (1977:180) noted another distinctive hogbacked form which, after some hesitation, was included with Type 4A. Type 4A adzes are characteristically robust and deep-bodied, designed to withstand heavy impact. But one class of very slender narrow hogbacked gouges was obviously of a more delicate design (see Figure 3.56). These hogback gouges would have been reserved for finer gouging work, probably for gaining access to corners in deep excavations like the apex of canoe prows and bows where the slenderness and length and of these adzes would have been an advantage, if not a necessity. Skinner adds that they have also been used 'for cutting slots and grooves' (1974:108). Because they function in a very different way to robust Type 4 adzes, and have more in common with smaller gouges, these adzes are included with Type 6 below.

Duff's Type 4E (with a grooved tang) and Type 4F (no butt reduction) are not standardized adze forms in New Zealand. A number of Southland Type 4 adzes have grooved tangs (for example, Figure 3.53a) but are very different from the Duff 4E form which is common to Easter Island. The
very small number of adzes observed in this research that may be judged as belonging in these
categories bear only a passing resemblance to the more standardized forms seen in Easter Island
(for 4E) and Samoa (for 4F), and this resemblance may be regarded as accidental rather than
deliberate.

**Discussion of Archaeological Data** (Figure 3.52-3.55).

Functional experiments suggested different though related uses for 4A and 4B, the 4B adze being
a compromise between the deep gouging action of the 4A and the shallow shaving action of broad
bladed types. The former was probably a task that could be performed by other types of adzes
which may explain the relative infrequency of the 4B form compared with 4A. Primary 4B adzes
were rare (Figure 3.53b and Figure 3.63a being two of these primary forms) and most are modified
and reworked 4A adzes (see Table 3.2). Ongoing blade rejuvenation of 4A adzes has the effect of
broadening the blade to such an extent that the blade often becomes the broadest part of the adze.
Reworking of broken butt sections had a similar outcome.
The widest range of materials were used for this form reflecting the robust nature of the Type 4
design which enabled even fairly weak rocks to be viable for use.
In the North Island, among minor stone sources Type 4 is the most frequent form represented
along with the slender hogback gouges, some of which have been reworked from larger Type 4
adzes (see Table 3.3). For example Northland basalt, Waikato basalt and Wairarapa silicified
limestone adzes have very similar Type 4 frequencies. Frequencies of Type 4 adzes are also high
for Motutapu greywacke. In comparison the frequency of Type 4 among Nelson/Marlborough
argillite primary adzes found in the North Island is very low. This is probably because local rocks
could be utilized for this form.
These findings may have significant implications for understanding adze distribution and how
adzes representing 'rival products' came to be found on the doorstep of local quarries (Davidson
1981,1984:199). While local materials may have been adequate for use when rendered in robust
forms such as Type 4, Type 1 adzes in high quality imported materials were generally preferred
over local products. In terms of manufacturing costs and functional benefits, this choice may have
been one born more of necessity than preference.

**Size/Dimensions/Edge Angle** (Tables 3.5-3.9).

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Apart from the obvious most significant difference, that of having very narrow blades, Type 4A adzes are significantly thicker than all primary forms except the Southland 1D form, and have markedly more robust edge angles in keeping with the deep gouging action they were designed for. They do not reach the weights and lengths of Type 1 or large Type 2 adzes, however, rarely exceeding 300mm in length or 2000gms in weight. Nevertheless, 4A adzes are significantly longer and heavier than all other adze types, including 4B. The largest 4A adze recorded for this research was Skinner's type specimen (1974:109, Figure 6.9) from Owaka, Southland, a finely finished adze rendered in Southland argillite (not basalt as identified by Skinner) 364mm long, 81mm thick and 2870gm weight. The longest Nelson/Marlborough argillite adze (from a D'Urville Island source), provenanced to the Otago area, is 332mm long and weighs 2150gm (see Figure 3.52b with a similar sized adze in pounamu). Tahanga basalt 4A adzes were significantly smaller and lighter than their argillite counterparts with the largest adze (found at Te Arai, on the Aupouri Peninsula, Far North) 301mm long and weighing 1800gm.

Predictably 4B adzes have significantly wider blades than other Type 4 forms. The finding of at least two 4B adzes at Waitaki River Mouth refutes Duff's assertion that the form is '...not known from any Moa-hunter sites...'; none were recorded from Wairau Bar for example (1977:182). Indeed, the finest and largest specimen observed in this research was from the Waitaki River Mouth adze assemblage (see Figure 3.63a), rendered in D'Urville Island argillite weighing 1350gm and with a length of 268mm. Primary Tahanga basalt forms are most common in the North Island (Figure 3.53b). While generally smaller and less robust tools than 4A, 4B adzes have comparable edge angles denoting a similar action. In the case of type 4B, this action may have involved making wider V-shaped cuts in the initial hollowing out of canoes as demonstrated in the functional experiment above.

Shape

All Type 4 adzes have a thick cross-section equal or more than the maximum width with the back always wider than the front and, for all but type 4B, with the sides curving in to a narrow blade. Most Type 4 adzes had triangular cross-sections with the apex to the front ground or/and hammerdressed flat to prevent lashing wear and to lead into the narrow cutting edge. The minority with more rounded sub-triangular cross-sections were rendered in Southland materials where
extensive hammerdressing was influential on form. As a consequence of its wider blade, 4B adzes were more commonly sub-quadrangular with triangular butts. The two 4B adzes rendered in Southland materials were more distinctly quadrangular in section, the only features distinguishing them from Type 1 back-wider-than-front forms being the greater thickness, the narrower blade width and, most significantly, the more robust edge angle.

Type 4 adzes were most consistently angulated after Type 1, reflecting the need for secure hafting (Table 3.13). In a similar pattern to Type 1, Tahanga basalt Type 4 adzes, followed by D'Urville Island argillite, have the highest frequencies of angulated profiles reflecting the main method of shaping - flaking (see Figure 3.55a, Figure 3.60e and g for Tahanga basalt examples). In contrast, the heavily hammerdressed forms made of other Nelson/Marlborough argillite sources and Southland materials, are more rounded.

**Blade Curvature and Chins**

Type 4 adze blades were predominantly straight (Table 3.14) with blade corners well protected behind a robust bevel and the manner by which the sides curved in to a narrow blade. Hollow-grounding of the bevel was uncommon for Type 4 except, as seen previously with other adze forms, among adzes rendered in Southland materials. Only 4B adzes showed some deviation from this pattern with higher frequencies of curved blades and hollow ground bevels (Table 3.15) reflecting their functional status as a compromise between a wide-bladed surface cleaning action and the deep gouging action of the narrow bladed 4A.

Chins, where they were present, were commonly the outcome of angulation and thus more frequently seen on Tahanga basalt and D'Urville Island argillite adzes. A small number of Southland Type 4 adzes had raised chins reflecting the influence of hammerdressing (for example, Figure 3.53c).

**Hafting** (Table 3.16).

All Type 4 adzes have some form of butt modification reflecting the importance of secure hafting given the heavy tasks they performed. A similar pattern to Type 1 adzes exists in which Tahanga basalt adzes have higher frequencies of offset butts while for the South Island argillites, butt reduction by lime garnet hammerdressing is more common. Again, heavily reduced and grooved
Figure 3.52: Large Primary Type 4 Adzes.
Figure 3.53: Large Primary Type 4 Adzes.
Figure 3.54: Large Primary Type 4 Adzes
Figure 3.55: Large Type 4 Adzes
Figure 3.56: Large Type 6 Adzes and Preforms
and 3.62b). A small number of Southland and D'Urville Island argillite Type 4 adzes have lugs to the front apex of the butt, one at the poll, the other at the shoulder, to enhance hafting security (see Duff's type specimen for 4A, 1977:179, Figure 42).

No Type 4 adzes had haft polish on the poll and only two adzes had hammerdressed polls; both made of greywacke. Only a small number had haft polish evidence and this was restricted to the back of the adze. This evidence suggests that no Type 4 adzes were hafted in line with the shaft as was often the case with small gouges. These adzes, more so than the flat faced broad four-sided adzes, may have required fibre padding to stabilize the butt on the haft sole, as Bonica did to haft his Type 4 adzes to a flat soled foot. Such devices may have prevented or delayed the attainment of haft polish.

**Manufacture and Symmetry** (Table 3.17-3.19).

For Type 4 adzes a similar pattern to Type 1 exists. Tahanga basalt and D'Urville Island argillite adzes are finely flaked to shape with D'Urville adzes maintaining the highest flaking standards. Hammerdressing was largely confined to butt reduction for D'Urville Island argillite and Tahanga basalt, though for the latter an equal number were without any hammerdressing. Motutapu greywacke adzes mirror Tahanga basalt in having little or no hammerdressing and in being only lightly ground. They do tend, however, to be more finely flaked than Tahanga basalt adzes. Adzes rendered in other Nelson/Marlborough argillite sources and in Southland materials had, in contrast, high frequencies of hammerdressing and grinding. Among these materials, adzes exhibited higher flaking standards than for Type 1 and 2 reflecting the relative ease of flaking Type 4 adzes. This involved relatively low angled trilateral flaking which demanded neither the time or skill invested in the high angled quadrilateral flaking seen for Type 1 and 2.

For Type 4 preforms where blank origins could be identified, cobble and core blanks were dominant. Flake blanks were generally not of adequate length or thickness.

Type 4 adzes were usually well formed and finished but not generally to the standard seen with Type 1 and large Type 2 adzes. This reflects the relative ease of manufacture with Type 4 and the lesser importance of symmetry given the robust nature of the form.
Type 5

**Task/Solution:** Excavation tools for working in confined spaces (canoes, bowls):

**Solution:** Type 5. Laterally hafted tools.

**Operation:** Adzing stroke with follow through. Low angle of attack.

**Action:** Low angle of attack, moderate force of impact.

**Functional Requirements:**
1. There is a need for frontal convexity and blade curvature especially toward the driving corner in order to shape curved surfaces and to protect the blade corner which takes the initial impact.
2. Moderate edge angles and cross-section thickness due to an intermediary function in both shaping but also maximizing amount of material removed.
3. A wide blade to increase the amount of material removed in each stroke.
4. Adequate length to reach the inner recesses of vessels.
5. Butt modification is essential if no specially designed or modified foot (recessed) is incorporated into haft. This is achieved by lateral reduction on the opposite side to that in contact with the haft. The side lashed against the haft foot needs to be flat to increase stability.

**Conditions:**
1. Raw Materials: Relatively tough and hard but no real necessity to optimize either of these qualities.
2. Manufacturing Requirements:
   Some selection for blank type in order to accommodate the relatively wide blade. In replication experiments, one of the Type 5 adzes used in the functional experiment above was made from a flake blank. Risk and skill levels are moderate with shaping by trilateral flaking as with Type 3 and Type 4. Some attention is required to ensure the correct blade curvature and edge angle.

**Duff Type:** Type 5A.

**Skinner Type:** Type 10.

The functional role of Type 5 adzes is clearly defined by the manner by which it was hafted. As described by Duff:
when the adze was hafted the cutting edge would lie along the same plane as the long axis of the haft as in the European axe. The bevel...is formed on only 1 side of this blade, normally the right side...so that the implement is classified as an adze, and would be used as such. This means it would be used for trimming the inner wall of narrow excavations in wood, such as canoe hulls, food bowls etc, where the normally hafted adze would be inconvenient, but not for purposes for which an iron chopping axe would be used.' (1977:184).

Moore, Keyes and Orchiston (1979) describe the way a side-hafted adzes should be viewed:

'...the right hand side of the adze is taken as that which is adjacent to a viewer's hand when the adze is placed on its base (with apex uppermost) on a table with the cutting edge pointing directly away from the viewer, i.e. the right lateral surface coincides with the right side of the artisan swinging the hafted specimen.' (1979:59).

Discussion of Archaeological Data (Figure 3.57-3.59).

Type 5 adzes are regarded as the rarest and most specialized adze form (Duff 1977; Moore, Keyes and Orchiston 1979). Yet a prevailing problem exists in that while the Type 5 adze appears to have served a special and vital role in the excavation of deep narrow confined spaces characteristic of Polynesian canoes, its actual occurrence in the archaeological record is rare, both within New Zealand, and in tropical East Polynesia in particular. Pitcairn is the only other Polynesian island where side-hafted adzes appear to have been used. Alternative methods of excavating deep narrow confined spaces must have been in existence. Both Duff and Skinner suggest the possibility of affixing a rotatory sleeve to the haft enabling 'normal blades' to be used in a side-hafted manner as was done elsewhere in the Pacific including Polynesia (Duff 1977:186; Skinner 1974:113; Moore, Keyes and Orchiston 1979:53).

The rarity of the form in New Zealand may be overstated by Duff, however. Since the first publication of his finalized adze typology in 1950, the numbers of side-hafted adzes recorded have increased significantly, especially in the North Island (Moore, Keyes and Orchiston 1979). A number of previously unrecorded specimens are included in this research (see Appendix C). Additionally it is apparent in the archaeological data that, unlike other adze forms, once a Type 5 adze broke or suffered major blade damage, the distinguishing characteristics were quickly obliterated by subsequent repair and reworking. Nor was it possible as a rule during manufacturing experiments to rework broken pieces of other types of adzes into a Type 5 form. The major
problem encountered was that few broken pieces were large enough to provide the broad cutting edge or the length required for a side-hafted adze. No reworked specimens were observed in the present study though three specimens were broken pieces where reworking attempts had failed. Breakage and bad damage probably made Type 5 adzes redundant in their former tasks and it is possible that they were often reshaped for other purposes. The reshaping of a broken Type 5 adze would probably involve extensive reflaking of the apex side to form a more symmetrical bevel and cross-section for normal hafting and use. A rounded quadrangular or plano-convex cross-section would probably result. Some Type 5 adzes may have been reworked or modified into Type 3 adzes. Of note is that several specimens recorded in Moore, Keyes and Orchiston's 5A list (1979:60-73) have bevels and functional features more consistent with Type 3 (for example the Pig Bay adze and Crosbie’s Settlement adze) than Type 5.

Thus the majority of specimens identified in this study were generally complete and either primary forms, well-formed preforms or adzes where repair has been minor. Type 5 preforms can prove difficult to identify unless they are well formed. This is particularly problematic with specimens found at quarries. For example, I regard as dubious the specimens listed by Moore et al. (1979) which were found at the Tahanga quarry and nearby at Opito Bay; also the preforms rendered in chert. Personal observation revealed these to be in a rough ill-formed condition and their resemblance to Type 5 may be fortuitous.

In conclusion the relative rarity of the Type 5 adze may be real but it is exacerbated by the rapid disappearance of the form once damage or breakage occurred. Additionally the form could only be acquired by working new material thus replacement would necessitate a return visit to the quarry or communication with exchange partners. Difficulty in replacement may have stimulated alternative solutions such as the rotatory sleeve at a quite early date in areas distant from raw material sources (Keyes 1971:92). This may provide another explanation for their rarity.

Consistent with the interpretation that right-sided bevels relate to right-handedness (Duff 1977:184), left-sided Type 5 adzes are very rare. The discovery, however, of several caches featuring both left and right-sided Type 5 adzes prompted an alternative suggestion that both were used together, and corresponded to hollowing out the opposite sides of a canoe (J.Coster pers.comm.). One cache was found on the Aupouri Peninsula (Figure 3.57a and b) and consisted of two finished Tahanga basalt adzes. The other two Type 5 adzes were among a larger cache of eight D’Urville Island adzes and preforms from Big River on the upper west coast of the South Island. Both were preforms (Figure 3.58). The difficulty with Coster’s explanation is the relative
infrequency of left-sided compared with right-sided Type 5 adzes. With this problem in mind, Bonica manufactured both right and left-sided Type 5 adzes. Bonica is left handed and demonstrated a decided preference for the left-sided Type 5 adze in functional experiments regardless of what side of the kumete was being hollowed out. When changing sides, the same side-hafted adze could be used simply by the operator working from the opposite direction.

Tahanga basalt and Nelson/Marlborough argillite were the favoured materials for Type 5 adzes (Table 3.3 and 3.4). There is also a marked preference in the North Island for Tahanga basalt (Table 3.3). This choice may reflect the desire for a relatively tough sturdy tool. In the North Island, Nelson/Marlborough Type 5 adzes are, in contrast, quite rare and mainly confined to the southern half of the North Island. Again, D'Urville Island sources dominate among adzes of Nelson/Marlborough argillite.

Size/Dimensions/Edge Angle (Table 3.5-3.9).

Side-hafted adzes were fairly robust tools. Aside from lateral hafting, another characteristic of Type 5 adzes are their wide blades relative to length. These are significantly wider than other adze forms except large Type 2 and lugged Type 1 adzes. Much of the hollowing out process would have been accomplished by these adzes, hence the wide blade enables a wider surface area to be covered with each stroke. The steeper edge angle compared with other timber dressing adzes would have also contributed to the fast removal of wood.

Nelson/Marlborough argillite adzes are significantly longer and heavier than Tahanga basalt adzes and have wider blades. These results are similar to those obtained by Moore, Keyes and Orchiston from their study of 104 side-hafted adzes (1979:75).

The largest Type 5 adze thus far recorded from New Zealand is the D'Urville Island argillite preform from Big River (Figure 3.58b) measuring 338mm long with a weight of 2515gms and a blade width of 126mm. This preform is well flaked to its approximate final form, and requires only some grinding of the bevel and blade to make it operational, thus the great size of this adze is not due to an early stage of manufacture. Nevertheless, no finished specimens approach it in size either in this present study or that of Moore et al (1979). The largest finished adze is from Invercargill and is rendered in Southland argillite (Figure 3.59a). The adze measures 290mm in length with a blade width of 92mm and a weight of 1530gms. It has seen some repair and has suffered bad blade damage so originally may have been longer and with a wider blade. A smaller primary left-sided
Figure 3.57: Type 5 Adzes.
Figure 3.58: Type 5 Preforms from Big River Cache.
Figure 3.59: Type 5 Adzes
D'Urville Island argillite adze from Wairau Bar has the widest blade recorded at 104mm (Figure 3.61d). The heaviest finished adze is also of D'Urville Island argillite, part of the Hurunui River Mouth cache, and weighs 1813gms.

The largest Tahanga basalt Type 5 adze is provenanced rather vaguely to 'Wairarapa' and is 245mm long, with an 81mm wide blade and a weight of 1200gm (Figure 3.59c). A well formed Motutapu greywacke preform from the Matatuahu site near Manuakau Harbour head in Tamaki, however, is longer at 251mm with a wider blade of 93mm and of similar weight - 1165gm (see Prickett 1987:8, Figure 10). The majority of Type 5 adzes are approximately 200mm in length, with weights approaching 1000gms, blades around 80mm wide and edge angles of 42 degrees (Table 3.5-3.9).

Shape

The cross-sections of the majority of side-hafted adzes observed in this study are triangular and relatively robust compared with the majority of Type 2 and Type 3 adzes. Almost all Type 5 adzes share with Type 3 rounded profiles (Table 3.13) including transverse convexity of the front and marked curvature of the blade (Table 3.14), features designed for trimming the concave inner surfaces of canoe hulls. The shape and curvature of blades and bevels may be the most significant functional features of side-hafted adzes. Several adzes listed as 5A on Moore, Keyes and Orchiston's (1979) list are rejected by Bonica as he states that the shape of the bevel and blade would not permit their use as side-hafted adzes (Bonica, pers.comm.), despite the presence of an asymmetrical tang. Yet an unusual pounamu adze from Waitaki River Mouth has a laterally reduced tang on both sides but with a blade and bevel so characteristic of a side-hafted adze that it would, in Bonica's opinion, be difficult to use in any other way (see Figure 4.13a).

All have triangular or sub-triangular chins but hollow-ground bevels are less common than for Type 3 and Type 1 adzes.

Hafting (Table 3.16).

Almost all Type 5 adzes have a laterally reduced tang on the side opposite the driving blade corner. Only the left-sided Tahanga basalt adze from the Whiritoa cache (Law 1982:55 - Figure 3.5) had no discernible tang. A secure hafting device would have been particularly important for
this type of adze given its placement on the haft foot. In functional experiments, Bonica hafted his side-hafted adzes onto a flat-soled foot with padding in the manner of his other adzes. No poll modification was seen on archaeological Type 5 adzes and very few had haft polish.

**Manufacture and Symmetry** (Table 3.17-3.19).

The majority of Type 5 adzes were well made and primarily shaped by low-angled trilateral flaking. Apart from the hammerdressing applied to form the lateral tang, very little hammerdressing was present. Similarly, grinding was often confined to the bevel area only. As such, Type 5 adzes were less of a challenge to manufacture, requiring considerably less time and effort than larger Type 1 and Type 2 forms.

One of the experimental 5A adzes was made from a flake blank which took less than half an hour to flake out and approximately five hours to hammerdress and grind. This adze was quite small, however (see functional experiment above), and flake blanks were rarely of the width and length for Type 5 adzes. Nevertheless, two of twenty-four Type 5 preforms were identified as deriving from flake blanks.

**Type 6**

**Task/Problem:** Gouging and chiselling - surface decoration (carving), grooving, lashing holes/perforation and grooves, shaping corners and apexes.

**Solution:** Type 6 Narrow bladed tools, curved cutting edge for gouging, straight cutting edge for chiselling.

**Action and Operation:** Variable as explained above.

**Functional Requirements:**
1. Size and hafting relative to size and type of task.
2. Small short deep-bodied gouges and chisels slotted into in-line hafts and hammer-driven with a mallet would need robust cross-sections and edge angles to withstand the impact of hammer blows for making lashing holes and deep grooves. They are likely to resemble Type 4 in design due to employment in similar tasks but on a much smaller scale. One difference would be the manner of
hafting. Mallet driven gouges were, from ethnographic examples, slotted into recessed handles, thus we might expect less butt modification and more poll modification or/and evidence of haft polish on the poll from rubbing against the haft.
3. Long slender gouges with very narrow blades for shaping corners, particularly in the inner recesses of a canoe hull.
4. Other small thin sectioned, lower angled forms would probably be adequate for surface detail and decoration, and were probably hafted in the normal manner.

**Conditions:**
1. Raw material Requirements: For mallet-driven gouges and chisels there is a need for particularly tough materials in order to withstand the considerable stresses imparted. For operations requiring a relatively high angle of attack (e.g., making lashing holes) blade corners are particularly vulnerable. One solution is to round off the corners completely so that no corner exists. Due to their vulnerability to breakage, long slender hogback gouges are likely to be made of tough materials. Hardness is also valuable for these precision tasks so we might expect a preference for highest quality materials.
2. Manufacturing Requirements: From replication experimental results and from observations in the archaeological record, the majority of small chisels and gouges were rarely primary forms rather the outcome of reworking larger primary forms like Type 4 or the slender hogback gouges. Reworking had a higher success rate and was a faster method of production than primary manufacture and was, thus, a viable method for producing these small forms. The nature of the hogback form also constrains its reworking flexibility so that little else but smaller gouges can result. This practise also freed adze-makers at quarries to concentrate their time and energy on the manufacture of large adzes that could not be produced from reworking. Also small flakes, often the by-products of adze manufacture and reworking, were suitable for thin-sectioned chisels and gouges.

**Skinner Type:** Type 6.
**Duff Type:** Type 6A, 4D.

Duff defines these as tangless gouges and chisels of circular cross-section (1977:190). The problems of classifying the group of small chisels and gouges has been discussed above. The
major functional criteria for classifying gouges and chisels should be whether they were hafted in line with the haft and used by striking the haft butt with a mallet, or hafted in the normal manner of adzes. Unfortunately because chisels and gouges are so rarely found hafted, and where there is an absence of use-wear on the polls of these gouges and chisels, the method of hafting can prove impossible to ascertain. Additionally Bonica has demonstrated that these adzes can be hafted in different ways depending on task requirements.

Discussion of Archaeological Data

Slender Hogback gouges (Figure 3.56).

Large primary slender hogback gouges were rare (see Table 4.3 and Figure 3.56a-d)) reflecting their specialized function and possibly their greater vulnerability to breakage compared to the more robust 4A which played an essential role in fast and effective wood reduction. They were, however, quite common in the Wairau Bar assemblage, mainly as preforms. Two unfinished and exceptionally long thin slender gouges were found in Burial 39, and are made from D'Urville Island argillite (one of these adzes was later stolen - Jim Eyles pers.comm.). They represent extreme examples of the type, both being over 350mm long, and very thin (30mm) and narrow (28mm maximum width) but weighing only 470gm (see Figure 3.61b), and are nothing short of miraculous in terms of technological achievement. The largest finished specimen was found at Waitaki River Mouth, North Otago, and is also of black D'Urville Island argillite (300mm long and 905gm weight). The disproportionate length to thickness of these adzes as well as the significantly lower edge angle identifies them as designed for far more delicate tasks than the sturdy heavy Type 4 forms, and make them ideal tools for use in tight corners. In other materials these slender gouges are smaller. The Whiritoa cache of Tahanga basalt adzes contains a typical Tahanga basalt example (Law 1982:55 - Figure 3.5). This cache of four adzes, comprising 4B, Type 3B, Type 5 adzes and the slender gouge, represents a canoe-hollowing out tool kit, possibly one stored away shortly after a sustained period of use judging by the chipped blades.

Almost all slender gouges were triangular, the exceptions being two rounded specimens, one of pounamu, the other of Motutapu greywacke. As well as being significantly narrower, thinner and lighter that the robust Type 4, these slender gouges had significantly lower edge angles (Table 3.5-3.9).
The high standard of flaking for the slender gouge form reflects the dominance of D'Urville Island argillite. These adzes are narrow and thin relative to length and thus would have entailed higher costs in manufacture and a much higher risk of transverse fracture than for the markedly more substantial 4A and 4B. Many of those observed had suffered breakage (for example, Figure 3.56f). Predictably the slender gouges used for gentler work have less well-defined tangs. Butt reduction would have been a particularly risky procedure with these forms.

Chisels and Gouges (Figure 4.23).

While a large number of chisels and gouges were recorded, only a very small number could conclusively be identified as mallet-driven (Duff 6A). These were characterised by rounded deep-bodied profiles, steep edge angles and a high frequency of rounded corner-less cutting edges (Figure 4.23g). A large number were broken reflecting the amount of stress placed on these gouges from the force imparted by the mallet.

As expected, high quality materials dominate this sample, though the number of Motutapu greywacke gouges is perhaps surprising in the North Island sample (Table 3.3). In the late period, mallet-driven gouges were most commonly rendered in pounamu (Duff 1977:192), the optimal material for this form. In this research, pounamu gouges were only included if there was good evidence associating them with an early period context, and these number 13. One was part of the Putere cache (Simcox collection now in the Hawke's Bay Museum) found with Nelson/Marlborough argillite adzes (see Appendix D). This cache was recovered from what Simcox has described as '...the most predominantly Moa-hunter site in Southern Hawke's Bay' (Simcox notes, collated by D.Millar 1993:7). The others were recovered from Wairau Bar (4) and Waitaki River Mouth (8).

Considerable variability characterises the remaining sample of gouges and chisels (see Figure 4.23). This predominantly reflects the blank forms from which they were derived. Over a quarter (26.7%) of the total sample were made on small waste flakes that were very thin and had low edge angles (see Figure 4.23s and t). They were particularly common among very narrow and straight bladed forms but their fragile nature makes it doubtful that they were ever mallet-driven and used for chiselling per se unless the force was applied very gently and carefully. An attempt by Bonica to use such an implement in this manner resulted in a transverse fracture in a short space of time. Nevertheless, these small flake adzes could be made very quickly and potential blanks could be
readily obtained from flakes produced from reworking adzes, thus they may have been more expendable than other adze forms.

The majority of chisels and gouges were more robust tools with equal width to thickness ratios, and were quite short and compact. Most gouges have been reworked from broken pieces of Type 4, occasionally Type 3 and possibly Type 5 adzes (see Figures 4.23c,f,j,l,m,n and v) while chisels are commonly reworked from the broken pieces of Type 1 and 2 adzes (see Figure 4.23a,d,e,g,o,p,u). There is also considerable variability in butt modification, from well defined (Figure 4.23e,j and p) to entirely absent (Figure 4.23,i, q and u). Those with an absence of butt modification usually had hammerdressed or ground polls. A range of hafting methods is therefore evident.

**Type 7**

The functional types of adzes listed above can all be described as fairly specialized tools in terms of the specific tasks they were designed to perform. It is possible that they were reserved for these tasks exclusively. However, small to medium tools were probably required for a range of more everyday chopping and trimming tasks like shaping posts and shafts and smaller wooden items like gardening implements, dishes, beaters and pounders. Most of these wood-working tasks were probably undertaken by adzes reworked from the broken pieces of large primary types outlined above. These adzes are classed here as **Type 7** and will be discussed in greater detail in Chapter Four which describes how adze form and function changes through cycles of use and reworking.

**Summary**

The primary functional types outlined above were standardized in terms of functional features such as length, thickness, blade width and edge angle as predicted from functional experiment results. Archaeological data were also consistent with predictions confirming that within functional parameters, variability in adze morphology and finish reflect solutions to different raw material and manufacturing problems. Drawing from considerable experience in studying Australian stone
hatchets as well as making and using them, Dickson states:

'Good workmanship is making an implement so that it will be well suited for its purpose without undue waste of effort...wide scope for variation and compromise...so many of the traits that can be distinguished and even measured have no meaning for the toolmaker...it is necessary to look for essential design features...those that determine the suitability of the tool for its intended purposes.' (1981:99).

Function dictated what features and dimensions were required but raw material and manufacturing techniques determined how these features were to be actualized. With the highest quality materials (flakeability, hardness, toughness) like D'Urville Island argillite, functional requirements could be optimized (for example, increases in length and blade width, lower edge angles and thickness) and design ideals realised. Lower quality materials had weaknesses that needed to be compensated for. Problems may have been related to functional qualities or to difficulties producing the form required. Weak but hard materials like Motutapu greywacke imposed limits on size. Tough but relatively soft materials like greywacke were likely to have narrower blades and more blade curvature to provide greater protection to blade corners. Materials like the Southland and Nelson/Marlborough river argillites were impressively hard and tough but lacked the fine flaking qualities to enable this use potential to be realised in optimal form using traditional techniques. Technological adjustments involving an increase in hammerdressing during the shaping process solved the problem. The Tahanga basalt adze-makers did not have this option and had to persist with the flaking technique. Where raw material qualities were extremely optimal, we see elaboration of design elements, for example, grooves, ridges and knobs with lime garnet hammerdressing, and marked angulation and length with high quality flaking materials. The East Polynesian immigrants brought with them an adze manufacturing technology based on the flaking of fine-grained tough materials. But adze makers in New Zealand were confronted with a much wider variety of raw materials than they had hitherto experienced, thereby providing them with a greater range of technological choices. The technology they were familiar with, however, influenced the choices that were initially made regarding raw material selection, and generally saw a continuation of the adze production strategies that had been practised in the home islands. Experience with new materials, however, including new manufacturing materials, may have seen quite rapid adjustments even though functional requirements may have remained the same. For example, a task requires excess removal of wood so a thick, heavy robust-angled adze with a
secure hafting device is needed. Standardized adze types such as quadrangular 1A, central East Polynesian 3A and Southland 1D would all fulfil these functional requirements, yet they exhibit considerable morphological variability. These morphological differences primarily reflect technological adaptations to raw material constraints.

The technological repertoire that developed in Southland, one that resulted in forms like Duff 1D and 1C, was responsive to two major factors, the generally variable flaking quality of the stone materials available and the presence of an extremely effective hammerdressing material - hydrogrossular garnet.

In Southland there was, therefore, a strong motivation to convert from a flaking technology to one based on hammerdressing, even for materials where the potential to flake adzes to shape existed. But flaking was not dismissed entirely from the repertoire. It was retained where it was effective and viable, for example, in the breaking up of large parent forms and in blank roughing out to remove excess material quickly. Southland may, thus, prove to be an example that documents quite rapid changes in adze technology from the time of initial settlement. The influence of the hammerdressing technology was evident on almost all the adzes made in Southland materials, including adzes from early stratigraphic contexts at sites like Waitaki River Mouth, Shag River Mouth, Pounawea and Papatowai. Indeed, it is possible that while adze-makers in the rest of the country were busily flaking their adzes to shape, the Southland artisans had already discovered the potential of lime garnet and were using it to advantage. The effectiveness of lime garnet is expressed by the degree of elaboration on Southland adzes, for example, deep tangs, chin ridges and large sized adzes.

In the Nelson/Marlborough area lime garnet was also present but the availability of exceptionally high flaking quality D'Urville Island argillite saw the continuation of the flaking technology and the results were some of the largest and most finely made adzes in Polynesia. Lime garnet was not ignored, however, but again used to best advantage to provide a secure hafting device. Later, as use of the D'Urville Island quarries declined, lime garnet provided a solution to the problem of working the very tough poor flaking, yet very accessible, river argillites. Also lime garnet was of such quality that 'Archaic' forms were able to be wrested from 'intractable' materials like pounamu (for example, Figures 3.52a and 3.53d).

Undoubtedly the variability exhibited among adzes from other Polynesian island groups may reflect similar differences in raw material quality, including the nature and quality of manufacturing tools like hammerstones. For example, in Hawai'i where the use of hammerdressing
was rare and flaking the primary shaping method, Type 1 adzes have characteristically angulated profiles with offset tangs and steep sides (see Figure 3.47b and Brigham 1902:Plate LVI). In contrast, in Central East Polynesian islands like the Societies, Cooks and Austral Islands where hammerdressing became the predominant method of shaping, features like raised chin and shoulder ridges, heavily reduced and well-defined tangs and hollow-ground bevels are common and often elaborately rendered (see Figure 3.47a for example). In his description of Southern Cook Island adzes, Duff makes frequent mention of hammerdressing as the method by which these features were created (1974:125-139). The distribution of lugged or 'horned' adzes also shows a strong correlation with island groups where hammerdressing was the primary shaping method (Duff 1974:125-130;1977:Figure 32:153). Another outcome of hammerdressing is the difficulty of achieving right angles so that adzes with the front notably wider than the back prevail. This was a feature of Southland adzes, and the emergence of the triangular Duff 3A form in central east Polynesia is probably not unrelated to the method by which they were manufactured. The often thick cross-sections, size and robust edge angles on these adzes suggest their suitability for performing tasks undertaken by quadrangular Type 1 adzes in New Zealand and Hawaii (see Figure 3.48a and Figueroa and Sanchez 1965:Figures 66,71; Duff 1977:173 - Figure 39 for illustrated examples).

We might, therefore, predict that in Central East Polynesia raw material suitable for making adzes was of limited flakability, was relatively soft and/or that the adze-makers in these islands possessed a superior hammerdressing material. Indeed, from geochemical analysis, Sheppard describes the basalt from the Cook Islands as being relatively soft due to a low silica content (pers.comm.).

In New Zealand, it might also be possible that the hammerdressing technology, which became the principle shaping technique throughout the country in the Classic period, developed in the South Island first. While Classic Maori artefacts from the South Island are generally considered as an intrusion from the North Island, at least one author has considered that the reverse might also be the case (Davidson 1993:251). Certainly it is likely that the Southland 1D adze was the first fully hammerdressed adze form made from coarse-grained stone to be developed in New Zealand. The advantages of marrying such a technique to this type of stone would have become well known throughout the country, though it may not necessarily have been adopted until changes in social or/and environmental circumstances prompted responses to new conditions and solutions to new problems. The flaking technology involved high costs and placed high constraints on raw
materials. As such it was probably very vulnerable to adverse changes such as the depletion of high quality material at source areas (which may have lead to critical increases in searching time), and disruptions in communication and distribution networks. The advantages of hammerdressing were low risk, low skill, and low waste of material; adze-makers need not be tied to long periods at quarries as required by the flaking technique. Additionally the hammerdressing technology allowed the use of previously under-utilized raw materials. Of major significance, the hammerdressing of coarse-grained tough materials was probably a much faster and more economic method of adze manufacture.

There are also indications in the data that raw materials and adze designs were matched to maximize the valued qualities of each in terms of functional performance. In the North Island, local rocks that lacked the toughness of Nelson/Marlborough argillite and Tahanga basalt could be pressed into service for Type 4 adzes, a robust design more resistant to breakage and damage than others. Motutapu greywacke was probably valued for its hardness, a quality important in producing a particularly sharp cutting edge for cleaning down and shaving wood, an action that does not require excessive force, and this may explain why Type 2 is the most common form rendered in Motutapu greywacke. The heavy work undertaken by Type 1 adzes required them to be made of particularly tough materials, and this provides a reason why they were so scarce among Motutapu greywacke adzes, yet very common among adzes of Tahanga basalt and Nelson/Marlborough and Southland argillite.

The criteria employed by Duff to define his types were the presence/absence of a tang and the shape of the cross-section. The results above suggest that while these criteria may be related to the functioning of the adze in general they do not define different functional types. Rather, again, both features reflect more the nature of the raw material and the manufacturing tools available.

The decision to modify the adze butt rather than the wooden helve to aid hafting security appears to have developed in East Polynesia, hence the importance Duff attached to it (Green 1971; Duff 1977). The finding of this thesis, that tangs are most commonly present on large adzes, may be more significant for understanding what motivated such a development. For in East Polynesia, adzes also became larger and longer (Leach 1993), possibly as a consequence of achieving higher levels of flaking skill and due to the availability of higher quality raw materials (e.g., the Mauna Kea quarry in Hawaii and the Tautuma quarry on Pitcairn). Butt modification may, therefore, have developed in response to the hafting difficulties posed by large adzes, and higher quality materials and increased flaking skill would have facilitated such a development.
The flaking technique and the tang feature were well developed by the time the East Polynesians colonised New Zealand, as was the trend toward large adzes. The tang feature retained its importance to scholars of New Zealand prehistory because, by the late period, tangs had all but
Figure 3.60: Tahanga Basalt Adzes from Tauranga Harbour Mouth.
Figure 3.61: Adzes from Wairau Bar.
Figure 3.62: Adzes from Waitaki River Mouth.
Figure 3.63: Adzes from Waitaki River Mouth.
disappeared; the role of providing hafting security having been transferred to the wooden helve. It was probably not a coincidence that adzes also decreased in size. Notably, distinctive Classic period forms that did retain tangs, for example, Hawke’s Bay adzes, were also large heavy quadrangular Type 1 forms.

Thus butt modification is not directly linked to specific task requirements. Rather, where a task requires the use of a large adze, it is more likely to be tanged. As demonstrated in the data above, the type of tang and the degree of modification was generally guided by the nature of the adze materials and the tools used to shape them.

The shape of the cross-section is also of secondary importance. Of primary significance is the thickness of the section relative to length and blade width. The shape of the cross-section is influenced more by raw material quality and manufacturing techniques than it is by function. Thus the Central East Polynesian triangular-sectioned 3A adze probably performed the same sorts of tasks as the quadrangular-sectioned adzes in Hawaii and New Zealand despite the difference in cross-section shape. Similarly very narrow quadrangular forms could fulfil the same functional role as Type 4 if thickness to width ratios and edge angles were comparable. The profiles showing the thickness and edge angles on a variety of four-sided Hawaiian adzes (Brigham 1902:408, Figure 74) demonstrate a range of edge angles from very robust (at least 60 degrees) to very low (less than 40 degrees). Low edge angles are also matched consistently to thin rectangular cross-sections, as are thick quadrangular cross-sections to robust edge angles. Notably the largest adze thus far recovered from Hawaii (555mm long) is a thin rectangular low edge-angled Type 2 form (Brigham 1902:Plate LVII). Central East Polynesian triangular-sectioned adzes show similar variability in thickness and edge angle with a consistent correlation between the thickness of the cross-section and the degree of edge angle (see Duff 1974:129-135,Figures 62-67; Figueroa and Sanchez 1965:Figures 65-71). The focus on adze standardization as reflected by cross-section shape has drawn attention away from the variability evident in functionally significant features. This has caused some problems for scholars who feel that changes in function must have accompanied changes from the variable 'Archaic' adze-kit to the simplified Classic 2B adze-kit (Best 1975,1977), or otherwise assert that different adze forms or 'types' do not represent different functional forms (H. Leach 1981:168). Certainly the Type 5 adze is absent from the tool-kit in later times and a change in canoe hull design may well be the reason (Best 1975,1977; Moore, Keyes and Orchiston 1979). But replacements for adze forms like Type 4 and Type 3 remain unclarified, yet, judging from Classic period wooden artefacts, such adzes would still have been needed.
However it is likely that among the numerous tangless, four-sided adzes classified as 2B, considerable variability in size, blade width and curvature, cross-section thickness and edge angle will be found that may well reflect the functional range of tools defined for the early period. Nor should we forget that a number of functional features seen on the stone blade in the early period were transferred to the wooden haft in the later period, for example, the hafting attachment. A composite haft would also provide significant length and weight to the stone piece. Thus much of the variability seen on the stone adze component in the early period may have later been transferred to the wooden component which rarely survives in the archaeological record. Archaeologists have been concentrating on the wrong attributes for answers to major questions concerning adze morphology and variability, particularly in regard to how adzes functioned.

The implications of these results suggest that using adze types to trace ancestral connections and culture-historical relationships, as Skinner and Duff attempted to do, are unlikely to be successful. Polynesian island groups shared an ancestral technological repertoire but this was very sensitive to new conditions especially to the qualities of the raw materials available. The evident differences in adze morphology between Polynesian island groups closely related in time probably reflects rapid adjustments to raw material quality and availability.

There is also no need to require cultural isolation for differences to develop. We need only to look at the differences in New Zealand adzes owned by people obviously in close contact, for example, Southland and Nelson/Marlborough groups. At the Waitaki River Mouth site which is centrally located between these two regions, adzes rendered in Nelson/Marlborough argillite and Southland materials were present in similar frequencies. The morphological distinctions evident in adzes imported from these regions reflected the different raw materials they were made of (see Figure 3.62 and 3.63 for adzes from Waitaki River Mouth) and the different techniques employed to make them. This may also explain morphological similarities between adze assemblages of different materials from sites hundreds of kilometres apart. For example, the Tahanga basalt adze assemblage from Bowentown at the mouth of the Tauranga harbour in the North Island (Figure 3.60) has close parallels to the Wairau Bar assemblage from the South Island which is composed mainly of D'Urville Island argillite adzes (Figure 3.61). Both assemblages contain adzes shaped predominantly by flaking and where hammerdressing was generally limited to butt modification. One notable difference is the smaller size of the Tahanga basalt adzes reflecting the superior flaking quality of D'Urville Island argillite. In contrast, the relative dearth of hammerdressing on Northern North Island primary adzes compared to their Southland counterparts produces marked
morphological differences. Functional features were consistent, however, and the Southland 1D adze and the Tahanga basalt back-wider-than-front Type 1 adze would have performed the same sorts of tasks; the differences in form can only be explained by raw material variability and the properties of manufacturing tools.

Adzes were primarily designed to fulfil utilitarian roles. Stylistic considerations were secondary. Adze-makers were only likely to persist in making adzes in the old way if the technological system continued to work and costs stayed within manageable limits. With tool efficiency and reliability as major goals, they would also have been motivated to making improvements in the management of costs, be it by improving design, by finding a faster, safer more economic method of manufacture and/or by using a better material. It is likely that similarities in adze design and finish between Polynesian island groups will suggest a similarity in raw material quality; a close cultural relationship need not be evoked to explain this phenomena. For example, Janet Davidson has noted a close resemblance between Pitcairn adzes and those from Wairau Bar (1984:95,96). Pitcairn adzes like the finely flaked Type 3 adze in Figure 3.41a suggest a stone with the superior flaking quality and toughness of D'Urville Island argillite.

Raw material quality also ultimately dictates manufacturing techniques. Understanding how raw materials operated in use and during manufacture, therefore, provides the means by which to account for much of the observed variability in Polynesian adze design.

Given these findings, and the emergence of raw material as a primary factor in explaining adze morphology, we also need not evoke the rise of high-status specialists and high-ranking consumers to explain the event of major quarries and mega-adzes, nor to give this event the significance it has hitherto been assigned (Leach 1993:41). Major quarries were major due to an abundance of high quality flakeable raw material. Adze size, standardization and distributional range reflect the benefits in manufacture and use of these high quality materials in which design ideals could be optimized.

Nor is the argument that the use of these major quarries began as a single significant event throughout Polynesia conclusive (Leach 1993:40, Table 4.4) with dates for the beginning of major quarry use available for only two tropical Polynesian quarries, Mauna Kea in Hawaii and Tataga-Matau in Samoa.

Additionally, there is not the need to resort to explanations wherein large adzes developed as 'symbols of a community specialization' or '...constituted a new and desirable fashion' or were the exclusive property of high-ranking, high-status individuals or families (Leach 1993:41).
Undoubtedly they were valuable and expensive but this should not be stressed at the risk of ignoring the most fundamental aspect of an adze - that they were tools, that they were designed as solutions to wood working problems, and that with high quality materials these problems could be solved with maximum benefit. Functional experiments have shown that large adzes would have reduced the time and effort involved in large wood-working projects (like canoe building) to a significant degree. Increasing or maximizing size can be considered as having important functional benefits and in possibly allowing wooden items to be built on a grander and more innovative scale. People were apparently prepared to go to extra efforts to obtain these materials and the adzes made from them.

Status and mana would more likely result from the special wood-working abilities of adzes made of high quality raw materials like D'Urville Island argillite. Southland 1D adzes would surely comply with Leach's criteria identifying adzes from important major quarries - very large, standardized and with design extras like elaborately rendered tangs and chins - and could readily qualify as ceremonial high-status adzes. The same could be said of the elaborately hammerdressed Central Polynesian 3A adzes, but in both cases, there is no known association with major quarries. The reason for this is that they reflect a different technology which produced little in the way of by-products, unlike flaking where huge amounts, from replication experimental evidence, ofdebitage can be generated in a very short space of time. It is not the 'major quarry' that is significant but the plentiful supply of high quality raw materials at these quarries.

While some were side-lined as burial goods, and some may have attained 'ceremonial' or heirloom status over time, many of the largest adzes recorded in New Zealand, for example the broken and modified Grovetown adze and the damaged Patea adze, both over 500mm long and over 5000gms in weight, had most definitely been used, and with a vigour that goes beyond ceremonial and ritual use.

Herein lies another explanation for the variability in adze morphology, the observation that only a small percentage of the total number of adzes examined in this research were in original or primary condition (Table 3.2). From this small sample, the influences on primary adze design have been discerned but the majority of adzes have seen considerable use, modification and reworking. Major changes in adze morphology were the outcome, especially after an adze had suffered transverse fracture and the pieces were subsequently reworked. Once this had occurred it was unlikely that adzes could be used in the tasks they were originally intended for. Critical loss of length, weight, blade width and edge angle were problems that would have constrained use options. A problem
with existing typologies is that they treat all adzes as being in primary condition, as original designs. Yet it is possible that some adze types were solely the outcome of reworking. Some design elements like flaring blades on wide bladed adzes may have served not only to improve adze performance but also to facilitate repair of blade corner damage. Likewise, maximising length may have served to extend use-life.

Manufacturing methods and raw material quality may continue to be influential during the use-life of adzes. Flaking allows for effective and quick rejuvenation and reshaping but has the disadvantage of being wasteful. With length and blade width already critical on broken pieces, more conservative reshaping methods may have been desirable. Adzes made of high quality imported raw materials might have had higher rates of curation, and a greater range of reshaping options might have existed for adzes made of highly flakeable raw materials. As a result of being tougher and harder, adzes of D'Urville Island argillite, for example, may have had longer use lifes and retained their original form and function for longer. This would have further increased their value.

What happened to adzes as they proceeded through use-life stages, and the degree of curation they experienced, is the subject of the next chapter.
Table 3.2: Functional Adze Type Frequencies for South and North Island

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Table 3.3: Functional Type by Stone Type for North Island Adzes

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<th>% Tahanga Basalt</th>
<th>% D'Urville Is Argillite</th>
<th>% Nelson/Marl Argillite</th>
<th>% Motutapu Greywacke</th>
<th>% Northland Basalt</th>
<th>% Waikato Basalt</th>
<th>% Taranaki Argillite</th>
<th>% Silicified Limestone</th>
<th>% Other</th>
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<td>1.6</td>
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Note: Includes Finished Adzes only (excludes preforms and expedient flake adzes).
Table 3.4: Functional Type by Stone Type for South Island Adzes

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<th>D'Urville Is Argillite</th>
<th>Nelson/Marl Argillite</th>
<th>Southland Argillite</th>
<th>Basalt + Volcanic</th>
<th>Pounamu</th>
<th>Greywacke</th>
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Note: Includes Finished Adzes only (excludes preforms and expedient flake adzes).
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<th>Standard Deviation</th>
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<th>Range mm</th>
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* well formed preforms have been added to increase the otherwise small samp
# includes D*Urville Island sources
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<th>Mean mm</th>
<th>Standard Deviation</th>
<th>Standard Error</th>
<th>Range mm</th>
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*well formed preforms have been added to increase small primary samples
# includes maximum width for Type 4 and Type 6
Table 3.7: Maximum Thickness for Primary Adzes\* by Functional and Stone Type

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\*well formed preforms have been added to increase small primary samples
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*well formed preforms have been added to increase small primary samples
Table 3.12: Blade Width relative to Body Width

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Note: Preforms included are well-formed and close to completion.
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Table 3.14: Blade Curvature for Primary Adzes

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Table 3.15: Chins and Hollow-ground Bevels for Primary Adzes

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* Angular chins = chins created by angulation
### Table 3.16: Butt Modification for Primary Adzes

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228
Table 3.18: Hammerdressing for Primary Adzes

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## Table 3.19: Grinding for Primary Adzes

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* Reflects Wairau dominance of sample
CHAPTER FOUR: USE-LIFE.

Introduction

As outlined in Chapter One, a characteristic of curated technologies was the maximization of tool use-life. Instead of being discarded when they broke or were damaged, tools were repaired or modified to render them useful again.

In many published reports concerning New Zealand adze assemblages (for example, Barber 1994:380; Challis 1976:480-81; Prickett 1987; Walls 1979:12) there is frequent mention of adzes with the appearance of having been reworked. Even Duff recognised that one of the two Type 2B adzes he identified at Wairau was the '...refashioned blade portion of a large adze, probably a 1A originally, from which the original tanged butt had been broken away' (1977:167).

In his notes Simcox describes with interest the numbers of adzes found in the extensive dune sites of Southern Hawkes Bay and Northern Wairarapa that had the appearance of being reworked from the broken pieces of much larger adzes. His drawings show attempts to reconstruct from these smaller reworked adzes the types of adzes they had originally derived from (Simcox notes collated by D. Millar, 1993). It is regrettable that his findings were not brought to the attention of archaeologists sooner for the influence of re-fashioning on adze morphology has been virtually ignored and was not acknowledged by Duff when he formulated his typology. This in part reflects a general disregard for the adze as a tool.

We could expect that, as a consequence of repair and reworking, many adzes would undergo significant morphological change during their use-life. We might also expect that major changes in form and size would have as an outcome changes in function, value and the contexts in which adzes are found. Thus, for archaeologists, identifying the state of an adze when it entered the archaeological record is of fundamental importance. Existing adze typologies (e.g., Duff 1977) designed them. As a consequence, existing typologies fail to differentiate between adzes with significantly different histories.

'State' therefore describes the use-life stage of an adze when it entered the archaeological
record. The adze states are presented below in a hypothetical chronological sequence; what Shott has referred to as '...a trajectory of increasing curation' (1989:24) and what Nelson has described as a process of 'sequential reduction' (Nelson 1991:70). This may have often, in reality, been disrupted by both deliberate and accidental processes. Indeed some of these states capture this disruption; for example, when the reshaping of broken preforms and adzes failed and the pieces were discarded.

This typology, based on the use-life state of adzes when they entered the archaeological record, was first formally introduced at the 1994 New Zealand Archaeological Association Conference held in Whangarei (Turner n.da). Since then it has proved effective in explaining the variability evident in the Shag River Mouth adze assemblage (Smith and Leach 1996). I would, however, question Smith and Leach's classification of many of the Shag River Mouth adzes as primary as many of their illustrations show 'primary' adzes that appear to have received considerable modification and reworking.

In order to compare frequencies of different adze 'states' only the North Island adze sample is generally considered in this Chapter. For the South Island adzes, a complete sample was examined only for Rotokura, Wairau Bar and Waitaki River Mouth which are included for purposes of comparison with the North Island sample.

**Adze States**

The different states of unfinished and finished adzes are described below.

**Unfinished Adzes**  N = 2316 (Table 4.1).

The presence, state and frequency of preforms in a site/area/region is important for defining who was involved in adze production and who was possibly controlling adze distribution. Analysis of Tahanga basalt flake assemblages (Turner and Bonica, 1994) demonstrated that only the people of the east coast Coromandel had direct access to the Tahanga basalt quarry. However, flakes were seldom considered of any value to collectors and it has only been in recent years that excavated samples have been retained. Flake samples, therefore, may be biased. Preforms, including small flake preforms, in contrast, were more likely to be collected and
retained. Additionally they may provide evidence on whether adzes were fully finished before being gifted, exchanged or traded. From previous research (Turner and Bonica 1994:25), it was predicted that Tahanga basalt preforms were unlikely to be distributed to others outside the area until the flaking stage was completed. This is due largely to the high risk of breakage that the whole flaking process entails. In the absence of flake samples, the presence, state and frequency of preforms in an area has the potential to inform on the degree to which areas were or were not involved in adze production, and may be valuable in defining the extent of adze production areas.

**Roughout (RO) N = 62.**

A 'roughout' describes an adze at an early stage of manufacture where little or no fine trimming is evident. As defined for the adze manufacturing sequence of Tahanga basalt adzes:

>'The term Roughout refers to the blank that has been modified, but where final form is undefined and shaping judged to be rough and without refinement. The cross-section is usually indefinite, often but not always, the bevel is unformed and there is generally only one or two sides flaked.' (Turner 1992:70).

From analysis of flake assemblages and preforms at the Tahanga quarry itself and from the east coast Coromandel sites involved in Tahanga basalt adze production (Turner and Bonica 1994), it was demonstrated that adzes were rarely removed from the quarry until after the roughing out process had been successfully completed.

Roughouts and preforms found at quarries were excluded from the present research as they were the focus of a previous study (Turner 1992). Thus it is not surprising that very few roughouts were recorded from sites beyond the source. The majority were found at T10/940, a secondary production site on a ridge above Opito Bay at the base of the Tahanga quarry where the fine trimming of large Type 1 preforms was the predominant activity (Turner 1992:122). The remainder mainly came from Motutapu Island, the major source area of Motutapu greywacke, from sites close by at Sunde (R10/25) and Pig Bay (R10/22). Similar to T10/940 at Opito, these roughouts were in the minority in an assemblage that consisted mainly of preforms at an advanced stage of flaking. A number were also derived from the Te Horea middens at the Raglan harbour mouth suggesting that sources of local basalt were close, possibly found in the streams.
and rivers that open out onto the coast (many of which have been infilled and altered by encroaching sand dune movement) and drain into the harbour.

**Rough Preform (RPF) N = 1003.**

'A preform is an unfinished adze where shape, cross-section and final size are well defined. The bevel is usually roughly formed, but not necessarily the tang which may not take shape until after hammerdressing.' (Turner 1992:72).

Rough preforms describe those at a late stage of manufacture where shaping is not finished and where further flaking is generally required. Given the evidence outlined in Chapter Two from the east coast Coromandel which suggested that only local people had access to the Tahanga quarry and were involved in adze production, and that it was unlikely that adzes would be distributed prior to the completion of the risky flaking stage, rough preforms are particularly valuable for defining production areas. This data is considered in Chapter Five and Six.

**Primary Preform (PPF) N = 712.**

These are well formed primary preforms where the flaking stage is complete, or, in the case of broken specimens, close to completion. The final and intended form is clearly defined. Hammerdressing is occasionally present.

**Reworked Preform (RWPF) N = 539.**

Reworked preforms are broken pieces where attempts to reshape them into smaller preforms have failed, either due to flaking problems or another transverse fracture. The reworking process produced a distinctive set of flakes, and identification and analysis of these in the east coast Coromandel adze production sites demonstrated that reworking of broken preforms was a common practice (Turner and Bonica, 1994). Reworking also produces distinctive preforms though what remains at sites are those where the reworking attempt failed. Previous analysts of the adze assemblages from the numerous east coast Coromandel midden sites noticed how small preforms were compared to those found at the Tahanga quarry (Jolly and Green 1962:42; Davidson 1975a:36; Boileau 1980:85) where the mean length was 180mm (Turner 1992:134).
Examination of both reworked preforms and forms reworked from broken finished adzes in the archaeological sample prompted a series of reworking replication experiments with broken preform pieces and a few near finished adzes that had broken during hammerdressing (see Turner 1992:266-268 for the reworking of a broken Motutapu Greywacke Type 1 adze). Reworking proved to have a much higher success rate than primary manufacture, and was faster and easier to accomplish (Turner and Bonica 1994). The only serious limitation was the size of the resulting adze. From the broken sections of very large Type 1 and Type 2 adzes (over 300mm length), medium sized adzes could be reworked and this may have been an additional advantage with the very long adzes common in D'Urville Island argillite, but for most other raw materials smaller adzes would result (see Figures 4.1 and 2 for experimental reworked adzes).

The strategy of reworking enabled adze-makers at the quarry to do two things:

1. Concentrate on the more challenging task of making large adzes.
2. Remove large viable preforms before the most risky and time-consuming stage of fine flaking in order to maximize the number of large blanks that could be made and roughed out.

In this way time and effort were managed efficiently toward producing the range of medium and large adzes required.

Small Scrappy Flake Adze and Preform Group (SFG)  \(N = 1587\).

Another benefit of completing preform flaking and reworking broken preforms and adzes at domestic residences was the provision of a large number of small flake blanks that could be opportunistically employed for a variety of uses. These included the use of unmodified flake edges as scrapers, cutters and saws, modification into a range of points including drill-points and awls, and the manufacture of small delicate adzes, chisels and gouges. Like reject adzes and preforms from failed reworking attempts they are commonly found in early midden or working floor contexts (personal observation), and are the only example of an expedient or opportunistic technology seen in relation to adzes. That is, they are manufactured quickly in a matter of minutes when required, used and then discarded - very probably in an uninterrupted sequence, and in the same context. A thin suitably shaped flake can be selected from a pile of waste flakes then the sides are either snapped off or bifacially or unifacially flaked. Usually grinding is
limited to the blade edge but sometimes high spots like the bulb of percussion are ground flat so that the adze fits more securely in the haft. Dante Bonica has experimented with these small (rarely over 10cm in length) and somewhat fragile adzes (see Figure 4.19k,n,u,v for archaeological examples and Figure 4.1 and 4.2 for experimental examples) and found them effective in removing ridges on wood left by larger adzes, and in the shaping of a variety of small wooden items, particularly those requiring delicate and intricate work (notching, for example). The presence of these adzes, therefore, may indicate that wood working was occurring at the site, whereas the curated status of the other adze forms may mean they would generally be removed from working areas and stored somewhere safe and secure.

Another significant aspect of this group of adzes is that they provide evidence of adze manufacture and reworking in an assemblage or area where flakes have not been collected. For this purpose, this group of adzes can be further divided into the following categories:

*S Small Flake Preforms (SFPF) N = 555.*
Small flake preforms made from the waste flakes from secondary adze manufacture. Generally they have been discarded due to transverse fracture before they could be finished and used.

*S Small Flakes from waste flakes (SFW) N = 465.*
The same as above except these specimens have been finished (ground) and used.

*S Small Flake adzes (SFA) N = 567.*
Small flake adzes made from flakes resulting from the reworking of broken adzes. As such, they often retain some of the original ground surface. The difference between these and reworked adzes is that reworked adzes are derived from the 'core' of a broken adze while small flake adzes are derived from flakes resulting from the reworking process.

**Finished Adzes** N = 7203.

**Primary Adzes** N = 644 (8.9% of finished adze total).

These are adzes that have seen minor or no observable use. When Duff formulated his
typology (1950) what he was really describing was a set of primary adzes. The majority of his type specimens were drawn from the rich and early Wairau Bar assemblage, many as burial offerings along with primary preforms. The majority of the burial adzes had seen little or no use (see Table 4.1), and therefore provided rare contextual evidence of highly valued and desired adze forms. Moreover, the large size of the burial sample provided evidence for the standardized nature of these forms or 'types'. Other primary adzes and preforms were found as caches in the habitation area (Jim Eyles pers.comm. and notes). These adzes were the focus of Chapter Three where it was demonstrated that they were also standardized designs with specific functions, and when adze-makers made visits to the quarries, it was these functional types that they were intent on producing.

Given the time and effort invested in the manufacture of these adzes, and their value as wood working tools, it is highly unlikely that such adzes would have ever been deliberately discarded while in operational condition. There is little evidence of this in the archaeological record. Thus primary adzes probably entered the archaeological record under exceptional and unusual circumstances such as burials and as 'caches'.

Finds of adze caches usually comprise primary adzes also (see Appendix D for a list of recorded caches and their details, Figure 4.3 and Table 4.1). These probably represent stores of valuables that, through quirks of fate (like their owner dying suddenly), were never recovered (Kornfield, Akoshima and Frison 1990). A number of caches have been found buried adjacent to fireplaces and hearths indicating domestic residences (Shag River Mouth- Skinner 1924b, Waitaki River Mouth - Anderson 1989, Wairau Bar- Duff 1977, Jim Eyles pers.comm., Tumbledown Bay - Brian Allingham pers.comm.).

A few may have been sidelined as heirlooms, but most 'ceremonial' adzes may have acquired their special status through association with ancestors and special wood working projects rather than being made specifically to fulfil essentially non-utilitarian functions. In Tikopia toki tapu or ritual adzes were:

'...prime canoe-building tools...one can presumably link their sacredness in part with the fact that only clams of exceptional size could provide a working blade of the length and thickness required. The elaborate ritual surrounding these adzes may then also be regarded as an enactment at symbolic level of the technological and social value of these crucial implements.' (Firth 1959a:150).
Table 4.1a: State

<table>
<thead>
<tr>
<th>State</th>
<th>All Data Sets</th>
<th>North Island</th>
<th>Wairau Bar</th>
<th>Waitaki</th>
<th>Rotokura Burials</th>
<th>Wairau Caches</th>
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Finished only 7203 6414 250 452 87 36 19 160
Total 11146 9711 619 560 256 90 59 296

* 50 Caches recorded - 16 North Island, 34 South Island (see Appendix D).

Table 4.1b: State Frequencies for Finished Adzes

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<thead>
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<th>State</th>
<th>% All Data Sets</th>
<th>% North Island</th>
<th>% Wairau Bar</th>
<th>% Waitaki</th>
<th>% Rotokura Burials</th>
<th>% Wairau Caches</th>
<th>% All Caches</th>
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* includes Type 7, scrappy flake adzes, rough ill-defined preforms
Table 4.3: State by Functional Type for North Island Adzes

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<th>Repair</th>
<th>%</th>
<th>Modif</th>
<th>%</th>
<th>Fail</th>
<th>%</th>
<th>Rework</th>
<th>%</th>
<th>Unident</th>
<th>%</th>
<th>N=</th>
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<td>3083</td>
<td>48.1</td>
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*Mainly Motutapu greywacke and Taranaki argillite pebble 2B adzes
In Chapter Three it was seen that two of the largest adzes yet found in New Zealand, from Patea and Grovetown, had evidence of extensive use. Additionally two large and finely formed D'Urville Island argillite Type 2 adzes found in the Far North region have decorative notching up both sides. One has bad blade damage under repair by hammerdressing, the other had suffered a bad chip to one blade corner which had been subsequently but not perfectly repaired (Figure 4.4). These adzes are exceptionally qualified for the classification of 'ceremonial adze' yet all have suffered damage that could have only come about from extensive and rigorous use. It is possible that as adzes of this quality became increasingly more difficult to obtain, the use of those already in possession may have become progressively constrained to the extent that such use finally approximated the 'ritual removal of the first chip' (E.Best 1974).

The introduction of European tools may have further reduced the actual work undertaken by ceremonial adzes or toki tapu. It was only after European arrival that Tikopian toki tapu were assigned more ritualistic roles: 'In former times it was used as an actual working implement...' indicating that originally working and ceremonial adzes were usually one and the same (Firth 1959a:152,159). Their ceremonial status was related to the special tasks they performed like the building of canoes.

Primary adzes made up only 8.9% of the finished adze sample but 1.7% were broken (Table 4.1). This is consistent with the expectation that such adzes would enter the archaeological record in this state only under unusual circumstances. The higher frequency of primary adzes at Wairau Bar (19.2% of the finished sample) is an illustration of this (Table 4.1). Adzes were found in 21 of the 44 burials uncovered at Wairau, and at least nine separate caches of adzes were recovered from the habitation area. These were often located close to hearths associated with house structures (Jim Eyles field notes and pers.comm., R.Duff 1977 and field notes). While adzes from caches and burials made up 24% of the total of adzes from Wairau, almost three quarters of the adze sample of complete primary adzes came from these contexts - contexts where primary adzes are most likely to be recovered. The context of the other primary adzes at Wairau is unknown, having been collected after disturbance by ploughing or occasionally unearthed from spoil heaps (Jim Eyles pers.comm.), thus they too may have come from burials or more probably from stored caches inside houses. It is notable also that all the large tanged Type 2 adzes were found either as burial goods or in caches, as were the majority of unbroken Type 1 adzes and the two finished Type 5 adzes (Table 4.2). A similar pattern is observable for complete and well formed primary preforms (Table 4.1).
There has been a regrettable tendency in the literature to follow Duff's lead by classifying all Wairau adzes not found in burials as coming from the 'area of midden refuse' (Park 1972:96) and attempting to draw significant conclusions from this contextual distinction (Park 1972; Simmons 1973). But the distinction between adzes found with burials and those found in the 'midden area' need not be attributed to temporal differences (Park 1972:96,97; Simmons 1973:25). Rather the 'midden' area reflects the greater range of contexts in which adzes were found. The high frequency of broken preforms, expendable small flake adzes and failed rework attempts in the general Wairau Bar adze assemblage indicates working floor contexts while the caches suggest association with domestic residences.

In contrast, no complete primary adzes were observed in the Rotokura assemblage and the majority of adzes and preforms were broken (see Table 4.1). While Barber finds '...this apparent dearth of completed adze forms...' curious and invokes improbable scavenging theories to explain this phenomena (1994:382,390), valuables like completed adzes are hardly likely to be found in working floors and rubbish dumps. The adze sample from Rotokura reflects this working floor context and consists mainly of broken and failed adze and preform reworking attempts and opportunistically fashioned and discarded small adzes made from waste flakes. One exception was a cache of two Type 1 preforms that were in need of further flaking and may have been cached at the working floor with the intention of finishing them at a later date.

From the functional experiments outlined in Chapter Three, primary adzes emerge as being quite specialized tools. Some may have been used more than others, but forms like Type 3, Type 5, and large Type 1 and Type 2 adzes in particular may only have been used for special projects such as canoe building. They were probably considered too valuable for everyday use. From manufacturing experiments and observations made of flakes and preforms from secondary production sites in domestic residences close to the Tahanga quarry (Turner and Bonica 1994), it was demonstrated that small and medium sized adzes were made available by reworking the broken pieces of larger preforms and adzes. The provisioning of large adzes, however, required a much greater effort. All the adzes employed in the kumete project could not have been manufactured from broken pieces, even though a dearth of raw material provided a strong motivation to attempt to do so. This is partly the reason why constructing the tool kit for the project was so prolonged. Additionally these large and specialized forms are very difficult to make demanding high quality unflawed
Figure 4.5: Repaired and Modified Type 1 Adzes.
Figure 4.1: Experimental Reworked Adzes and Preforms.
Figure 4.3 – Top: Whiritoa Cache 2.
Figure 4.4 – Bottom: Notched Far North Adzes with Well-used and Damaged Blades.
homogenous material and suitable blank shapes. Even when these criteria are satisfied, frequency of transverse fracture is high and their manufacture entails much waste of raw material (Turner 1992; Turner and Bonica 1994). The cost of acquiring these primary adzes, be it through direct access and manufacture at the source, or via trade and exchange, was probably, therefore, considerable. The impetus to preserve these adzes in their primary state was a likely response to this situation. To squander these adzes on tasks they were not absolutely required for was probably not a common practice. A similar observation was made by Phillips in the New Guinea Highlands where certain axes were reserved ‘...for the job only it would do.’ (1979:111). Mundane tasks like making posts and fences and cutting down small trees was probably relegated to less valuable reworked and modified adzes. Primary adzes were, thus, likely to spend extended periods in storage, more so than reworked adzes.

The composition of adze caches found to date tend to support this scenario (see Table 4.1) as 64.2% of adzes found in caches were primary adzes or preforms. The prominence of unfinished primary forms in adze caches also reveals that their manufacture was a protracted process, one that probably took place over a long period of time and in different places. Bonica has similar caches, stored as reserves to be finished when required. In the past, they may also have been a reserve for gifting and exchange purposes. Reworked adzes that had been successfully reflaked but not reground were found in several caches suggesting that major repair and remodelling was also completed in stages rather than on a single occasion.

From their informants among the Duna of the Papua New Guinea Highlands, White and Modjeska (1978a) discovered that the deaths of their owners also resulted in axes spending considerable time in storage. On the occasion of their owner's demise, axes were usually passed down to sons. Frequently, however, sons were too young to assume this responsibility and they therefore remained in storage in the safekeeping of their mothers who would hand them over to their sons when they came of age. This could take up to fifteen years during which the axes were never used (White and Modjeska 1978a:280). This provides another dimension to the significance of storage extending the use-lives of adzes.

All but 1% of primary adzes were able to be identified according to the functional typology introduced in Chapter Three (Table 4.3). Only six adzes presented difficulties, generally by having steep edge angles matched to fine cross-sections or low angled bevels with a thick cross-section. Repair and modification did not appear to account for these differences. Primary adzes were significantly longer, heavier and thicker than all subsequent use-life states and wide-bladed primary forms had significantly wider blades. The features and dimensions of
primary adzes have already been outlined in Chapter Three and are summarized in Tables 4.4-4.15.

**Repaired Adzes**  N = 628 (8.7% of all finished adzes).

The original form is still apparent but these adzes have seen episodes of major bevel and blade repair. This generally manifests as a narrowing of sides in the blade/bevel area and some reduction of adze length (see Figure 4.5a) but no marked changes in functional features (for example, edge angle). At this stage they would still be able to perform the tasks they were originally designed for.

Nevertheless, repaired adzes were significantly shorter, thinner and lighter with narrower blades than primary adzes. There was, however, no difference in edge angle (Tables 4.4-4.8). This data suggests that even without major damage and breakage (like blade snapping and transverse fracture), significant changes were brought about through regular maintenance and repair.

At this point the common forms of blade damage can be examined as these were the major cause of repair and may have influenced repair strategies.

**Forms of Blade damage (Table 4.9 and 4.10)**

The majority of finished adzes had undamaged blades and these were mostly symmetrical even among reworked adzes (Table 4.10). Very few had not seen any discernible use, however. Only 1.5% of the finished adze sample had blades that appeared never to have been repaired or to have experienced extensive use. Even among primary adzes most blades had seen some use and minor repair. If the experimental results are an indication, most primary adzes had probably already seen considerable use before they entered the archaeological record.

Over a third of the finished adze sample had blades that were damaged or had been repaired unsuccessfully or incompletely (Table 4.9). Among those damaged but not repaired, blade corner damage was predominant (see Figure 4.6 for adzes where major blade corner damage has occurred), most frequently to the front of the adze, and this was consistent for all adze forms. For a number of narrow bladed forms, notably Type 4, the whole blade edge had been removed (Figure 4.11b and c). This result was comparable with other blade condition data which demonstrated that
Figure 4.5: Repaired and Modified Type 1 Adzes.
Figure 4.6: Adzes with Badly Damaged Blades.
the most prevalent form of blade asymmetry were corners that had been rounded or squared off at an angle notably higher than the rest of the cutting edge (Table 4.10). Chipped and snapped blade corners were also the most common form of edge damage in Dickson's experiments with stone hatchets and observed in archaeological collections (1981:45).

In Chapter Three it was observed that most wide-bladed forms had flared blades. This had benefits in use but would also have enhanced repair and preserved symmetry (as outlined in Chapter Two).

**Modified Adzes**  N = 628 (8.7%).

These adzes have seen significant morphological modification through use, repair and maintenance but generally appear not to have suffered breakage (i.e., a transverse fracture or end shock). A modified appearance may have come about suddenly during the major repair of bad blade and bevel damage (for example, the damaged adzes in Figure 4.6 would have required extensive modification to render them serviceable again), or gradually after long episodes of blade and bevel rejuvenation. In practice it can sometimes be difficult to determine if the truncated appearance of some adzes is due to reworking after a transverse fracture or to reshaping as a consequence of major blade damage like corner snapping. Where there was doubt, they were placed in this category.

Modified adzes are generally much narrower and shorter than when first made, particularly in the bevel and blade area for wide-bladed adzes (see Figures 4.5-4.10 and Tables 4.4-4.8). An important difference from repaired adzes is that major changes in form and size have occurred and many have seen overall reshaping. With often marked reduction in length and blade width, and notably shorter bevels and steeper edge angles, functional performance was undoubtedly affected for some types. At this stage, many may have been retired from special service and relegated to the Type 7 category of everyday work adzes.

Modification results in less steep angled sides and the loss of angulation. Modified adzes are, instead, characterized by rounded contours and a chunky somewhat truncated appearance (Table 4.11).

As seen above, blade corner chipping and snapping were the most common forms of blade damage for all types. Corner snapping in particular would have required extensive repair (see Figure 4.6) and considerable modification of form. This is evident in the high percentage of
parallel-sided adzes with narrow blades (see Figures 4.7 and 4.8) that no longer flare out. Just under half still have flared blades (Figure 4.5 and 4.9) reflecting an alternative option for the repair of bad blade damage - the reflaking of a completely new bevel and blade. While blade width is maximised, a disadvantage of this kind of repair is a sacrifice in length. Repair that involved reconstruction of the bevel and blade was also a protracted and risky process, one that probably could not be completed in one uninterrupted session.

Both types of repair generally necessitate reshaping of other dimensions, particularly when a new bevel and blade have to be formed with a workable edge angle. Thus not only side trimming but reduction in thickness was often required. Even given these adjustments, bevels are commonly rounded, shorter and significantly steeper than primary and repaired adzes. As a consequence of extensive remodelling these adzes are significantly shorter, lighter and thinner than primary and repaired adzes, and wide-bladed forms have significantly narrower blades. Many would no longer have sufficient length or weight to be used in the tasks they were originally designed for and may have been 'down graded' to more mundane chopping and trimming tasks. Only 42.7% of modified adzes could have continued to be used as originally designed and these were generally Type 1 adzes (Figure 4.5). Being consistently larger as primary adzes, functional status could be retained for longer. Some 4A adzes were converted to 4B at this stage as the blade, in contrast to Type 1 and 2, widened with repair (Figure 4.11f). There is also a marked drop in the frequencies of Type 5 adzes. Examples like the specimen from Tom Bowling Bay (Figure 4.13b) show that its use-life as a side-hafted adze is in jeopardy and this may be the reason why the repair of this adze was never completed. The blade and most of the bevel have snapped off and all the back has been reflaked as part of the thinning down process.

The Waitaki River Mouth pounamu adze (Figure 4.13a) and the Waimea West argillite adze (Figure 4.13c), both with rectangular, rather than triangular cross-sections, are anomalies in terms of their status as Type 5 adzes. Technically the pounamu adze blade and bevel would be operational in use as a Type 5 adze but this could be stated less confidently for the Waimea West adze where the asymmetrical lateral tang came about during the modification process.

The butt data for Type 1 adzes (Table 4.11) indicates that butts and polls were also often modified. The polls on modified adzes sometimes display evidence of reflaking where the poll was used as a striking platform in the flaking process of thinning down. Tangs also appear to have needed adjustment. It is likely that with the reduction in length, tangs became to 'long' and had to be
Figure 4.7: Modified Type 1 Adzes.
Figure 4.8: Modified Type 2 Adzes showing Side Reduction.
Figure 4.9: Modified Type 1 Adzes.
Figure 4.10: Modified Large Type 2 Adzes.
Figure 4.11: Modified and Damaged Type 4 Adzes.
Figure 4.12: Modified and Damaged Type 3 Adzes.
Figure 4.13: Modified Type 3 and Type 5 Adzes.
Figure 4.13: Modified Type 3 and Type 5 Adzes.

shortened and modified to fit the new dimensions of the adze. For many, such a secure hafting
device was no longer necessary and butt reduction on the majority of modified adzes is rarely
well defined.

Reflaking was usually quite rough and there was generally little attempt to restore an adze to its
former well-finished state (Table 4.11). The reality was, however, that even given high levels of
flaking skill, damage like the snapped blade corners illustrated in Figure 4.6, presented serious
repair problems, none the least being the risk of transverse fracture, and would have placed high
constraints on symmetry. Thus it is also not surprising that a high percent of modified adzes have
asymmetrical blades compared with primary and repaired adzes (Table 4.10). Modified adzes
often have one blade corner higher than the other (for example, Figure 4.8a-c,f), and this is
usually rounded off indicating repair of bad blade corner damage.

Reworking Attempts  N = 1425 (19.7%).

These are broken adze pieces, usually the butt or bevel end of an adze, where attempts at
reshaping have failed or, in some cases, may have been postponed. This category includes
midsections and fragments where reworking has resulted in another transverse fracture and
where evidence of reshaping can be discerned (for example, reflaking over previously ground
surfaces).

These adzes are generally found in early midden and refuse contexts as a consequence of being
discarded after reflaking failed and ruined the shape, and are often found in association with adze
manufacturing flakes if close to source, or with reworking adze flakes and other
caracteristically early midden material (personal observation), when outside production areas. A
few failed reworked adzes were observed in caches and were generally in a state where reflaking
had been successful but finishing postponed.

The value of this state is that the technological process of reshaping is 'caught' in motion, and
provides insights into how the reworking of broken pieces was accomplished.

The main method by which broken adze pieces were reshaped was by flaking, a flexible
technique for this purpose. For both butt and bevel pieces, the fracture plane served as the
primary striking platform for reflaking a new bevel and blade on butt sections, and for butt
modification and thinning down on bevel sections. This process commonly produced long narrow blade-like flakes, a type of flake rarely produced in primary adze manufacture (Turner and Bonica 1994).

The existence of small reworked adzes made of 'Archaic' adze materials at the time of European contact suggests that the use-life of adzes may have been considerable. The Duna of the Papua New Guinea highlands maintained that their large stone axes had a use-life of some 15 years (White and Modjeska 1978a). However, their New Zealand equivalents may have had more specialized roles and thus spent more time in storage and less time in use. Certainly in the functional experiments described in Chapter Three, the spongy dried out kauri complete with knots and nails placed undue stress on the stone adzes which were used with considerable force. Nevertheless, Bonica felt confident that there was little risk of breakage or bad blade damage and finds it difficult to believe that, well designed and expertly wielded, they could break (Bonica pers.comm.). The adze sample examined in this research suggests, however, that many adzes did eventually break. Only 21.9% (Table 4.1) of all finished North Island adzes appeared never to have suffered breakage or transverse fracture at some point in their use-lives (complete primary, repaired and modified adzes).

One possible explanation is that, after an as yet unknown period of use, the adze became 'tired'. The stress absorbed by the adze during periods of use may have accumulated over time until it reached a critical level at which point a transverse fracture occurred - generally at the midpoint of the adze - its weakest point. A similar situation occurs during manufacture (see Turner 1992 - Chapter Three). The excessive force used during flaking can initiate microscopic fractures or cracks that may not immediately result in breakage. At a later production stage, during relatively gentle flaking or even hammerdressing, the adze may suddenly and unpredictably snap in two. It is possible that early Polynesian wood workers were aware of, and anticipated, the eventuality of adze breakage much as they did when making them. Some may have been sidelined as burial goods or heirlooms before this could happen. But, as with adze manufacture, the precise moment of breakage during use was obviously unpredictable, as evidenced by the large number that did break. Again as with unfinished broken adzes, a strategy was in place to salvage the broken pieces - reworking.

The practice of ritual and deliberate breakage of adzes has been accepted by some authors (Brassey 1985; Leach and Leach 1979; Smith and Leach 1996). Archaeological documentation of this is very rare however. In none of the assemblages I examined has this practice been
conclusively identified. This includes two known examples that have been cited as proof of ritual breakage. One example is an Ohana argillite adze that Leach and Leach claim was deliberately broken and flaked into a grave at Washpool (1979:210), the other was a case where broken fragments and flakes of a large black argillite adze were found on the floor of a house at Pouerua, one portion of which was reputedly removed to another area for use as a hangi stone (Marshall 1990:179) though Brassey disputes the provenance of this piece (Brassey pers.comm.). From personal observation of these adzes, it is clear that both show signs of reworking and modification. In the Washpool case the adze had suffered bad blade damage which was being repaired by flaking back the broken edge. It is possible that the process of repair was interrupted by the death of the person who owned it, thus both the adze and the detached flakes were placed in and near the grave. In the Pouerua example, the initial reworking attempt of a bevel portion had resulted in another break. Several pieces were subsequently modified for other purposes. A sizable portion of this adze was not recovered by excavation and it is likely that this larger piece was successfully reworked and removed for use and storage elsewhere.

The common practice of reworking broken adze pieces is in itself an argument to suggest that deliberate breakage was not a usual occurrence. If adzes were broken in the context of ritual ceremony, it is reasonable to suppose that the aspect of ritual would extend to the disposal of the resulting pieces. It seems unlikely that they would be allowed to re-enter the realms of ordinary life by the process of reworking.

Archaeology affords few direct glimpses into the nature of ritual, particularly relating to the early period. Evidence of burial practices provides a rare insight. Nevertheless, not one of the large sample of burial adzes at Wairau Bar was broken (personal observation; Jim Eyles pers.comm.) though several were reworked specimens. Other known examples of adzes interred as burial goods mirror the Wairau Bar evidence (Sumner burial ground, Opito, Farewell Spit, Horowhenua, Ahuahu (Great Mercury Island), Whakatane). The Washpool example remains an exception, but even here the evidence is far from conclusive. The seven 'mutilated' adzes from Shag River Mouth showing evidence of 'deliberate destruction' (Smith and Leach 1996:140) may also be regarded as inconclusive largely due to an inadequate description as to what precisely made the blade damage on these adzes distinct from others figured (for example, there appears to be little difference between the adze in Figure 10.31g:141 where an attempt at reworking has failed, and Figures 10.32j and h:142 - 'mutilated' adzes).

The possibility of deliberate breakage by enemies is also unlikely, particularly for the early
period where evidence of conflict is slight. The careful storage of these valuable items would also reduce their vulnerability to destruction by antagonistic parties.

Nor is it likely that large adzes would be deliberately broken up to make smaller ones. As outlined in Turner and Bonica (1994), small and medium sized adzes (less 200mm long) are much easier to manufacture and could generally be made from broken pieces, and sometimes from local sources of poorer quality rock. Replacing larger adzes, in contrast, either required a return to high quality sources to work the stone itself, or negotiation with people controlling adze production. Large adzes were, thus, likely to be the most difficult and the most expensive to acquire.

Evidence of smashed adze pieces appears to be virtually absent in the New Zealand archaeological record. Fragments seen in archaeological assemblages very often showed evidence of reworking (i.e., reflaking over previously ground surfaces), and where context was recorded, are usually found in working floors or ‘workshop’ areas. Similar pieces were generated in reworking experiments as a result of further transverse fractures and ‘endshock’. Refitting of broken pieces, even where surface collection and excavation procedures have ensured that everything is retained, is also uncommon, again suggesting that re-cycling was a common practice.

Repair of blade edge damage was possibly another cause of adze breakage. In adze manufacture, blade and bevel formation carries a very high risk of transverse fracture. The longer and thinner the adze, the higher the risk of breakage. This would apply equally, if not more so, to finished adzes. Minor shallow chips could be repaired by grinding but more serious blade damage would have required reflaking (Bonica, pers.comm.). Furthermore, successful repair of blade damage like that seen on the adzes in Figure 4.6 would command a flaking skill comparable to that required in manufacture.

At this point it is relevant to consider what the archaeological data reveals about the causes of adze breakage.

*Causes of Adze Breakage* (Table 4.12).

Of a sample of 698 broken bevel sections from finished North Island adzes, 39.2% were in an undamaged condition or had minor chips, 38.7% displayed reflaking attempts, and 22% were damaged but not reflaked. Thus 39.2% of breakage may have been caused by use while 38.7%
may have been caused by repair of bad damage. However it can be difficult to ascertain whether reflaking occurred prior to breakage thereby possibly causing it, or was part of the reworking process after breakage. In addition, breakage as a consequence of blade reflaking may have occurred during the first few blows leaving little or no discernible evidence of a reworking attempt on the broken piece. Finally it is not implausible for bad blade damage like corner snapping to have occurred instantaneously with adze breakage (as may have been the case for the Wairau Bar adze in Figure 4.6b). Because of these problems and the lack of experimental data, the causes of breakage remain inconclusive.

When the sample of broken bevel portions is examined minus failed reworked attempts and damaged blades, 28.0% were failed attempts at reflaking the blade while 71.9% were undamaged blades. This result suggests that while most breakage occurred during use, breakage during adze repair was not uncommon.

Over 26% of the total finished adze sample were broken pieces (see Table 4.13). Of this number (1753), 65% had evidence of a failed reworking attempt. A further 16.6% were generally small fragments like midsections which were also probably the result of a rework attempt or were too small to be reworked (recorded as ‘unidentified’ in Table 4.13. Only 115 viable broken pieces (of salvageable size and dimensions) had not been reworked. This represents only 1.7% of the finished adze total. Curiously, broken bevel ends dominate this sample (66.9%), an unexpected result given the greater ease of reworking bevels compared to butt ends (as indicated at Hahei and Mt Camel and in replication experiments). There was, however, a slightly higher number of failed rework attempts for butt ends (see Table 4.13).

Evidence that reworking broken quadrangular adzes was more difficult than reworking rectangular pieces is apparent in the data. This can be seen in the high frequency of failed reworked attempt for quadrangular sectioned pieces compared with rectangular sectioned portions (Table 4.14). In contrast, among completed and reused reworked adzes, rectangular sections are more prevalent than quadrangular. The data for reworked preforms shows a similar result; 40% of rejected reworked pieces were quadrangular compared to 16.8% of rectangular sections. This result supports that of reworking experiments where short chunky quadrangular pieces required far more thinning down in order to provide for adequate hafting and bevelling and were more often rejected due to shaping problems. Rectangular pieces took less time and effort to rework successfully. Viable rectangular broken bevel portions that had not seen any reworking attempt were, however, more common than quadrangular bevels (Table 4.13).
probable reason for this is that broken quadrangular bevel portions from Type 1 adzes were longer with wider blades than rectangular bevels derived from smaller Type 2 adzes (large tanged forms being relatively uncommon among Type 2). This suggests that for reworking, size, especially length, was an important factor in the selection process.

Nevertheless, these are minor differences considering the small size of the unreworked sample which provides evidence for the intensive reworking of adzes and the conservation of valuable raw materials and confirms that adzes were highly curated tools. Rarely were damaged adzes and broken pieces discarded if some potential to reshape the stone remained.

The frequency of reworking in the South Island was probably as intensive if the data from Wairau Bar, Rotokura and Waitaki River Mouth is any indication. The preform evidence from both the former two sites suggest direct access to the Nelson/Marlborough quarry sources (Table 4.1), yet both show high frequencies of adzes with some evidence of reworking. Among the finished adzes from Wairau Bar, 44.4% are either failed attempts at reworking or successfully reworked adzes, with a higher frequency of 83.9% from Rotokura. The difference in frequencies reflects the different contexts from which the adze samples were drawn. The Rotokura sample derives mainly from a working floor context, hence the majority comprising the 83.9% are adze pieces where an attempt at reworking has failed. The Wairau Bar sample is drawn from a much wider range of site contexts, the most notable being the burial areas. Additionally, Jim Eyles recalls that broken adze pieces were commonly not retained during excavations and surface collections, thus the actual number of adzes resulting from a failed rework attempt was probably much higher. The retention of material was far more rigorous at Rotokura (Don Millar pers.comm). The problem of adze samples reflecting different site contexts is discussed in detail in Chapter Five.

The adze assemblage from Waitaki River Mouth is similar in size to the adze assemblage from Wairau Bar, but with a higher number of finished adzes (see Table 4.1). Almost half the number of finished adzes at Waitaki were failed rework attempts or reworked adzes (49.2%)

A number (N=433) of broken adze pieces in the total adze sample, generally after a reworking attempt had gone wrong, were re-used for other purposes, most commonly as hammerstones, but occasionally some were retouched to form points or awls. The narrow butt and bevel ends of 4A adzes and other gouges were favoured for the latter types of tools.

Other rejected and broken pieces with evidence of fire fractures and pits may have been re-used as hangi (oven) stones (N=251).
Seventy-six adzes had evidence of an *Outre Passe* fracture (Turner and Bonica 1994:10,11, Figure 1), and all were failed reworking attempts (63.1% of the sample were finished broken adzes and 36.8% were broken preforms). No stone type appeared to be particularly vulnerable to this sort of fracture and, as experienced in replication experiments, it probably occurred much in the manner of a transverse fracture - suddenly and unpredictably.

**Reworked Adzes**  \( N = 3351 \ (46.5\%)\).

These are broken adzes that have suffered a transverse fracture and have subsequently been reworked successfully and reused. During the early or Archaic period the reshaping method followed a similar procedure to manufacture; flaking was the primary technique followed by varying degrees of hammerdressing and grinding. Depending on original size, adzes may have experienced several reworking episodes during their use-life though this is often difficult to determine. Also, with length generally halved for reworked adzes, dimensions were stabilized (length more proportionate to width and thickness) and the risk of breakage was reduced considerably. The low frequency of broken reworked adzes supports this probability (Table 4.13). Reworking experiments and comparisons of reworked adze dimensions with those of the primary forms they were derived from provided valuable aids in recognizing reworked adzes as did comparisons with adzes exhibiting failed reworking attempts.

As pieces became smaller, more extensive hammerdressing and grinding was applied (Table 4.11). While reflaking is a fast and effective reshaping method it is also very wasteful. But with small pieces there is less surface area thus the labour involved in hammerdressing and grinding decreases. However, with the exception of one distinctive form, all these adzes had some evidence of initial reshaping by flaking, and their occurrence, along with failed reworking attempts, in the earliest sites so far discovered in New Zealand (including Wairau Bar), suggests that reworking was an ongoing and continuous process undertaken from the earliest period of occupation (for example, reworked and failed reworked adzes were found in the earliest and subsequent layers of occupation at Mt Camel, Washpool, Pig Bay, Tairua, Rotokura).

Reworked adzes comprise almost half the finished adze total (Table 4.1). Combined with failed reworked attempts and fragments likely to have come from the same process, almost three quarters (73.5%) of the finished adze sample may represent evidence of reworking. This again indicates a high level of curation.
The data presented in Table 4.3 and 4.11 demonstrate that the original form of an adze is quickly obliterated once reworking takes place. The original form for only 5.5% of reworked adzes could be identified but even for this number, very few could have been used as originally intended due chiefly to a marked reduction in length and weight.

For the major stone types particularly, reworked adzes are the most frequent state (Table 4.15). This is particularly high for Nelson/Marlborough argillite. The majority of Nelson/Marlborough argillite finished adzes appear to be at more terminal stages of their use-lives. Almost 62% of North Island Nelson/Marlborough argillite adzes are reworked compared with 43.4% of Tahanga basalt adzes and 50.2% of Motutapu greywacke adzes. This is likely to be related to the greater success in reworking Nelson/Marlborough argillite due to its superior flaking qualities, and also its greater value.

In Chapter Three it was shown that primary Type 1 adzes were predominantly large sized (over 200mm in length) while other types had a more variable size (length and weight) range. Type 1 adzes, therefore, have been selected to discuss in some detail the significant changes in adze dimensions and finish through use-life stages (see Table 4.11).

**Type 1**

There are significant differences between primary, modified, repaired and reworked Type 1 adzes for all adze dimensions. Reworked Type 1 adzes are significantly shorter, thinner and lighter with narrower blades than all the other aforementioned states. For the small sample of reworked Type 1 adzes, derivation from the broken butt and bevel ends of large Type 1 adzes is clear (Figure 4.14 and 4.15), but for the much larger sample of reworked quadrangular adzes (Figure 4.16) it is generally difficult, if not impossible, to identify the original form, and some may have derived from Type 2 or even Type 3 or 4 adzes. A change from a reworked Type 1 to a reworked quadrangular adze may have come about in several different ways:

1. Gradual reduction in weight, length and blade width as a consequence of ongoing repair and maintenance (Figure 4.16c from Figure 4.15d for example).
2. Further modification of the whole adze as a consequence of bad blade damage (Figure 4.16a and f for example).
3. Another transverse fracture and reworking episode (Figures 4.16i-m).

The latter was possibly the least common situation given that, despite a significant difference in length, most reworked quadrangular adzes are not half as long as reworked Type 1 adzes which would be expected if transverse fracture of reworked adzes was a regular occurrence. The problem of classifying adzes by specific 'sequential reduction' stages is complicated even further by the observation that at all stages a certain number of adzes suffered transverse fracture. The use-life of an adze in a primary or repaired state may have progressed to breakage point without the event of major blade damage which generally necessitated major modification. Drastic foreshortening as a result of major blade damage repair may have forestalled breakage given the reduction of stress on the cross-section. The small number of broken modified adzes supports this possibility (Table 4.13). Again, despite the evidence that almost all Type 1 adzes began their use-lives as large adzes over 200mm in length, there is considerable variability with some adzes reaching over 400mm in length. For example, the reworked Ohana argillite adze illustrated in Figure 4.15a may have once been close to 400mm long. Had it snapped again (and the robust nature of the cross-section relative to length and width makes this unlikely), reworked adzes such as those illustrated in Figure 4.15b and Figure 4.16i may have resulted. The reworking of primary adzes with an original length of 279mm would produce reworked adzes of about 140mm long, close to the average length of the reworked Type 1 adzes (144mm) examined (Table 4.11). Reworked quadrangular adzes, in contrast, may have been reworked from broken repaired and modified Type 1 adzes. Continuous use, repair and modification at the reworked stage serve to further obscure previous reworking and/or modification events. In conclusion we cannot say that the majority of reworked quadrangular adzes represent a second reworking episode, though most may have had longer use-lives than reworked Type 1 adzes. For almost all (an exception possibly being Figure 4.15a) of the reworked adzes in Figure 4.14, 4.15 and 4.16, their functional roles would have changed and they were probably relegated to everyday chopping tasks (Type 7). It is possible that some of the very small chisels in Figure 4.23 (for example 4.23e and p) were derived from Type 1 adzes though they could equally have derived from Type 2. Figure 4.23a is a rare example of a large chisel deriving from a modified or reworked Type 1 Tahanga basalt adze that may have suffered a lateral rather than transverse fracture. This chisel was found with a modified Type 4 adze of the same stone in Palmerston North. Both had been reflaked successfully but were awaiting the finishing process of grinding. Adzes exhibiting lateral...
fractures were generally quite rare; another example is a Type 3 adze illustrated in Figure 12d.

Reworked Type 1 butt portions usually retain the original tang (Figure 4.14c and d, Figure 4.15a and b) but there is generally little effort expended in reducing the butt on reworked bevel portions (Figure 4.14a and f, Figure 4.15 d-e) and polls often display the transverse fracture plane. Usually sharp corners and flake scars are bruised to avoid haft and lashing damage. Reworked quadrangular adzes rarely display butt reduction though often the area is hammerdressed, including the poll. Some are so truncated (Figure 4.15b and Figure 4.16l, for example) that some form of socketing on the wooden helve must have been needed to secure them. For these reworked adzes, butt and poll modification was geared to the problem of securing a short adze rather than a large heavy one as was the case with primary adzes.

As seen in Chapter Three, primary Type 1 adzes were well made. Flaking was of a high standard with visible hammerdressing concentrated mainly in the tang area. Any hammerdressing that may have been applied to the body and bevel during manufacture was often obscured by subsequent grinding. Grinding was generally applied to most surfaces of the adze but usually not to the degree that flake scars were totally obscured. This condition changed through the use-life trajectory, however, with hammerdressing and grinding increasing through stages of repair, modification and reworking (Table 4.11). Flaking appears, in contrast, to diminish through use-life stages both in quality and application.

Clearly symmetry and appearance were of little importance for reworked adzes (for example Figure 4.14a, and Figure 4.16a and d). Symmetry and balance were especially critical on large adzes where length was disproportionate to thickness, and for adzes required for precision shaping. This may explain why, as adzes progressed through episodes of modification and reworking and decreased radically in length, less attention was given to both the symmetry of the adze overall and to cutting edge symmetry (see Table 4.11 and 4.10). Primary adze blades were mainly symmetrical though even minor repair could result in small imperfections. Reworked adzes in comparison, had much higher frequencies of roughly repaired and asymmetrical blades (Table 4.11). Relegation to rough wood working tasks would also have placed less emphasis on the need for an adze to be well-formed. Very few reworked adzes showed any signs of angulation but often had rounded, irregular contours with parallel sides or blade corners that curved inward (Figure 4.14b,c,e and Figure 4.15b,c and e).
Figure 4.14: Reworked Type 1 Adzes.
Figure 4.15: Reworked Type 1 Adzes.
Figure 4.16: Reworked Quadrangular Adzes.
Problems seen above in identifying a use-life sequence for Type 1 adzes are repeated with Type 2 adzes and are exacerbated by the greater variability in size among primary forms. Similar patterns of modification and reworking are evident (Figure 4.17). Some are more clearly derived from the large tanged form (butt ends - Figure 4.17a shown along side Figure 4.17b, a broken unrefitted butt portion demonstrating 'before' and 'after' reworking, and bevel portions - Figure 4.17c and d). The strategy of reworking Type 2 adzes, however, produced distinctive 'Duff' forms, notably Type 1B (94% reworked/rework attempt) and 2B (96% reworked/rework attempt), which, along with Type 6 (79.1% reworked/reworked attempt), could be termed secondary Duff types. In the early period these forms do not appear to have been primary designs (apart from the rare long slender Type 6 form).

1. Type 1B  N = 156 North Island (Table 4.2 and Figure 4.18).

Of this type Duff notes:

>'Among the Wairau argillite adzes are two small tanged adzes of quadrangular [in fact very much rectangular!] section, but with so little depth between front and back that it was impossible to provide a grip by reducing the butt below the level of the blade; consequently this was effected by reducing the butt laterally to form a 'spade-shouldered' grip. I propose to distinguish this small class as Variety B of Type 1.' (1977:156).

Of note was another 1B adze, found in Burial 28, of pounamu. Duff also observed the frequency with which this type is rendered in pounamu in the South Island and calls it one of the rare 'transmitted' forms to be carried over from the early period to the late (1977:156).

While Duff thinks that the greatest significance of the 1B adze is its similarity to Asian forms from Burma and Cambodia, the present study indicates a greater significance, for, with a few rare exceptions, the 1B in the early period was never a primary adze form, but rather the distinctive tang was a means of rendering broken adze pieces useable, and able to be hafted, again. Much as extreme length imposes hafting difficulties, so does a critical lack of length, particularly when it is desirable to conserve blade width and edge angle. Especially when adzes have thin cross-sections, lateral reduction of the butt provides necessary hafting stability without blade width reduction, and can be readily accomplished by flaking and/or hammerdressing. It was a favoured method of reworking the broken bevel portions of large tanged Type 2 adzes.
when adequate length was present and where the wide blades of these adzes could be preserved (see Figures 4.18a, g and h). The generally small size of this type (see Table 4.4 and Figure 4.18) also supports the likelihood that 1B adzes in the early period were commonly the outcome of reworking. This could, however, be seen as a circular argument. As Duff noted, lateral reduction was applied precisely because these adzes were small. Nevertheless when size is considered with other attributes, the case for reworking is strengthened. These other attributes include a high blade width to length ratio and an abrupt poll termination indicative of the transverse fracture plane. There are often remnants of flaking scars below this surface when the adze was derived from the bevel section. This probability is further supported by reworking replication experiments (Turner 1992:266) and the technique of using the broken surface as the striking platform also proved effective for thinning down broken preform pieces. Apart from the pounamu specimens, the other 1B adzes from Wairau were reworked. As with frontal reduction on Type 1 adzes, lateral tang reduction is a continuous variable and is present on adzes, particularly reworked adzes, in varying degrees so that most adzes with lateral tang reduction do not have the marked spade shouldering seen on Duff’s type specimens. To avoid confusion, I have classified as 1B only those adzes where reduction is marked and shoulders are clearly defined. 1B adzes, however, make up only a small percentage of the number of reworked rectangular adzes (8.4%). The majority lacked tang reduction (see Figure 4.17 and 4.19) and butt modification was usually confined to front corner hammered dressing.

In contrast to reworked 1B adzes in early flakeable materials, 1B adzes rendered in pounamu are generally primary forms. South Island 1B adzes were significantly longer than North Island forms largely due to the inclusion of a number of pounamu 1B adzes (found in caches with early or ‘Archaic’ adze forms). In Southland a number of primary forms rendered in argillite also show marked lateral reduction (Figure 3.37) but due to additional frontal reduction are classified by Duff as 1C. Both pounamu and argillite forms show the use of lime garnet to create the marked lateral tang, a feature shared with other Southland forms.

Thus a reworking technique employed in the early period probably gave rise to a primary form that was suited to both the production techniques applied (sawing) and to the quality of a new raw material (pounamu), and therefore persisted into later periods of occupation.

The majority of 1B adzes were under 100mm long (Table 4.4) which is almost half the mean length of the smaller Type 2 forms (Duff 2A) from which many probably derived (see Figure 18b, c, d, and f). The marked lateral tang was generally accomplished by flaking using the fracture
plane as the initial striking platform. After some side trimming, hammerdressing was usually applied to smooth sharp edges left by flake scars.

Reworked 1B adzes were significantly longer, thicker and heavier with a wider blade than other reworked rectangular adzes with only slight or no butt modification (Tables 4.4-4.8). Thus a tendency for lateral tangs to be placed on longer reworked pieces existed. Some reworked 1B adzes were, however, very small (see Figure 18e).

The marked frequency of Nelson/Marlborough argillite reworked 1B adzes compared to other materials reflects both the flaking properties of the stone, their greater length as primary adzes and their generally finer cross-sections (Table 4.15). The reworking of thin-sectioned Type 2 adzes coupled with the fine flaking control imparted by Nelson/Marlborough argillite would have facilitated the placement of a lateral tang on bevel portions. Primary Nelson/Marlborough argillite adzes were also significantly longer than other materials and as a consequence broken pieces were also longer. In contrast they are not common among Tahanga basalt reworked adzes possibly due to the thicker cross-sections of primary adzes and the flaking limitations compared to the argillite.

Of all wide-bladed reworked forms, 1B adzes had significantly wider blades (see Table 4.5) which may reflect the originally wider blades of Nelson/Marlborough argillite adzes and the ability to provide a hafting device which allows blade width, bevel length and edge angle to be preserved. The lateral tang, however, often takes up half the length (see Figure 4.18) so it is doubtful that many could be used with a follow-through stroke. They may have proved useful for one-handed trimming work on shafts and other small projects.

2. **Reworked 2B**  N = 1265 North Island (Table 4.2 and Figure 4.20).

Duff describes his Type 2B as:

'...so characteristic of the North Island of New Zealand that it might well be called the North Island type....it is rare and intrusive in the South Island...not yet found in any Moa-hunter site....the type of medium-sized adzes of rounded quadrangular section without grip...always comparatively thick between the front and the back, the absence of any attempt to convey a tang or 'grip' is much more significant than in the thin Variety A...in side view the cutting edge often appears as a wedge-like apex of the mutually convex planes of the front and back...also characteristic..to be completely ground on every surface including the poll.' (1977:163,164).
Additionally the 2B adze is considered one of the hallmarks of Classic Maori material culture (Golson 1959a). Thus it was surprising to identify such a large number of these adzes (see Table 4.16) rendered predominantly in fine-grained materials from quarries that ceased production prior to, or simultaneously with, the emergence of the 2B adze (see Chapter Five). Indeed they were the most common Duff form among materials like Tahanga basalt and Nelson/Marlborough argillite. The 2B form rendered in these materials is distinctive from the 2B form rendered in coarse-grained materials and illustrates some of the problems with the Duff 2B classification. This is the most vague and ill-defined of Duff’s types, and demonstrates his unfamiliarity with this form of adze compared to the Archaic forms, and his unfamiliarity with North Island adzes in particular. Any detailed assessment of an assemblage of North Island adzes begs either a much tighter definition, or better, a total reclassification that reflects the variability and, more importantly, the significance of some forms hitherto classified as 2B. An understanding of the development and significance of the 2B type in the North Island has been greatly hindered by the ‘blanket’ classification of the majority of North Island adzes as 2B. A large number of adzes examined in this research were quadrangular and rectangular amorphous forms, many the outcome of reworking. However, previous researchers, including Duff himself, have classified these forms (for example Figure 4.16b,c,e and h, Figure 4.17c,d and j) as Type 2B. But these, like the two Wairau Bar adzes classified by Duff as 2B, are not the very small truncated steep bevelled forms identified as reworked 2B in this research. Rather they are quadrangular and rectangular forms representing the early reworking technology, one primarily based on reshaping by flaking.

The reworked 2B proper as defined in this thesis represents a change from an earlier reworking technology based on reflaking as the principle reshaping method to one based on hammerdressing and grinding.

Features that distinguish them from other reworked adzes are (see also Figure 4.20d-h and j-x):

1. A truncated form, often as wide as they are long, and frequently with a square shape (Figure 4.20l,p and x). They are consistently small in size, rarely exceeding 100mm in length. This is the major feature that distinguishes reworked 2B adzes from their primary coarse-grained counterparts. In the Oruarangi assemblage, Best (1977) also noted a consistent difference in size between 2B adzes made of Tahanga basalt, and those made of coarse-grained materials though
he was unable to provide an explanation for this observation. An explanation can now be provided: The Tahanga basalt 2B adzes were reworked from the broken sections of larger, earlier forms, while the coarse-grained 2B forms were primary adzes.

Reworked 2B adzes are significantly shorter and lighter than other reworked rectangular forms (including reworked 1B adzes), but of equal thickness to reworked rectangular adzes (Table 4.4-4.8). The latter result may suggest, as is likely, that some reworked 2B adzes derive from what were originally quadrangular Type 1 adzes. An interesting result is that reworked 2B adzes have significantly wider blades than other reworked rectangular adzes (except reworked 1B). This indicates that reworked 2B adzes were not necessarily the terminal stage of an earlier 'reduction sequence'; one that may have proceeded through the following stages: Primary, Repaired, Modified, Reworked 1B or rectangular, reworked 2B, or modified reworked rectangular adze. While there was a significantly higher frequency of very small adzes among reworked 2B adzes, Figure 4.19 illustrates that among other reworked rectangular forms, very small adzes were present. Instead reworked 2B adzes may represent a new more conservative method of reworking and a new and effective way of rendering smaller pieces usable while maximizing blade width. For example, there is twice the number of reworked 2B adzes under 50mm compared with reworked rectangular and 1B adzes, and they are significantly shorter.

2. Reworked 2B adzes are so truncated, however, that there is scarcely room for the bevel which is uniformly short (often 1cm or less from chin to blade edge). While generally with a thin rectangular cross-section, bevels are very steep angled, significantly more so than earlier reworked forms and even the majority of quadrangular adzes, and usually have a sharply demarcated chin (see Table 4.11). This type of bevel would not permit the adze to be used in a fine shaving stroke at a low angle of attack or to penetrate deeply into the wood. They would have been best suited to one-handed light chopping tasks. Very few were broken, and it is likely that the square shape provided a resistance to transverse fracture.

3. A major technological difference is that reshaping was accomplished by the safer techniques of hammerdressing and grinding (Table 4.11). One or two faint flake scars are usually present, but these generally relate to previous reworking/modification episodes, and are a testimony to their origin from earlier forms. In contrast to other reworked rectangular adzes of similar size (for example Figure 4.19c,j,o and y), where appearance is generally rough, reworked 2B adzes are
carefully finished and quite symmetrical.

4. That a change in haft design occurred is indicated by these very short squat forms - they would have required recessed or socketed hafts. Like primary 2B forms rendered in coarse-grained materials, reworked 2B adzes are characterized by a complete lack of butt modification. Attention has, instead, been transferred to the poll which is commonly ground or/and hammerdressed and many feature haft polish (see Table 4.11); tangible evidence of a change in hafting. The likely socketing of the stone adze-head into the haft may also explain the greater symmetry and more complete finish on these reworked forms compared to the earlier roughly reflaked ones.

This very standardized reworked form has never been found in early sites but excavated examples have been found on pa and in late dated contexts, i.e., Great Barrier (Okiwi - Figure 4.20o and p), Oruarangi (Figure 4.20f), Oue Pa - Figure 4.20l, Maioro (Fox and Green 1982), Raupa (Prickett 1990, 1992); Otakani Pa, South Kaipara (Bellwood 1972), Station Bay Pa, Motutapu Island (Davidson 1972). Their technological and morphological features have a much greater affinity with the coarse-grained 'Classic' 2B form than with the original adze forms they were derived from. This suggests that as adze manufacturing technology changed over time, so did adze reworking technology, both of which had a marked effect on adze morphology. Reworked 2B forms were probably derived from adzes that were among the last to be made at the major quarries like Tahanga and D'Urville Island before they ceased production. The increasing difficulty and eventual unavailability of primary adzes may have seen intensification in the reworking of broken pieces and a more conservative technology applied that was neither as risky or as wasteful as flaking.

Precisely which came first - the reworked fine-grained 2B form or the primary coarse-grained form - is difficult to establish archaeologically. But, as demonstrated in replication reworking experiments (Turner 1992), the practise of reworking broken adze pieces in the Archaic period would have prompted certain technological adjustments (like a change in the hafting device to accommodate a drastic reduction in adze length), adjustments that may have given rise to new methods which proved very successful and effective when transferred to coarse-grained and previously under-utilized local materials. Indeed, some earlier reworked rectangular adzes like Figure 4.19c,j,m,o and y may represent 2B proto-types, the shape being a natural outcome of
reworking and ongoing modification and repair. A similar situation may have occurred with the 1B adze. Some rare examples like Figure 4.19l present elements of both early and late technology, being essentially a reworked 2B adze with a well-defined and grooved tang. A small number also feature a blade at each end (Figure 4.20w where both blades are in working order). These adzes suggest some variability in hafting methods also.

Certainly the new technology eradicated many of the problems apparent in the early system (low production rate, high risk, high skill, the need for imported high quality materials). If this was the case, then people may not have been 'forced' to turn to their local rocks at all, and the change from the large and finely made adzes of the early period to the standardized and simplified Classic 2B adze should not be viewed as a 'devolution' in adze technology, but a change to a more viable and efficient method of production. The Southland adze-makers, in possession of lime garnet, responded in a similar manner, choosing to employ hammerdressing as a major shaping technique rather than persisting with flaking, regardless of raw material.

The majority of reworked 2B adzes were in good working order (see Table 4.11) and it is evident that many were still in use at the time of European arrival. This evidence has significant implications for understanding the durability of adzes. The data here suggest that, carefully used, stored and repaired, and successfully reworked when finally broken, a large Type 1 or Type 2 adze made in the 16th century could still be in operation in the 18th century as a very small reworked 2B adze.

The idea (Best 1977; Fox and Green 1982; Leach 1990,1994) that local people in later times continued to exploit the old quarries to make these forms is not supported by the archaeological record. I have observed no preforms approximating this form at the quarries or in assemblages from secondary production centres. Nor does it explain why 2B adzes made from early materials like Tahanga basalt and Nelson/Marlborough argillite are so consistently small. Additionally a small number of failed rework attempts show this reworking in progress (Figure 4.20h).

Based on the data collated for this thesis, the distribution of reworked 2B adzes is widespread particularly in the northern half of the North Island, mirroring the distribution of their coarse-grained primary counterparts (see Table 5.3, Chapter Five). There are no discernible concentrations around quarries. Indeed the opposite occurs. In the case of the east coast Coromandel, the area of Tahanga basalt production, the frequency of reworked 2B adzes is decidedly low. Nor do quarries like Tahanga provide suitable blanks for easy conversion to this form. As tested by experimentation, even making 2B adzes from flakes is not technologically
viable. Pieces from already heavily modified and reworked adzes are, however, eminently suitable, and the morphological features of the reworked 2B form clearly indicate derivation from such pieces.

An alternative explanation (Barber 1994:380,381), involving the scavenging of reject adze pieces from earlier sites by later occupants, is equally unlikely. Given the evidence of intensive reworking since earliest times the availability of suitable pieces must be questioned, as would their visibility and durability. Buried they would be difficult to find, and when exposed on the surface they would be subjected to particularly detrimental weathering processes, especially given the characteristic coastal locations of early settlements.

The large number of reworked 2B adzes rendered in Nelson/Marlborough argillite (Table 4.16) again reflects the intensive curation of the most valued and inaccessible adze material in the North Island. Again, the decline in the availability of such a valuable material may have moved reworking technology ever closer to the reworked 2B form.

Nelson/Marlborough argillite reworked 2B adzes proved to be significantly smaller than those made in other stones (see Table 4.16) while Motutapu greywacke 2B adzes were larger. Again this may relate to the more intensive curation of a superior and more malleable stone. The larger size of Motutapu greywacke 2B adzes may, in contrast, relate to the continuing use of Motutapu greywacke over time.

The argument that the distribution of primary Nelson/Marlborough argillite adzes continued over time is proposed by Prickett (1989). Prickett examined a sample of 36 Far North Nelson/Marlborough argillite adzes in the Auckland Museum and identified 'two marked typological groups' (1989:135), one consisting of eleven 'Archaic' or early forms, and the other containing 25 late 2B forms. Stratigraphic evidence from Nelson/Marlborough sites (Barber 1994; Millar 1971; Wellman 1962) shows a pattern whereby distinctive D'Urville Island argillite (Ohana, black Mt Ears) is replaced over time by other Nelson/Marlborough argillite sources. Additionally a notable increase in argillite with water-rolled cortex, signifying a transfer from the use of high altitude quarries to (mainland) river sources, accompanied this change (Barber 1994; Challis 1991). This change may also be discernible in adze distribution patterns and provides a chronological sequence for change in the use of Nelson/Marlborough argillite over time. Prickett discovered that eight of the eleven early forms were D'Urville Island argillite but only five of the 25 late forms were of these distinctive materials. This, Prickett asserts, is evidence for continued distribution of Nelson/Marlborough argillite adzes into the late period to a region most remote.
from the source. It is also proof, according to Prickett, that the late forms were not the outcome of reworking earlier ones:

'If later adzes were simply reworked material than the same proportion of D'Urville Island stone might be expected in the late as well as the early group. Instead there is less.' (1989:143).

I have re-assessed Prickett's sample and increased it substantially. I have identified and classified all the late forms listed and illustrated by Prickett as reworked adzes. The results from this larger sample, by comparing states from each end of the use-life sequence, do not support Prickett's hypothesis (see Table 4.17). The frequency of D'Urville Island argillite adzes was consistent among Nelson/Marlborough argillite adzes of all states in both the 'early group' and 'late group'. Reworking may thus be reinstated as the primary method by which Nelson/Marlborough 2B argillite adzes entered the archaeological record. Again the state of an adze is an important feature when considering distribution patterns. If adzes had long use-lives, as both functional experiment results and the high frequency of reworked adzes in the archaeological data seem to suggest, then many adzes may have survived several generations, and experienced a number of shifts in residence. Reworked adzes especially may have been finally deposited in the archaeological record in a completely different context and location than when originally acquired. This is discussed in greater detail in Chapter Five.

The dominance of D'Urville Island sources among Nelson/Marlborough Type 1 and large Type 2 adzes, seen in the archaeological samples examined in Chapter Three, is also present in the Far North and Prickett's sample. In a small sample like Prickett's the inclusion of several Type 1 and large Type 2 adzes made of D'Urville Island argillite may have been responsible for skewing his result.

Prickett's study was the primary source of information for Helen Leach's assertion (1994:248) that the distribution range of imported adzes like those made of Nelson/Marlborough argillite increased over time. A reappraisal of this data, in addition to evidence from a much larger sample of adzes, suggests a more likely possibility; that the distribution of imported adzes contracted over time, a pattern also observed in the decreasing frequencies over time of a variety of imported stone.
Figure 4.17: Reworked Type 2 Adzes.
Figure 4.18: Reworked Type 1B Adzes.
Figure 4.19: Reworked Type 2 Adzes and Small Flake Adzes.
Figure 4.20: Primary and Reworked Type 2B Adzes.
Reworked 2B adzes are rare in the South Island. Only nineteen were observed and recorded in the adze collections of eight South Island Museums including a cache from Waipapa Bay comprising a reworked 2B and what could be considered a prototype 2B with a badly damaged blade (Figure 4.20i and j), and an example in local basalt from Moa Bone Point Cave (Figure 4.20g). The majority were rendered in Nelson/Marlborough argillite (84.2%).

**Type 3** (Figures 4.12 and 4.21).

Type 3 adzes generally retained their basic lenticular shape, distinctive triangular bevel and curved blade after being reworked. In the North Island the tangless Type 3B is the most common primary form but it is suspected that many were converted into the tanged 3A form after reworking. For example the frequencies of primary and reworked 3A adzes are the same while the number of untanged primary Type 3 adzes exceed reworked untanged forms. The placement of lateral tangs on bevel pieces followed a similar procedure to that described for reworked 1B adzes above and served a similar purpose in conserving blade width (see, for example, Figure 4.12a and b, Figure 4.21b and c).

They were probably used for similar tasks involving the shaping of curved surfaces but on a smaller scale, for example, the shaping of bowls rather than canoe hulls. A number may have been refashioned into rounded gouges (Fig 4.23c and f), particularly narrow butt portions.

**Type 4** (Figure 4.22).

Large Type 4 adzes appear to be more vulnerable to transverse fractures occurring at the shoulder of the adze rather than the mid-section than other types of adzes (Figure 4.22b and d). This is usually the thinnest point on these adzes and may explain their tendency to break at this junction.

They were also less of a challenge to rework given the already steep rounded bevels characteristic of primary forms. The adze illustrated in Figure 4.22a is an example where a large broken butt portion has been speedily rendered operational with only minor modification. This was greatly assisted by the nature of the transverse fracture. The sides of the adze were roughly reflaked then 2cm of the broken surface was reground to form a new cutting edge. The rest of the broken surface was left unmodified. The adze in Figure 4.22g is a similar example on a broken
bevel section. The butt area was simply thinned down to the back of the adze (using the fracture plane as the striking platform) before the adze was re-used.

The functional status of larger reworked portions like those in Figure 4.22a and d may have been retained but the loss of weight for most reworked Type 4 adzes would have relegated them to lighter gouging work (Type 6).

The long slender thin hogback gouges (Figure 3.56) were more vulnerable to transverse fracture and broken pieces, especially bevel sections, were commonly reworked into Duff Type 6A adzes (compare, for example, the broken section from Titahi Bay in Figure 3.56f to the Type 6 adzes in Figure 4.23j,m,n and v). The polls of many Type 6 adzes show remnants of the broken transverse fracture surface which was commonly used as a striking platform for thinning down and for the occasional creation of a new tang (for example, Figure 4.23m from Wairau Bar). The majority of primary slender gouges were rendered in Nelson/Marlborough argillite, especially from D'Urville Island, and consistent with this evidence, reworked Type 6 adzes reflect a similar frequency.

**Type 5** (Figure 4.13).

Unlike other adze types, the unique features of side-hafted adzes are rapidly lost once major damage occurs. This is undoubtedly a factor in the low frequencies recorded for this type of adze.

When blade width and length became critically reduced, the function of side-hafted adzes may have been limited to the extent that they were completely refashioned into a different type of adze. The specimen from Hot Water beach (Figure 4.13d) has seen extensive modification with much reduction of length and blade width. Had the modification of the Tom Bowling Bay adze (Figure 4.13b) been completed, it may have resembled the Hot Water beach adze. Both were probably no longer suitable for canoe work, and use may have been limited to the hollowing out of small items like bowls. Once broken, it is unlikely that the Type 5 pieces would have been reworked into smaller Type 5 adzes as neither the length or blade width would be present to make this feasible. No reworked Type 5 adzes were observed in this research, and the three failed reworking attempts were only identified as Type 5 after close and critical scrutiny by both Bonica and myself. Attempts to make Type 5 adzes from broken pieces during manufacturing experiments also failed.
Figure 4.21: Reworked Type 3 Adzes.
Figure 4.22: Reworked Type 4 Adzes.
Figure 4.23: Chisels and Gouges.
Figure 4.23: Chisels and Gouges.

The reshaping of a broken Type 5 adze would probably involve extensive reflaking of the apex side to form a more symmetrical bevel and cross-section for normal hafting and use. A rounded quadrangular or plano-convex cross-section would probably result. Some Type 5 adzes may have been reworked or modified into Type 3 adzes. Several specimens recorded in Moore, Keyes and Orchiston's 5A list (1979:60-73) have bevels, blades and shapes more consistent with Type 3 (for example the Pig Bay adze - Figure 4.12e and the Waipapa Bay adze - Figure 4.12f) than Type 5. The reworking and modification these adzes have evidently received makes it difficult to identify their original form and function.

Unidentified Adzes  N = 530 (7.3%).

These are adzes either of indeterminate state or the products of special conditions. The majority of adzes in this category are broken pieces and fragments that were too incomplete for identification (see Table 4.1). It is strongly suspected that most of these fragments resulted from transverse fractures during reworking or repair but they lack the evidence of reflaking to classify them as such. Also included here are some rough flake adzes and unusual forms where the degree of use and repair could not be determined with confidence. An example of the latter situation is where bevels and blades have been reground in recent times on modern grinding wheels.

Some regionally distinctive forms are also included in this category. In Taranaki and Tamaki, use of local fine-grained materials, Taranaki argillite and Motutapu greywacke, continued into the Classic period, long after the Tahanga basalt and Nelson/Marlborough argillite quarries had ceased production (house terrace sites at Station Bay (R10/38) and Administration Bay (R10/497) Motutapu, pa in Tamaki - Taylors Hill, Maungarei; Taranaki Pa - Pukearuhe - Lawrence and Pickett 1984:16 and other pa - Urenui, Bellblock, Tarata, Okaiawa, Manaia, Whakamara - Taranaki Museum catalogue records). A significant aspect of these adzes is a change in form and technology from earlier Archaic forms which represent adaptations to the Duff 2B form, but with distinctive attributes that reflect the properties of the raw materials.

The small stubby tangless Motutapu greywacke ‘2B’ forms are generally more roughly finished and poorly formed compared with their coarse-grained counterparts (Figure 4.20a and m). This
reflects the difficulties of hammerdressing and grinding the very hard Motutapu greywacke compared to the ease of working softer coarse-grained materials with these methods. Thus flaking continued to be the initial shaping method. One reason for the continuous use of this fine-grained material was the shape of the parent material. An assemblage from a recently excavated house and terrace site on Motutapu Island (R10/497 - undertaken by the Auckland University Anthropology Department and students in 1995 and 1996 directed by Professor Geoff Irwin) overlooking Administration Bay demonstrates the use of small water-rolled pebbles commonly found on the beach below. These were often split laterally to form two blanks. Some rough bilateral flaking was generally undertaken to trim the sides before hammerdressing began.

Taranaki argillite was also very hard and difficult to hammerdress and grind. The Taranaki adze-makers, like the Motutapu greywacke adze-makers in Tamaki, had a major advantage in the shape and size of the parent material. Small flat smooth water-rolled pebbles found in local rivers were ideally shaped for conversion into small to medium rectangular tangless adzes with a minimum of shaping (see Figure 4.20b and c), less than was required with the generally thicker Motutapu greywacke pebbles. Another distinctive attribute of Taranaki pebble adzes is the manner by which blade corners curve in rather than flaring out following the outline of the pebbles from which they were derived. Unlike the coarse-grained 2B adzes and the stubbier Motutapu greywacke forms edge angles on Taranaki pebble 2B adzes are often quite low reflecting the toughness as well as hardness of the material.

An interesting observation in the Taranaki region was that a number of reworked Nelson/Marlborough adzes 'mimicked' the Taranaki argillite pebble adze form. An example is the D'Urville Island black argillite adze illustrated in Figure 4.19g. It was found at Te Kopunga Pa, Okaiawa with several Taranaki argillite pebble adzes and other reworked Nelson/Marlborough adzes.

**Summary of Results**

The data presented above emphasize the importance of recognizing the use-life state of an adze. Adzes in New Zealand represent a highly curated technology. Almost every aspect of an adze changed as a consequence of ongoing use, repair, modification and reworking. The North
Island sample was dominated by high frequencies of reworked adzes that reflects this high level of curation. In addition very few viable broken pieces had not seen some attempt at reworking.

Primary adzes, in contrast, were uncommon and would have entered the archaeological record only under exceptional circumstances, for example, when side-lined as burial goods or as a result of accidental loss while in storage.

Adze form changed as adzes progressed through the use-life trajectory, with the original form becoming difficult to discern at the modified stage and almost completely obliterated once the adze broke and the pieces were reworked. Adze function probably changed accordingly. Primary adzes were made to specific designs for specific purposes. Once the features characterising these designs were no longer present, adzes could not perform the tasks they were originally designed for. Their status may have changed also. Primary adzes were probably reserved for the construction of important items like canoes and houses and may have acquired mana or special status as a result of association with important projects and people. Reworked adzes were, in contrast, likely to have been relegated to everyday rough wood working tasks.

The major change as an adze progressed from primary to reworked was a marked decrease in size, especially length. This change alone would have been sufficient to cause a change in the tasks assigned. The majority of primary adzes were over 200mm long while reworked adzes predominated among adzes under 100mm long. Reworked adzes also had significantly narrower blades, thinner cross-sections, weighed less and had progressively steeper edge angles and shorter bevels.

Other adze features changed with ongoing episodes of modification and reworking. Primary adzes commonly had well defined sharp angled cross-sections and profiles which were often flaked finely to shape. Cross-sections and profiles on reworked adzes tended to become more rounded and indefinite as a consequence of applying more hammerdressing and grinding. Wide bladed primary adzes had narrow polls and flared blades but with episodes of modification and reworking sides became straighter and more irregular. Surfaces on reworked adzes became progressively more well ground as the application of flaking decreased with reduction in adze size.

Most primary adzes had some form of butt modification, commonly frontal reduction, and tangs would have been important to insure a secure fit between stone blade and haft, especially for large heavy adzes. On smaller lighter adzes hafting security was less essential. Butt modification was present on only a small number of reworked adzes, usually confined to lateral reduction on
thin-sectioned adzes, or by the action of rounding front corners by hammerdressing. On reworked bevel sections the broken fracture plane was often used as a striking platform to trim down adze surfaces, and on butt sections, was used to form a new bevel and cutting edge. Few primary adzes had poll modification reflecting the predominant method of hafting where the tanged butt was lashed to a flat footed one-piece helve with the poll projecting beyond the lashing area. Poll modification was more characteristic of reworked adzes suggesting that many were fitted into recessed or socketed helves as a consequence of their much reduced length. Functional experiments demonstrated that adzes could be used for significant periods before any physical evidence of that use could be discerned by the naked eye. The vast majority of finished adzes examined for this research had been used, many extensively and over a long period of time. The number of primary adzes that appeared never to have been used was low. Significantly, some of the largest Type 1 and 2 adzes ever recorded had strong evidence of use in the form of bad blade damage and painstaking attempts to repair it. Notable examples are two finely formed notched specimens from the Far North and the very long Patea adze. Experimental evidence suggested that such damage could only result from very rigorous and extended periods of use, use that went far beyond ritual removal of the first chip at the beginning of important wood working projects. The apparent use of such large adzes is also evidence that adzes approaching 500mm in length and weighing between 5-6kgs could and were able to be used, no doubt with impressive effect. This evidence raises doubt that adzes were ever specifically made in early period New Zealand for exclusively non-utilitarian purposes. Ceremonial status was likely accrued over time through association with special objects like canoes and special people and ancestors, especially given a probable long use-life in a primary state. Finely rendered primary adzes may have been reserved for special projects like canoe-building and probably played a major and vital role in their construction. During functional experiments, the evident durability and efficiency of stone adzes made it difficult to envisage what precisely would have caused them to break. The number of reworked adzes and broken sections recovered from the archaeological record suggests, however, that breakage did eventually occur. Until breakage occurs with the experimental adzes, causes of breakage may remain a mystery. Examination of cutting edges on broken pieces, while confused by the practise of blade rejuvenation and reworking, revealed that use must have been a major cause of breakage while a smaller number may have suffered a transverse fracture during blade repair. Snapped and chipped corners were the most common forms of blade damage and
subsequent repair would have resulted in considerable modification of other areas of the adze, often involving reduction in thickness and width, and most noticeably in length. The flared blades on primary adzes may have been a device that not only maximized blade width but also anticipated the problem of corner damage repair. Side trimming would not need to be so extensive or to cover such a wide area when repairing corner damage on flared blades, and for initial or minor damage, repair may have been confined to the bevel area. This is apparent in the archaeological data where flaring of the blade decreased through use-life stages (Table 4.11). Repair of blade corner damage would, however, usually necessitate reflaking which carries a high level of risk, especially for large adzes, and this may be the reason that the damage on the Patea adze blade was being repaired by the laborious but safer method of hammerdressing.

Symmetry was an important feature of primary adzes, particularly for large forms like Type 1 and tanged Type 2 adzes where an even distribution of mass contributed to adze performance and prevention of adze damage. The aesthetic appearance of primary adzes was gradually eroded as they proceeded through use-life stages, and as a consequence their value and functional status was probably downgraded. Adzes derived from reworked preforms were probably put aside for local use only and it is unlikely that they would have been distributed beyond the source area.

Only half the finished adze sample could be classified according to Duff's typology. A major flaw of the typology was the failure to account for changes in adze morphology over time as a consequence of use. The data presented above demonstrated how quickly the original primary form of an adze changed once major blade damage and breakage occurred.

Of note was the observation that the most frequent Duff type recorded for the major stone materials used in the North Island (Tahanga basalt, Nelson/Marlborough argillite and Motutapu greywacke) was the reworked 2B adze. These small and very standardized forms were significantly smaller than other quadrangular and rectangular reworked forms and represent a change in reworking technology, a change that may have been implicated in the changes over time in primary adze technology. They were well ground with only a few faint flake scars still apparent. Two other distinctive characteristics were very short steep bevels and poll modification that provide information on the manner by which most of these adzes were hafted and how they functioned. Their small size and short steep bevels probably confined reworked 2B adzes to light chopping tasks, and their extremely truncated length and poll modification indicate that many were slotted into recessed or composite helves.

Raw material qualities also influenced the adze forms produced by reworking. An example is
the reworked 1B adze, commonly rendered in Nelson/Marlborough but relatively uncommon in Tahanga basalt. The fine cross-sections and superior flakability of Nelson/Marlborough argillite (and almost 70% of the Nelson/Marlborough argillite 1B sample was of D'Urville Island argillite) facilitated the formation of laterally reduced tangs. On the generally thicker Tahanga basalt adzes this was not so readily accomplished nor did the flaking properties of the stone lend itself to marked spade-shouldering. The 1B form was later transferred to primary pounamu adzes that had characteristically thin cross-sections and where lime garnet could be used for effective tang reduction.

Nelson/Marlborough argillite dominated the reworked 2B sample. Indeed, the majority of Nelson/Marlborough argillite adzes were reworked. This result was unexpected given that the qualities of Nelson/Marlborough argillite adzes would predispose them to longer use-lives than other raw materials exploited in the North Island. But its high value and superior flaking quality may have seen a higher rate of curation and reworking success. Additionally, the distribution of Nelson/Marlborough argillite may have ceased before that of closer sources like Tahanga basalt and Motutapu greywacke, particularly to areas most distant from the source. An observation made of Nelson/Marlborough argillite adzes in Southland collections was similar. Though not recorded, the majority provenanced to this region were small much reworked specimens, an observation also made by Smith and Leach (1996) of the Shag River Mouth adze collection. Once adzes of valuable materials were no longer available a probable response may have been to intensify curation strategies.

The reworked 2B adze is, in appearance and finish, quite a different sort of adze from other reworked types which retain many features characteristic of early primary forms. Most reworked adzes were generally reshaped by flaking, and though they were often finished more thoroughly by hammerdressing and grinding, they were generally quite roughly formed and variable in form, often with some minor butt modification. Reworked 2B adzes were, in contrast, very standardized forms and shaped primarily and carefully by hammerdressing and grinding. Their similarity to late primary 2B forms in coarser-grained rocks is obvious. Reworked 2B adzes may, therefore, represent a marked change in adze technology. Whether the reworked 2B form preceded the later primary 2B forms, possibly abetting their development, or was alternatively a response to such a development, is addressed more fully in the next chapter.
Conclusion

Both experimental and archaeological data support the probability that adzes had long use-lives and underwent considerable morphological change as a consequence of intensive curation. Another important effect of continuous repair and reworking was changes in function. The state or use-life stage of an adze when it entered the archaeological record is therefore of fundamental importance when analyzing adze assemblages if we want to adequately explain tool variability. Adze morphology and variability, therefore, represent a complex interaction of raw material quality, manufacturing techniques, functional requirements and the effects of ongoing repair and reworking. Previous research (Turner 1992; Turner and Bonica 1994) detailed the strategies guiding raw material procurement and adze production. Chapter Three and the present chapter have been devoted to understanding adze function, design and use-life, hitherto missing elements when considering the technological organisation of adzes. One other important aspect that may have been influential were the choices available regarding raw material availability and the strategies involved in procuring adzes.

Having defined the principles that influence adze morphology, it is now possible to more effectively explain the contexts that adzes were found in, at both intra and inter-site levels. Some confusion still exists regarding the residential status of early sites (Davidson 1984) and little is as yet known about how imported materials and products were distributed around the country. Adzes as 'the analytic unit of comparison' (Nelson 1991:86) have the potential to provide information on site function and occupation duration as well as on the distribution and communication networks these sites were involved in.

In the early period, desirable rock sources for adze manufacture were unevenly distributed and many regions may have had to import almost all their adzes. As a highly curated technology entailing complex production and use-life stages that often took place in different contexts (Turner and Bonica 1994), and which continued to leave a trail of repair and reworking evidence in the archaeological record throughout their use-lives, adzes and associated by-products can be used to explore behavioral strategies underpinning settlement pattern and interaction. This is the subject of the next chapter.
Table 4.4: Length Data for Complete North Island Adzes

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<th>Type/State</th>
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<th>Mean mm</th>
<th>Standard Deviation</th>
<th>Standard Error</th>
<th>Range</th>
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Table 4.5: Blade Width Data for Complete Finished North Island Adzes

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297
Table 4.6: Thickness Data for Complete Primary North Island Adzes

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Table 4.7: Weight Data for Complete Finished North Island Adzes

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<td>8.3</td>
<td>3-435</td>
</tr>
</tbody>
</table>

Table 4.8: Edge Angle Data for Complete Finished North Island Adzes

<table>
<thead>
<tr>
<th>Type/State</th>
<th>N</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Standard Error</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Primary/Repaired</td>
<td>249</td>
<td>50</td>
<td>3</td>
<td>0.2</td>
<td>40-60</td>
</tr>
<tr>
<td>1 Modified</td>
<td>36</td>
<td>58.4</td>
<td>4.8</td>
<td>0.8</td>
<td>46-74</td>
</tr>
<tr>
<td>Quadrangular Reworked</td>
<td>37</td>
<td>58.9</td>
<td>6.8</td>
<td>1.1</td>
<td>31-46</td>
</tr>
<tr>
<td>2 Primary</td>
<td>61</td>
<td>38.9</td>
<td>4</td>
<td>0.5</td>
<td>31-46</td>
</tr>
<tr>
<td>1B Reworked</td>
<td>39</td>
<td>41.7</td>
<td>4.7</td>
<td>0.7</td>
<td>31-51</td>
</tr>
<tr>
<td>Rectangular Reworked</td>
<td>39</td>
<td>43.8</td>
<td>4.3</td>
<td>0.7</td>
<td>35-55</td>
</tr>
<tr>
<td>2B Reworked</td>
<td>62</td>
<td>63</td>
<td>5.4</td>
<td>0.7</td>
<td>53-74</td>
</tr>
<tr>
<td>3 Primary</td>
<td>43</td>
<td>37.8</td>
<td>5.1</td>
<td>0.8</td>
<td>28-50</td>
</tr>
<tr>
<td>3 Reworked</td>
<td>21</td>
<td>39.2</td>
<td>18.1</td>
<td>4</td>
<td>30-45</td>
</tr>
<tr>
<td>4A Primary</td>
<td>71</td>
<td>61.3</td>
<td>4.3</td>
<td>0.5</td>
<td>53-73</td>
</tr>
<tr>
<td>Gouges Reworked</td>
<td>39</td>
<td>48.4</td>
<td>5.5</td>
<td>0.9</td>
<td>36-40</td>
</tr>
</tbody>
</table>
Table 4.9: Blade Condition for Complete North Island Adzes

<table>
<thead>
<tr>
<th>Type of Damage</th>
<th>% All</th>
<th>% Primary</th>
<th>% Repaired</th>
<th>% Modified</th>
<th>% Reworked</th>
<th>% Unidentified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good Condition</td>
<td>12.6</td>
<td>21.3</td>
<td>6.4</td>
<td>8.2</td>
<td>13.4</td>
<td>6.6</td>
</tr>
<tr>
<td>Use Wear*</td>
<td>31.6</td>
<td>34.8</td>
<td>23.8</td>
<td>26.7</td>
<td>33.3</td>
<td>27.6</td>
</tr>
<tr>
<td>Minor Chips</td>
<td>12</td>
<td>15.6</td>
<td>8.8</td>
<td>9.6</td>
<td>8.5</td>
<td>12.6</td>
</tr>
<tr>
<td>Rough Repair</td>
<td>3.3</td>
<td>1</td>
<td>5.8</td>
<td>5.6</td>
<td>3.5</td>
<td>2</td>
</tr>
<tr>
<td>Heavy Use</td>
<td>3.9</td>
<td>1.9</td>
<td>6.1</td>
<td>6.5</td>
<td>3.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Front Corner chip</td>
<td>5.3</td>
<td>3.3</td>
<td>4.3</td>
<td>4.8</td>
<td>6.1</td>
<td>5.3</td>
</tr>
<tr>
<td>Back Corner chip</td>
<td>2.6</td>
<td>2.5</td>
<td>2.5</td>
<td>1.7</td>
<td>2.7</td>
<td>3.3</td>
</tr>
<tr>
<td>Both Comers</td>
<td>1.3</td>
<td>1.1</td>
<td>0.5</td>
<td>2.3</td>
<td>1.2</td>
<td>2</td>
</tr>
<tr>
<td>Edge + Corner</td>
<td>2.8</td>
<td>4.5</td>
<td>2.3</td>
<td>2.9</td>
<td>2.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Front Edge</td>
<td>2.3</td>
<td>1.7</td>
<td>1.3</td>
<td>2.3</td>
<td>2.2</td>
<td>3</td>
</tr>
<tr>
<td>Back Edge</td>
<td>1.9</td>
<td>2.2</td>
<td>1.2</td>
<td>1.9</td>
<td>1.9</td>
<td>2.7</td>
</tr>
<tr>
<td>Both Edges</td>
<td>2.1</td>
<td>2.2</td>
<td>1.7</td>
<td>2.5</td>
<td>2.3</td>
<td>3.3</td>
</tr>
<tr>
<td>Major Damage#</td>
<td>11.5</td>
<td>5.1</td>
<td>15.6</td>
<td>14.8</td>
<td>11.4</td>
<td>16.3</td>
</tr>
<tr>
<td>Under Repair</td>
<td>8</td>
<td>2.1</td>
<td>19.2</td>
<td>9.2</td>
<td>7</td>
<td>9.1</td>
</tr>
<tr>
<td>N =</td>
<td>4634</td>
<td>436</td>
<td>445</td>
<td>523</td>
<td>3096</td>
<td>134</td>
</tr>
</tbody>
</table>

# Use-wear = blades with blunt, striated edges or with use polish
* major Damage = snapped blade corners - see Figure 2

Table 4.10: Blade Symmetry (undamaged blades only)

<table>
<thead>
<tr>
<th></th>
<th>% Primary</th>
<th>% Repaired</th>
<th>% Modified</th>
<th>% Reworked</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symmetrical</td>
<td>94.6</td>
<td>64.6</td>
<td>50</td>
<td>64.4</td>
</tr>
<tr>
<td>Asymmetrical</td>
<td>3.1</td>
<td>10.7</td>
<td>31</td>
<td>19.2</td>
</tr>
<tr>
<td>Rough Repair</td>
<td>2.2</td>
<td>24.6</td>
<td>18.9</td>
<td>16.3</td>
</tr>
<tr>
<td>N =</td>
<td>328</td>
<td>263</td>
<td>296</td>
<td>1928</td>
</tr>
</tbody>
</table>
Table 4.11: Changes in Type 1 Adzes through the Use-Life Sequence Compared to Reworked 2B Adzes

<table>
<thead>
<tr>
<th>Change Type</th>
<th>Primary Type 1</th>
<th>Repaired Type 1</th>
<th>Modified Type 1</th>
<th>Rework Type 1</th>
<th>Rework Quad</th>
<th>Rework 2B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Length</td>
<td>277.8 mm</td>
<td>236.6</td>
<td>184.3</td>
<td>144</td>
<td>102.5</td>
<td>70.2</td>
</tr>
<tr>
<td>Mean Blade width</td>
<td>74.0 mm</td>
<td>68.5</td>
<td>57.5</td>
<td>54.5</td>
<td>44.7</td>
<td>41.7</td>
</tr>
<tr>
<td>Mean Thickness</td>
<td>49.0 mm</td>
<td>44</td>
<td>38.2</td>
<td>36.9</td>
<td>27.7</td>
<td>19.3</td>
</tr>
<tr>
<td>Mean Weight</td>
<td>1749 gm</td>
<td>1271</td>
<td>735.6</td>
<td>546.3</td>
<td>257.2</td>
<td>126</td>
</tr>
<tr>
<td>Mean Edge Angle</td>
<td>50 degrees</td>
<td>50</td>
<td>58.4</td>
<td>58.9</td>
<td>58.9</td>
<td>63</td>
</tr>
<tr>
<td>Steep Sides*</td>
<td>80.1</td>
<td>72.3</td>
<td>54</td>
<td>55</td>
<td>42.5</td>
<td>51.2</td>
</tr>
<tr>
<td>Flared Blades*</td>
<td>79.6</td>
<td>66.6</td>
<td>52.1</td>
<td>46.5</td>
<td>29.5</td>
<td>49.7</td>
</tr>
<tr>
<td>Angulation*</td>
<td>76.1</td>
<td>70.5</td>
<td>21.4</td>
<td>14.2</td>
<td>2.1</td>
<td>0</td>
</tr>
<tr>
<td>Fine Flaking*</td>
<td>64.5</td>
<td>59.3</td>
<td>25.9</td>
<td>21.4</td>
<td>12.9</td>
<td>8.6</td>
</tr>
<tr>
<td>Hammerdressing#</td>
<td>27.1</td>
<td>28.2</td>
<td>51.4</td>
<td>39.2</td>
<td>20.8</td>
<td>11.9</td>
</tr>
<tr>
<td>Grinding#</td>
<td>52</td>
<td>55</td>
<td>64.5</td>
<td>67.4</td>
<td>70.2</td>
<td>96.2</td>
</tr>
<tr>
<td>Butt Modification*</td>
<td>100</td>
<td>100</td>
<td>88.1</td>
<td>65.7</td>
<td>47</td>
<td>0</td>
</tr>
<tr>
<td>Poll Modification*</td>
<td>0</td>
<td>0</td>
<td>35.6</td>
<td>39.3</td>
<td>75.7</td>
<td>97.2</td>
</tr>
<tr>
<td>Blade Symmetry*</td>
<td>94.6</td>
<td>64.6</td>
<td>50</td>
<td>46.4</td>
<td>64.4</td>
<td>73.8</td>
</tr>
</tbody>
</table>

N = 93 78 87 56 625 1152

* = Frequency
# = Moderate to extensive Hammerdressing/grinding

Table 4.12: Blade Condition for Broken Bevel Portions

<table>
<thead>
<tr>
<th>State</th>
<th>% No damage</th>
<th>% Damaged</th>
<th>% Under Repair</th>
<th>N =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>63.4</td>
<td>20.6</td>
<td>15.3</td>
<td>47</td>
</tr>
<tr>
<td>Repaired</td>
<td>31.9</td>
<td>24.8</td>
<td>42.8</td>
<td>61</td>
</tr>
<tr>
<td>Modified</td>
<td>56.8</td>
<td>28.4</td>
<td>14.1</td>
<td>21</td>
</tr>
<tr>
<td>Failed Rework</td>
<td>22.8</td>
<td>26.6</td>
<td>54.5</td>
<td>391</td>
</tr>
<tr>
<td>Reworked</td>
<td>52.4</td>
<td>35.7</td>
<td>11.8</td>
<td>66</td>
</tr>
<tr>
<td>Unidentified Adze</td>
<td>60.8</td>
<td>29.1</td>
<td>10</td>
<td>112</td>
</tr>
<tr>
<td>All</td>
<td>39.2</td>
<td>22</td>
<td>38.7</td>
<td>698</td>
</tr>
<tr>
<td>Unreworked + Undamaged blades</td>
<td>71.9</td>
<td>0</td>
<td>28</td>
<td>153</td>
</tr>
</tbody>
</table>

300
### Table 4.13: North Island Broken Adzes

<table>
<thead>
<tr>
<th>State</th>
<th>% Butt Ends</th>
<th>% Bevel Ends</th>
<th>% Fragments</th>
<th>N= All Broken</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>6.4</td>
<td>6.7</td>
<td>6.8</td>
<td>111</td>
</tr>
<tr>
<td>Repaired</td>
<td>0.6</td>
<td>8.7</td>
<td>0.8</td>
<td>68</td>
</tr>
<tr>
<td>Modified</td>
<td>0.4</td>
<td>3</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Failed Rework</td>
<td>68.4</td>
<td>56</td>
<td>72.5</td>
<td>1154</td>
</tr>
<tr>
<td>Reworked</td>
<td>4.6</td>
<td>9.4</td>
<td>2.7</td>
<td>104</td>
</tr>
<tr>
<td>Unidentified</td>
<td>19.4</td>
<td>16</td>
<td>17</td>
<td>292</td>
</tr>
<tr>
<td>N=</td>
<td>639</td>
<td>732</td>
<td>382</td>
<td>1753</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Viable but not reworked</th>
<th>%</th>
<th>%</th>
<th>N=</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>66.9</td>
<td>0</td>
<td>115</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Viable Quadrangular</th>
<th>%</th>
<th>%</th>
<th>N=</th>
</tr>
</thead>
<tbody>
<tr>
<td>68.4</td>
<td>46.7</td>
<td>0</td>
<td>62</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Viable Rectangular</th>
<th>%</th>
<th>%</th>
<th>N=</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.5</td>
<td>53.2</td>
<td>0</td>
<td>53</td>
</tr>
</tbody>
</table>

### Table 4.14: Reworked Quadrangular and Rectangular Adzes and Preforms

<table>
<thead>
<tr>
<th>State</th>
<th>% Quadrangular</th>
<th>% Rectangular</th>
<th>Total N=</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failed Rework</td>
<td>43.4</td>
<td>23.5</td>
<td>1154</td>
</tr>
<tr>
<td>Reworked</td>
<td>28.8</td>
<td>55.8</td>
<td>3214</td>
</tr>
<tr>
<td>Rework Preform</td>
<td>40</td>
<td>16.8</td>
<td>463</td>
</tr>
<tr>
<td>All N =</td>
<td>33.3</td>
<td>44.1</td>
<td>4831</td>
</tr>
<tr>
<td>State</td>
<td>% Tahanga Basalt</td>
<td>% Nelson Marlborough Greywacke Argillite</td>
<td>% Motutapu Northland Waikato Basalt</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------</td>
<td>----------------------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>Primary</td>
<td>10.2</td>
<td>8.3</td>
<td>4.5</td>
</tr>
<tr>
<td>Repaired</td>
<td>8</td>
<td>8.3</td>
<td>5.3</td>
</tr>
<tr>
<td>Modified</td>
<td>8.5</td>
<td>7.5</td>
<td>6.6</td>
</tr>
<tr>
<td>Failed</td>
<td>23.7</td>
<td>12.1</td>
<td>22.2</td>
</tr>
<tr>
<td>Rework</td>
<td>43.4</td>
<td>61.4</td>
<td>50.2</td>
</tr>
<tr>
<td>Adze*</td>
<td>6</td>
<td>2</td>
<td>10.8</td>
</tr>
</tbody>
</table>

| N = All Finished | 2336 | 2566 | 855 | 188 | 73 | 135 | 49 | 212 |
| Roughout       | 3.1  | 0    | 3.1 | 0   | 2.5 | 0   | 0  | 3.6 |
| Rough Preform  | 48   | 22.4 | 40.2| 69.7| 47.5| 75  | 54.5| 57.3|
| Primary        | 24.7 | 62.9 | 30.3| 23.2| 20 | 25  | 45.4| 24.3|
| Preform        | 24   | 14.6 | 26.1| 6.9 | 30 | 0   | 0  | 14.6|

| N = All Unfinish | 1144 | 116 | 504 | 43 | 80 | 8 | 11 | 82 |
| Scrappy Flake Adze N= | 776 | 290 | 160 | 38 | 9 | 8 | 14 | 17 |
| All N=          | 4256 | 2972 | 1519 | 269 | 162 | 151 | 74 | 311 |

* = unidentified state or special types like Taranaki argillite and Motutapu greywacke pebble adze
Table 4.16: Reworked 2B Adze Length by Raw Material

<table>
<thead>
<tr>
<th>Stone</th>
<th>N</th>
<th>Mean mm</th>
<th>Standard Deviation</th>
<th>Standard Error</th>
<th>Confidence Interval 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tahanga basalt</td>
<td>333</td>
<td>68mm</td>
<td>18</td>
<td>1.66-70</td>
<td></td>
</tr>
<tr>
<td>Nelson/Marlborough</td>
<td>544</td>
<td>65mm</td>
<td>21.1</td>
<td>0.9 63-67</td>
<td></td>
</tr>
<tr>
<td>argillite</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motutapu greywacke</td>
<td>195</td>
<td>83mm</td>
<td>26.9</td>
<td>1.8 80-87</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>49</td>
<td>73mm</td>
<td>20.9</td>
<td>2.5 68-78</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1121</td>
<td>70mm</td>
<td>22.6</td>
<td>0.6 68-71</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.17: Far North Nelson/Marlborough Argillite Adzes

<table>
<thead>
<tr>
<th>Stone</th>
<th>% Primary</th>
<th>% Reworked 2B</th>
<th>% Type 1</th>
<th>% All</th>
</tr>
</thead>
<tbody>
<tr>
<td>D'Urville Island</td>
<td>69.6</td>
<td>66.6</td>
<td>72.7</td>
<td>66</td>
</tr>
<tr>
<td>Other</td>
<td>30.3</td>
<td>33.3</td>
<td>21.2</td>
<td>33.9</td>
</tr>
<tr>
<td>All N=</td>
<td>33</td>
<td>63</td>
<td>33</td>
<td>268</td>
</tr>
</tbody>
</table>
CHAPTER FIVE: CONTEXT AND DISTRIBUTION

Introduction

This thesis has thus far been primarily concerned with identifying the influences on adze morphology. Chapter Three determined that function was the guiding principle while the character of suitable raw materials and the techniques applied influenced how the required adze form was realized. Chapter Four looked at what happened to adzes during their use-life, one that was prolonged by the practise of reworking. Recognizing adze state emerged as significant in understanding how adzes entered the archaeological record and under what contexts.

This chapter looks at the broader picture - how this knowledge can be used to inform on site function and inter-site relationships. Definition of both is necessary in order to identify trade and exchange patterns as perceived from the distribution of adzes – the subject of Chapter Six. Adzes, as artefacts, are associated with, and represent, distinct activities which in turn represent certain contexts within sites and certain relationships among people located at sites across the cultural landscape.

Adzes are the product of a curated technology and this has important implications when using adzes as units of analysis in studies of site function, settlement role, and trade and exchange:

1. There are staged episodes of manufacture, each with distinctive debitage. This evidence provides the potential to identify who was involved in adze production and to make distinctions between producers and consumers.

2. Production rates were slow and costly but functional benefits were high. Production costs were likely to have been passed on to consumers. Thus adzes were probably very valuable, handled carefully and stored when not in use. They were not generally discarded after breakage as the value of adzes also reflected the value of the stone materials they were made of. Use-life was enhanced by recycling thus the point of discard is less likely to represent the place of use. Complete and operational (or repairable) adzes were probably stored at the place where people
spent most of their time. The time and effort required in manufacture, repair and reworking suggests that these activities were not generally done 'on the spot'. Rather wood-workers, during a wood working project, would have a back-up supply, and return broken bits and damaged adzes to the home base for fixing at a later date when there was time to spare - during 'down-time'. Also typical of a curated technology, adze kits were heavy as was the range of tools used in their manufacture, repair and reworking. This would have reduced their portability. Thus it would be unlikely, for example, to find evidence of finished adzes and the debris from adze reworking and repair at a temporary fishing or hunting camp. Many early New Zealand sites are classified as temporary food processing camps (for example, Anderson and Smith (1996a) of the majority of 'moa-hunting' sites on the east coast of the South Island, and Shawcross (1972) of the Mt Camel site in northern North Island), yet most of these sites have yielded large assemblages of adzes in various states. For many New Zealand early sites large artefact collections dominated by stone tools exist for which no contextual information is available. By identifying the state of adzes when they entered the archaeological record, there is the potential to reconstruct a range of site contexts (death/burials, storage/houses, workshops, middens).

3. Adzes made of high quality raw materials like Nelson/Marlborough argillite and Tahanga basalt were distributed over long distances, an aspect that makes them eminently suitable for the study of trade and exchange relationships. For any study of distribution and interaction, however, the context in which the adzes were found and the settlement role of the sites where they were found are crucial factors. To understand the process by which adzes were distributed around the cultural landscape, the cultural landscape itself must be defined. As observed in Binford's study of the Nunamiut hunter-gatherers (1977,1979), acquisition of raw materials was embedded in a seasonal round that involved bi-annual shifts of base residences. From these, hunting trips were undertaken that followed migratory herds over distances of up to 140kms. Nomadic hunting and gathering groups could collect raw materials as they passed through source areas in their territory. People permanently located in one area, in contrast, either had to make special trips to source areas or acquire raw materials and products through trade and exchange. It is necessary, therefore, to define the degree of temporary or permanent/sedentary occupation before determining the nature of trade and exchange patterns. It is also necessary to demonstrate that sites reflecting exchange relationships were contemporary.
One disadvantage of curated technologies is that products are less likely to be discarded at the point where they were first received. The archaeological record represents the context of discard rather than the context of exchange (Hodder 1978). But adze state is helpful in this regard. Adzes found in early use-states (primary, repaired) are more likely to represent the place where they were first acquired. For example, the presence of primary adzes at a site is likely to indicate:

1. Storage = houses and/or burials - places where people spend most of their time.

2. The original context of acquisition.

A model outlining the steps that need to be addressed in order to arrive at an understanding of the trade and exchange patterns which may have existed during the early period of New Zealand prehistory is presented below. Step A is the subject of the present chapter while steps B-C are described in detail in Chapter Six.

**A Model for Defining the Distribution of Early New Zealand Adzes**

**A. Context**

1. The nature of the settlement pattern - was the procurement of raw materials/products embedded in a seasonal round involving residential shifts or did people operate from permanent residences which involved either special trips to sources or trade and exchange relationships?

2. Site distribution, location and function of early sites in New Zealand (the significance of contexts in which adzes are found). If permanent residences can be established, the following issues require attention:
   - Are sites from which adze samples derived contemporary and do all represent permanent residences?
   - Examine dating evidence and the range of survivals - are all aspects of everyday life represented? (are all adze states represented?)
3. Do the adze samples represent contexts of initial acquisition? To investigate this, adze state needs to be examined, and adze samples assessed for comparability and possible bias.

**B. Production** (see Chapter Six)

**C. Distribution** (see Chapter Six)

Aspects of context will now be examined in detail below.

**A. Context - The Pattern of Early Settlement**

In New Zealand the degree to which people during the early or 'Archaic' phase of Maori culture practised logistical or residential mobility remains an issue of some debate (Davidson 1984:151,163-170) though recent publications on the Shag River Mouth (North Otago) excavations are informative in this regard (Anderson and Smith 1996a; Anderson, Allingham and Smith 1996). Anderson and Smith (1996a) assert that this site, described as a 'transient village', was occupied continuously for a period of some 20-50 years in a location boasting an abundance and variety of 'wild foods'. When the immediate environment could no longer sustain subsistence needs, the village was abandoned and the inhabitants shifted to another unexploited location (1996a:368,369). Only a small number of all the southern New Zealand sites are classified by Anderson and Smith as 'transient villages' however, and the majority of east coast river mouth sites in the area are described as '…localities of repeated, seasonal processing of moa carcasses for consumption and storage' (1996a:364). In the following discussion I put forth the argument that these sites, along with similar settlements in the North Island, also functioned as villages characterised by continuous occupation.

Archaeologists generally refer to a set of criteria or indicators to determine whether a site was occupied on a temporary or permanent basis. These are listed briefly by Anderson and Smith (1996a:360) and discussed in detail by Rafferty (1985). These are discussed below with reference to the sites from the early settlement phase of Maori culture.

**1. The presence of substantial structures**
Substantial (often rectangular) houses and ceremonial structures are commonly associated with permanent sedentary settlements while simple quickly constructed circular huts are associated with communities that practised high residential mobility (Rafferty 1985:129).

In New Zealand early sites, dwellings of any description are notoriously uncommon and continue to elude archaeologists. Shag River Mouth, where 44 hut sites have been recorded, is a notable exception (Anderson and Smith 1996a:361). This lack of house evidence has been a factor in classifying many sites as temporary camps. Because Maori houses and structures were made of non-durable materials (wood), hearths and post-hole patterns are generally all that remains of dwellings in the archaeological record. Post-hole patterns in early sites, however, seldom provide illumination and commonly indicate structures like wind-breaks, cooking shelters and drying racks rather than dwellings (Davidson 1984:159). The substantial rectangular house excavated at Moikau, Palliser Bay (Anderson 1986; N.Prickett 1979,1982) is the only example of this kind known from any site dated to the early phase, but there are suggestions that the 12th century date for this site may be too old (Anderson 1991:786; Davidson 1983:301; Foss Leach pers.comm.).

Ethnographic and archaeological evidence from the late 'Classic' phase and post-European period show that houses, including round huts, commonly had centrally placed stone-lined hearths to provide light and warmth. However, hearths were not always present or stone-lined and could take ‘...the form of shallow scoops filled with ash and charcoal...' (Davidson 1984:160). The latter type in particular may be difficult to distinguish from separate cooking fires and outdoor fireplaces in the absence of post-hole patterns (Anderson 1986; Leach 1972a).

The rarity of post-holes indicating dwellings may relate to the type of house or 'hut' that may have been a common form in early sites - the circular freestanding hut of 'cruck' construction (Anderson 1986:104-106). Ethnographic records of similar huts used in the 19th century during the mutton-birding season in southern New Zealand (defined as the area extending from Rakaia River Mouth in south Canterbury to the bottom of the South Island - see Figure 5.1 and Figure 5.2 for locations mentioned in the text, also Anderson and Smith 1996b:289). While seemingly of an insubstantial and flimsy nature, some of the larger huts are known to have lasted 40 years with regular maintenance. Additionally they were warm, wind-resistant, quick and easy to make and provided more head and floor space than rectangular huts (Anderson 1986:102-104). They may, therefore, have been the characteristic house type of permanently occupied early New Zealand
sites. Rafferty also notes that the association of circular huts with sedentary communities in the ethnographic record is not uncommon (1985:130).

The difficulty, however, lies in identifying them from the meagre evidence that they leave behind in the archaeological record. Also, many of the early reports of 'hut-sites' are regarded by Anderson as dubious (1986:101), containing as they do vague references to 'circular hollows' and 'fireplaces' (for example, Griffiths 1941,1942,1955; Teviotdale 1939) with little further qualification.

The problem with identifying evidence of dwellings is exacerbated by post-depositional processes. Erosion, ploughing and vigorous fossicking have exacted a heavy toll on almost all known early sites to the extent that for southern New Zealand some archaeologists doubt if any remain intact for future investigation (H.Leach 1972b:14). House sites are particularly vulnerable to these destructive processes. Janet Davidson noted that even the substantial dwelling at Moikau had rather shallow post-hole depths averaging fifteen centimetres (1984:158). Interestingly this is approximately the depth of the disturbed plough zone recorded at Waitaki River Mouth (Knight and Gathercole 1961:23). Ploughing also accelerates surface erosion and it has been estimated that the surface on the Wairau Bar site deflated rapidly by some 30 centimetres after ploughing (Anderson 1989:123). Few early sites have escaped ploughing, particularly on the east coast of the South Island. Some sites were first ploughed over one hundred years ago. The Rakaia River Mouth site, for example, was first ploughed in the 1870's (Haast 1872a). The unusual preservation of 44 hut sites at Shag River Mouth may be partly attributable to the fact that it has never suffered this kind of disturbance. Teviotdale made frequent references to the difficulties of locating huts at Waitaki River Mouth because ploughing had '...destroyed all surface features such as hut sites so no information can be obtained there' (1939:168). In contrast, the greater depths of ovens and middens (75cm-100cm depths recorded for Rakaia Mouth - Trotter 1972:134, and Waitaki Mouth - Knight and Gathercole 1961:24; Teviotdale 1932:95) may have favoured their survival, and may partially explain why they are often the most dominant and visible feature in these sites.

Teviotdale's interest in seeking out hut sites highlights another source of destruction, that of fossicking which, as in Teviotdale's case, was often intensive, extensive and without restraint (Leach 1972b). Indeed, Knight and Gathercole refer to the Waitaki River Mouth site as having been a 'happy hunting ground for fossickers' (1961:22). Fossickers commonly targeted hut sites because they knew them to be the most likely repository for valuable artefacts, but they usually
destroyed structural evidence in the process and rarely recorded any details about them before doing so (Thomson 1944:50; Trotter and McCulloch 1989:37). Teviotdale, while digging at Waitaki River Mouth in the 1930's, was himself impeded by the work of fossickers who had been there before him:

'...I found no heaps of ashes where fires had been, and saw no fireplaces in situ. Several of the hut-sites had large stones lying on them, but the fireplaces had all been destroyed by curio-hunters' (1939:171).

This may explain why he and other fossickers failed to unearth the large numbers of adzes that were not discovered until ploughed up by farmer Willetts in 1952 (Duff 1977:73). Surface evidence of the probable hut sites they were associated with had been destroyed (possibly by wind erosion after the site was first cleared) prior to this event, but the adzes, probably cached in the floors of these huts (as seen at Wairau Bar, for example - Duff 1977:78), escaped detection until further disturbance exposed them.

Coastal sites at river and harbour mouths are also vulnerable to vertical erosion, often from both seaward and harbour/riverside margins, while active sand dunes and wind erosion are additional problems. It is estimated that as much as half of the Waitaki River Mouth site has fallen into the sea and all of the Pounawea site has met this fate (Anderson 1989:131; Anderson and Smith 1996b:290). Inland sites appear to have fared slightly better in the preservation stakes and circular huts have been excavated at several of these in southern New Zealand (Hawksburn and Glenaray - Anderson 1980; Anderson 1989:144-148).

Little evidence remains in the archaeological record to inform on the nature of ceremonial structures. The few rare examples (recovered from swamps) of early styles of wood carving like the Kaitaia Lintel and the Temuka 'Crescent' carving (Skinner 1974:35; Trotter and McCulloch 1989:44,45) may indicate that ceremonial structures existed but nothing remains in original context. Burial areas are also seen as inferring more permanent occupation. Burials are, however, even more elusive than hut sites, possibly for the same reasons. The 44 burials found at Wairau, like the hut sites at Shag Mouth, are a remarkable exception, and it is pertinent to note that the evidence for hut sites at Wairau is sparse and ill-defined (Anderson 1989:124). The burials at Wairau were also
Figure 5.1: Map of New Zealand showing Major Regions.
Figure 5.2: Map of Southern New Zealand.
Figure 5.2: Map of Southern New Zealand.

discovered by accident as a result of ploughing, and the circumstances that brought them to the attention of the academic world at that time (1939) was probably also exceptional (Duff 1977). Only three burials have been recorded from Shag River Mouth and little is known about them (Allingham 1996:23,32). Their location at the eroded seaward margin of the site may indicate
that much of the original burial ground has been removed by the sea. A tendency to place burial areas on the periphery of habitation sites (as at Wairau) may have facilitated their disappearance from the archaeological record at other sites like Waitaki (Allingham 1996:32; Anderson and Smith 1996b:278). Other early burials containing grave goods - notably adzes - are Rakaia River Mouth (Haast 1872b), Redcliffs (Haast 1875), Kaikoura (Anderson 1989:126), Pleasant River (Anderson 1989:136), Farewell Spit (Nelson Museum catalogue), Washpool (Leach and Leach 1979), Horowhenua (Atkin 1948), Whakatane (Whakatane Museum catalogue), Opito (Olsen 1980), Hahei (Edson and Brown 1977), and Ahuahu (Auckland Museum catalogue).

In summary, the absence of dwellings and burials in early New Zealand sites are not reliable indicators of permanent or temporary occupation. 'Absence' is more likely to be the outcome of 'disappearance'. But some information may be sought from artefacts that may have been found in houses. Indeed the more lively descriptions of the artefacts accompanying vague references to 'fireplaces', not to mention the artefacts themselves, may be very significant in this respect. Prominent in the descriptions of 'finds' found at 'hut-sites', 'fire-places' and 'circular hollows' are adzes - sometimes in caches, and there are frequent references to complete finished 'valuables' being found away from cooking and food processing areas (for example, Griffiths 1941,1942,1955; Haast 1872a; Hutton 1876; Teviotdale 1924,1932,1939). It was this pattern at Rakaia River Mouth, where unground flake tools were found in association with cooking and food processing areas while ground stone tools (adzes) were found in other contexts like fireplaces, that led Haast to advance the erroneous theory that the flaked tools belonged to a Paleolithic culture and the adzes to a later Neolithic people (Haast 1872a). While Willetts did not describe any features associated with the adze caches he ploughed up, the adzes themselves indicate that they were probably associated with a storage structure of some kind, and the archaeological evidence suggests that, for the early period, this structure is most likely to be a dwelling.

2. Subsistence practises and ecological factors

The types, range and abundance of food remains are also considered informative in assessing the permanent or temporary nature of a site. Factors such as the ability of a site’s catchment area to sustain a permanent settlement are important considerations, including not only the abundance of resources within them but their availability and accessibility. If important foods are only
available in certain seasons in different places there are two basic strategies. One is to follow the food in a seasonal round involving high residential mobility. The other is to catch, collect and/or produce a surplus of food during times of high availability and preserve and store enough of it for times of low availability. This enables the population to stay in one place for the whole year, that is, continuously (Rafferty 1985:118,124,125).

In New Zealand, where there are distinct seasonal changes and, where the ethnographic record indicates that Maori had a long tradition of a subsistence strongly influenced by the seasonal round, faunal analysis was once considered by archaeologists to have the potential to identify the season a site was occupied (see, for example, Shawcross 1972). But as Davidson has noted, such studies proved useful for telling us what people were doing in summer (when conditions were favourable for catching and gathering food) but not in winter. Maori also have a long tradition of food storage and preservation indicating that what was caught and collected in summer was not necessarily eaten, or the remains discarded, at that time (Davidson 1979,1984:145,146,169). Additionally, where extensive analyses have been conducted on a wide range of faunal material from a site, seasonal indicators have indicated a seasonal variation that covers the whole year. Such was the case when this was undertaken for Shag River Mouth (Anderson and Smith 1996b:283). The perception that most early sites represented temporary camps was more readily accepted when gardening was not considered to have played a role in subsistence at this time (Duff 1977; Green 1963). But evidence from the Coromandel Peninsula, Tamaki and Palliser Bay has since demonstrated that gardening was probably practised from the time of initial settlement (Bulmer 1989; Davidson 1984:117-121; Leach 1979a,1984). Furthermore, Palliser Bay was an area considered marginal for gardening thus it is highly likely that tuber cultivation was practised in other parts of the North Island, and possibly in the South Island as far as Bank's Peninsula, at the same time, if not earlier, particularly in warmer more optimal areas like Northland. While some authors still express doubt about the importance of horticulture in the early period (Anderson and McGlone 1992:215; McGlone, Anderson and Holdaway 1994:138), cultigens were obviously important foods in tropical Polynesia, and the efforts required to induce them to grow successfully here indicates that their importance was probably retained in New Zealand (H.Leach 1984:70,71). Additionally, an abundance of accessible protein does not mean that people would readily give up their vegetables, types of food not so forthcoming in the native New Zealand environment (Anderson and McGlone 1992:200).

Davidson comments:
'If the first settlers were horticulturalists, however, they must have sallied forth from established settlements, at which some people remained to tend gardens and store produce' (1984:165).

Ethnographic data for some 150 cultures from different places in the world demonstrated that 90% of those that practised agriculture were sedentary (Rafferty 1985:134). Anderson, however, cites historic evidence from southern New Zealand to argue that the practise of horticulture does not necessarily tie people permanently to one location. In southern New Zealand, horticulture was not possible until after the Europeans had introduced the hardy potato. Yet despite its cultivation, southern Maori continued to be highly mobile undertaking seasonal expeditions for resources that could be located hundreds of kilometres away (1991:790). But this was not strictly residential mobility. Villages were continuously occupied by at least some proportion of the population (Anderson and Smith 1996a:370). Additionally, the tender tropical cultigens that had to be adapted to New Zealand's more temperate and seasonal climate undoubtedly required greater care and more constant attendance. Firth, drawing on ethnographic evidence, states that there was only two months of the year in New Zealand (April and May) which did not involve a constant round of gardening duties (1959b:70-75). Underground storage facilities were also an important horticultural device to keep the crop viable over winter, and again, this may have tied people to one place for long periods of time.

Calculating the amount of food represented from the faunal remains at a site has also been used to assess the nature of occupation. An example is Shawcross' 1972 study of the faunal remains recovered from the Mt Camel site at the mouth of the Houhora Harbour in the Far North. Combined with stratigraphic evidence, Shawcross concluded that there was not enough food eaten at Mt Camel to have sustained more than twelve seasonal occupations by a small group of people (1972:605). From a re-examination of the Mt Camel material, Nichol stated that permanent occupation at Mt Camel was feasible if the input from horticulture was taken into consideration (1988:212).

While East Polynesians brought only one domestic animal (apart from the kiore or Polynesian rat) to New Zealand, the kuri or dog, it appears in most early archaeological sites. For some early communities dogs were an important contribution to the diet, for example, Motutapu Island and Whangamata on the Coromandel east coast (Allo 1970,1972; Nichol 1981,1988; Smith 1981). Evidence from sites like Sunde on Motutapu suggest that dogs may have been kept in pens
(Nichol 1981). Keeping and breeding dogs for meat and raw materials would have been much
easier at permanent settlements.
Thus, for most of the North Island and possibly the north east areas of the South Island,
involvement in horticulture may have favoured the permanent village over a series of seasonally
occupied camps. But south of the Banks Peninsula, there was no such constraint because the
harsher climate made gardening impossible. It is fortunate, therefore, that recent studies
concerning the nature of early settlement have focused on this area, an area that was particularly
abundant in wild foods, notably the moa and fur seal. Moa tended to be largely concentrated in
the hinterland while seal breeding colonies were common on the mainland coast, particularly in
southern New Zealand (Anderson 1982a,1989; Anderson, Allingham and Smith 1996; Anderson
and Smith 1996a). Thus, almost every river mouth along the east coast of the South Island has
evidence of a 'moa-hunting camp' suggesting that people placed themselves at locations which
maximised access to inland and coastal resources. Furthermore, in southern New Zealand
particularly, early sites contemporary with the coastal settlements are found in upriver inland
A model of 'integration and mobility' was first introduced by Anderson in 1982 to explain the
subsistence/settlement system in early southern New Zealand and remains more or less unaltered
in light of results from recent excavations at Papatowai (Anderson and Smith 1992) and
especially Shag River Mouth (Anderson, Allingham and Smith 1996; Anderson and Smith
1996b).
Of over 180 'moa-hunting' sites in southern New Zealand (see Anderson 1989:121 Figure 9.1
and 1989:142 Figure 10.1), only eight, including Shag River Mouth, have been defined as
sedentary settlements '...occupied continuously for some years...' (Anderson and Smith
1996a:360). All inland sites and the majority of coastal sites are defined as temporary 'moa-
processing camps' (Anderson 1982a,1989; Anderson and Smith 1996a:364), though a few were
also fishing camps, stone quarries and 'ti-processing' stations (Anderson and Smith 1996b:289).
The eight sites identified as sedentary settlements or 'transient villages' are classified as having a
coastal economic focus. At these sites fishing, sealing and shell-fishing were practised in addition
to moa-hunting. A wide range and abundance of artefacts also accompanied this diverse faunal
range. The temporary sites, in contrast, had an inland economic focus characterised by a narrow
range of artefacts and a faunal assemblage dominated almost exclusively by moa. All these sites
were tightly linked but were not all occupied at the same time. Permanent occupation was
probably of short duration (20-50 years as indicated by the Shag River Mouth evidence) during which the inhabitants exploited resources in the immediate environment. When these were depleted, villages were shifted to the next unexploited, unoccupied location. Temporary inland focus sites may have been used intermittently for longer periods of time. This subsistence/settlement system appears, from the radiocarbon dates, to have had its inception some time in the 13th century, reached its peak in the 14th and early 15th centuries, and collapsed by the mid-15th century, possibly after no further viable areas remained to be exploited, and after moa became extinct and seals had been extirpated (Anderson and Smith 1996b:286-290).

There are problems with this model, however, and the relationship between the inland focus temporary sites and the coastal focus permanent sites is poorly defined. In 1932 Teviotdale advanced the theory that sites like Waitaki were exploited seasonally by people from permanent settlements further north like Wairau Bar. In this theory moa were hunted and partially butchered at riverside inland sites then freighted down the river to the coast by means of quickly made reed boats (mokihi). At the river mouth large scale cooking in earth ovens took place and the meat was preserved in fat and stored in bags made of bull kelp. These were then removed from the camp and taken back to the permanent settlements. Thus preservation and storage played a major role in the functioning of these temporarily occupied 'moa-processing camps'. But it was not until systematic excavations were undertaken in the 1980's that this theory could be properly tested. Excavations at sites like Hawksburn (Anderson 1980), Papatowai (Anderson and Smith 1992) and Shag River Mouth (Anderson, Allingham and Smith 1996), and detailed analysis of the faunal remains found there, revealed little evidence to support the major role of preservation in Teviotdale's model. Anderson and Smith state that:

'As far as we can tell, neither long distance movement of food supplies nor preservation of seasonally abundant resources played a significant role in subsistence' (1996b:289).
Instead it appears that most of the food cooked in ovens at both temporary and permanent sites was consumed in situ. Additionally the inferred social habits of moa and the evidence from butchery sites do not support the idea of mass capture but rather the taking of individuals or small family groups (Anderson 1989:150,151).

This evidence introduces a major problem with the Anderson model. Temporary sites do not appear to have food resources that were unavailable in the immediate environment of permanent sites. Thus it is difficult to understand why people were apparently going further afield to hunt and process moa when there was an ample supply, and seals and fish besides, much closer to home. Shag River Mouth is some 60 kilometres south of Waitaki River Mouth and Anderson and Smith suggest that it is possible, given the contemporaneity of occupation indicated by the radiocarbon dates, that the Shag Mouth inhabitants were among those who visited Waitaki (1996b:287). This appears to contradict an earlier statement which states that at Shag River Mouth 'All major classes of fauna disclosed patterns of butchery indicative of processing on or near the site...' and that 'All fauna are taxa which probably lived in the local area' (1996b:286,287). Regrettably, the actual extent of this 'local area' is not clearly defined.

This problem may be overcome by suggesting that people were going to sites like Waitaki for some other reason, and that moa were hunted, cooked and eaten while people were engaged in some other unspecified activity or activities. For Waitaki at least, the numerous wood working tool-kits recovered there might provide a clue to this unspecified activity. We might, for example, perceive Waitaki as a 'wood-working' camp, possibly for the manufacture of canoes. The Waitaki River was long, wide, swift, straight for much of its course and provided access, not only to inland moa populations and sources of silcrete, but to stands of beech and totara forest. Both moa and logs (possibly partially roughed out) could be easily and quickly floated down the river to the site at the mouth where river channels and the nearby lagoon would have provided easy and secure anchorage (Anderson 1989:131,132; Teviotdale 1939:168). Stands of forest may have
been less frequent and less accessible by river in the drier more sparsely forested central Otago region to the south. With such an explanation, the Anderson model may be accommodated intact. But there are other inconsistencies. One relates to the assumption that a wide range of both faunal and artefactual remains must be present before a site can be declared of permanent settlement status. Thus the eight 'transient villages' identified by Anderson and Smith (1996a:360) form two clusters on the southern coastline where such a range of fauna is available. Between Moeraki and

Bank's Peninsula seal colonies were rare and fishing conditions difficult north of Awamoa (Anderson 1989:152). No site in this area (south Canterbury) has been classified by Anderson as a transient village. Anderson states that it was the range of fauna, not an abundance of moa, that determined village location but this becomes a circular argument. The largest sites in terms of areal extent have been found in the South Canterbury area. The site at Rakaia River Mouth may have covered 80 ha and Waitaki River Mouth is by far the largest site on the east coast at an estimated 120 ha (Anderson 1989:131; Haast 1872a; Trotter 1972). Of the 'transient villages' identified by Anderson and Smith (1996a), none are larger than 8 ha (Pleasant River and Harwood) and Shag River Mouth is about 2 ha (Anderson 1989:134,136,137). The very large 'moa-processing' sites like Rakaia and Waitaki are characterised by huge quantities of moa bone and ovens and middens that resulted from the cooking and processing of moa. At Waitaki River Mouth, the cooking of at least 29,000 moa and possibly as many as 90,000 in an estimated 1200 ovens may have taken place according to Anderson (1989:133). At Shag River Mouth an estimated 3300 (minimum) to 9240 (maximum) moas were cooked and consumed. With the average moa at Shag providing about 55 kgs of meat and with an average consumption of 0.25 kg a day per person, this number of moa could have fed 100 people for 20-56 years (Anderson, Worthy and McGovern-Wilson 1996:212). Moa undoubtedly contributed more to the protein intake of the Waitaki inhabitants than at Shag where seals and dogs may have provided an additional 0.15 kgs of meat per person/day (Smith 1996:198). So if each person had one moa 'steak' a day (0.5 kgs average with larger more active adults eating more and older people and children eating less), 29,000 moa would last 100 people 87 years and 90,000 moa would feed the same number for 271 years. While Anderson admits that such calculations are highly speculative (1989:133), they do indicate that sites like Waitaki were as capable of sustaining permanent populations as those like Shag, albeit with a more restricted meat menu. Nor are these sites
completely devoid of other fauna. The remains of seals and other marine mammals, dog, fish, shellfish and a range of small birds have been recorded. A varied range of food remains is not of primary importance in Rafferty's discussion of 'Indicators of sedentariness' and there are many ethnographic examples of sedentary communities which focused on one main source of protein (Rafferty 1985). Closer to home are the Moriori of the Chatham Islands who, without moa and unable to garden, located their permanently occupied villages close to seal breeding colonies which provided up to 80% of their diet (Sutton 1982:176). Rather it is the reliability and availability of a resource that may be important (Rafferty 1985:119). There is no evidence that suggests moa were not available all year round, though spring may have been favoured because eggs could also be taken then (Anderson 1989:154).

It is the restricted range of artefacts found at sites like Waitaki and Rakaia that give additional and possibly critical weight to the interpretation that they are temporary moa-processing sites. But it is likely that the presence of some artefacts is highly correlated to the range of faunal remains. For example, fishing gear is notably abundant at identified coastal permanent sites like Shag River Mouth and Little Papanui (Simmons 1967; Smith, Campbell and Bristow 1996) but, predictably, is very uncommon at inland economic focus sites. Again the uneven nature of archaeological investigations (neither Waitaki or Rakaia have been subjected to the detailed level of analysis and excavation of Shag River Mouth), and the damage wrought by post-depositional processes means that an absence or scarcity of evidence should not be taken to mean it was not present and more abundant in the past. The interpretation of artefactual remains is another problem with Anderson's model and this is addressed in the next section.

3. Portable artefacts

The abundance and particularly the range of artefacts found in a site is generally seen as a good indicator of sedentariness. People who settle in one place are no longer constrained by the need to minimise the load they have to carry from place to place. The amount of material entering the archaeological record is also likely to increase with the amount of time people spent at a site. Additionally, when people spend most of their time in one place a greater variety of activities is likely to be represented. A very restricted range, in contrast, is more likely to represent specialised use of a site, and by inference, usage of a temporary or intermittent nature (Rafferty 1985:135).
Sites from the early period in New Zealand are "...surprisingly and predictably uniform in the richness of their artefactual content" (Groube 1967:16). But the implications of Groube's statement was largely ignored in the early literature when the majority of early sites were considered to be temporary camps. Nevertheless, in 1967 Groube made a very pertinent observation:

"The common description of Moa-hunter (or Archaic) settlements as 'encampments' or 'camp-sites' is clearly a misrepresentation of the evidence. The most characteristic feature of early sites in New Zealand is the generalised range of survivals, including not only food debris...but completed artefacts (adzes, fishhooks, ornaments) broken and abandoned artefacts, debris of manufacture..., cooking remains..., evidence of houses and home hearths, burials..., and (in North Island sites) evidence of storage associated presumably with agriculture. Such sites with a wide range of evidence from many levels of activity do not suggest a true camp-life, rather a settled, although not necessarily fully permanent 'village' life, where almost all the ordinary activities of day-to-day life..., round the year activity (replacement of lost or worn-out artefacts..) as well as crisis involvement (deaths, burials, births) take place in one area" (1967:15).

By this time, however, interest in artefact studies was declining as archaeologists were urged to extend research to other types of analysis like that of faunal remains and settlement patterns. The context in which artefacts are found and the activities they represent have been particularly neglected (Anderson 1982a:68,69; Davidson 1993a:246,247). It is ironic that Shawcross' focus (1972) on faunal analysis and the model of temporary occupation he proposed for Mt Camel totally disregarded the wide variety and abundance of artefacts found there, artefacts which Nichol later noted would be "...a little out of place in a fishing camp, but they would be very much at home if the site was a perennially occupied settlement" (1988:206).

These artefact assemblages are generally biased to items made of durable materials, mainly bone and stone. Wood working (adzes) and fishing gear commonly dominate among finished complete artefacts while other items like ornaments, tattooing chisels, needles, bird spears, harpoons (probably used for catching sea mammals) are less frequent and are usually represented by only a few specimens. By far the most numerous and visible artefacts are expedient flake tools, broken and exhausted artefacts and the debris and by-products of artefact manufacture. They are visible by virtue of the contexts they are often found in which is either concentrated in a workshop area (sometimes beside houses as may have been the case at Heaphy river mouth - Scarlett and Wilkes 1967:198; Anderson 1986:110) or discarded along with other rubbish (like food remains) in a
midden heap.

In southern New Zealand certain flake or 'blade' tools have a close contextual association with moa cooking and processing areas. Other tools also often found in this context are split water-rolled greywacke cobbles known as 'teshoa' and 'flat, polished stone knives' called ulu (Anderson 1989:158). Despite replication experimentation with some of these tools (Kooymen 1985; Schmidt 1993), their precise functions remain unclear, and are inferred primarily from the contexts they are found in. The use-wear and retouch patterns appear to indicate a diverse range of activities, however, and not withstanding variation in terms of material and form, I have observed a similar array of tools in early North Island sites where moa are known to have been processed and eaten (east coast Coromandel, Mt Camel, Te Horea Raglan) and where they have not (Tauranga Harbour, Motutapu Island, South Kaipara Head). Additionally, the perceived lack of a blade technology in the North Island, and the almost complete absence of blades in North Island 'moa-hunting' sites, despite the availability of suitable raw materials (Anderson 1989:170), suggests that they were not essential moa processing tools, though handy if you had them. These tools are also found outside the cooking and butchery areas, often in association with hut sites and 'fireplaces', as Teviotdale and other excavators of those times attest in their descriptions of finds (for example, Teviotdale 1939 at Waitaki). They have also been recovered, along with other artefacts, from excavated hut sites at Glenaray, Hawskburn and Shag River Mouth (Anderson 1989:144,145,147,148; Smith 1996:53).

Additionally, there is a close correlation between tool 'type' and material so that the blade technology is almost wholly associated with one material - silcrete, while teshoa are made from split greywacke spalls. As a consequence of this, there is a close geographical association of material and tool type with teshoa found mainly in sites along the Canterbury coast where beaches contain suitable water-rolled cobbles, and silcrete blades found mostly at sites in southern New Zealand where all known silcrete quarries have been located (Anderson 1989:159-161). Similar patterns are seen in the North Island. Tools identical in form and probably function to the South Island teshoa are found in Motutapu Island sites where nearby beaches provide similar suitable water-rolled cobbles amenable to splitting (personal observation). I have also observed a common pattern wherein locally available materials are used for a much greater range of functions and tool types than is seen in sites where these materials had to be imported. For example, Mayor Island obsidian in Tauranga sites and the opportunistic use of waste and reworking flakes in adze producing sites on the Coromandel east coast, Motutapu Island, Te
Horea and Rotokura demonstrate a diverse range of tools (sawing, drilling, chopping, scraping, cutting, incising, reaming). In these cases, availability overcomes suitability. An obsidian flake may not be the most efficient tool for the task at hand but because there is an endless supply replacement is not a problem. Imported materials, in contrast, tend to be reserved for the tasks they are optimally suited for. Thus at sites like Waitaki where silcrete was one of the few local high quality stone materials, it may have performed a range of tasks that extended way beyond moa processing. Indeed, the examples of silcrete tools from Waitaki, illustrated by Shawcross (1964) and examined by myself in the Willetts collection, suggest such a range.

It is this set of artefacts which dominate assemblages at inland economic focus sites and thus, with regard to the Anderson model, compliments neatly the prominent features at these sites, that is, moa cooking and processing areas. The picture, however, is not as clear as this. Notwithstanding that the numbers of teshoa, ulu, blades and flake tools may represent activities beyond moa processing, there is the problem of explaining other artefacts at inland economic focus sites that do not relate to this activity. At Waitaki, reel and whale tooth ornaments and amulets, stone and bone flax beaters, minnow lures, finished and unfinished fish hooks, sandstone files, hammerstones, bird spears, sinkers, a bone chisel, an unfinished harpoon head, drillpoints, obsidian flakes and cores, at least 34 large hoanga and a large number of adzes have been found (Davidson 1984:103; Duff 1977:73-74; Teviotdale 1932:96,1939; personal observation). At other south Canterbury 'moa processing sites' like Rakaia, Pareora, Normanby and Wakanui a similar array of items have been found in addition to needles, fish hooks, bird spear points, hammerstones, files, chert and obsidian cores (Griffiths 1941,1942,1955; Haast 1972a; Trotter 1972).

What Anderson stresses, however, is the low frequency of these artefacts at inland economic focus sites relative to their abundance at coastal economic focus sites like Shag River Mouth and Little Papanui (1989:155-157). But at the latter sites it is the abundance of fishing gear and tools related to the manufacture of fish hooks (drillpoints and sandstone files) which stand in greatest contrast.

Fishing requires a lot of equipment and fishing gear probably needed frequent replacement particularly if we accept Anderson and Smith's estimate that one fish hook would only be good for catching '...eight or nine fish before being lost or broken' (1996b:280). Drillpoints and files were probably tools primarily designed for one-piece fish hook manufacture. Drillpoints have been associated with wood working (H.Leach 1979b) but from experiments conducted by
Bonica, stone and bone gouges, chisels and reamers were more efficient in making perforations in wood. Making suspension holes in ornaments would also require the use of drillpoints but ornaments would require less frequent replacement. The presence of the odd drillpoint at inland economic focus sites may be related to ornament manufacture. The association of drillpoints with the debris from failed fish hook manufacture is frequently seen in early sites, for example at Shag River mouth (Smith, Campbell and Bristow 1996:95) and Mt Camel (Roe 1969:23). Additionally, in late period sites where one-piece bone fish hooks are rare or absent, drillpoints are also very uncommon (Furey 1996; personal observation). Rounded files were usually required to ream and smooth the inner curvature of one-piece hooks after the central core had been drilled out. 'Attrition' saws were probably also related to fish hook manufacture in the sawing out of fish hook blanks or 'tabs'. Indeed, fish hook manufacture probably accounted for much of the bone working activities at early sites. Other items made in bone like ornaments, tattooing chisels, needles and harpoon points are generally quite rare compared to fish hooks, and would not have required such regular manufacture. For example, a breakdown of 6,751 artefacts excavated from the Shag River Mouth site (Anderson and Smith 1996b:280 - Table 20.2), reveals that 89.3% are flakes, blades and fragments thereof, 1.9% are adzes, adze fragments, flakes and tools related to adze manufacture and repair (i.e., hammerstones and grindstones though these were undoubtedly used for other items including those made of bone), 6.7% are fish hooks and tools related to their manufacture, and 1.2% is made up of other items like ornaments and tattooing chisels. Thus it is not surprising that inland economic focus sites have a scarcity of evidence relating to bone working.

The equipment required to hunt moa appears, in contrast to fishing, to be largely absent or unidentifiable in the archaeological record. Harpoon points are generally associated with the hunting of sea mammals like dolphins and are too rare to have been a standard method of capture. The use of snares and possibly wooden spears are most likely, although, being made of perishable materials, they do not survive in the archaeological record (Anderson 1989:150,151).

The number of artefacts relative to site size is another aspect that appears to exaggerate the scarcity of artefacts at some inland focus sites. Anderson notes that while the number of adzes found at Waitaki may seem significant, they were derived from an area some 60 ha in extent, whereas a similar number of adzes from Shag river came from an area of only 2 ha (1982:60). But much of the evidence at Waitaki suggests that not all of the site was used or occupied at the
same time. The site comprises three terraces divided by old river channels (and notably, most of the adzes ploughed up by Willetts came from one portion of Terrace 2). It is possible that these were occupied sequentially as the river channels changed course (Anderson 1989:131). The presence of ovens and hut sites actually in some of the dried up river channels adds support to this. It should also be noted that site size estimates based on the extent of flake and oven distributions (as in the case of Waitaki, for example) may be misleading and not indicative of population size.

Differential use of space may be relevant here. Sites like Wairau Bar and Shag River Mouth are situated on relatively narrow strips of land enclosed on three sides by river, sea and lagoon. Options for village 'sprawl' were therefore constrained and a likely solution could have been the more intensive use of space, i.e., ovens and huts repeatedly rebuilt over old ones. This was not a problem at sites like Waitaki and Rakaia where inhabitants may have used space in a horizontal rather than a vertical pattern, spreading habitation, cooking and food processing locations across a much wider area over time. For instance, at Rakaia: 'The ovens appeared to be in five or six rows each extending a kilometre or so across a corner of the plains...' (Anderson 1989:129). Different uses of space will also influence site formation processes. A deep cultural deposit is often seen as indicating more permanent occupation, for example, in one area the stratigraphy at Shag Mouth was 2.5m deep compared to the shallow stratigraphy found at Waitaki (Anderson and Smith 1996a:361; Teviotdale 1932:95). Anderson also notes that the shallow stratigraphy at Waitaki was probably due to 'spatial expansion' (1989:132). Conversely evidence of stratification has previously been used to support periodic episodes of site occupation and abandonment. Such was the case for Mt Camel where Shawcross (1972) asserted that the twelve layers separated by sterile sand and fish scale lenses represented twelve summer seasons of occupation. Occupation layers separated by river silt or sand have also been observed at sites like Waitaki, Hawksburn and Pig Bay (Anderson 1989:132,145; Golson and Brothers 1959). Notwithstanding that the twelve occupation layers at Mt Camel have since proved difficult to identify from the latex rubber pulls made at the time of excavation (Nichol 1988:199-206; Anderson and Wallace 1993:11), the excavators at Shag River Mouth experienced first hand how quickly sand can build up. They often had to remove 10-15cm of sand that had blown over excavation areas overnight (Anderson and Allingham 1996:40). Of the 15cm layer of river silt that divided the cultural layers at Hawksburn, Anderson comments 'This might have built up in a day or two, and the radiocarbon dates indicate no difference in age' (1989:145).
Features and artefacts may actually prove harder to locate on large sites where cultural evidence is scattered over a wide area. Duff comments on Waitaki that '...the absence of surface indications in a site so thinly spread over 150 acres defeated Teviotdale's hopes of finding the rich habitation area' (1977:73). Thus the frequency of artefacts relative to site size is not a reliable measure particularly when, in the case of Waitaki and Rakaia and many other sites, much of the habitation and burial area may have long since been claimed by the sea.

It might be more useful to consider the nature, rather than the number, of artefacts that have survived to understand the range of activities represented at these sites, and from this, reach conclusions about the nature of settlement. Notable is the range of artefacts from sites like Waitaki, Rakaia and Pareora that indicate the manufacture of items. The harpoon point at Waitaki is both unfinished and broken suggesting that it suffered accidental breakage during manufacture at the site. A number of ornaments were also in an unfinished and/or broken state at Waitaki, Rakaia and Pareora. Teviotdale found caches of worked bone at Waitaki, including a cache of over forty fish-hook tabs in the floor of a hut. Teviotdale commented that these were intended to be taken away to permanent villages and adds later that fish hooks found at Little Papanui may have made from tabs prepared at Waitaki (1932:96,100). But we might ask why they were left behind at Waitaki if this was the case. The flax pounders at Waitaki (Willetts collection- personal observation) and the 'crude pounders' (Griffiths 1941:230) listed for Normanby indicate the preparation of flax fibre, a time consuming task. At the house site on Motutaupo Island (R10/497), similar unmodified beach cobbles of suitable shape were used for pounding and their association with many small flakes of obsidian (used to make the cut across the outer leaf in order to gain access to the silky fibre inside) indicates their likely use in fibre preparation for clothing.

Perhaps most conclusive of all is the adze evidence. We might expect, given their time consuming nature, that secondary manufacture, repair and maintenance would probably take place at residences during periods of low activity such as winter where weather conditions may have constrained hunting, food gathering and the collection of other resources. An example of this might be when the harvest from gardens was safely stored away and where attention could be given to the making, preparing and repairing of 'personal gear' (Binford 1979:263; Nelson 1991:79). Valuables like adzes were also most likely to be stored safely at the place where people spend most of their time.

The high levels of curation described in Chapter Four indicate that rarely were broken adze pieces or damaged adzes discarded. Generally they were retained for reworking at a later date.
when there was time to spare. Therefore we would expect adzes and the by-products associated with secondary manufacture, repair and reworking to be found primarily at base residences, and not necessarily at the place where adzes were used.

Some authors have associated curated and heavy tool-kits with a sedentary settlement pattern and simple portable tool-kits with high residential mobility (Bleed 1986:740; Shott 1986:20). In New Zealand the curation of adzes was primarily related to the high costs involved in manufacture but the tool-kits of early Maori were, nevertheless, decidedly heavy and bulky. For example, the main adze kit employed in the construction of the *kumete* (one each of Type 1, Type 2, Type 4A and 4B, Type 3 and Type 5, plus hafts) weighed close to 16 kilograms, and undoubtedly a backup supply of replacement adzes would have been needed at wood working sites in the event of blade damage or breakage. Tool-kits required for the manufacture, repair and reworking of adzes would have been even heavier. A range of hammerstones and grindstones (some of which could weight 30 kgs or more; for example, those in the Willetts collection from Waitaki) would have been essential equipment for all wood workers regardless of whether they made the adzes themselves or not. Then there is all the equipment and materials required to make fishing gear, hunting and food processing gear, fibre preparation and ornaments, as well as the items themselves. For example, a core of Mayor Island obsidian found at Hurunui River mouth in North Canterbury weighed 48 kilograms (Trotter and McCulloch 1989:42). The heavy non-portable nature of Maori material culture, therefore, suggests there would have been a need for a place to keep and store all these items when not in use. Additionally, items like adzes took considerable time, skill and effort to make and repair thus they would need to be prepared well in advance of use. The Nunamiut

'...never went into the field with personal gear that was not in good condition....worn items or those in need of repair were either repaired first or replaced before leaving..' (Binford 1979:263).

We would, therefore, hardly expect to see this sort of evidence at temporary camps where the primary purpose was the capture or collection of certain foods or/and other resources. For example, it appears illogical for people to wait until they reach their summer fishing grounds say, for example, at Mt Camel, before making their fishing gear. Time that could be spent fishing would be consumed in the lengthy task of making fish hooks and extra costs would include transporting the tools to make them. With such a complex and heavy material culture it is
unlikely that early Maori ever had high residential mobility. Nevertheless, despite the highly curated and heavy gear of the Nunamiut, they moved between winter and summer base residences in order to locate themselves close to migratory game:

'Any move from the...residential site is almost always preceded by the preparation of a cache at the site for items which will not be used again (until return)...entering a passive state' (Binford 1979:257).

Thus the problem of a heavy load was solved by storing unwanted (passive) gear at base residences and caching supplies in advance of use at certain locations (insurance gear) and in anticipation of need. Often caches were made in response to opportunistic finds or procurement of raw materials embedded in other expeditions (hunting trips). Hunting trips took place from, and returned to, base residences where gear was made and prepared prior to trips and returned there even when in a broken state. Kornfield, Akoshima and Frison (1990), assert that the practice of caching is not restricted to sedentary societies. Highly mobile foragers like the !Kung and Australian Aborigines cached items at places they knew they would return to in the future and where these caches of items or raw materials would be needed (Kornfield, Akoshima and Frison 1990:307). The cached items at the McKean site in Wyoming were scrapers made on flakes - 'expedient' tools - though Kornfield, Akoshima and Frison state that 'caches are a way of curating tools' (1990:307). The McKean site had a full range of site components including burials, hearths and a diverse range of domestic artefacts. The authors describe this site as a '...repetitively-used location...by small groups who engaged in similar activities from one occupation to the next...' (1990:303,305).

Whether the caching of adzes in New Zealand sites could indicate a similar scenario to the Nunamiut or McKean site occupants is questionable, though some authors have made such an interpretation (Anderson 1989:134 for Waitaki River Mouth). But it must be queried whether the use of adzes was constrained to any one season or period. It is possible that primary adzes were reserved for particular tasks such as canoe making and that there may have been a certain favourable period and certain favourable places for such undertakings. Hence tool kits may have been stored at these places as 'passive gear'. Nevertheless some types of adzes would have been required on a regular basis and would need to be on hand at all times ('active gear' - Binford 1979). After a period of extensive use, it is probable that a number of adzes would have required repair and all would need resharpening before being used again. Broken adzes and adzes with
blades in damaged condition would be taken home to await the lengthy process of reworking and repair at a convenient time unless hammerstones and grinding stones were also cached at the working site. Again, a similar problem exists as with the fishing gear above. Wood-workers would probably go to a wood-working site to work wood not to engage in repair and preparation of the tools they needed before they could do so. Tool-kits or caches of adzes exhibiting chipped and damaged blades are also likely to be found most commonly at permanent/semi-permanent settlements.

The large numbers of complete finished adzes found at Waitaki, and the range of functional types, is unsurpassed by any other adze assemblage I have observed in this research, and this includes Wairau Bar (see Table 4.1 and 4.2). The people at Wairau were involved in adze production thus many of the complete primary forms are unfinished, and most finished specimens were found with burials. Many of the caches at Wairau also comprised unfinished adzes. The adzes at Waitaki, in contrast, are mainly finished adzes (see Table 4.1). Interestingly, a considerable number had damaged and chipped blades and were clearly in need of repair, and in some cases, extensive modification (this is discounting fresh damage that may have been inflicted by the plough). It is difficult to explain why these were left behind at a site where, according to Teviotdale (1939:177) and Anderson (1989:134) the scheduling of time was organised primarily around the cooking and processing of moa.

Others have interpreted areas where adzes were concentrated as wood-working areas where adzes were actually used (Knight 1965; Anderson 1979). Teviotdale, feeling the need to explain what wood-working tools were doing at the Waitaki moa-processing camp, decided they were there to do the odd canoe repair (1932:97). The range of functional types at Waitaki (Table 4.2), however, exceeds beyond doubt maintenance requirements. Trotter provides a more rational explanation for the adze-kits found at Rakaia:

"Their sizes, numbers and shapes suggest heavy and reasonably sophisticated carpentry rather than, say, chopping firewood, and this in turn suggests permanent settlement with the construction of dwellings and canoes" (1972:138).

The reference to dwellings is interesting. But the types of dwellings indicated by the archaeological evidence thus far recovered from early sites (the Moikau house aside), does not suggest that adzes designed for 'sophisticated carpentry' were much in demand for their construction. While the presence of substantial dwellings made of dressed timber can not be
discounted, other possible explanations may be equally, if not more, valid. Additionally some types of adzes like Type 3 and Type 5 may not have been required in house building. Both types are unusually frequent at Waitaki which boasts the largest number of Type 5 adzes (six, possibly seven - see Appendix C) recovered from any one site in New Zealand. This leaves the more likely option – canoe building. With mokihi used for river transport, narrow hulled single outrigger or double-hulled canoes would be used for coastal travel. While the evidence from Shag River Mouth would appear to discount frequent long-distance coastal journeys (Anderson and Smith 1996:289, who nevertheless appear to argue indirectly for them by merit of the cluster of coastal 'temporary camps' in south Canterbury being relatively distant from the cluster of coastal villages in Otago and presumably in north Canterbury and Marlborough - Wairau Bar), evidence from other sites, at least as demonstrated by the range of imported stone materials, suggests that canoes were in use on a regular basis, and obviously important at most sites for fishing. The description mentioned above of Waitaki as a 'wood-working camp' is one way of explaining the adze-kits at Waitaki. Adze-kits were undoubtedly taken up river to the forest to fell and rough out trees but it is highly unlikely that they would be left up there. What might be in doubt is if many were actually used at the river mouth itself. There is no reason why canoes may not have been completely finished in situ before being floated down river to the coast. Rather Waitaki may have been a place where wood-working kits were stored. However, if we need a reason for people being at Waitaki long enough to eat all those moas, then the arrival at Waitaki mouth of felled or roughed-out logs for extensive finishing might be the best explanation.

The concept of Waitaki as a temporary wood-working camp might be acceptable if it were not for the evidence that adze finishing, repair and reworking also took place there. The number of complete finished adzes is large, but so is the number that are broken, that exhibit major damage and that have been rejected as a result of reworking failure (see Table 4.1). The presence of complete finely formed preforms is also problematic. The people at Waitaki were not involved in adze manufacture but were importing some finely flaked primary preforms made from Nelson/Marlborough and Southland argillite. Several adzes made from Southland materials are in the process of hammerdressing. One pounamu adze is partially sawn in half. The presence of large hoanga also provides evidence that the long and laborious process of adze grinding was taking place at Waitaki. Small expedient adzes made on reworking flakes also feature in the Willetts collection. Similar assemblages have been found at other 'temporary' sites like Rakaia, Pareora and Normanby (Griffiths 1941,1942,1955; Haast 1872a; personal observation). At
Rakaia the manufacture of adzes from a local material known as 'palla' was undertaken (Haast 1872a).

In summary, a full range of domestic activities is represented at sites like Rakaia and Waitaki which add up to considerable periods of time and effort being spent there; in short, evidence of continuous rather than temporary occupation.

There is a further significant difference when we compare the adze assemblages from sites like Waitaki and Rakaia with Shag River Mouth. Smith and Leach noted that most of the Shag River Mouth adzes made of imported materials were much reworked and close to exhaustion and that it was possible that these adzes were brought in with the original settlers of Shag and not replenished thereafter. Use of local basalts seems to have replaced imported adzes during the site’s occupation (1996:143). When he examined the Shag River mouth adze collection, Skinner noted that "...they are uninteresting and not as numerous as expected" (1924b:17). The same cannot be said of the adzes from sites along the south Canterbury coast. Caches of finely formed Nelson/Marlborough argillite preforms and adzes have been found at Waitaki, Rakaia and Pareora (see Appendix D). One primary Type 3 adze found at Normanby has even been identified from petrographic analysis as Tahanga basalt from the Coromandel Peninsula in the North Island (S.Best 1977:319). At Waitaki River Mouth a wide range of imported materials is evident in similar frequencies including D'Urville Island and Nelson/Marlborough argillite, Bluff Harbour argillite and other Southland volcanic rocks, a variety of basalts probably including Canterbury (Bank's Peninsula) and Otago sources, plus a smaller number of pounamu adzes from the South Island west coast (personal observation). These materials are represented in all adze states but prominent among complete primary forms are imported adzes from Nelson/Marlborough and Southland.

The evidence of large numbers of adzes imported from opposite ends of the South Island could be interpreted as representing the different groups that exploited the site at Waitaki. It is difficult, however, to explain why they came all the way to Waitaki when the resources there could be found much closer to home. Even more problematic is why they brought adzes with them, including unfinished ones, and left them and damaged ones behind.

I suggest that not only was Waitaki a permanent settlement but that it may have functioned as a central place in the settlement/subsistence pattern of the South Island east coast. Today the Waitaki River forms the boundary between north Otago and south Canterbury. It may also have been an important boundary in the past. Trotter and McCulloch (1971) observed consistent
stylistic differences in the rock art between north Otago and south Canterbury. This evidence may indicate that 'territorial divisions' (Anderson 1983:21) existed at this time and Anderson suggests that ‘...the Waitaki River operated as some kind of cultural boundary' (1983:20). While comparing the Wairau Bar adzes to other assemblages from sites along the South Island east coast, Duff noted that '...the Waitaki must be regarded as the effective southern limit of the (Nelson/Marlborough) argillite adzes on the east coast, although odd ones turn up farther south' (1977:142). A similar pattern can be seen regarding the distribution of Southland argillite adzes; they are relatively infrequent north of Waitaki (personal observation). Thus the Waitaki River Mouth site may have functioned as an important interaction zone between north and south communities. It may have been a place where people from both areas periodically visited for social and economic exchange, and it is tempting to envisage that during these occasions considerable feasting took place. The wide range of adze materials certainly suggests a high level of regular long distance contact with people from different areas of the South Island. If we make the distinction that people were mobile but not their settlements, the size of the resident population of Waitaki may have been similar to that of Shag River or Wairau Bar. But the Waitaki settlement could (in terms of both food and space), and probably did, accommodate a much larger number of people on a regular basis. Furthermore Waitaki River Mouth not only stood at the entrance to southern New Zealand but was also a major gateway into the interior where the river functioned as a 'conveyor belt', an important highway, extending as far as the Otago lakes near the west coast and providing access en route to moa, timber, silcrete and at the lakes, pounamu (which, though not as popular in the early period as it was in later times, was nevertheless present on a minor level in most moa-hunting sites on the east coast) (Anderson 1982b:121; Duff 1977:271). When considering settlement options it is hard to believe that people would not be eager to claim guardianship of this prime location, and claim it by stationing themselves there on a permanent basis. While Teviotdale described Waitaki as a 'bleak windswept spot' which would have held little attraction for permanent settlement (1932:96), the same could be said today of sites like Wairau Bar and those at Palliser Bay. Anderson proffers a different view of Waitaki River Mouth, among others, as being situated '...in areas of relatively high sunshine hours and frequent warm dry winds' (1983:13).

In light of this re-interpretation of Waitaki as a permanent settlement, an interpretation that could be equally applied to other river mouth sites, the role of inland sites must also be re-examined.
Given that most of the resources exploited by the inhabitants of Waitaki River Mouth site were located inland, it is not surprising that numerous sites have been found along the river. These mainly cluster near the gorge in the MacKenzie Basin some 60-90kms from the coast where the river divides into three smaller rivers that drain into the lakes (Anderson 1989:142,143). Inland sites include silcrete quarries, rockshelters and ti-processing sites but are mainly sites similar to those found at river mouths. Two sites in particular are quite extensive - Te Akatarewa (4 ha) and Woolshed Flat (0.6ha but probably larger) - but both have suffered from ploughing and river erosion and little is known about them (Anderson 1989:143; Duff 1977:272). Early reports recorded stone-lined hearths from several sites (Te Akatarewa, Waitangi, Shepherd's Flat), ovens, a number of ornaments including unfinished reels of moa-bone and serpentine, a few adzes including a very large (over 300m long) primary Type 3 black D'Urville Island argillite adze from Kurow, evidence of bone working, as well as large numbers of silcrete blades and flake implements. Faunal remains included dog, freshwater shellfish, a range of birds including some coastal species, moa eggshell and vast quantities of moa (Duff 1977:272; Anderson 1982a:57,1989:142,143). At Te Akatarewa

'...fully ten acres of moa bones were found on a low flat near the (Waitaki) river...proved that over a lengthy period thousands of birds had been consumed on the premises or cut up there, and the meat transported to other camps down the river' (Duff 1977:272).

While none of the interior sites up the Waitaki River have seen detailed archaeological investigation, several near the Taieri and Clutha Rivers have - Hawksburn and Glenaray. Again these sites present a similar range of activities to the coastal inland focus sites. Moa butchery and cooking patterns indicate that moa were rarely killed at these sites and generally some initial processing occurred before moa were returned to the site, usually as leg joints - the portion which contained most of the meat and the most valuable bones for industrial purposes. As seen at the coastal sites, evidence of preservation is rare and it appears that moa meat cooked in ovens was most often consumed in situ. Additionally Hawksburn and Glenaray are some distance from the river (as are several up the Waitaki River, for example, Waitangi) indicating that access to river transport was not a primary consideration (Anderson 1989:147,154). At Hawksburn, evidence of 'domestic structures' proved elusive until concentrations of artefacts led to the discovery of several stone-lined hearths. In a typical pattern, these dwellings, probably circular huts, were
found away from the ovens and middens (Anderson 1979:50,56). Notable among the artefacts were adze flakes and fragments 'representing perhaps 50 implements' including the butt end of a Type 1 adze with incipient lugs (Anderson 1979:56,57). Adze flakes and fragments were also found associated with the circular huts at Glenaray (Anderson 1989:148). A small number of complete adzes have been found and, while other artefacts like bone chisels and awls, worked bone, drillpoints, obsidian, *pounamu*, and sandstone files were not common, they were present. At Hawksburn fragments of an ivory reel necklace were recovered. Most of these artefacts are also associated with hut sites (Hamel 1978:119; Anderson 1979:56,57; 1989:155-157). While Anderson interprets the adze fragments and flakes as evidence of adze use (1989:156), a more likely interpretation is the reworking of adzes. People also paused long enough in inland areas along the Waitaki River to daub rock faces and cave walls with drawings (Duff 1977:271,272; Anderson 1983:12; Trotter and McCulloch 1971).

Thus, at inland sites, people were involved in activities that extended beyond moa cooking and processing, activities that furthermore represent considerable investments of time. While Anderson admits that the site at Hawksburn '...may have been continuously inhabited for several years during the main occupation' (1989:147), he concludes that they were '...probably occupied repeatedly for short periods by people whose main settlements were located at places where resources other than moas were at least as important' (1989:157).

Anderson suggests that there are basically two 'catchment strategies' reflected by the distribution of inland and coastal sites (1989:153). The first pattern has large sites at the river mouths with very few or no inland sites (Wairau, Rakaia, Wakanui and Shag would be examples). These sites are located at the mouth of short, fast straight rivers which provide access to a reasonably close catchment area. Hunting trips could operate from base camps/villages and were of only several days duration. The second pattern has small sites at the river mouth and numerous inland sites. Rivers are long and winding and moa catchment areas were considerable distances from the coast (Taieri and Clutha Rivers). Thus more time and effort was required to reach moa hunting grounds, possibly a week to get there and a few days to return. Therefore hunters were away from coastal sites for longer periods of time and operated from inland base camps (like Hawksburn). The link between inland and coastal sites, however, relies heavily on the assumption that preservation was taking place at the inland sites so that bulk moa meat could be returned to the coast in an edible state. Yet the evidence for preservation remains inconclusive. Furthermore, the pattern at Waitaki appears to suggest both strategies. In summary, the evidence falls short as a
satisfactory explanation. Anderson is also inconsistent regarding whether people could withstand the harsh winter conditions inland. In 1989 he suggests from ethnographic evidence (where inland camps were recorded as occupied in winter during the weka hunting season) that there would be little difference in climatic conditions between coast and inland areas, and that few inland sites are found above the snowline (1989:154). By 1996, Anderson and Smith were asserting that winter conditions were too harsh and that inland sites were probably only occupied in summer (1996b:287). I suggest that the Waitaki River sites may represent a discrete settlement/subsistence system wherein there was considerable and possibly continuous movement of people between inland sites and the coastal settlement at the mouth. This is not much different from Anderson and Smith's suggestion of 'a pattern of community fission and fusion probably with a preference for winter occupation on the coast and summer occupation of the interior' (1996b:287). This is stated with reference to Shag River where the river mouth site forms the 'hub' of such a system. I would assert that the existence of a similar system is equally valid for Waitaki. The artefact evidence in particular suggests that the role of inland sites was more complex than that of simply functioning as 'moa-hunting camps'. They may have been self-contained 'units' where someone was usually at home, especially for Waitaki and other river systems with an interior economic focus. Rather than a scenario of launching special expeditions inland, people and resources may have been continuously coming and going with ebbs and flows depending on conditions. For example, the population at the river mouth may have increased significantly during winter and some social and economic exchanges with people from other communities may have taken place at this time.

In conclusion many of the problems with Anderson's model can be solved if we accept that all the South Island coastal river mouth sites and many inland sites functioned as villages that were continuously occupied by a fluctuating number of people.

For the North Island, even if gardening could be discounted from the subsistence base of early settlements, the locations and artefact assemblages of early sites identify them more as continuously occupied permanent villages than as temporary camps.

As the North Island comprises the study area for examining patterns of trade and exchange, discussion of these issues is presented in greater detail below.
The North Island Study Areas

The purpose of this section is to establish the locations of early permanent settlements in the North Island landscape, to determine whether they were occupied at the same time, and to ascertain whether the adze samples adequately represent units of trade and interaction. Each region is discussed separately and, in Chapter Six, the interaction between them is established.

**Far North.** (see Figure 5.3 for sites and locations mentioned in the text).

The Far North region, defined here as the area north of Whangarei on the east coast and Waipoua on the west coast, provided favourable conditions for Maori settlement. There are numerous harbours on both coasts as well as offshore islands. The long Aupouri Peninsula, only five kilometres wide at its narrowest point, may have been perceived as an island-like environment by East Polynesian settlers. Seal colonies (Smith 1989) and moa (Anderson 1989) were evident in addition to an abundance of fish and shellfish. Additionally the sub-tropical climate of the ‘winterless’ north provided optimal conditions for the successful adaptation of tropical East Polynesian cultigens (Davidson 1982a).

**Archaeology:** A number of excavations and site surveys have been undertaken in the Far North. Much of the Aupouri Peninsula has been surveyed (Davidson 1975b-e; Coster 1983,1989; Slocombe 1993). Slocombe has recently surveyed extensive areas of middens in the sand dunes in the Cape area along the coast and up to four kms inland from northern 90 Mile beach on the west coast to Ngakengo Beach on the east coast near the mouth of the Parengarenga Harbour. Early artefacts, hearths, working floors and burials were among the features commonly observed. In an earlier survey of the Cape area, Davidson recorded a large number of pit and terrace sites and a smaller number of Pa (Davidson 1975b-e,1982a:14). These site types were rare in the narrow low lying tombolo or sandspit south of the Cape area where the landscape has become almost totally denuded by wind erosion and mobile sand dunes. Prior to reforestation work, Coster (1983) carried out extensive surveying of the numerous deflated midden sites located predominantly in the dunes inland from 90 Mile Beach. Samples from intact shell deposits were also collected for radiocarbon dating. From the analysis of these dates (also incorporating
previous dates from the area including Mt Camel and Twilight Beach) and the composition of the middens, Coster (1989) proposed a three-phase model of settlement for the Aupouri Peninsula. In the initial period of occupation (A.D. 950-1450) settlement was coastal (Twilight Beach and Mt Camel), and subsistence may have been primarily based on wild foods. The second phase of settlement (A.D. 1450-1650) saw expansion into the central inland zone after the coast became destabilized by deforestation and sand dune movement. Here on the forested and fertile Holocene soils early Maori practised horticulture but were probably forced to the abandon the area in the mid 17th century as fertile land became depleted and sand dunes encroached. In the third phase (A.D. 1650-1800) people returned to inhabit the more stable areas around the Cape area and Houhora but made only seasonal excursions
Figure 5.3: Map showing Far North Locations.
to the coast between these areas to exploit shellfish leaving little behind but middens largely composed of shells (Coster 1989:70).

One of the more famous excavated early sites in the North Island is Mt Camel (N03/59) at the mouth of the Houhora Harbour. Faunal analysis revealed a wide variety of wild foods including seals, moa and a wide range of other birds, dolphins, fish and shell fish as well as the consumption of the domesticated dog (Shawcross 1972). While Shawcross surmised that food remains would have been sufficient only to feed a small group for twelve successive summer seasons, the probability that the Mt Camel inhabitants gardened nearby and the wide range of artefacts excavated and surface collected from the site (see Table 5.1), including many in an unfinished condition, suggest, as argued above, more permanent occupation. Additionally, new radiocarbon dates derived from the latex pull samples and combined with previous dates show that occupation of site began in A.D. 1250-1400 and that 'the stratigraphic division is chronologically insignificant' for the main layers (Anderson and Wallace 1993:12).

A smaller excavation of an early midden site has been undertaken at Twilight Beach (Taylor 1984) where sea mammal butchery and bone working took place. This site was part of a larger suite of sites where a wider range of artefacts and activities were found (Slocombe 1993). Radiocarbon dates (A.D. 1285-1414) suggest that the site was contemporary with Mt Camel (Anderson 1991:776).

South of the Aupouri Peninsula, the west coast harbours and coastal margins have also been surveyed (Leahy and Walsh 1979; Irwin 1985:10,11). Site records from the area reveal early settlements typically located at the mouths and along the coastal margins of the Hokianga, Whangape and Herekino harbours. A series of predominantly early middens named after the local beach at Mitimiti stretches between the Whangape and Hokianga Harbour (Chris Booth
pers.comm.; John Klaricich pers.comm.). These middens contain a range of bone material including sea mammal, dog and fish and characteristically early artefacts. Several excavations of early west coast middens have taken place recently - at Ahipara (N05/302 - 1992 Joan Maingay pers.comm.), Panahe (N18/219 - Michael Taylor pers.comm.; Nichol 1988) and Long Point (O06/515 - 1996 Michael Taylor pers.comm.). A radiocarbon date is available from Panahe - A.D. 1265-1405 (Michael Taylor pers.comm.).

Site surveys have been conducted along the east coast from the Karikari Peninsula where a number of early middens at Maitai Bay and Karikari Bay (which faces the Houhora Harbour), are described as 'rich artefactual sites' (Phillips 1987:59). Robinson described early middens in the sand dunes of Tokerau Bay which contained moa bone and noted a burial that may have contained a moa egg, though the human bones and egg shell were found at different times (1963a:13). Anderson is cautious about accepting the cultural association of the moa bones and eggshell due to the tendency for cultural and natural deposits to become mixed together in deflated sand dune areas (1989:110). Middens of an early nature have also been recorded from Taipa and Coopers Beach in Doubtless Bay, Whangaroa Harbour Mouth, Bay of Islands, Whanganuru and Whananaki Harbour Mouths (Robinson 1963a; DOC Northland site record file). A small collection of early artefacts and evidence of early horticulture was excavated on Moturua Island in the Bay of Islands (Davidson 1982a:19-20). While rejecting the earliest date for the site, Anderson accepts those placing occupation of the site between A.D. 1285-1525, again suggesting contemporaneity with Mt Camel and Twilight Beach (1991:785). Apart from this site, archaeological signs of early occupation on the east coast are slight, prompting archaeologists to talk of an 'Archaic Gap' between Doubtless Bay and Whangarei (Davidson 1982a:13,26). But both site records and artefact finds suggest that this gap is, to quote Davidson, 'more apparent than real' (1982a:26).

**Artefact Collections:** Large artefact collections are known from the Aupouri Peninsula and some have been deposited in local Museums. The huge Bollons collection, now housed in the Museum of New Zealand (Wellington) contains a number of ornaments, adzes and other artefacts from the Cape area including a necklace of dentalium nanum beads, shell amulets and a serpentine reel (Skinner 1974:83, Duff 1977:135). The Gleave collection (now in the Far North Museum, Kaitaia) from the sand dune sites between Scott Point and Motupia Island contains a large number of adzes as well as one piece fishhooks, minnow lures, birdspear points, files and
drillpoints. A similar array and abundance of artefacts was recovered by Aupouri Forestry workers during marram grass planting from the same inland areas surveyed by Coster (1983). Unfortunately none can be provenanced precisely to any of the sites in Coster's study (Coster 1989). The Wagener collection (some of which is in the Auckland Museum with the bulk housed in the Wagener Museum at Houhora) and smaller collections in the Far North Museum contain adzes from the 'sandhills' west of the Houhora harbour from Waihopo to Moturangi extending the cluster of central Aupouri sites revealed by survey to this southern region.

The largest collection of early artefacts from the Far North comes from Mt Camel. Judging by the number of people I have meet who have collections from the Houhora Harbour Mouth, also a favourite camping spot in modern times, Mt Camel must have been a major centre of early settlement, certainly more than the excavated portion of the site indicates (estimated as being about 1.5ha in extent with less than 2% excavated - Davidson 1982a:18). The range of artefacts is listed in Table 5.1. Some 281 adzes were examined from Mt Camel of which less than half were excavated. The remainder are surface collections (Wagener, Blucher and Hensley collections). An additional 16 adzes come from coastal sites nearby at Great Exhibition Bay (including a new record of a side-hafted adze from the Hensley collection - see Appendix C), where seal and bird bone middens have also been examined (Millener 1981; Smith 1989).

Other early artefact assemblages have been reported from Doubtless Bay, Whangaruru Harbour Mouth, Purerua Peninsula and Whananaki Harbour. Burials have been observed in the vicinity of these early middens though they could equally be associated with the later middens that overlay them (DoC Northland site record files). A finely formed though broken triangular minnow lure made of serpentine was found at Whananaki (Golson 1959b) and a rare chevroned pendant was found at Whangamumu in the Bay of Islands, a location not far from Moturua Island. The stylistic features of this pendant have been likened to those of the Kaitaia Lintel (actually found at Pukepoto according to Skinner 1974:35).

A private collection (with the Booth family of Kerikeri, Bay of Islands) contains assemblages of early artefacts from the Whangaroa Harbour Mouth and coastal margins and from the Purerua Peninsula in the northern Bay of Islands. This private collection also contains a large assemblage of artefacts from Mitimiti. Additionally, the Sunde collection (private collection, Auckland) has a small collection of early adzes from the Mitimiti sand dunes. Small collections of early artefacts from the North and South Hokianga Heads and coastal sandhills are retained by the Klaricich family (Waiwhatawhata). Without these private collections, evidence for early settlement on both
the west and east coasts would be very meagre. All the adzes in these collections have been examined in this present study as have those from the excavations listed above.

**Adzes:** The Far North region produced a large number of adzes (N=1111). Compared with the Aupouri Peninsula, collections of early adze forms or late forms reworked from early ones are small for the southern area with 129 provenanced to the west coast between Awanui and the Waipoua river (beyond which no early artefacts have been recorded until the Kaipara Harbour Mouth), and 219 adzes between the Karikari Peninsula and Whananaki Harbour on the east coast (see Table 5.3). This disparity in numbers does not appear to be a sampling problem as, in contrast, primary 'Classic' 2B adzes commonly rendered in local gabbro are abundant. The reason an apparent 'Archaic Gap' appears to exist on the east coast is supplied by the adze data, particularly when frequencies of early functional adze types and states are compared between the Aupouri Peninsula and the larger area to the south (see Table 5.3). In Aupouri Peninsula collections reworked 2B adzes are rare in marked contrast to the east coast where they are common, especially in the Bay of Islands (46.7% of 62 reworked 2B adzes from the southern east coast come from the Bay of Islands). This suggests that much of the Aupouri Peninsula had been abandoned before this marked technological change had occurred. Furthermore, over half of the Aupouri Peninsula reworked 2B adze total are provenanced to the Cape area where occupation continued into the late period. For the central Aupouri area, late primary 2B adzes are even rarer and almost all the adzes in the Aupouri Forest Headquarters collection and Gleave collection reflect an early technology, as do all the adzes from Mt Camel except for the one primary gabbro 2B butt found in the uppermost late layer.

The Aupouri Peninsula is also characterised by large numbers of primary adze types including five side hafted adzes and numerous Type 1, Type 2, Type 3 and Type 4 adzes (see Table 5.3). Though overshadowed numerically by late forms, some fine primary forms were also recorded from the southern area.

Of six adzes recorded with the unusual characteristic of notched corners, five come from the Far North area (the other, a D'Urville Island argillite large Type 2 adze, is from Waipiro, East Cape). Four are very large Type 2 adzes rendered in Nelson/Marlborough argillite. The fifth specimen is a Type 3 adze made of Tahanga basalt with notches less finely rendered than seen on the argillite adzes.

Thus in the early period, the whole of the Aupouri Peninsula appears to have been the major
centre of settlement in the Far North with smaller enclaves at harbour mouths and peninsulas on both coasts of the much larger area to the south. When the deforested fragile dune soils of Aupouri lost their fertility and began to break down, the majority of the population moved south (Wallace and Coster n.d).

The late settlement of the southern area is well represented by the large number of pa, and in a pattern that reflects the high frequencies of reworked and primary 2B adzes, these are particularly dense in the Bay of Islands (Davidson 1982a:14). Of note is that the occupation of the Pouerua kainga (village), pa and garden complex in the inner Bay of Islands commenced in A.D. 1450-1550 (Marshall 1990:180,182; Sutton 1990:209-211), about the time that the early settlements of Aupouri were largely abandoned.

This introduces a major problem with Coster's model of the Aupouri Peninsula settlement chronology, particularly for the central area, where the adze data and the survey data (Davidson 1982a:14), suggests settlement ceased first. It is my feeling that the dates from the inland area are too late and that settlements of this area were contemporary with the coastal settlements at Twilight Beach and Mt Camel. The very low numbers of reworked 2B adzes (none of which came from the Aupouri Forest Headquarters Collection or from the inland sites) and the high frequencies of primary adze forms are consistent with collections from early sites for which dates are available including Mt Camel and sites beyond the region, notably the Hauraki Gulf, east coast Coromandel and Palliser Bay, all of which date between A.D. 1200-1500 (see Table 5.1). The dates (drawn primarily from Anderson 1991) for these early settlements are remarkably uniform as are the adze assemblages excavated from them. As is demonstrated below with reference to Table 5.2, the adze assemblages from later sites contemporary with Pouerua show an equal consistency - one that is in marked contrast to the adze and artefact assemblages dated from the early period. For example, the adze assemblage from Pouerua is dominated by primary gabbro 2B adzes and the fragments of only one D'Urville Island adze argillite were recovered (Sutton 1990:200; Marshall 1990:157). Interestingly, no reworked 2B adzes made from early materials were found. But a Nelson/Marlborough argillite reworked 2B adze was recovered from an excavation of Paeroa Pa on Moturua Island in the Bay of Islands, known from historical records to have been occupied in 1772 (Davidson 1982a:20-21).

Indeed Coster was mindful of possible bias when samples for dating were collected. One problem was that over 40% of the sites were completely deflated and that almost all the dates were derived from marine shell samples from intact shell middens (1989:57). But these may also
have been later deposits left by visitors from the south.

Coster also overlooks the probability that some of the early settlers actually chose to inhabit the central inland area rather than being forced into it by encroaching sand dunes from the west. The hypothetical early sites on the coast at Ninety Mile Beach may well have been destroyed or covered by sand but what we see in the archaeological record is a series of sites that just happen to cluster in an area between the headwaters of Parengarenga and Houhora harbours and a narrow strip of land for which a central location offers access to both east and west coasts, not to mention fertile gardening soil. It is more likely that settlement was both coastal and central. There are further problems. If we accept Coster's model that all the inland sites were occupied sometime between A.D. 1450-1650, then it is difficult to explain how the people there continued to import primary Tahanga basalt adzes at a time when the Coromandel adze makers had ceased production (as expressed by the dates for the Coromandel sites where adze production took place - see Table 5.1).

A shift in settlement from Aupouri to the southern area may explain problems concerning the 'Archaic Gap' along the southern east coast. Archaic or early settlement may not have been as extensive as it was on the Aupouri Peninsula but from the above mentioned evidence it is clear that areas like the Bay of Islands and the Whangaruru, Whangaroa and Whananaki harbour mouths were occupied from early times. The relative dearth of early sites and early artefact assemblages is probably linked to the increase and intensification of settlement in these areas during the late or 'Classic' period so that late settlements and late artefact assemblages dominate the archaeological record. As Davidson suggested (1982a:26), differential erosion and site destruction processes may explain the difference between the adze assemblages of the Aupouri Peninsula and the area further south. Yet it appears that southern early settlements were also located in low lying coastal locations vulnerable to erosion and sand dune deflation, conditions similar to those in Aupouri, and the small number of early artefacts, including adzes, appear to have come from middens exposed in the sand dunes (DOC Northland site record file, Auckland Museum catalogue, Booth collection catalogue). Aware of the problem of possible sample bias, all attempts were made to track down private adze collections from the southern area. But while other small private collections are known from the Aupouri Peninsula which exhibit a similar range to those from the Gleave and Aupouri Forestry Headquarters collections (D.Simmons notes and drawings, Auckland Museum), few others apart from the Booth collection could be traced for the south east coast area (Taylor pers.comm.; Booth pers.comm.). Additionally, while museum
collections tend to be biased to complete and finished adzes, the Booth, Gleave, Mt Camel and Aupouri Forest Headquarters adze collections contain large numbers of broken adzes and fragments, small flake adzes and adze pieces where reworking attempts have failed as well as complete specimens, all of which suggests that there was a good non-selective retention of material and that these collections are adequate representations of the cultural landscapes they were taken from.

For purposes of comparison when considering interaction between settlements, the collections from the Cape area, the central Aupouri area, and Houhora may be considered as contemporary units but the large numbers of reworked 2B adzes in the southern area pose a problem. Their absence from all dated early sites in the North Island means they should be excluded from samples used to identify patterns of trade and exchange in the early period. Additionally, most are unlikely to have entered the archaeological record in the place they were first distributed to when in a primary state, especially in the Far North where there may have been major shifts in population from the Aupouri Peninsula to the southern area. A similar problem may exist with other reworked adzes. A solution may be to compare three sets of data - the whole sample, the sample with reworked 2B adzes removed, and a sample consisting only of early forms in either a primary, repaired or modified state (see Table 5.4).

Within samples there are fluctuations among the three sets of data, notably the tendency for Nelson/Marlborough argillite adzes to have the highest frequencies when reworked 2B adzes are included, and the lowest when only early forms are considered. As discussed in Chapter Four, the dominance of Nelson/Marlborough argillite among reworked 2B adzes and other reworked forms may be the result of two factors - a higher curation rate due to the greater value of metasomatized argillite and a higher reworking success rate due to the superior manufacturing properties of the stone.

Data for the local basalt adzes shows an opposite pattern. Very few were reworked 2B adzes possibly because the switch to coarse-grained gabbro, found with the same suite of rocks (the Tangihua ranges - S.Best 1975) as the fine-grained altered basalt, had already been made. It was probably easier to hammerdress and grind a gabbro pebble into shape than it was to extract a similar form from a broken altered basalt adze.

Nevertheless, the differences among data sets do not exceed 10% and are constant enough to evaluate the relative importance of different stone types within different Far North areas.

From Table 5.4, two significant observations can be made when comparing samples from
different Far North areas. One is the marked dominance of Tahanga basalt adzes in the sample from Houhora. The other is the relatively high number of Nelson/Marlborough argillite adzes in all the other samples. Given the availability of an adequate local material, and the fact that two other high quality sources were much closer (Tahanga basalt and Motutapu greywacke), this result is surprising. What it may suggest is that for the larger part of the early period, distance was no obstacle when it came to acquiring adzes made of the best quality materials. The marked contrast at Houhora is more difficult to explain. I initially suspected that it was a sample problem related to the fact that the Houhora area contained the only sizable excavated sample and that this and the
majority of the other adzes were from one specific site - Mt Camel. But comparisons between the various surface collections and between these and the excavated sample revealed no differences - Tahanga basalt remained consistently dominant in all adze states and in all samples. Analysis of the flake sample from the Mt Camel excavations revealed a similar result (see Appendix A). Comparing different surface collections for the rest of the Aupouri area (e.g., the Gleave Collection, The Aupouri Forestry Headquarters Collection and general museum collections) and, where sample size allowed, collections from specific locations (e.g., Tom Bowling Bay, Te Werahi, North Cape) also showed no deviation from the overall pattern of raw material distribution. In the final analysis, the distribution pattern seems to be a real one. The difference at Mt Camel may relate to the specific role of the site, primarily the close relationship with the east Coromandel area which is revealed not only by the large amounts of Tahanga basalt but by an equally large proportion of Mayor Island obsidian and Kuaotunu sinter (S.Best 1977:318). Recent examination of the Mt Camel obsidian, however, reveals a higher percentage from Keao than previously thought (S.Best pers.comm.)

Raw Materials and Adze Production: The Mt Camel assemblage is also distinguished by a considerable number of Tahanga basalt preforms where flaking had not been completed (31 of 45 broken and reworked preforms; the remainder were local materials). Analysis of the flake collection did not suggest involvement in Tahanga adze production (Turner and Bonica 1994) but the number of broken and reworked preforms suggest otherwise. Possibly these represent extensively reworked adzes where no grinding evidence remains, but if so why are they so common at Mt Camel and not elsewhere? The extent of adze production is not on the major scale seen on the east Coromandel coast but nevertheless Mt Camel represents the one exception encountered in this research of secondary adze manufacture taking place so far from the quarry (350kms by sea from Opito to Mt Camel). Again this evidence strengthens the association between Mt Camel and the east coast Coromandel.

Given the strong representation among finished adzes in the Cape and central Aupouri areas, it is surprising that so few local altered basalt preforms were recorded, particularly as a source area was probably located in the Cape area (Fred Brooke pers.comm.). A number of working floors where the manufacture of altered basalt adzes took place have been recorded along the south east coast from Doubtless Bay (Taipa river, Manganui Harbour Mouth) to the Whangaroa Harbour Mouth (DoC Northland site record files, Chris Booth pers.comm.) and in the Cape area
A flake sample from the Long Point midden at the Hokianga Harbour Mouth was also examined (Appendix A). The reworking of adzes (Tahanga basalt, Nelson/Marlborough argillite, Motutapu greywacke and local basalt) was the predominant activity represented along with some minor adze manufacture using water-rolled basalt cobbles that could be found on the beach below (personal observation). Notably, among the adze assemblage (N=16, all were failed rework attempts, including a Tahanga basalt Type 5 adze, except for two rough broken local basalt preforms) Nelson/Marlborough argillite is the only material represented among the reworking flakes but not among the failed reworked adzes. This evidence supports further the likelihood that there was a higher success rate in reworking adzes of this stone.

The Far North area contains a number of obsidian sources located between the Whangaroa and Whangaruru Harbour areas (Moore 1988:4). Chert also appears to have been plentiful in most areas with sources recorded at Twilight Beach (Taylor 1984), Tom Bowling Bay (Moore 1977), Whatuwhiwhi (personal observation; Fred Brooke pers.comm.), Hokianga and Herekino Harbours (Michael Taylor and Tore Kronqvist pers.comm.; personal.observation). Thus the Far North area was quite self sufficient regarding essential stone materials. Yet there was an obvious preference for imported materials, especially at Mt Camel where most of the chert, obsidian and adze stone came from the Coromandel/Tauranga region.

**Mid North** (see Figure 5.4 for locations and sites mentioned in the text).

The Mid North, as defined in this thesis, covers the area from Whangarei and Dargaville in the North to Helensville and Whangaparaoa Peninsula in the south. The east coast is characterised by harbours, off-shore islands and peninsulas. The west coast is dominated by the largest harbour in New Zealand - the Kaipara - which boasts more than 3200 kms of coastline (Bryne 1986).

**Archaeology:** The east coast represents another 'Archaic Gap' except for the area around Whangarei Harbour North Head. Site record forms (DOC Northland) and early reports (Thorne 1876) place early sites in the sandhills and dunes at Horahora, Pataua, Taiharuru, Ocean beach and
Smugglers Bay at the mouth of the Whangarei Harbour. These sites contain early artefacts, hearths, burials, as well as the bones of sea mammals, dogs, fish and birds including moa bone and egg shell, though Anderson (1989:110-111), again due to the possible mixed nature of the deposit, questions the cultural validity of the moa remains. These middens have obviously been exposed for a very long time as Thorne's 1876 report indicates. They have also been extensively fossicked and are largely destroyed. This may partially explain the dearth of early settlements on this coast. A source of high quality chert has also been located at Onerahi in the inner Whangarei Harbour. Flakes from this source have been found at the Smugglers Bay site among others (Fredericksen 1990:157). Findspots of early artefacts on the southern side of Whangarei Harbour at Ruakaka, the mouth of the Waipu River, Mangawhai Heads, the Whangateau and Mahurangi Harbour Mouths and Whangaparaoa Peninsula suggest that early settlements were present in this area. But, as was the case further north, site surveys and the majority of artefacts reflect the intensification of settlement over time with pa and shell middens predominant (Morwood 1975; Nichol 1980; DoC Northland site record file).

Surveys and excavations of the Kaipara Harbour reflect predominantly late settlement (Irwin 1985; Spring-Rice 1996) but surface collections of early artefacts from both the South and North Heads of the harbour indicate that early settlements contemporary with Mt Camel and Twilight Beach were present. Irwin suggests that early gardening practices on the north side of the harbour at Pouto led to accelerated erosion and sand dune mobility (1985:97,111-112).

No excavations of early sites have been undertaken in the Mid North region though a number of pa have been investigated, notably at Pouto, but also Otakanini and Waioneke on the southern side of Kaipara Harbour, and Ruarangi in the inner Whangarei Harbour (Bellwood 1972; Davidson 1982b; Irwin 1985; McKinlay 1971). The earliest date from Irwin's study comes from the undefended phase of a small terraced knoll with kumara pits (Waikere Creek Pa - A.D. 1462-1530) while the earliest defended site or pa is dated between A.D. 1487-1605 (Irwin 1985:69-70). Both Waioneke and Ruarangi Pa were occupied in the 16th century but an undefended phase for Otakanini has produced the early date of A.D. 1273-1429. There are, however, probable inbuilt age problems with the Otakanini dates (S.Best 1977:309; Davidson 1984:249), and none have survived Anderson's culling process (1991:784).

**Artefact Collections:** Private collections, held by the Grace and Waller families (South Kaipara).
from a large now completely deflated and sea eroded early site at Kaipara South Head (Q09/529) contains the most comprehensive collection of early artefacts, including vast quantities of chert flakes, drillpoints and flake tools from a local high quality source nearby at Hukatere in the inner harbour (Wilson 1991; Spring-Rice pers.comm.). Like most surface collections there is a strong bias to stone artefacts (see Table 5.1), those of bone not surviving long in exposed conditions and more vulnerable to being swept away by the sea than heavier items of stone. Smaller collections of early artefacts, mainly adzes, come from the North Head/Pouto area though some are more vaguely provenanced to 'Kaipara heads' so could have come from either side of the harbour. The small Schneider Collection of early adzes was recovered from the Pouto dunes with a large grindstone or hoanga.

Excavations of Otakanini and Waioneke Pa produced very different and identifiably 'Classic' assemblages including pounamu adzes and ornaments, barbed bone points from composite fish hooks, patu (clubs) fragments and both primary greywacke 2B adzes and reworked 2B adzes made of Nelson/Marlborough argillite and Tahanga basalt, though the specimen from Otakanini was a surface find (Bellwood 1972; Davidson 1984:69,98,99,102; McKinlay 1971 - see Table 5.2).

The William Frazer collection from the Whangarei area, now in the Northland Regional Museum, is the largest collection from the east coast. Early fishing gear (unbarbed 1-piece fish hooks and minnow lures) and early adze forms have been recovered from the Whangarei heads and coastal sites while a large unusual stone imitation whale tooth pendant has been found at Mangawhai (Duff 1977:114,115).

Adzes: The total number of adzes recorded from the Mid North was 752. Over 70% of this number came from the Kaipara harbour. Regrettably a large number (N=105) from museum collections have no further information as to their precise location and are provenanced rather vaguely to 'Kaipara' including a side hafted adze. The large collection of adzes from Q09/529 (N=141) plus the smaller collections from North Head/Pouto, and a number provenanced more vaguely to 'Kaipara Heads' clearly indicate the early settlement focus of the harbour (see Table 5.3). Inner harbour collections, in contrast, are dominated by reworked adzes, and the highest frequencies of reworked 2B adzes for any region of the North Island were found here. They were accompanied by even larger numbers of primary 2B adzes made from coarse-grained rocks. While the shape of the harbour meant that a large area and range of resources could be accessed.
over short distances from a harbour mouth vantage point, it is probable, as Irwin (1985) suggested, that forest clearance and gardening practices lead to the degradation of the immediate environment. Eventually, some time in the 15th century (at about the same time the Aupouri people were experiencing similar problems), people moved and focused settlement on the more stable inner harbour. At the harbour mouth vertical shifts in settlement were made to terraces with a sheltered aspect and they were orientated to the inner harbour, not the coast (for example, Otakanini). Indeed a small number of primary and reworked 2B adzes in the Grace and Waller collections came from an eroding pa located above the early settlement. The contrasts between the artefact assemblage from Q09/529 and sites like Otakanini and Waioneke, particularly the adzes, suggests that they were not contemporary.

The east coast adze collections reflect a pattern almost identical to that of the coast further north. Small numbers of early adze forms have been found from the sites listed above but they are outnumbered by reworked and primary 2B adzes.

**Raw Materials and Adze Production:** (Table 5.3 and 5.4). Very few preforms have been found in the Mid North, an area largely devoid of suitable fine-grained rocks for adze making. An exception is the proximity of the northern Hauraki Gulf area to the Motutapu greywacke sources, thus the lack of preforms and other evidence of adze manufacture is surprising. It may be a sampling problem but a large collection from the Whangaparaoa area, for example, contains a number of broken adze fragments and several small scrappy flake adzes, but the only preform is a large complete finely flaked Tahanga basalt Type 1 form (found at Waiwera).

Both the flake sample at Q09/529 (Appendix A) and the adze collection suggest that the inhabitants of Kaipara Heads relied solely on imported adzes. They were importing adzes that reflect a wide range of sources however, including Tahanga basalt, Nelson/Marlborough argillite, Motutapu greywacke, the occasional Waikato basalt and Northland basalt adze and even an adze or two of Taranaki argillite. The prevalence of Nelson/Marlborough argillite among reworked 2B adzes is again evident, but among primary imported forms, Tahanga basalt clearly dominates despite the closer Motutapu greywacke source in the Hauraki Gulf. Notably most of the obsidian from Q09/529 has been sourced to Mayor Island with smaller amounts possibly from Great Barrier, Coromandel, Northland and Taupo (Spring-Rice 1996; Wilson 1991:24).

A similar distribution of imported adze materials is seen among early forms on the east coast though the frequency of Motutapu greywacke adzes is higher.
Tamaki (Auckland) (see Figure 5.5 showing locations and sites).

The Tamaki region was probably always 'prime real estate' (as its traditional Maori name 'Tamaki-makau-rau' - 'the maiden contested for by a hundred lovers' implies) comprising two harbours separated by a narrow strip of land less than a kilometre wide (the Tamaki portage), a number of offshore islands in the sheltered Hauraki Gulf on the east coast, and a central fertile field of volcanic cones upon which some of the most impressive pa in the North Island were built and where gardening activities may have commenced at an early date (Bulmer 1989).

Archaeology: Both late and early settlement are well documented for the region. Again early settlement on the west coast was focussed at the harbour mouth, this time at the Manukau Harbour. On the south side is the site of Matatuahu where a large collection of predominantly early artefacts has been made by the Brambley family (detailed by Prickett 1987). A small excavation was also undertaken at this site which provided a sample of bone material formerly missing from the surface collection (Jolly 1960). The bones of moa and other birds, sea mammals, dog and fish were recovered though the moa bone was probably imported for industrial purposes (Anderson 1989:112; Prickett 1987:29; Smith 1989:77). Another early site once existed in the sandhills of Whatipu on the northern side of the harbour mouth where a similar though less comprehensive collection of artefacts has been made (Lawrence 1989). Other early artefacts have been recovered from the sand dunes at Muriwai but most of the sites along the Waitakere coast have produced predominantly late 'Classic' artefacts (Lawrence 1989). No radiocarbon dates are available for the early sites at the Manukau Harbour Mouth.

Some distance south of the harbour mouth is the site of Maioro, located one kilometre inland. Termed an 'undefended habitation on a defendable knoll' (Fox and Green 1982:57), this site is interesting in having produced early dates for the first phase of occupation - A.D. 1159-1284, though Anderson suspects that inbuilt age may be implicated (1991:786).

Evidence of early settlement in the inner Manukau and Waitemata harbours is virtually non-existent, though a small number of early adze forms have been found on the coastal margins of Mangere and Ihumatao (S.Best 1975:29; Copsey 1974; Lawrence 1989).

Early occupation of the Hauraki Gulf Islands, particularly Motutapu and Ponui, is well documented, and a number of excavations have taken place on the aforementioned islands.
While seal, whale, and imported moa bone have been recorded from these sites, dogs seem to have been particularly important in the diet (Anderson 1989:111; Davidson 1970a; Davidson 1978a; Golson and Brothers 1959; Nicholls 1964; Nichol 1981, 1988; Scott 1970; Smith 1981). A number of pit and terrace sites have also been excavated on Motutapu Island as well as the pa at Station Bay (Figure 2.3) (Davidson 1970b, 1972; Leahy 1970). Regrettably the radiocarbon dates for these sites are problematic and only the date from the pa is acceptable - A.D. 1526-1561, 1632-1955 (Anderson 1991:785). The timing of the Rangitoto eruption plays an important role in deciphering the chronology of the Motutapu Island sites and this is dated to A.D. 1375-1430 (Nichol 1988:461). Only the Sunde site appears to have been occupied prior to the eruption and is dated between A.D. 1266-1446 (Anderson 1991:769, 785). At this site, Nichol claims there was evidence that people made gardens in the still warm ash (Nichol 1981:254). The other early excavated site at Pig Bay may not have been occupied until after the eruption and only the uppermost occupation layer has an acceptable date - A.D. 1483-1661 (Anderson 1991:769, 785). Less well known and now virtually invisible in the built up landscape of Auckland city are early settlements at the mouth of Waitemata Harbour and Tamaki River. Deflated surface collections of mainly stone material from the mudflats and intertidal zones of Torpedo Bay at the north head of the harbour, along the beaches between the south head and Tamaki River, on the southern side of the river at Bucklands Beach and possibly on the coastal margins beyond (a stone reel is also recorded from Howick - Duff 1977:135), are testimony that they did once exist (Auckland Museum catalogue; DOC Auckland site record files; personal observation).

Above and inland from these early coastal sites, and along the Tamaki river, are numerous pa and habitation sites, a number of which have been excavated (see Bulmer 1994 for a summary of these). They include Oue Pa (Harsant 1981), Taurere (Taylors Hill) (Leahy 1991) Puketapapa Pa (Mt Roskill) (Fox 1980), Maungarei Pa (Mt Wellington) (Davidson 1975f, 1993b), Hamlins Hill (Davidson 1970c), among others, and a cluster of habitation sites near the Tamaki portage (Fisher Rd, Westfield, Harris Rd, Cryers Rd, Wiri - Furey 1986; Foster and Sewell 1989; Bulmer 1994). None of these sites were occupied before the 15th century and so do not appear to be contemporary with the early settlements in the Hauraki Gulf or at the Manukau Harbour Mouth.

**Artefact Collections:** Prickett claims Matatuaahu as '...undoubtedly the region's most important "archaic" assemblage' (1988:92), and this is certainly the case, not only in the abundance of artefacts.
Figure 5.5: Map showing Tamaki Locations.
but in the presence of some rare types like the twin-lobed serpentine pendant and harpoon point (Prickett 1987:15,29). Another harpoon point was found on the other side of the harbour (Lawrence 1989:78). From this site in the Whatipu sandhills a large amount of bone material was recovered including one piece fish hooks, needles, tattooing chisels, minnow lure shanks as well as shell and bone ornaments, files, hoanga, drillpoints, adzes and fragments. A smaller collection of early material was recovered from the Muriwai sand dunes (Lawrence 1989:21-25,66,72-78). A similar array of artefacts has been found at Pig Bay (R10/22) and the Sunde site (R10/25) on Motutapu Island and at Motunau Bay (S11/20) on Ponui (see Table 5.1). Surface collections of early artefacts have also been made on Motukorea (Fredericksen 1991), and Waiheke (Auckland Museum catalogue). The artefact assemblages from the later sites listed above are in marked contrast and this includes Maioro.

**Adzes:** The adze sample from the Tamaki region is large (N=1593) reflecting the number of excavations that have taken place, as well as numerous individual surface collections. Almost all these collections are now in the Auckland Institute and Museum. Due to the status of the region as an adze production area, 34.2% of the sample are preforms in various stages of manufacture. The Brambley adze collection from South Manukau Heads (N=90) together with the smaller sample of adzes from North Head and several provenanced less precisely to 'Manukau Heads' (N=24) suggest occupation contemporary with Kaipara Heads and the Aupouri Peninsula (see Table 5.3). Seventy five percent of the Waitakere coast sample comes from Muriwai with over half of the remainder somewhat vaguely provenanced to 'Waitakere' or 'West Coast'. Apart from the cache of Tahanga basalt Type 1 and Type 4 adzes and a few other early forms in various other states from Muriwai, the majority are reworked 2B adzes and other reworked adzes suggesting predominantly late occupation of the coastal area as is also indicated by Lawrence's review of the sites and other artefacts found in the area (1989).

Both excavated and surface collections from the inner Manukau and Waitemata harbours, the central volcanic stonefields and the Tamaki river are also characterised by high numbers of reworked 2B adzes and other reworked adzes. The two Nelson/Marlborough argillite adzes at Maioro are reworked. One is a reworked 2B adze and the other is well ground and has probably seen several episodes of modification and reworking. Neither can be used to support the early date for Maioro, nor do they indicate the continued importation of Nelson/Marlborough argillite adzes in
the 15th and 16th centuries as Fox and Green suggest (1982:76-78). The other adze, a Motutapu greywacke chisel is also a reworked adze. Reworked 2B adzes have also been excavated from Taurere (Taylors Hill), several of the Tamaki River sites and Oue Pa. Broken pieces from recognisably early forms have been excavated from several pa including Tahanga basalt Type 1 fragments rejected after a failed reworking attempt (Puketapapa, Maungarei). Had they been successfully reworked a 2B form may have resulted. The few Type 3 adzes recorded are also small reworked forms. Two of the five Inner Manukau Harbour primary adzes came from the Mangere area (both Tahanga basalt Type 1 adzes) while from nearby Puketutu Island, a Motutapu greywacke Type 4 adze was recovered. Primary adzes in the Inner Waitemata and volcanic fields area are even rarer and apart from the examples mentioned above, no early forms have been found from the excavated later sites.

In contrast, numerous early forms have been found from the Waitemata Harbour Mouth and coastal margins (Takapuna, Devonport, Karaka Bay, Ladies Bay, Hobson Bay, St Heliers Bay, Bucklands Beach). Early adze forms also dominate in collections from the Hauraki Gulf Islands. Exceptions are the adze assemblages from the excavated undefended terrace settlements at Station Bay and Administration Bay and the pa at Station Bay (Motutapu Island – see Figure 2.3). The one adze excavated from the pa was a reworked Tahanga basalt 2B adze.

One of the problems excavations on Motutapu Island have sought to address was the relationship between the early beach middens and working floors (Pig Bay, Sunde) and the many pit and terrace sites. There exists the possibility that these different site types represent different but contemporary components of the same settlement system (Davidson 1970b:31-32) or even that the beach sites represent temporary visits from mainland residents (Davidson 1982b:42). As mentioned above, no reliable dates are available for the undefended sites at Station Bay (R10/31, R10/38) and are not yet available for the terrace and house site (R10/497) at Administration Bay thus a comparison of the artefacts remains the main method of understanding the relationship. The Station Bay sites yielded relatively few artefacts but a barbed composite fish hook point and
a *pounamu* pendant fragment were found at R10/31 as well as a number of adzes (Leahy 1970:70-72,79,80). The Administration Bay house floor was quite rich in artefacts including a considerable number (R10/497) of barbed fish hook points and a large adze assemblage including a *pounamu* chisel. The fishing gear is clearly different from that found at Pig Bay and the Sunde site which comprised one piece fish hooks, drill points and minnow lure shanks (Davidson 1970a:24,1978a:2; personal observation). As Davidson has previously noted, the continued use of Motutapu greywacke over time for adzes has served to confuse rather than clarify the relationship between the beach and terrace sites, though she notes that the adzes at the Station Bay undefended sites are present in a 'more restricted range of types' than at the Pig Bay and Sunde sites (1972:9). The adze evidence has also been used to infer that the 'Archaic' phase lasted for longer on Motutapu than elsewhere (Brothers and Golson 1959:576).

From my analysis of all these assemblages it is apparent that between the abandonment of the beach sites and the occupation of the terrace sites, a definite change in adze technology had taken place. All the adzes and preforms from Pig Bay and the Sunde site represent the early technology where flaking was the predominant technique. Even in the upper layer at Pig Bay, a finely flaked portion of a Type 4 preform was found. But at Station Bay and Administration Bay the adze and preform assemblages are characterized by small stubby rectangular and quadrangular forms made from split water-rolled cobbles that were roughly flaked before being heavily hammerdressed and ground. They may be regarded as very rough renditions of the Classic 2B adze. As outlined in Chapter Two, the fine-grained and very hard nature of Motutapu greywacke saw the retention of at least some rough bifacial flaking in the initial shaping but grinding was still an inordinately slow and laborious process with this stone. Hammerdressing became a more viable option for these small forms but the properties of Motutapu greywacke resulted in forms less finely finished and ground compared to primary 2B adzes made of coarse-grained materials. Flake assemblages from both sets of sites also show distinct differences (see Appendix A). Those from Pig Bay are characterised by a range of large and small trimming flakes with multiple flake scars demonstrating flaking skill and evidence that the final adze form was achieved primarily by flaking. Hammerdressing flakes were rare. Flake assemblages from Station Bay and Administration Bay show relatively high frequencies of hammerdressing, are rarely longer or wider than 5cm and seldom demonstrate multiple scarring. Among the assemblages from
mainland sites like Taurere (Taylors Hill) and a number of pa including Maungarei, these stubby hammerdressed adze forms are also common.

Differences in the sources of obsidian between the beach and terrace sites are also apparent. Over 70% of the obsidian from the Pig Bay excavation came from Mayor Island whereas almost all the obsidian from the Administration Bay house floor came from Great Barrier Island (S.Clout 1995). Davidson makes a similar observation for the Station Bay sites and the Sunde site where Great Barrier obsidian predominated for the former and Mayor Island for the latter (1972:7).

In summary, the adze evidence does suggest quite strongly that the terrace sites were occupied at a later date than the beach middens and working floors. Furthermore, and somewhat perplexing, the complete change in adze technology suggests some lapse in time between abandonment of one and occupation of the other. The cultural sequence proposed by Davidson for Motutapu (1972:11-12) places the undefended Station Bay sites after the Archaic phase represented by Pig Bay and Sunde, before the Classic phase represented by Station Bay pa, and contemporary with mainland sites like the undefended phase of Mt Wellington (Maungarei). The adze data examined in this thesis would appear to support this model. For example, no reworked 2B adzes were recovered from any of the undefended sites on Motutapu, yet the one adze from the pa was of this type, and is the only one thus far recorded from the island.

The gap in occupation between the beach and terrace sites as perceived from the adze data may, however, indicate that the island was abandoned and then re-occupied by a different group of people. Certainly the flaking on the small stubby preforms appears cruder than it ought to be, and the flaking skill evident at Pig Bay is almost completely lacking in the Administration Bay and the Station Bay assemblages (especially R10/31) even though the material used is of the same generally fine-grained quality. But it is quite possible that early terrace sites have yet to be identified by excavation. It is interesting to note that the Pig Bay working floor and midden site was periodically flooded leaving layers of water-laid ash between cultural deposits. This may have been beneficial in providing a regular clean-up of the area but it is likely that the inhabitants (and from the other evidence discussed above and below I am suggesting that Pig Bay was probably permanently occupied) located their domestic residences at a higher elevation. But Motutapu Island is notorious for the indistinct nature of surface archaeological features - another problem that the excavations were designed to address (Davidson 1970b:31), and terraces relating to the early period of occupation may be even more difficult to identify.

Additionally, the adze evidence does not suggest that Archaic forms continued to be
manufactured at Motutapu for longer than in other regions. Indeed, if the Pig Bay occupation can be placed between the Rangitoto Eruption of A.D. 1375-1430 and 1483-1661, and the Sunde site at A.D. 1266-1446, then the Archaic phase on Motutapu may have been relatively brief, and they were probably contemporary with sites at the Manukau Heads, Kaipara Heads and Aupouri Peninsula. The Station Bay and Administration Bay undefended settlements are likely to be contemporary with sites on the mainland which have very similar assemblages including the rough Motutapu 2B adzes. Sites would include the Tamaki River cluster of sites, Taurere, the undefended phase of Maungarei and others, all first occupied in the late 15th century to the early 16th century.

Thus a picture emerges in which the Manukau Heads sites, the Waitemata coast sites and the Hauraki Gulf Island beach sites are the discrete settlement units of the early period in Tamaki. The artefact assemblages indicate a wide range of domestic activities and functions characteristic of permanent residences. The 17th-18th century beach midden at Galatea Bay on Ponui Island, in contrast, contained little more than evidence of shell fishing and processing (Terrell 1967). The early gardening evidence at the Sunde site provides further support for the permanent nature of early settlement on Motutapu. On the mainland there is also evidence that gardening was practised at the same time sites like Matatuahu were occupied, though Anderson rejects most of the dates that demonstrate this (1991:785-786). But, as argued earlier, it seems that where people could garden, they did, and Tamaki provided ideal growing conditions. Davidson suggests that people may have been permanently stationed near the gardening areas (1982b:36), but the reverse may have also been the case. People stationed at Matatuahu could easily have crossed over to Mangere to tend their gardens in the same time it takes many of us to get to work in the present day. Indeed the adze and other artefact data strongly supports the latter scenario and it is interesting to note that the small number of early adzes found in the inner Manukau harbour came from the Mangere area. It is probable that as coastal environments deteriorated, people focused more intensely on inner harbour resources, including gardening land, until finally it became more sensible and economic to actually move there permanently (Cassels 1972a).

**Raw Materials and Adze Production:** The distribution pattern of raw materials between the west and east coasts and harbours are quite different. It is clear that only the inhabitants on the Hauraki Gulf Islands and those located along the adjacent east coast of the mainland were actively involved in Motutapu greywacke adze production. In addition to the islands of
Motutapu, Rakino, Waiheke, Ponui and Motukorea, working floors with evidence of Motutapu greywacke adze manufacture (preform fragments and flakes - see Appendix A) have been located at Torpedo Bay, Devonport, Hobson Bay, St Heliers Bay, Karaka Bay, Tahuna Torea (on the coastal flats below Taurere), Bucklands Beach and Kelly's Beach. Collections from these areas, which include a range of other stone materials like obsidian and chert, have all been recovered from completely eroded contexts (usually redeposited on mud flats) and in most cases there is nothing left of the site they came from (Auckland Museum catalogue; Bonica pers.comm.; personal observation). Undoubtedly there were other working floors within this area but the adze data does not suggest that the Motutapu adze production complex extended much beyond it (see the discussion above on the Mid North east coast, and below for the Firth of Thames).

Continued access and exploitation of the stone over time is evident in the data for the later sites further inland (volcanic area) and along the Tamaki River. But the majority of the preforms found at these sites are stubby roughly formed and hammerdressed 2B adzes.

On the mudflats at the mouth of the Tamaki River, flakes, preforms and adze fragments display early characteristics. Directly above and about one kilometre from the shore is Taurere where most of the preforms and adzes are late forms. A small number are fragments or reworked portions from earlier forms and imported materials (Tahanga basalt and Nelson/Marlborough argillite) and it is tempting to infer that they are the last remnants of adzes originally imported or made by the people who once lived on the coast at Tahuna Torea. For the mainland at least, this might also indicate some continuity in settlement; that Taurere was not occupied by 'newcomers' to the area but rather by descendants of the Tahuna Torea inhabitants. A similar situation may have occurred on Motutapu though the evidence is less conclusive. At the undefended settlements of Station Bay and Administration Bay, evidence for the reworking of earlier forms is sparse, and the presence of imported materials is completely absent. This contrasts with the early sites where, though quite rare, adzes and flakes of Tahanga basalt and Nelson/Marlborough argillite are found, and where the reworking of broken preforms and adzes was a common activity, despite the proximity of the Pig Bay and Sunde sites to the Motutapu sources. Demonstrating this relationship is hindered primarily by a sampling problem in terms of both the sites (see above) and the artefacts. The sample of adzes from the later sites on Motutapu is very small in comparison to the large numbers excavated and surface-collected from Pig Bay, the Sunde site and other early sites (for example, Emu Bay and Sandy Bay). While there is a bias in both sets of data to reject material, the samples from Station Bay and Administration Bay are
almost totally comprised of broken or unfinished specimens, while from the earlier sites, a number of finished and complete adzes were recovered. When these sites were abandoned, valuable pieces (particularly of imported materials) and adzes in working condition were probably taken away, and possibly one such piece turned up as a reworked 2B adze on Station Bay Pa, notably not made of Motutapu greywacke but Tahanga basalt. Additionally, the difference in the two technologies results in different deposition patterns in the archaeological record. Flaking was a high risk technique and both primary manufacture and reworking resulted in frequent failure due to breakage and asymmetry. In addition abundant debitage was created. But the hammerdressing technique creates very little waste material, is far safer and probably resulted in a much higher production and reworking success rate. For example, adze production was a predominant activity at both the Pig Bay and Administration Bay sites but the Pig Bay excavation produced close to 12,000 adze flakes and fragments while the Administration Bay site produced just over 600 pieces (see Appendix A). The area excavated was similar for both sites.

Fewer Motutapu greywacke adzes were crossing over the Tamaki portage to the Manukau Harbour and west coast than expected given the proximity of the source. Stranger still is the frequency of Tahanga basalt adzes which came from a greater distance away, and which had to pass through the Motutapu greywacke production zone and travel along the same route to reach sites like Matatuahu. At this site, Tahanga basalt adzes were almost twice as common as Motutapu greywacke adzes suggesting that they could be readily obtained (Table 5.4).

Absent at Matatuahu is any involvement in the production of Motutapu greywacke adzes. The few preforms (an equal number of Motutapu greywacke and Tahanga basalt) found there were finely formed specimens where flaking had been completed and they probably arrived at the site in this state. This is unlikely to be a sampling bias; though flakes were generally not retained, the adze collection contains many broken fragments, some so extensively reworked that if it were not for small remnants of grinding they could be mistaken for preform pieces.

Like the site at South Kaipara Head, a range of other imported and local materials were represented at Matatuahu, notably Nelson/Marlborough argillite and a few Taranaki argillite, Waikato basalt, Motutapu Island chert and local basalt adzes. Tahanga basalt adzes also dominate the small samples of early adzes from the Waitakere coast and inner Manukau Harbour. While Lawrence asserts that adze production based on the exploitation of local basalt sources was a focus at Muriwai (1989:29), there is little evidence in the adze data reviewed here (which
includes most of Lawrence's sample) to support this. Some quite fine-grained basalts are found on the beaches and in the rivers along this coast but the flaking quality, as tested in replication experiments, is generally poor. Only five of the 75 Muriwai adzes examined here may have been made of local basalt. Macroscopically they were distinctively different from Tahanga basalt, being considerably coarser-grained. Two were very similar to the basalt found in the Waikato region. None were early forms. Also, apart from a rough broken chert preform, no other unfinished adzes indicative of adze manufacture are evident in the Muriwai assemblage. This may reflect a sampling bias but, given the range of 'lesser' artefacts collected from the area including adze fragments, it is likely that, if preforms were present, they would have been retained.

**Hauraki Plains and the Firth of Thames** (see Figure 5.6 for sites and locations mentioned in the text).

This area lies south of Orere Point and Kereta and is characterised by several large rivers (the Waihou and Piako) which wind their way inland through flat low-lying plains that once contained extensive swamp lands. The rivers drain into the Firth of Thames, a body of water squeezed between the ranges of the Coromandel Peninsula and the Hunua ranges to the west.

**Archaeology:** The late prehistory of Hauraki is well documented archaeologically from excavations of a number of swamp pa located along the Waihou River (S.Best 1980; Green and Green 1963; Phillips 1986,1988,1994; Prickett 1990a,1992; Shawcross and Terrell 1966). Most famous of these is Oruarangi from which a large and definitive 'Classic' artefact assemblage has been recovered, albeit mainly through unsystematic fossicking (Fisher 1934,1935,1936; Golson 1959a; Furey 1996). Radiocarbon dates from Oruarangi, Paterangi and Raupa suggest that Oruarangi was one of first sites to be occupied but this was no earlier than A.D. 1420-1580, and this pa along with others like Raupa, were occupied into the historic period (see Table 5.2 - Best 1980; Law 1982; Prickett 1992).

Evidence for early settlement is sparse. Oruarangi may well represent first occupation of the rivers and plains. No sites along the coastal margins of the Firth of Thames have been excavated and little is known about settlement in this area, though pa are well represented (Law 1982:51).
**Artefact Collections:** Large assemblages have been collected from the Waihou River sites with the assemblage from Oruarangi being the most comprehensive of any late site in the North Island. Many farmers in the area have private collections though some of these are now in museums (for example, the Avery collection from Hikutaia is now in the Auckland Museum). The largest assemblage still in private hands is the Murdock collection (Hikutaia) which was examined in the course of the present research. In contrast, collections from the coastal Firth of Thames area are small (and a number were discovered in a most unlikely repository - The Thames School of Mines).
Figure 5.6: Map showing Hauraki Plains and Coromandel Locations.
Figure 5.6: Map showing Hauraki Plains Locations.

The collections strongly reflect late settlement and are characterised by an almost complete absence of 'Archaic' artefacts. The few exceptions come from Oruarangi, notably two serpentine reels that, in the context of the rest of the collection, were probably heirlooms.

**Adzes:** $N = 430$. The adzes at Oruarangi have caused some consternation to previous authors. Simon Best noted that 20% of the adzes were not typical of the Classic 2B type, and possessed 'Archaic affinities' (1980:79). He also observed relatively high numbers of Tahanga basalt adzes and that some retained 'Archaic features' (1980:72). Additionally, Best noted that the Tahanga basalt 2B adzes were all very small (under 70mm long) and were morphologically distinctive from those rendered in coarse-grained materials (1975:27-29,57).

Fisher identified two distinct adze types at Oruarangi: Type A is long, thick, narrow and tapering with a rounded bevel while Type 2 is short, broad and thin with a short steep bevel (Fisher 1936:15-16). Later Shawcross and Terrell took measurements in order to define the two types quantitatively but found no significant differences (1966:423). Using a different statistical approach, Law selected 35 adzes from Koputarahi on the Piako River (Murdock Collection) ‘...to see if the variation with the 2B type can be expressed in a way which has some archaeological value' (1995:97). The two significantly different types produced from his data matched those defined by Fisher except in the bevel shapes (1995:102). But while Law concluded that his types were 'an efficient way of describing variations in that collection' (1995:101), he came no nearer to explaining the cause of this variation. Unfortunately Law dismissed raw material as an influential factor recalling Duff's (1977:165) assertion that 'Maori clearly imposed culturally preferred shapes onto intractable rock types...', and the effects of reworking were similarly dismissed (1995:101).

From my analysis of the Murdock collection including the Koputarahi sample, the Oruarangi
assemblage (Auckland Museum, Otago Museum and Murdock Collection), a large assemblage from Hikutaia, the excavated assemblages from Raupa and the adjacent site of Waiwhau, and smaller samples from other sites, the explanation is clear. Dominant among Fisher's Type B adzes are reworked 2B adzes, mainly of Tahanga basalt, but also Nelson/Marlborough argillite and Motutapu fine-grained greywacke (13 of the Koputarahi adzes examined by Law 1995 were of early fine-grained materials, five being reworked 2B). Indeed, after the inner Kaipara Harbour, the highest frequencies of reworked 2B adzes were found in the Hauraki Plains region and close to 80% of all adzes made of early materials are heavily reworked (see Table 5.3). A Tahanga basalt reworked 2B adze was also recovered from excavations at Raupa (Prickett 1990a).

Early forms are correspondingly rare, particularly at Oruarangi. But it was at Oruarangi that the most distinctively 'Archaic' adze of the region was found, a large finely flaked Tahanga basalt Type 1 preform. Additionally several other Tahanga basalt adzes, while much repaired and modified, are obviously derived from earlier forms. This evidence coupled with the predominance of Tahanga basalt among the reworked 2B adzes, suggests that some of the people who first occupied the site may have come from the east coast Coromandel. Of interest is the observation that most of the east coast Coromandel beach settlements were abandoned at the same time Oruarangi was first occupied (see Table 5.1 and Phillips 1994). In a scenario reminiscent of that described for Shag River Mouth (Smith and Leach 1996), people brought the last of their 'Archaic' adzes with them and thereafter no further Tahanga basalt adzes were imported, presumably because the quarry had fallen into disuse by that time. Only one was not subsequently extensively used, modified and reworked. The reasons for this are unclear and open to speculation. The closing of the quarries for whatever reason is likely to have prompted new strategies in curating adzes. Apart from pounamu the fine-grained materials would have been functionally superior to those made in coarse-grained materials especially in providing a sharper and more durable cutting edge. The reworked 2B adzes, many less than 50mm long, bear witness to the desire to keep them functional for as long as possible. Thus safer and more conservative methods of reworking were applied. This is evident on the other reworked and modified specimens. As also seen in the later sites of Tamaki, reworked and modified adzes in Hauraki sites have been reshaped primarily by liberal amounts of hammerdressing (including those where a reworking attempt has failed or been postponed) and debitage produced from flaking and reflaking adzes is rarely found.

At the other end of the spectrum, an interesting feature among the small sample of early forms in
Hauraki is the high frequency of Type 1 adzes. This is not simply the outcome of these adzes being much larger to begin with (therefore taking much longer to wear out) as some are in a primary or repaired state. Again intensification of curation strategies may have seen these adzes, probably the most valuable and highly prized, increasingly preserved for only the most essential and specialized tasks until they acquired the role described ethnographically by Elsdon Best (1974 - wherein they were used only in a ceremonial capacity to remove the first chip in the construction of a canoe or house). Several exist today as heirlooms, for example, 'Te Toki a Matariki', a D'Urville Island argillite Type 1 adze belonging to the Tainui iwi of Waikato. According to traditional accounts this
adze was used to take the first and last chips in felling a tree for a canoe and just before launching, and also in the construction of a major house (McKay 1973:412).

The frequency of early forms is slightly higher for the Firth of Thames than for the river settlements, and the frequency of reworked 2B adzes is relatively low. This might suggest some settlement of the coastal area in the early period.

**Raw Material and Adze Production:** Other evidence that occupation of the Hauraki area was almost exclusively late is the absence of any involvement in Tahanga basalt or Motutapu greywacke adze production even though the area is central to both sources (see Figure 5.5). It is apparent, however, that geographically the Firth of Thames and its river systems are 'off the beaten track', distant from the main coastal highway that links the Hauraki Gulf with the top of the Coromandel Peninsula. There were suitable sources of adze stone on the coast between Orere Point and Kaiaua where beaches and rivers contained abundant water-rolled cobbles of greywacke suitably shaped for adzes as well as patu and pounders (personal observation). The greywacke is part of the Waiheke group of greywackes which also includes the Motutapu source (Prickett 1992:91-92), but from field evidence and replication experimentation, only the stone on Rakino and Motutapu is consistently fine-grained. The Firth of Thames greywacke is more coarse-grained than Motutapu greywacke, but is tougher and much easier to hammerdress and grind (experimental evidence). Use of this material is evident for the manufacture of the Classic 2B adzes in the Hauraki region. Some later rough fine-grained Motutapu 2B adzes (including a preform) were present but generally the stone appears to have had a very minor influence.

Tahanga basalt adzes, in contrast, dominate in all states, particularly among early forms, again suggesting that the Hauraki inhabitants once had strong connections to east coast Coromandel. A small number of Taranaki argillite adzes are represented by both reworked and late pebble forms in the Oruarangi, Koputarahi and Hikutaia assemblages. These possibly reflect inland connections with Taranaki via Waikato along the Piako and Waihou rivers.

**Coromandel and Great Barrier Island** (see Figure 5.6 for sites and locations mentioned in the text).

The Coromandel Peninsula is another region that presented conditions optimal for early Maori settlement. Islands and small harbours abound on the west coast above Kirita Bay and regularly
down the length of the east coast. Seal colonies and moa were present on the east coast (Smith 1989; Anderson 1989) and climatic conditions were ideal for the adaptation of tropical East Polynesian cultigens, particularly on some of the offshore islands like Ahuahu (Great Mercury) where the average temperature is said to be some five degrees higher than the mainland and where kumara could have been grown all year round (Edson 1973:94; Rowland 1975:198,199).

Archaeology: Perhaps no other area in the North Island has been the focus of more intensive archaeological attention than the east coast of the Coromandel Peninsula. Before archaeologists arrived on the scene, the area was another fossickers 'happy hunting ground'. Much of this focus, both archaeological and amateur, was, however, concentrated on the eroding highly visible and early artefact rich beach middens (Davidson 1979; Law 1982). Thus the early settlement of the area is well documented though somewhat uneven in terms of the range of site types excavated. Subsequent surveys have revealed a wider range of site types including pit and terrace sites, and several of these have been excavated (Davidson 1975a; Furey 1981; Golson 1959a; Green 1963) but the relationship between these and the beach midden remains unclarified. At Skipper's Ridge I and Sarah's Gully storage pits were revealed and radiocarbon dates provide evidence that horticulture was practised during the early period (though Anderson (1991:782) rejects the dates from Skipper's Ridge due to inbuilt age). The numerous excavated beach middens between Opito Bay and Whiritoa as well as middens at Port Jackson at the tip of the Peninsula and Harataonga on Great Barrier Island all date to a similar period of occupation and have very uniform faunal and artefact assemblages (see Table 5.1). Evidence of house structures has remained elusive but this probably reflects the bias toward midden excavations (Crosby 1977; Foster 1983; Furey 1990,1991; Harsant 1985; Jolly 1978; Law 1972; Leahy 1974). Faunal analysis has failed to prove that occupation of the beach middens was of a seasonal and temporary nature (Davidson 1979). The range of activities reflected in the beach middens, the evidence of gardening and the obvious value of the area for settlement make it highly probable that occupation was on a permanent basis. As seen elsewhere, the majority of settlements were located at or near harbour mouths (Whitianga, Tairua, Wharekawa, Whangamata). Occupation appears to have been particularly extensive on the Kuaotunu Peninsula and in Mercury Bay. Though not excavated and now completely covered by modern beach houses, deflated material from a site at the mouth of the Whitianga Harbour stretches over a kilometre on the mud flats and may have been more extensive before infilling for the wharf and marina took place (personal observation). Even given
the amount of archaeological attention the east coast Coromandel Peninsula has received, the impression that it was one of the major centres of early occupation is probably well founded. Less is known of early occupation on the west side of the Peninsula above the Firth of Thames. The coastal environment is very similar to that on the east coast and the Coromandel, Manaia and Te Kouma harbours are also very close to the Hauraki Gulf Islands thus early settlements probably existed. The archaeology of late settlement has received less attention. The few excavated middens that post-date the earlier ones show a much narrower range of faunal and artefact material (Allo 1972; Law 1972,1982). The high profile of the area in the early period appears to have diminished in later times (Law 1982:57) possibly because the precipitous nature of much of the Coromandel Peninsula constrained settlement expansion.

**Artefact Collections:** Even before the spate of excavations on the east coast Coromandel, records of early and rare types of artefacts were consistently reported from the area (see, for example, Duff 1977:132,135), notably a large number of early ornaments including two rare chevroned pendants from Mercury Bay (one is a recent and unpublished find now housed in the Mercury Bay Museum), reels of serpentine and complete necklaces (Foster 1983). Burials containing grave goods have also been reported (Edson and Brown 1977; Olsen 1980). Law comments that 'The wealth of personal ornaments from the region can be seen as indicative of the wealth or prestige of the inhabitants' (1982:56), again reinforcing the importance of this area in the early period (see Table 5.1 for the range and types of artefacts found).

**Adzes:** The Coromandel Peninsula produced the largest sample of adzes (N=2430). Both museum and private collections (the Murdock collection - miscellaneous, the Harsant collection from Hahei, the Hamilton collection from Whitianga, the DOC Port Fitzroy collection from Great Barrier) are represented and all the excavated assemblages are included. The sample is generally biased to broken preforms, small expedient flake adzes and broken adze fragments - many the outcome of failed reworking attempts. This reflects the midden context from which much of the sample derives and the role of east coast Coromandel in Tahanga basalt adze production. But Table 5.3 reflects the large numbers of primary adzes and early forms also found in this area. In contrast, frequencies of reworked 2B adzes are very low. No reworked 2B adzes were excavated from the early midden sites, but the 2B adze from the late site at Skipper's Ridge II was a
reworked form made of Motutapu greywacke. Two very small (less than 50mm long) reworked 2B adzes (Motutapu greywacke and Nelson/Marlborough argillite) were also excavated from a late site at Okiwi, Great Barrier Island, along with a primary 2B adze of coarse-grained greywacke (personal observation).

The adze data reviewed here supports the evidence above in suggesting that settlement diminished in the late period and that the depletion of wild foods, the limited potential for expansion into the hinterland and the cessation of adze production saw a proportion of the population leave the region and possibly move into uninhabited areas like the Hauraki Plains.

The west coast Coromandel data (not including Port Jackson), reflects a different scenario compared to the east coast, and both this area and Great Barrier Island have much higher frequencies of reworked 2B adzes suggesting that occupation was steady throughout the prehistoric sequence.

**Raw Material and Adze Production:** The evident wealth of the early east coast Coromandel Peninsula may be partially attributed to its role as a major adze producing area. It may not be by accident that the densest concentration of early sites is found near the Tahanga basalt quarry (Kuaotunu Peninsula and Mercury Bay). All the early midden sites in the region have produced large quantities of adze manufacturing debitage. From my analysis of the flake assemblages from these sites and others outside the area (Turner and Bonica 1994) it was apparent that only the east coast Coromandel inhabitants and their neighbours in the Tauranga Harbour had direct access to the Tahanga basalt quarry (though evidence discussed above may require Mt Camel to be included here). The preform data support this result. Most of these sites also had localised sources of high quality chert and obsidian (Best 1975; Moore 1977,1988; personal observation).

While involvement in Tahanga basalt adze production extended north to Port Jackson and Great Barrier Island, the west coast Coromandel Peninsula inhabitants do not appear to have been included. The preforms in this area are all made from a local fine-grained argillicious material. At least one source has been located at Waioro River near Colville (personal observation). In the Thames School of Mines there is also a small collection of preforms from a working floor at Waioro. Adzes of this material were present in the Hauraki Plains area.

Predictably Tahanga basalt adzes dominate among finished adzes for the whole region, and only on Great Barrier Island do Nelson/Marlborough argillite and Motutapu greywacke adzes turn up in any number. A local source of basalt was exploited on Great Barrier Island (Spring-Rice 1962) but only on a minor level.
Figure 5.7: Map showing West Bay of Plenty, Waikato and Central Plateau Locations.
Figure 5.8: Map showing East Bay of Plenty, East Cape and Hawke Bay Locations.
Bay of Plenty (see Figure 5.7 and 5.8 for sites and locations mentioned in the text).

The Tauranga Harbour should rightly be included above as it is an extension of the east coast Coromandel Peninsula early settlement complex. There are, however, good reasons why the area has been considered separately. One reason is that the early settlement of the harbour is poorly known archaeologically compared to the Coromandel east coast to the extent that O'Keefe, from extensive surveys of the area, stated that there was a '...lack of typically early sites in Tauranga county' (1991:143). This is assuredly not the case as is demonstrated below. Another reason is some differences reflected in the adze collections.

Archaeology: Many threads of information had to be brought together to relocate the site at the Tauranga Harbour Mouth. Further problems were experienced in accurately provenancing some adze assemblages to this site. The site was first uncovered in 1901 when 'great numbers of burials' were exposed after a gale (Kathleen Fletcher notes, DoC Rotorua). It was inspected by Gilbert Mair shortly afterward who made a large collection of artefacts at the time and later described the site in tantalising but woefully uneven detail (Mair 1902). The site was thereafter systematically dug over for several decades by a large number of fossickers and collectors, notably Hovell and Bell who reputedly removed some 2000 complete and 'good' adzes from the site (Kathleen Fletcher notes. This information remains unsubstantiated as the collection is not available for study). The site, variously called 'Waihi Beach', 'Katikati' and sometimes 'Athenree' and 'Bowentown', is located at the Katikati entrance to the Tauranga harbour on the west side (Golson 1961:14,40; Melvin 1961:16). Details on the precise location are frustratingly vague and the grid reference on the Site Record form (U13/149) is probably inaccurate. Today the only evidence that remains is a scatter of eroded cultural material on the mud flats near the Bowentown yacht club (U13/876/877) approximately one kilometre south of U13/149 (where no cultural evidence can be seen, deflated or otherwise - personal observation). It is possible that the site once covered the whole narrow strip of land between Athenree and Bowentown for when all the evidence is considered it was a settlement of some size and significance.

An early settlement was also located at the Tauranga entrance to the harbour at Pilot Bay and Moturiki Island, Mt Maunganui, largely known from various surface collections. Other early sites in the harbour were located at Kulim Park near Otumoetai, possibly near Kauri Point (O'Keefe 1991:143,145; Kathleen Fletcher notes) and on Matakan Island (Doug Sutton
pers.comm.; personal observation). No excavations of early sites have taken place in the western Bay of Plenty thus there is no information available on the range of wild foods. Use of moa, seal and dog bone is evident among the artefacts but Anderson (1989:112) states that the moa bone was probably imported (possibly from the Coromandel Peninsula).

Late settlement of the Tauranga Harbour is better known archaeologically. Over 2229 shell middens have been recorded from around the inner harbour and are also very common on Matakana Island (O'Keefe 1991:143; Doug Sutton pers.comm.). A high density of pa also characterise the area (McFadgen and Williams 1991; O'Keefe 1991). The Kauri Point excavations are the most well known especially the swamp where a large assemblage of wooden artefacts was recovered including many head combs (Golson 1961; Shawcross 1964b,1976). Radiocarbon dates suggest occupation began at about A.D. 1500 (Green 1978; Anderson 1991) and initially related to kumara storage.

Beyond the Tauranga Harbour the evidence for early settlement is sporadic and sparse. Early sites near Whakatane, Ohiwa Harbour and Opotiki Harbour are known mainly through the nature of artefact assemblages recovered. A small excavation at Paerata Ridge contained moa bone (probably industrial) and early artefacts (White 1971 and pers.comm.). Smith records seal bone associated with Archaic artefacts at Port Ohope (1989:88). A recent excavation at Tokitoki (W15/582), Ohiwa Harbour produced a range of stone materials and an early date of A.D. 1276-1286 (Rick McGovern-Wilson pers.comm.). An analysis of the adzes and adze flakes was included in the data for this thesis (see Appendix A). An 'Archaic' gap exists between Opotiki and Hicks Bay which may not be the result of archaeological bias as a survey of the area revealed no traces and the number of early artefacts from the area, including adzes, is almost nil (Leahy and Walsh 1982). The area has few of the environmental characteristics which attracted early settlers to other areas (for example, harbours and offshore islands).

**Artefact Collections:** A huge number of early artefacts have been taken from the Tauranga Harbour Mouth sites, particularly the Bowentown site (Table 5.1). This includes rare ornaments including serpentine reels and pendants (Mair 1902; Auckland Museum catalogue). A serpentine reel was also recovered at Whakatane near a burial ground (Leach 1983). Another burial at Whakatane was found with four Tahanga basalt adzes (Type 1, Type 2 and Type 4 - Anton Van der Wouden pers.comm.; Whakatane Museum records).

These artefacts stand in contrast to the assemblages derived from the Kauri Point sites which
share greater affinity with pit, terrace and pa sites from other regions in the northern North Island (See Table 5.2). They suggest a similar scenario - that of movements away from the low lying fragile coastal environments to more stable inner harbour localities with accompanying vertical shifts in settlement location.

**Adzes:** N = 909. Over 80% of the adzes examined from the Bay of Plenty are provenanced to the Tauranga Harbour (N=687 of which 406 come from the Waihi Beach/Katikati Entrance/Bowentown site and 180 from the Mt Maunganui/Pilot Bay site with 35 more vaguely provenanced to 'Tauranga'). A high proportion of the adze data from the harbour mouth sites reflect a working floor context and comprise large numbers of preforms, small expedient flake adzes and adze fragments rejected after a failed reworking attempt (see Table 5.3). Finely flaked preforms and primary early forms are also prominent in the data. Reworked 2B adzes appear more commonly in the inner harbour and a very small specimen (30mm long) was recovered along with primary coarse-grained greywacke 2B adzes from Kauri Point Pa.

The small sample from East Bay of Plenty also has high numbers of primary early forms but, apart from Tokitoki, lacks the working floor assemblages of the Tauranga Harbour.

**Raw Materials and Adze Production:** It is apparent from the adze data (Table 5.3 and 5.4) and the flake data (Turner and Bonica 1994; Appendix A) that the Tauranga Harbour Mouth occupants were engaged in Tahanga basalt adze production on a scale similar to their neighbours of the Coromandel east coast. Indeed Tauranga Harbour represents the southernmost extent of the Tahanga basalt adze production complex. The Tokitoki flake assemblage indicated that, unlike their neighbours in the west Bay of Plenty, they were not involved in Tahanga basalt adze manufacture. The working floor debitage, instead, showed intensive reworking (see Appendix A).

Rather there is a notable increase in the number of Nelson/Marlborough argillite adzes. For the western Bay of Plenty the dominance of Tahanga basalt is apparent though the area differs from the Coromandel east coast in the higher numbers of Nelson/Marlborough argillite adzes and, surprisingly, those of Motutapu greywacke. For the latter, this is more evident in the flake assemblage from Bowentown (U13/876-877, - see Appendix A), which suggests that some Motutapu greywacke preforms were also being finished there. Additionally, the Bay of Plenty represents the southern limit for the distribution of Motutapu greywacke adzes. Only five were
identified in the eastern Bay of Plenty data. While Moore (1981) identified a local source of basalt at Maketu where several flaked preforms were found, it appears to have played only a minor role as very few were identified.

The Tauranga Harbour had local sources of chert and obsidian (Moore and Coster 1989). Most significant of these is the Mayor Island source which was distributed throughout the country from early times (Seelenfreund and Bollong 1989). The nature of obsidian exploitation and procurement, and the nature of early settlement on the island is little known. This is due to a lack of surface archaeological evidence and to practical difficulties imposed by the almost completely bush covered and rugged terrain of the island. However, evidence of early coastal middens and settlements such as those seen on the mainland have not been discovered, despite attempts to relocate them. There are very few sheltered bays suitable for canoe anchorage or optimal for settlement. There are few areas of flat land and the crater rim rises, for the most part, steeply and suddenly, and is characteristic of most of the coast line. Of value, however, would have been the sub-tropical climate, the very rich marine resources and probably abundant bird populations. Only one adze from Mayor Island was observed in this research - a broken bevel section from a Tahanga basalt Type 1 adze.

In the absence of evidence from Mayor Island itself, it could be suggested from the large quantities of flakes and cores found in Tauranga sites, that the people there had unlimited access and possibly controlled access to the source. These same people also had direct access to the Tahanga basalt quarry. In effect, the east coast Coromandel and Tauranga Harbour inhabitants had access to and probably control over the two most valuable and widely distributed stone materials found in the North Island. This factor, possibly more than any other, may explain the evident wealth and high settlement density of the area in the early period.

**East Cape/Northern Hawkes Bay** (see Figure 5.8 for sites and locations mentioned in the text).

This region stretches from Cape Runaway in the North to Cape Kidnappers in the South. The coastline is characterised by river mouths and deep bays but no harbours and very few offshore islands.

**Archaeology:** Little is known about the early settlement of the East Cape area. According to
Jones and Moore 'Archaic sites are extremely rare on the east coast' (1985:81), and surveys of the area reveal a dearth of evidence (Jones 1989; Leahy and Walsh 1980). Nevertheless, early sites were exposed as a result of quarrying operations at Whangara (Jones and Moore 1985). At this site and several others near Tolaga Bay, Gisborne and the Ahiriri Lagoon in Hawkes Bay 'small moa-hunting sites' are identified (Anderson 1989:113). Sea mammal bone was also recovered from Whangara and Wainui, Gisborne (Smith 1989:87). Radiocarbon dates taken from midden samples at Cooks Cove, Tolaga Bay and Waipaoa, Gisborne place early settlement between A.D. 1250-1450 (Jones 1988; Anderson 1991:781).

Late settlement of the area is better known, both archaeologically (Fox 1982; Jones 1986, 1988, 1989) and historically (Salmond 1991).

**Artefact Collections:** No large assemblages of early artefacts are known from the area. A number of early ornaments are recorded including a serpentine reel from Tokumaru Bay, whale and moa bone amulets from Wainui, Gisborne and Whangara, a whale tooth unit from the Ahiriri Lagoon site of 'Rorookuri', and a twin-lobed pendant from Portland Island (Anderson 1989:111,113; Duff 1977:135; Prickett 1985; Skinner 1974:55,65). A small assemblage of early material has been recovered from the sand dunes at Hautai (Gisborne Museum). The Whangara sites mentioned above contained evidence of one piece fish hooks and tools related to their manufacture, obsidian and Nelson/Marlborough argillite reworking flakes (Jones and Moore 1985).

**Adzes:** The adze sample is quite small (N=231) for such a large area and a number are rather vaguely provenanced to 'Gisborne' and 'East Cape'. Early adze forms cluster around the areas already identified above, particularly Gisborne (where two side-hafted adzes have been found), where also reworked 2B adzes are common (see Table 5.3).

**Raw Materials and Adze Production:** For the first time Nelson/Marlborough argillite dominates the adze data and this is consistent from north to south in the area (see Table 5.4). Tahanga basalt adzes are still frequent among early forms, however, and again Nelson/Marlborough argillite adzes are prevalent among reworked and reworked 2B adzes. Preforms are rare, and apart from two complete and finely flaked Nelson/Marlborough preforms, only two rough flake preforms were recorded. These were rendered in chert as were two other
reworked adzes. Chert sources are commonly found in the Gisborne and Hawkes Bay area (Moore 1977) but few other, if any, fine grained materials were available locally for adze manufacture. Coarse-grained greywacke was pressed into service for Type 4 adzes on a minor scale employing heavy hammerdressing as the main shaping method. Being relatively distant from both the Nelson/Marlborough argillite and Tahanga basalt quarries, the inhabitants may have been motivated from early times to experiment with local rocks. Only one adze from the silicified limestone source at Aohanga was observed.

Southern Hawkes Bay and Wairarapa (see Figure 5.8 and 5.9 for sites and locations mentioned in the text).

This area extends from Cape Kidnappers to Palliser Bay. The coastline is characterised by regularly spaced river mouths and low lying coastal plains which rise after a short distance into a rugged and mountainous hinterland.

Archaeology: Early settlements have been discovered at almost every river mouth (and sometimes stretching between them) from Cape Kidnappers in the north to Riversdale and Orui in the south. Only one small excavation has taken place in southern Hawkes Bay (Blackhead - Christine Avidson-Smith pers.comm.) but the area was another favourite of collectors and a wealth of artefacts have been recovered (Duff 1977:135; Fox 1982:79; Simcox notes 1993 - Book 1 and 2). Anderson identifies Ocean Beach, Blackhead and Castlepoint as 'small moa-hunting sites' and seal bone also appears in the middens (Anderson 1991:111,113; Smith 1989:80).

Late settlement of the area appears, in contrast, to have been minor to the extent that it may have been the '...most thinly populated coast line of the North Island' and this is supported by historic observations (Simcox notes Book 2 1993:4). The potential for settlement and horticultural expansion was probably limited given the rugged nature of the hinterland. Fox notes that late settlement was centred instead on the fertile river valleys of Hawkes Bay and that populations in this area 'greatly increased' during the Classic period (1982:80).

Understanding early settlement of the southern Wairarapa region has been greatly enhanced by the comprehensive Palliser Bay survey and excavation project undertaken between 1969-1972 (Leach and Leach 1979). Excavations revealed gardening areas, domestic residences, cooking
areas, middens and burials all dated between the 12th and 16th century (Anderson 1991). The wide scope and range of excavation provided evidence that occupation in the area was permanent. Some of the coastal midden sites (for example, Black Rocks) were occupied only in summer but by people who had permanent dwellings nearby. Depletion of food resources and environmental degradation began to adversely impact on the health and wellbeing of the Palliser Bay inhabitants by about A.D 1450 and brought about changes in the settlement pattern, including the relocation of permanent settlements further inland. According to Leach and Leach (1979:264-266) environmental deterioration eventually resulted in major abandonment of the area by A.D. 1600. Such a pattern may have also been repeated on the east coast to the north.

**Artefact Collections:** Large artefact collections come from the southern Hawkes Bay river mouth sites, notably the Simcox collection which is now in the Hawkes Bay Museum. Regrettably attempts to track down the whereabouts of other large collections (Hunter, Lee and Gordon) were unsuccessful. Both Duff (1977) and Simcox (1993) recorded details on these collections, however. Additionally Simcox provided valuable notes on the contexts in which artefacts were recovered from. For example, one 'hut-site' described by Simcox at Blackhead contained six tattooing chisels, fifteen needles, a perforated shark tooth, several adzes (early forms) and other artefacts (Book 1 1993:32). A large number of ornaments have also been recovered from these sites including serpentine reels and amulets. A whale tooth necklace was found with a burial at Porangahau (Hunter Collection - Duff 1977:117). At Castlepoint one burial contained a large stylized whale tooth unit, while another, that of child, was found with a large number of dentalium units, possibly a shroud or garment of some kind (Duff 1977:432-433). A similar burial was also found at Washpool, Palliser Bay. Three other burials at Washpool contained adzes (Leach and Leach 1979:205-210). A large assemblage of other artefacts was also recovered from the excavations at Palliser Bay (see Table 5.1).

**Adzes:** The number of adzes examined from this region (N=338) does not adequately reflect the number that have been actually recovered from the river mouth sites in this area. The majority recorded are from the Simcox collection and, from his discussion of adzes in other private collections, can be taken as representative of the range of adze forms and materials (Simcox 1993: Book 1 and 2). Dante Bonica is also familiar with both Simcox's collection and others that could not be relocated.
Early forms and technology predominate in both the southern Hawkes Bay and Palliser Bay collections (Table 5.3). Notably reworked 2B adzes are extremely rare on the southern east coast and are entirely absent from Palliser Bay. This is in contrast to the frequency of this form further north in Hawkes Bay and East Cape. It may be inferred from the Palliser Bay chronology that both
Figure 5.9: Map showing Wairarapa, Taranaki, South West Coast and Cook Strait Locations.
areas were largely abandoned prior to the change in technology that resulted in the reworked 2B and the primary 2B form.

**Raw Material and Adze Production:** At Aohanga a source of fine-grained silicified limestone was utilized in the early period, particularly for Type 4 adzes. From a working floor in the sand dunes Simcox recovered a number of rough and broken preforms (Simcox 1993:Book 1). Two adzes excavated from the Washpool site at Palliser Bay probably came from this source. The use of this material was, however, vastly overshadowed by the importation of a large number of Nelson/Marlborough argillite adzes (see Table 5.4). But the people in this area, including the Palliser Bay inhabitants, were not involved in their manufacture. The few Nelson/Marlborough preforms recovered from the area are complete and finely flaked. They probably arrived to the region in this state. Flake assemblages from Palliser Bay and those recalled from collections on the southern Hawkes Bay coast (Bonica pers.comm.) all relate to the reworking of adzes, not their production (K.Prickett 1979:172; personal observation). While there is a definite trend for excavated assemblages to contain higher frequencies of broken and failed reworked adzes, the flake assemblages from Washpool and other excavated Palliser sites were unusual in consisting predominantly of very small flakes (most less than 1gm in weight - see Appendix A). This partially reflects the high standards of artefact retention during excavations (B.F.Leach pers.comm.), but does not explain the near absence of larger sized flakes which would be expected from a reworking assemblage. Indeed, reworking appears to have been particularly intensive at Washpool where the largest flake and adze assemblage was recovered. It is evident that the flakability and toughness of Nelson/Marlborough argillite saw many of the larger reworking flakes commandeered for drill-points. Eighty-five broken and complete Nelson/Marlborough argillite drillpoints were recovered from the Washpool excavation (personal observation). In character the flake assemblage is comparable to an experimental drillpoint making assemblage produced by myself (Turner and Bonica 1994). This may provide an
explanation for the very small flake size at Washpool and those recovered from the Moikau house floor. It is unlikely that broken adzes were used specifically as cores to produce drillpoint blanks as has been suggested by Leach (1979:95). These 'cores' or failed reworking attempts have large flake scars overlain by numerous small trimming scars too small to have produced suitable drillpoint blanks. Reflaking is also directed at forming new bevels and butts and not at the most advantageous points for removing flake blanks. Additionally it is interesting to observe that two of the four burial adzes were reworked adzes.

The intensive reworking activity at Washpool introduces a problem regarding the use of adze materials in defining the Palliser Bay inhabitants relationship with people outside the area and how this changed over time. From previous analysis of all the stone material from Washpool (K.Prickett 1975,1979), contraction of exchange networks was seen to occur during the time the site was occupied. The data also revealed that there was a shift of communications away from the north but intensified with the south (Leach 1978:399). But the major connection to the south was via the importation of Nelson/Marlborough argillite adzes which was assumed to have continued over time. Nothing in the Palliser Bay adze or flake data suggests this was the case. Rather, the scenario at Palliser Bay may have mirrored that of Shag River Mouth where the stock of adzes brought in by the original settlers was not replenished. Adze pieces rejected as a result of a reworking failure featured prominently at all three levels of the Washpool site and thus they can not be used to define changes in communication patterns over time. Furthermore the occupation length established by the radiocarbon dates is questioned by Anderson (1991:786) who, drawing on other problematic evidence from the site (no marked stratigraphic intervals indicated, lack of moa bone in the middens) suggests that occupation may have been somewhat later and briefer, that is, more in line with the dates established for other early settlements in the North and South Island (see Table 5.1).

There are other factors regarding the high numbers of failed reworked adzes at Palliser Bay which need to be considered before accepting that the situation at Shag River Mouth was also the case at Palliser Bay. One is a probable sampling bias. Other collections where excavated samples dominate have equally high frequencies of rework failures, for example, Mt Camel, the sites on the east coast Coromandel, and the Hauraki Gulf sites. Yet in all these cases the large numbers of preforms renders the Shag River Mouth scenario not applicable. The high reworking frequencies reflect two factors - the types of sites excavated (middens, working floors) and the retention of all material. Complete primary adzes are rarely excavated but are often found as isolated surface
finds from the same area. Exceptions are when burials are uncovered during excavations, but these are generally never excavated by design and are rarely detectable from the surface. A similar pattern exists in the Palliser Bay data - almost all the primary complete adzes were surface finds. The only two primary complete adzes excavated came from the burials. Of course such a bias might also explain the Shag River Mouth data, and suggests that caution needs to be exercised in making interpretations like those of Smith and Leach (1996) on the strength of reworking evidence.

As demonstrated with the Far North collections, variability in the frequencies of different raw materials between states is generally not great, thus while adzes and pieces thereof can not be used to document trends in communication and exchange relationships over time, they are at least viable for establishing the links that may have existed between sites occupied contemporaneously.

One clear observation that can be made is the low frequency of Tahanga basalt adzes, a frequency that decreases in a southward direction until none are present at all in Palliser Bay assemblages, not even among the flakes.

**Waikato** (see Figure 5.7 for sites and locations mentioned in the text).

The Waikato region on the west coast stretches from the Waikato River Mouth in the north to the Mokau River Mouth in the south, and is bordered by the Hauraki Plains and the Kaimai Ranges at inland margins. As well as river mouths, a notable and attractive feature of the Waikato coast is the three proximate harbours of Whaingaroa (Raglan), Aotea and Kawhia.

**Archaeology:** The late settlement of the Waikato area is well documented from the excavations of inland swamp pa at Ngaroto (Cassels 1972b; Shawcross 1968), Mangakaware (Bellwood 1978) and the undefended settlement at Aotea (Fox and Cassels 1983). All these sites were occupied after A.D. 1500 (Davidson 1984:247-249).

Early settlement is poorly documented in the archaeological record. A small amateur rescue excavation on the south side of Whaingaroa Harbour (Hunt 1962), and several small excavations in the Taharoa sand dunes (Bulmer 1978) are the only early sites excavated in the Waikato region but few details have been retained on these and no radiocarbon dates are available.

A number of surveys of the coast have been undertaken, however (Bulmer 1978; Coster and
Johnson 1975; Ritchie 1990; Wilkes 1995; Turner n.db; DOC Waikato site record file). From this evidence it is clear that the harbour mouths and coastal margins of the Waikato supported quite extensive early settlement between Taharoa and Marakopa in the south and Waikato River Mouth to the north. For example, from my survey at Te Horea (Whaingaroa River Mouth North Head) along a nine kilometre stretch between Te Hara point and the harbour mouth, early sites covering extensive areas (several acres at least) are almost continuous, particularly on either side of streams which occur regularly at approximately 100m intervals. At the harbour mouth the densest concentration of early sites once existed (Dante Bonica pers.comm.), but these have been largely destroyed by wind erosion. Directly behind the coastal middens are gentle north facing slopes which may have been suitable for gardening and some are terraced. The ridges between them feature generally small storage pits. At present, however, there is no way of knowing whether these features were contemporary with the middens nearby. Some of the middens were stratified with early bone and artefact rich middens overlain by homogeneous shell middens and separated by a deep band of sterile sand. Evidence of early settlement is also present at the Waikato River Mouth, Kaawa Stream and Waimai River Mouth to the north and Marakopa to the south (Auckland Museum catalogue; private collections). The majority of sites on the coast are exposed in large areas of sand dunes and most are considerably deflated and damaged by ongoing wind erosion. Working floors, burials, middens and cooking areas were common site features recorded. Wilkes (1995) noted large pebble scatters in his survey of the coastline between Kawhia and Awakino, one at Taharoa covering an area of some 11ha. These were generally associated with early cultural material and may have functioned as 'pavements' (Wilkes 1995:249) or possibly associated with house floors (as seen at the Heaphy River Mouth and South Island sites above). I observed similar pebble scatters in the sites at Te Horea. The small quartzite pebbles can be found locally on the beach.

Moa and sea mammal bone has been recorded from these middens (Smith 1989), and while Anderson (1989:112) doubted the cultural context of the moa bone, observations of moa bone in intact cultural deposits and in cooking contexts (Taharoa, Te Horea) since 1989 strengthens the case that the Waikato coast inhabitants hunted local moa populations (Wilkes 1995; Turner n.db).

**Artefact Collections:** Site survey descriptions reveal a typical range of predominantly early artefacts from the sites at harbour mouths and coastal margins (see Table 5.1). Very little material
from these early middens have reached museums. The largest and most comprehensive private collection is the Bird collection from the Te Horea sand dune sites and this collection has been examined for this research.

Adzes: N=448. Apart from the adzes in the Bird collection from Te Horea (N=194), the adzes from the harbours are not well provenanced, many being localized rather vaguely to 'Kawhia', 'Aotea' and 'Raglan'. An unusual number of primary adzes are also provenanced to 'Te Kuiti'. I suspect that many of these adzes were not found at the inland town that bears this name. Such was the case with another primary Type 1 adze in the Murdock collection. The given provenance (written on the adze) was 'Te Awamutu' but Pat Murdock explained that it actually came from the Kawhia sand dunes and that it was customary for collectors to classify adzes by the nearest known town, particularly when the coastal location or beach where they were actually found had only an unofficial locally recognised name (such as 'Te Horea' for example). In support of this, several 'Te Kuiti' primary adzes had a sand blasted patina characteristic of stone artefacts exposed in coastal sand dunes. Nevertheless, even when these specimens are retained in the 'Inland Waikato' sample, contrasts are evident when a comparison is made with the coast and harbour mouth sample (see Table 5.3). The latter reflects a predominantly early settlement focus while the former sample suggests predominantly later occupation.

While a few primary and reworked 2B adzes were found at Te Horea (though none were found in the early middens but at a site at the base of Te Horea Pa along with a number of barbed composite fish hook points and pounamu ornaments), most are among those provenanced vaguely to 'Raglan' or 'Kawhia', and I suspect they were recovered from inner harbour localities. At the Aotea undefended settlement some three kilometres from the harbour mouth, an Ohana argillite blade portion was excavated (Fox and Cassels 1983:87) and may have been part of a reworked 2B adze.

Raw Materials and Adze Production: The Waikato coast was another area almost completely self-sufficient in essential rock materials, a feature that would have enhanced its attraction to early settlers. The only stone type missing from the immediate environment was obsidian. A high quality distinctive chert was used extensively and one source has been discovered in the Whaingaroa Harbour (The late Keith Bird of Te Horea showed Dante Bonica the location of this source who in turn showed me). I have observed drillpoints and flakes of this chert in sites from Matatuaahu to Palliser Bay. For many south west coast sites of the North Island, Waikato chert
appears to have been the dominant source represented and almost all the drillpoints in the
Kaupokanui, Waverley, Paekakariki and Paremata assemblages are made of this material
(personal observation). Another raw material found in all these sites, including Te Horea, is red
obsidian. The likely source of this material is Taupo (Moore 1988; personal observation) which
may have been accessed via the Waikato River. Approximately 60% of the obsidian found in the
Te Horea sites, however, was green in transmitted light and, judging from hand specimen,
probably came from Mayor Island (personal observation).

Additionally, a fine-grained basalt was available for adze manufacture and most of the middens
between Taharoa and Te Horea contain abundant evidence of local basalt adze production,
particularly for the manufacture of Type 4 adzes. While a few Waikato basalt adzes have been
found as far north as Kaipara Head and as far south as Taranaki, for the main the local basalt
served local needs. It appears not to have retained this importance in the later period as only three
adzes made of this material were identified from inland Waikato (see Table 5.4). The rivers of the
inland region contain a plentiful supply of coarse-grained greywacke and, as the experiment
described in Chapter Two demonstrated, this material is far easier to work using the
hammerdressing technology compared with the coastal basalt. Imported materials, especially
Nelson/Marlborough argillite, retained their importance and are most commonly found in the
inland area as reworked 2B adzes.

Other local materials include slate used for minnow lures, ironstone for sinkers and high quality
sandstone for hoanga and files. The quartzite pebbles found on the beach were very efficient
hammerdressing stones and equally valuable for flaking chert and obsidian (based on replication
experiments).

Despite the local availability of adze quality stone, the coastal inhabitants of Waikato were
importing considerable numbers of Nelson/Marlborough adzes, particularly Type 1 and Type 2.
In contrast, Tahanga basalt adzes are present in only very small numbers, a situation almost the
reverse of that seen at Matatuhu and Kaipara Heads further north. Small numbers of Motutapu
greywacke adzes (equal to Tahanga basalt) were also present as were a few Taranaki argillite
adzes. Indeed, coastal Waikato is the only region outside Taranaki to feature primary early forms
in Taranaki argillite. The much higher frequencies of mainly reworked Tahanga basalt adzes in
the inland Waikato sample probably results from contact with the Hauraki Plains area in the later
period (Phillips 1994).
**Taranaki** (see Figure 5.9 showing sites and locations mentioned in the text).

Taranaki is the 'prominent bulge' (Prickett 1983:281) on the west coast between the Awakino and Wanganui Rivers. The coastline is exposed and characterised for the main by steep cliffs. These are, however, regularly intersected by river mouths. The rivers wind into and around a hinterland dominated by the prominent volcanic cone called 'Taranaki'.

**Archaeology:** While late settlement is highly visible in the Taranaki landscape in the form of a large number of pa, excavations of several large moa-hunting sites at the mouths of the Kaupokanui (covering about 5 acres) and Waingongoro Rivers (Buist and Yaldwyn 1960; Buist 1960,1962,1963; Anderson 1989:111,115-116) provide evidence for early settlement in the region. In addition to at least 11 different species of moa, 55 other bird species (mainly forest birds) were identified, including a number now extinct (Prickett 1983:296,298). Sea mammals also feature in these middens as well as fish and dog bone (Buist 1963:177; Smith 1989). Radiocarbon dates from Kaupokanui and Waingongoro place settlement between A.D. 1285-1442 for Kaupokanui and A.D. 1185-1449 for Waingongoro (Anderson 1991:781,786). While Prickett (1983:299; 1990b:5) considers that these dates place the initial occupation of Taranaki later than other regions, Anderson's reappraisal of radiocarbon dates from all known early sites, particularly those with evidence of moa-hunting (1991), suggests that Kaupokanui, Waingongoro and other Taranaki river mouth sites were occupied at the same time as sites in the Far North, Tamaki and Coromandel (see Table 5.1). Other early sites have been located at Opua (Fyfe 1988), Okahu, Waverley, Waiototara, Kai-iwi, and in the north, Waiwakaiho near New Plymouth (Field 1877; Buist 1962:234,236; Smart 1962a) where a similar faunal and artefact range is apparent. Undoubtedly, many of the other river mouths in the region were inhabited during the early period but Taranaki has one of the highest rates of coastal erosion, estimated at about 38cms a year (Prickett 1983:300), therefore it is likely that many sites have been lost to the sea. Most of the known early sites were first discovered and fossicked in the early 1900's, the site at Waingongoro as early as 1843 (Prickett 1983:294), and little remains of the site today.

**Artefact Collections:** The probable existence of many more early river mouth sites is indicated by the considerable numbers of early artefacts found from the area, especially the number of serpentine ornaments including reels, a twin-lobed pendant and unusual 'amulets' (Buist 1961;
Duff 1977:122,135; Prickett 1985; Skinner 1974:66). Table 5.1 lists the range of artefacts found at Kaupokanui and other south Taranaki sites where evidence for early settlement appears to be have been particularly dense. Surface collections also indicate early settlements on the coast of north Taranaki, notably between Urenui and New Plymouth. In both south and north Taranaki collections, Waikato chert, Mayor Island obsidian and Taupo obsidian feature strongly (personal observation - Taranaki and Wanganui Museum collections; Seelenfreund and Bollong 1989:180).

Adzes: Though the sample of adzes from Taranaki is large (N=662), many are poorly provenanced (see Table 5.3). Much time has lapsed since many of the collections that comprise the sample were made and few details have been retained. As seen in the Waikato collections, similar confusion over the precise geographic location is evident for the Taranaki sample. Indeed over 20% were provenanced simply to 'Taranaki'. The practise of localising collections to the nearest town is apparent also, and I suspect that many of the large number of adzes provenanced to 'New Plymouth' and 'Hawera' actually come from coastal river mouth sites nearby. Very few adzes have been localised to a precise site. The excavations of Kaupokanui and Waingangoro (also known as 'Ohawe') produced only a small number of adzes though surface collections contain more. It also seems clear that there is a real bias toward finished and complete adzes reflecting the period when most of these collections were made. Yet early field reports (Field 1877), the excavated assemblage from Kaupokanui (Robinson 1963b) and rare surface collections (Oeo and Waverley), present a different picture. At Oeo just north of Kaupokanui, for example, the adze assemblage is dominated by broken adzes and preforms, expedient flake adzes and pieces where a reworking attempt has failed. The smaller assemblage from Kaupokanui is similar but with the valuable addition of an adze flake sample.

Aggravating sample problems is the knowledge (based on pa densities and historical records - Prickett 1990a:6-8) that the population of Taranaki increased considerably over time. In the late period most people lived, built pa and gardened in river valleys along a '...coastal strip, which extended 1-6 kilometres from the sea-shore...' (Prickett 1990b:6). The adze sample reflects this scenario. For both south and north Taranaki, reworked adzes are predominant and early forms relatively infrequent. Curiously reworked 2B adzes are uncommon. This may be related to intensification in the use of Taranaki argillite over time and the discovery that small flat water-rolled pebbles could be readily transformed into small rectangular tangless adzes - a regional variation of the Classic 2B adze - with little cost in terms of time and effort. Additionally
Taranaki argillite has a hardness and toughness comparable to Nelson/Marlborough argillite, but was less desirable in the early period because of poor flakability. Thus there may have been no real advantage gained by converting broken early forms into reworked 2B adzes. Nevertheless, Nelson/Marlborough argillite reworked 2B adzes have been recovered from several Taranaki pa (Okaiawa, Urenui and Bellblock - Taranaki Museum catalogue) along with larger numbers of Taranaki pebble 2B adzes.

**Raw Material and Adze Production:** Use of the local Taranaki argillite appears to have been very minor in the early period (Table 5.4). The reason for this is plain - the Taranaki inhabitants obviously had no problems obtaining superior Nelson/Marlborough argillite adzes. Furthermore it is possible that they had direct access to the stone, especially D'Urville Island argillite. This is not notably obvious in the adze data where preforms are uncommon but I suspect a sampling bias is responsible. A number of rough as well as finely formed D'Urville Island argillite preforms have been found mostly from south Taranaki, along with numbers of expedient flake adzes made on waste flakes. More conclusive evidence is provided by the small flake sample collected from the Kaupokanui excavation (see Appendix A) where the frequency of waste flakes outnumbers significantly those with grinding and hammerdressing suggesting that some secondary adze manufacture was occurring there. In addition, 40 fragments of lime garnet hammerstones were found in the Kaupokanui assemblage indicating that the hammerdressing stage of manufacture was also taking place at the site and that lime garnet as well as Nelson/Marlborough argillite was being imported. In a straight line the distance from the south Taranaki coast to D'Urville Island is similar to the distance the Wairau Bar inhabitants would have had to cross to reach the island (approximately 130km). Thus it seems highly likely that south Taranaki marks the northern most extent of the Nelson/Marlborough argillite adze production complex.

With the availability of Nelson/Marlborough argillite there was evidently little interest in Tahanga basalt adzes. Yet a modest number were imported and appear also to have been favoured above the local stone. Several other reworked basalt adzes may have come originally from Waikato and a few ground flakes of both Tahanga basalt and Waikato basalt were present in the Kaupokanui assemblage as well as two Tahanga basalt adzes.

**South West Coast** (see Figure 5.9 and 5.10 for sites and locations mentioned in the text).
This area spans the coast between the Wanganui River and the bottom of the North Island including Wellington Harbour. River mouths punctuate the coastal plains of the northern area but to the south lies the Porirua Harbour, nearby offshore islands (Kapiti and Mana) and the adjacent Marlborough Sounds at the tip of the South Island.

Archaeology: The southern west coast presents a pattern of occupation almost the reverse of that seen further north in Taranaki. South of Wanganui, pa are rare and occupation appears to have decreased over time (McFadgen 1972). When Abel Tasman and his crew sailed up the west coast in 1642 they saw little signs of habitation (Salmond 1991). Rather excavations of 'moa-hunting' sites like Foxton (McFadgen and McFadgen 1966), Paremata at the mouth of the Porirua Harbour (Davidson 1978b; Sinclair 1977), Makara (Davis 1962), Paekakariki (Enys 1873; MONZ catalogue), Te-Ika-a-maru (Davidson 1976), Adkin's (1948) detailed study of the Horowhenua dune belt sites (an area lying between the Manuwaitu River Mouth and the Otaki River Mouth), and early surveys of the Wellington Harbour Mouth (Beckett 1963; Crawford 1873; McLeod 1919; Palmer 1956) have emphasised the early settlement character of the region.

At most of the excavated sites sea mammal bone was present in addition to moa (Anderson 1989; Smith 1989). At Paremata a large amount of dog bone, 18 species of fish and the bones from 26 other bird species were identified (Davidson 1978b:216-218; Leach and Davidson 1977:168; Sinclair 1977:161-162). The radiocarbon date from Paremata has been rejected by Anderson (1991:782) due to uncertain context but the large number of dates from Foxton place occupation of this moa-hunting site between A.D 1227-1392. The earlier date from Makara possibly suffers from inbuilt age but Anderson accepts those dating the site to a similar time period as Foxton (1991:786).

Artefact Collections: Large artefact collections have been made along the southern coast dune belt and from the dunes at the Porirua and Wellington Harbour mouths. Collections from the Horowhenua dune belt have been described in detail by Adkin (1948:43-102). Early adze forms and a chevroned pendant were recovered from burials and a large number of wooden artefacts were excavated from lake-beds, some of unusual and probably early style, including the canoe hull and outrigger float discussed in Chapter Three (Adkin 1962; Barrow and Keyes 1966). The site of Paremata was particularly rich in early artefacts including necklaces of whale tooth units, serpentine reels and a dentalium nanum necklace found with the burial of a child (Duff 1977:135;
Keyes 1967; Sinclair 1977:158; Smart 1962b). Table 5.1 outlines the range of artefacts found at Paremata and at other sites in the area.

**Adzes:** N = 701. Particularly in the northern regions, the adze collections suffer the same problem as experienced in Taranaki. Assemblages from specific sites that reflect the full contingent of adze states are very uncommon. Many have been assigned vague locations such as 'Wanganui', 'Horowhenua' and 'Wellington', but by matching collectors to published information (for example, Adkin 1948; Beckett 1963) some reconstructions of original provenance can be made. There is also an obvious bias wherein collectors and fossickers have favoured complete and finished adzes over broken ones. For example, Adkin provides details on the contents of the Horowhenua dune middens including 'rudely chipped blackstone implements' and ',...chips of blackstone and of flint;...grinding and sharpening stones...hammer and flaking stones...' (1948:10,44). The 'blackstone' is Nelson/Marlborough argillite and the 'flint' was probably from the Waikato source. But little of this material was collected though several lime garnet hammers in the Museum of New Zealand are from Horowhenua. The burial adzes, however, were kept and are now in the Museum of New Zealand. In contrast, the excavated adze assemblages from Paremata and Paekakariki are dominated by broken and reworked adze and preform pieces.

The adze collections from the south west coast and harbours are characterised by relatively high frequencies of early forms and very low numbers of reworked 2B adzes.

**Raw Material and Adze Production:** The people of the south west coast, especially the inhabitants at the Porirua Harbour Mouth, were probably closer to D'Urville Island than most of the inhabitants of the South Island (including the Wairau Bar people), who had to pass through the rough waters of the Cook Strait to reach D'Urville and the mainland sources of Nelson/Marlborough argillite. Due to the sampling problem discussed above, evidence for involvement in Nelson/Marlborough argillite adze production is more apparent from descriptions in published records than it is from the collections available for study today. Nevertheless, from Wanganui to Porirua Harbour small numbers of rough and often broken and reworked preforms were recorded (see Table 5.3). The best evidence is found in the excavated Paremata and Paekakariki assemblages where broken and reworked preforms were recovered as well as complete well-formed ones. While adze flakes do not appear to have been retained from the Paremata excavation (though they were evidently present and 'numerous' - Sinclair 1977:164), a
sample from Paekakariki demonstrates that the occupants of the site were engaged in Nelson/Marlborough argillite adze manufacture (see Appendix A). A small and selective flake sample has also been collected from the mudflats on Mana Island close to the Porirua Harbour Mouth (Tovey collection, Porirua Museum). Only large flakes (50-100mm maximum dimension) have been retained but almost all are waste flakes of D'Urville Island argillite and are very fine flat trimming flakes with multiple scarring on their dorsal surfaces. They could have only been produced from the fine trimming and reworking of very large, Type 1 and Type 2 preforms (Turner and Bonica 1994). A site has been excavated in the same area (Harwood 1991) but the flakes recovered there were not of the same character, nor did they reveal the same degree of flaking skill. Most were from the reworking of broken adzes, consistent with the nature of the small number of adzes excavated. Rough preforms where the flaking is unfinished have also been recovered from the Wellington coast and harbour mouth, including an interesting cache from Tongue Point (see Appendix D).
Figure 5.10: Map showing Nelson/Marlborough and Canterbury Locations.
Figure 5.10: Map showing Nelson/Marlborough and Canterbury Locations.

Nelson/Marlborough argillite is the major raw material represented among the adzes; little else was apparently used. Some local materials like greywacke were used in a minor capacity for Type 1 and 4 adzes, and there are a number of small rough flake adzes made from a poor quality local argillite. Tahanga basalt adzes, however, are not totally absent. Two were recovered from the Foxton moa-hunting site (Duff type 2C and 4A), several reworked pieces were excavated from Paremata and a cache of two adzes was found in Palmerston North (see Appendix D). In addition, a few Tahanga basalt flakes were among the sample from Paekakariki. Adzes of Taranaki argillite were not found beyond Wanganui.

Central Plateau (see Figure 5.7 for sites and locations mentioned in the text).

All the regions discussed thus far are predominantly coastal but a small sample of early adze forms and reworked adzes made from early imported materials were also provenanced to this central North Island region (N = 73). The majority came from the Taupo and Rotorua lake area. Several early sites have been excavated in this area, notably the cave at Whakamoenga (Leahy 1976), and the site at Tokoroa (Law 1973). Both had evidence of moa-hunting (Anderson 1991:114). Apart from these sites, inland occupation during the early period appears to have been sparse. The relationship between these two inland sites and the coastal sites is unclear. Both Law (1973:160) and Leahy (1976:68) suggest that these sites were occupied for short periods possibly
by groups visiting from the coast to exploit the Taupo obsidian sources. From the proximity of both to the Waikato River, it is possible that they had their permanent settlements on the Waikato coast. An interesting aspect at Tokoroa, however, was the dominance of Mayor Island obsidian (Law 1973:158; Seelenfreund and Bollong 1989:180,181). The location of the site also places it halfway between the Waikato and Waihou Rivers. Branching from the Waihou River, the Ohinemuri River reaches close to the east coast near Waihi. This route may have been the means by which a significant amount of Mayor Island obsidian was reaching the west coast and the people stationed at Tokoroa may have been instrumental in passing it along.

Several adzes were also recovered from the Tokoroa site by a local farmer after ploughing. They are early forms but were not able to be included in this research. It is difficult to determine the stone type from Law's description but they are probably rendered in Nelson/Marlborough argillite (Law 1973:156,157). Nelson/Marlborough argillite also dominates the adze sample observed for this research (see Table 5.4). Most of these adzes were found in the Lake Taupo region while the
Table 5.1: North Island Early Period Sites, Assemblages and Dates

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* See Chapter 5 for details and references for Radiocarbon dates (Note maximum ranges given).

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Table 5.1: North Island Early Period Sites, Assemblages and Dates
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* See Chapter 5 for details and references for Radiocarbon dates (Note maximum ranges given).

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1 Found at nearby Henderson Bay not Mt Camel
2 = complete necklace found

393
Table 5.2: North Island Late Period Sites, Assemblages and Dates

X = present

<table>
<thead>
<tr>
<th>Site/Area</th>
<th>Site Type</th>
<th>RC Dates*</th>
<th>Reworked 2B Adze</th>
<th>Primary 2B Adze</th>
<th>Reworked Early Forms</th>
<th>Pounamu Adze</th>
<th>Pounamu Ornaments</th>
<th>2-piece Fishhooks</th>
<th>Patu</th>
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<td>Pa</td>
<td>c.1800's</td>
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<td></td>
<td>X</td>
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<td>X</td>
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<td>1631-1739</td>
<td>X</td>
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<td></td>
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<td>Waioneke, Kaipara</td>
<td>Pa</td>
<td>1565-1755</td>
<td>X</td>
<td></td>
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<td>1550-1710</td>
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<td>1526-1561</td>
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<td>Raupa</td>
<td>Pa</td>
<td>1658-1828</td>
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<td>Pa</td>
<td>1447-1668</td>
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<td>Kauri Point, Tauranga</td>
<td>Pa</td>
<td>1427-1658</td>
<td>X</td>
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<td>1675-1833</td>
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<td>Mangakaware, Waikato</td>
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<td>1592-1746</td>
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* See Chapter 5 text for details and references to Radiocarbon dates and sites
# Fisher Rd R11/888
** Dates either not available at time of writing (R10/497) or not taken (Oue)

<table>
<thead>
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<th>Table 5.4: Breakdown of Stone Type by Region/Area.</th>
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<tr>
<td><strong>Percentage</strong></td>
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<tr>
<td><strong>Region</strong></td>
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<td><strong>Wellington</strong></td>
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<td><strong>Total</strong></td>
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majority of Tahanga basalt adzes were located in the Rotorua area. While frequencies of primary adzes are quite high (Table 5.3), the sample is dominated by reworked adzes, including reworked 2B forms, again most commonly rendered in Nelson/Marlborough argillite.

Conclusion

From the outline presented above, a number of consistent patterns emerge. Firstly, early settlements are located in very similar places. They are predominantly coastal with harbour and river mouths and their coastal margins most commonly selected. Offshore islands were also favoured particularly where they were proximate to harbour mouths and in sheltered bodies of water (east coast Coromandel, Bay of Islands, Hauraki Gulf). These areas were targeted precisely because they provided conditions that maximised self-sufficiency. Harbours probably provided the greatest potential to sustain subsistence needs over long periods of time. The 3200 kilometre coast line of the Kaipara Harbour is an extreme example. From one spot at the harbour mouth most of this area could be accessed over short distances. Not only does this represent optimal access to a vast reservoir of marine and forest resources but also to a large area of potential gardening land. Numerous navigable rivers and streams drain into harbours also, providing additional access to resources. Thus it is not surprising that some of the largest and most prominent early settlements in the North Island archaeological record are located at these primary locations (for example, the mouths of the Houhora, Hokianga, Tauranga, Kaipara, Manukau, Waitemata, Waikato, Whitianga, Porirua Harbours). By stationing themselves at harbour mouths, early Maori also had access to the equally rich resources of the sea and to the coastal highway. River mouths represented a similar potential, though compared with some of the larger harbours, this was probably on a more limited scale.

What the early settlers may not have been aware of was the vulnerability of the locations they chose as village sites. In the present day, harbour mouths and coastal margins on the west coast are exposed and continuously battered by strong winds. They do not present attractive locations for permanent habitation. This is perhaps why early occupation of the west coast is poorly understood archaeologically and why there is an emphasis on the east coast as the primary focus of first settlement (Prickett 1987). But when the first East Polynesian settlers arrived on the west
coast they found these areas forested (Anderson and McGlone 1992:217). The forest would have made all the difference, providing shelter and protection from the elements. Villages could be made in cleared spots within the forest and likewise gardening plots. Problems came with expansion, especially of gardening land, when forests failed to regenerate and when forest burn-offs may have occasionally gone out of control. Vegetation reconstruction from the study of charcoal and land snail samples by Wallace and Coster (n.d.) for the Aupouri Peninsula demonstrated that deforestation and gardening on the fragile dune soils resulted in the creation of shifting transverse sand dunes that ultimately rendered the environment unfit for habitation. This pattern was replicated in almost all the other west coast harbour and coastal areas (Wallace and Coster n.d.:2) and, from the discussion above, it is apparent that similar east coast locations suffered from the same process.

On the Aupouri Peninsula, particularly the low lying central tombolo, the inhabitants probably had little choice but to move out of the area. Inhabitants of the harbour mouths, however, were able to move into the more sheltered and stable inner harbour. Where rivers wound through fertile valleys, river mouth inhabitants were able to make similar shifts (for example, Taranaki). But in some areas the coastal plains were narrow and rose steeply into precipitous ranges therefore settlement expansion was limited (Coromandel east coast, Palliser Bay, southern Hawkes Bay and Wairarapa coast) and again may have resulted in settlement shifts out of the area.

A second point is that secure dates from a number of these early settlements suggest all could have been occupied at much the same time (Table 5.1). Close similarities in the range and types of artefacts and activities and faunal remains indicate that these sites fulfilled the same type of function - that of permanent villages.

As can be seen in Figure 5.11, the distribution of dated sites reveals a decided bias to the north east coast and the south west coast. The known dates are, however, very consistent between these two widely separated areas and suggest that it is highly likely that all were occupied at approximately the same time. Fortunately in the areas where no secure dates have been obtained there exists good evidence (as discussed above) for sites of an identical nature which were almost certainly contemporary with the dated sites.

Two further matters concerning the contemporaneity of these sites need to be addressed. One is whether the model presented by Anderson and Smith (1996b) for the Shag River Mouth settlement and extended to the South Island east coast in general can be applied to the North
Island coastal settlements. In this model (discussed above), settlement occupation spans are seen as being relatively brief - probably no more than 50 years for Shag River Mouth. A probable pattern was
Figure 5.11: Map showing the Distribution of Early Settlements and Dated Sites for the North Island.
suggested wherein villages shifted sideways, that is, to similar unoccupied locations on the same coast. While the large sample of radiocarbon dates enabled the time span of Shag Mouth to be more precisely defined, this is not the case for other early settlements. Even where a similar number of dates have been collected (for example, Foxton), sampling problems have seen the culling out of a significant proportion (Anderson 1991). Thus for the majority of dated sites, occupation spans cannot be defined. From the dates presented in Table 5.1, the best that can be said is that they were occupied some time between A.D 1250-1450, but were not necessarily occupied for the whole of this period. Closer examination of the stratigraphic evidence from sites like Mt Camel, however, suggests that separate cultural layers are generally not chronologically significant and dates from different layers frequently overlap. The deep stratigraphy at Shag River Mouth (2.5m in some areas of the site) did not signify a long period of occupation (Anderson and Wallace 1993; Anderson and Smith 1996b). Artefact assemblages also indicate that technological strategies remained fairly stable between layers (Table 5.1). Such evidence might indicate that North Island sites were occupied for similarly brief periods. The difficulty lies in determining the pattern of settlement shift during the early period. It can be easily argued that harbour mouths and large river mouths would have been the first locations to be claimed. The question to be answered is whether they were all occupied within a relatively brief amount of time and where their occupants went when it was time to shift, if indeed, there were any major shifts out of the immediate environment during the early period. There are certain important geographical and environmental differences in the North Island. One was the probable greater productivity and potential of North Island harbour locations compared to most South Island river mouth sites, not the least being gardening potential. For harbour environments in particular the evidence documented above suggests that, while there was a change from early coastal settlements to inner harbour settlements in the later period, this does not generally represent great shifts in distance. It follows that village relocations during the early period were unlikely to have involved more than localized transfers. For the North Island it may be more relevant to speak in terms of expansion and the potential for expansion rather than complete village relocation. It is likely that initial settlement focused close to the harbour and river mouths and then gradually spread outwards along coastal and inner harbour/river margins. For example, there does appear to
be a pattern wherein the density of early settlement evidence is highly concentrated at harbour and river mouths and diminishes with distance along the coast (the Te Horea settlement at Whaingaroa North Head is one such example of this settlement pattern). The settlement of the east coast Coromandel suggests a similar pattern with high site densities at Opito Bay, the location of the Tahanga quarry, and nearby Mercury Bay, and smaller occupied areas to the north and south until the large settlements at Tauranga Harbour Mouth are reached (and again this may not be completely unrelated to the proximity of Mayor Island).

There remains the currently contentious issue of whether population levels were of a size to see simultaneous occupation of virtually every harbour mouth and most major river mouths in the North Island during what can arguably be considered (from the radiocarbon dates) the initial settlement phase of New Zealand (Anderson 1991:792). Certainly the radiocarbon dates from the North Island suggest that two large areas in very different parts of the North Island (see Figure 5.11) could have been settled simultaneously. The equal attractions and optimal conditions of locations in undated areas make it unlikely that they were not also experiencing human occupation at the same time. Whether founding populations were small and took some time to become visible in the archaeological record (Sutton 1986, 1987, 1994) or whether New Zealand was settled by a large number of people in a short period of time (McGlone, Anderson and Holdaway 1994:148-149), the result was probably the same - simultaneous occupation of primary locations in all areas of coastal North Island by A.D. 1200-1250. This situation could also have existed even with a relatively small population. For example, if 20 primary locations in the North Island (see Figure 5.11) had a founding population of 50 people, then this only amounts to a total North Island population of 1000.

Taken together, this evidence suggests that the possibility of expanding or shifting settlement during the early period should not create problems in defining interaction patterns between different settlement areas.

The other factor concerns the popular theory that, in some areas, the 'Archaic' phase persisted for a longer time (Brothers and Golson 1959:576; Green 1963). Regrettably this theory tends to treat the 'Archaic' phase as if it were a separate entity with a life of its own. This equally applies to the idea that the 'Classic' phase was created by a group of people in one particular region. Artefacts, chiefly adzes and fish hooks, have been instrumental in identifying these areas (Hauraki Gulf, east coast Coromandel). But, for example, the continued use of Tahanga basalt and Motutapu greywacke by people living close to the source need not evoke retention of 'Archaic' ways of life.
- they were just doing what everyone else had started doing - using their local rocks instead of imports. Nor have I seen convincing evidence for the continued exploitation of the Tahanga quarry, rather the evidence represents the continued use and reworking of adzes that were made at the quarry during an earlier time. Use of Motutapu greywacke continued but technology changed and there is nothing in the evidence reviewed above to suggest that this occurred later than elsewhere.

The possibility that the 'Archaic' phase persisted for a longer time on the Aupouri Peninsula could be used to explain the difficulties outlined above wherein the late dates presented by Coster (1989) for the inland central area seem to be seriously at odds with the large 'Archaic' artefact assemblages found there. Yet I do not think retention of the 'Archaic' provides a viable explanation. My problem with this line of thinking is that while early settlements were permanently fixed in the environment and relatively self-sufficient, there was still considerable interaction among them. This is reflected primarily by the range and abundance of imported stone materials, a very consistent feature of early settlements. Prominent among these materials are imported adzes and associated by-products (flakes and fragments from manufacture and/or reworking). It is primarily the 'Archaic' nature of the imported adzes left behind in the Aupouri central inland area that highlights problems with the dates. It has been postulated earlier in this thesis that the decline in major quarry use and changes in adze technology are closely linked. While none of the main quarries relevant to this study like Tahanga or those on D'Urville Island have been dated, dates from secondary production sites can be used to discern when they were in use and for how long. This is again particularly clear for the Tahanga basalt quarry complex. A major difference between the early dated middens like Cross Creek, Hahei and Whitipirorua (see Table 5.1) and later ones like the Eastern Midden at Harataonga Great Barrier (Law 1972), the Wharf site at Whangamata (Allo 1972) and the Skipper's Ridge II settlement at Opito Bay (Bellwood 1969) is the large quantities of adze manufacturing debris in the former and the near or complete absence of such evidence in the latter. A similar chronological distinction can be made for Motutapu greywacke and Nelson/Marlborough argillite adze production. Though both materials continued to be exploited beyond the early period, a change in technology can be documented for both. For Motutapu greywacke this involved a marked decline in the flaking technique, an increase in hammerdressing and a change in the form of material exploited. Small flat pebbles approximating the size and shape of the required adze shape were primarily selected and the exploitation of outcrops and large boulders declined. A similar process is documented for
Nelson/Marlborough argillite. Stratified deposits on D'Urville Island (Wellman 1962) and at sites like Rotokura (Barber 1994) show a decrease in the use of D'Urville Island sources like Ohana and Mt Ears where the stone was quarried primarily from large masses of material (outcrops and large boulders) in order to make large adzes. In the late period layer at Rotokura (Challis 1991) and from predominantly late sites from Nelson, Motueka and Tasman Bay (see Figure 5.10) (Barber 1994; Challis 1978, 1991) water-rolled pebbles were selected from local rivers and then heavily hammerdressed into shape with lime garnet hammers. These forms are absent from 'moa-hunting' sites like Wairau, Kaupokanui, Parematia and the early occupation of Rotokura. Dates from secondary production sites, therefore, suggest that the systematic exploitation of major quarries like Tahanga and D'Urville Island had probably begun by A.D. 1200 and had ceased by A.D. 1450-1500. Yet, according to Coster's model (1989), the central Aupouri area was not occupied until A.D. 1450. The significant numbers of primary Tahanga basalt and Nelson/Marlborough argillite adzes may have been brought in to the area as the last batch of imports from the quarries before they closed down but there seems to have been no technological response to the subsequent scarcity of these materials. They continued to set aside these adzes as burial goods and continued to rework them using the old wasteful flaking technology. If the people of this area were continuing with old 'Archaic' ways at this time and onward to A.D. 1650 then they appear to have been living in complete isolation from their neighbours further south who had already adjusted to a technology entailing the manufacture of the 'Classic' gabbro 2B adze and were also reworking their old ones into a similar form using the same hammerdressing and grinding technology. This appears to be an unlikely scenario and I return to my previous conclusion: that the area was settled much earlier than Coster's dates suggest. Coster's dates may relate to use but not necessarily permanent settlement of the area in later times and this might explain the complete lack of reworked 2B adzes and the dearth of late forms in general. Aupouri is only one example but it reflects the problems when attempting to suggest that 'Archaic' ways of life persisted in some areas longer than in others. At all early phase settlements people appear to have been in regular contact with others outside their area. As discussed above, a wide variety and abundance of imported materials is usually evident at these sites and suggest a high level of inter-site communication. It is very doubtful if any settlement operated in the sort of social and economic vacuum that would provide conditions for 'Archaic' ideas and technology to persist to any noticeable extent.

One final point needs to mentioned. It is likely that no one source was discovered and exploited
before others (Anderson 1991:789; Davidson 1984:195). As an example, adzes and/or flakes of Tahanga basalt, Nelson/Marlborough argillite, Motutapu greywacke and local materials were present in the earliest layer at Mt Camel. Additionally the geological knowledge East Polynesians brought with them from their home islands would have enabled them to quickly seek out the fine-grained rocks they favoured. Even the presence of remote high altitude Nelson/Marlborough argillite sources would have been readily detected by the nature of deposits in the rivers directly below.

Having identified where the early settlements were, their function as permanent residences and the probability that they existed within a similar time frame, the interactions between these sites can now be examined. This is the subject of the next chapter.
CHAPTER SIX: TRADE AND EXCHANGE

Introduction

In Chapter Five, aspects of site function and settlement were discussed and defined. In this chapter attention is given to the mechanisms by which adzes were distributed. Understanding the strategies involved in production is the first step in this process. Production strategies, while not determining mechanisms of distribution, are likely to have had some impact, for example, in identifying who was involved in, and possibly had control of, production. The scale and extent of production might provide insights into the scale and extent of distribution. Other aspects of technology, for example, raw material quality, are important in understanding why some materials were favoured above others especially where adequate local materials were available. The evidence from functional experiments is valuable in informing on aspects of supply and demand, for example, what types of adzes were most in demand and how often.

Identification of production zones and source control by certain groups does not, however, necessarily indicate that a complex trade and exchange system was in operation, nor can the strategies of distribution be defined from this information. The distribution of finished adzes, the distances over which they were found and their abundance, as well as the number of settlements they are distributed to, contribute to an understanding of how the distribution of adzes was organised. But the presence of adzes from, for example, Source A at a particular site does not automatically mean that the people there were communicating directly with Source A producers. Different mechanisms of distribution have been identified from the ethnographic record (for example, the New Guinea highlands axe trade - Hughes 1977) and from archaeological studies (for example, Hodder and Lane 1982; Renfrew 1975). These range from relatively simple down-the-line or neighbour-to-neighbour exchange to complex redistribution by middle-men or specialist traders. But recognising the precise mechanism from the spatial distribution of imported artefacts can be difficult (Hodder 1978). Aspects that may be helpful to this end include the location of sources relative to settlements and the mode of transportation. Where sources and settlements are predominantly coastal, travelling effort can be much reduced by the employment of watercraft. In this situation it might be predicted that people would travel greater distances and make more direct contact with producers.

Before examining the present evidence on adzes, a review of previous studies concerning trade and exchange, both archaeological and ethnographical, is given.
A Review of Trade and Exchange Studies

There are two forms of evidence for understanding how products and materials were distributed, and how communities in different regions interacted with one another - the ethnographic record and the archaeological record.

The New Zealand ethnographic record comprises reports of observations made by early Europeans (for example, Colenso 1869) or collected from Maori informants several generations removed from those who actually made and used stone tools (for example, E.Best 1974). Unfortunately these documents reflect a situation wherein not only had changes occurred as a result of European influence but, well before European arrival, fundamental changes had occurred in that poorly defined and documented period between the early ‘Archaic’ and the late ‘Classic’ period. From archaeological evidence, a much wider range of imported stone materials are found in early prehistoric settlements compared with later sites. Additionally, the types of stone in use had changed, especially regarding adzes. Early adze manufacturing technology had disappeared from the repertoire so effectively that by the time of European arrival traditional knowledge of working quarries like Tahanga and D’Urville Island had virtually disappeared, as had knowledge of what the early technology entailed. This situation was not helped by the poorly developed geological knowledge and the low opinion and disinterest expressed by Europeans toward ordinary stone tools (K.Prickett 1975). Likewise documented accounts of the pounamu trade (Brailsford 1984) are of limited usefulness because the properties of the stone saw the development of a completely different technology (based on sawing) which probably impacted significantly on production and distribution strategies. A similar dearth of ethnographic evidence is seen for other Polynesian islands such as Hawaii (Lass 1994:12).

What can be said from ethnographic and ethno-historic records of late prehistoric and protohistoric Maori trade and exchange practises is that they give the appearance of being quite fluid. The exchange of goods and services was mediated via gift-giving and the principle of reciprocity (utu) which was often delayed (and this may have been the cause of conflict in a number of early contacts between Maori and European - Salmond 1991). This fluidity is expressed in the varieties of ways exchanges could be made. For example, regarding pounamu: ‘It was procured to some extent by making expeditions to the source of supply, and partly by exchange from tribe to tribe’ (Firth 1959b:407).

Firth adds:
‘Occasions for these reciprocal presentations was provided by the travels of chiefs, who, on visiting the village of a stranger tribe, were freely entertained by the leading man of rank there. As part of the hospitality gifts were made to them, often a choice kind, and these were returned either on the spot, or at some subsequent date, when the position of host and guest might be reversed. At times a definite expedition was undertaken by a party under the leadership of some person of rank, bearing with them food products or manufactured goods as presents to the people of a distant village, who would return the compliment after due hospitality by loading their visitors with gifts for their return’ (1959b:409).

Ethnographic studies from Papua New Guinea and Australia reflect a similar fluidity in the manner by which stone axes were distributed and exchanged. In both cases, those living close to axe quarries controlled access and produced axes. Among the Langda people of the Irian Jaya highlands, Toth, Clark and Ligabue (1992:66-70) observed that axe making was the preserve of male specialists who were accorded high status in this role, and lengthy apprenticeships were required to obtain the necessary skills. Manufacture was generally staged whereby roughing out was carried out at the quarry to reduce weight and fine trimming was completed back at the village. Then the axes were taken some six hours walking distance away to be finished on special grinding stones.

The Tungei people, who had access to the Waghi Valley axe quarries, organised periodic expeditions to make axes. Complex and labour intensive quarrying methods were required to gain access to the stone thus the production of blanks was a co-operative effort and all men participated. Thereafter axes were manufactured according to each man’s needs and most were destined to meet commitments to exchange partners. Only a few were of sufficient size and manufacturing quality to set aside as prestigious gifts in transactions like bridewealth (Burton 1984).

In southwestern Australia, where stone axe-making was still taking place in the 1830’s, access to the Mt William axe quarries was strictly controlled. Only certain family members were allowed to work the stone. People from outside the area came to the producers and exchanged with them to acquire axes for their own needs and to pass on to their neighbours (McBryde 1979,1984).

One of the largest ethnographic studies concerning trade and exchange was that undertaken by Hughes (1977) in the Central New Guinea Highlands. Some fourteen major axe quarries were located in a study area of approximately 135x160km (1977:177,178). As appears to have been the case in the studies above, axes were always traded in a finished state over distances of up to 100-250 kilometres. Axes were distributed throughout the area from quarries or production areas ‘...in a series of chain-like steps...’ (Hughes 1977:205), or down-the-line neighbour to neighbour.
exchanges. In the Mt Hagen area, most men were involved in these exchanges and though they travelled together, exchanges were on an individual basis through exchange partners ‘...who would be friends or relatives by marriage’ (Phillips 1979:110). Hughes also states that

‘Every man took part in ceremonial gift exchange and bartered on his own account when opportunity offered; there were no professional traders, no merchants...’; they acted as ‘owner-users’ rather than ‘middlemen’ (1977:203).

‘Owner-users’ is a term referring to the manner by which axes were often used for a period before being passed on. This resulted in a pattern wherein axe size decreased and bevels became steeper over distance, and where large axes were concentrated in areas close to the source (Hughes 1977:134; White and Modjeska 1978b:29). As seen above with the Tungei axe-makers, the number of well-made large axes manufactured was generally outnumbered by smaller forms and the supply of these axes was, therefore, depleted sooner along the chain of exchange. Among the Duna, who were some distance from an axe quarry, large high quality axes were difficult to acquire and were rarely given as bridewealth because they were too scarce to accumulate for such purposes (White and Modjeska 1978a:280). But in areas close to axe quarries, for example, those near the Mt Hagen quarries, large finely made axes were important in ceremonial exchanges and ‘were at the basis of wealth’ and made up half of the important items given in bridewealth transactions (Phillips 1979:111; Strathern 1965:190). Generally tribes like the Duna had only a vague idea where their imported axes originally came from and among Hughes’ informants only those within two miles of an axe quarry knew of its location (Hughes 1977:145,183; Phillips 1979:186; White and Modjeska 1978a:279). It appears that while the axes moved long distances, the people that moved them did not. Within Hughes’ study area travelling parties rarely went further than ten miles and the distance between ‘...close kinsmen and the furtherest trade friends was little more than 15 miles (24km) and was covered in the course of dual purpose trading and hunting expeditions’ (1977:203). Rarely did they travel beyond the territory of their relatives. The fact that travel was overland and involved traversing fairly rugged terrain may have some bearing on exchange mechanisms. Coastal canoe-traders regularly travelled long distances and into the territories of non-kin (Hughes 1977:204). Among the Duna the majority of transactions took place near the boundary of their territory. Axes were generally brought to within half a days walk into Duna territory by non-Duna speakers and traded for pigs and salt. Thus the Duna did not go to the production areas for axes - the axes came to them. White and Modjeska, on observing the range of sources represented among the Duna axes, noted that these reflected the number of

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kinship connections in different parishes (villages). Those not close to sources would acquire axes during kinship visits with those who were. Informants stated that if there was no kinship connection ‘...they had no socially acceptable reason for visiting the resource area’ (1978b:34). Thereafter, similar neighbour-to-neighbour exchanges involving axes were undertaken between Duna villages.

According to Hughes:

Dominant trade flows were between regions of contrasting resources, the highlands, the lowlands and the coast….created by and built up of the interlocking and overlapping personal trading networks of individual men’ (1977:210,212).

But while there were dominant paths along which certain products and materials like axes and salt travelled, most regions received products from different directions and sources so that no two regions were crucially dependent on each other for trade. Also due to the system by which products moved from neighbour to neighbour, the actual producers in different areas had no direct contact (Hughes 1977:213).

There appear to have been two distinct exchange contexts. ‘Ordinary trade’ the most common form of exchange, was characterized by immediate exchanges. Transactions could occur between non-kin and were usually arrangements made between individuals. No status was involved, conditions were unceremonial and geared to material benefit, and goods were always the products of specialized resources and/or labour (like axes). Ceremonial exchanges involved, in contrast, delayed gift return and were always between kin. Also there were often group exchanges mediated through a group leader. Conditions involved prestige and status, presentations were public and ceremonial, and socio-political benefits were stressed (Hughes 1977:210 - Table 17).

There is little evidence to suggest, however, that the production and distribution of axes given in ceremonial exchanges was more specialized than that of ordinary work-axes, and, apart from the ceremonial nature of the occasion, they were exchanged in the same down-the-line system. Like work-axes, ceremonial axes could be kept for a while, sometimes even used, before being passed on. White and Modjeska noted that most Duna men had one axe hafted and on hand for ‘day-to-day’ use and had others stored away to serve variously as replacements or to meet commitments to exchange partners on both an ordinary and ceremonial level (1978b:31). Hughes sees the two contexts of exchange as being ‘...idealisations, the poles at the ends of a continuum of occasions when goods change hands’ (1977:209). Thus ceremonial and ordinary work-axes appear to have
travelled along the same paths and reached settlements in the same ways but were exchanged in
different social contexts and under different conditions.

Informants in various areas also expressed some variability in defining the morphological
differences between ceremonial and ordinary work axes. Large fully ground thin finely made
axes were generally set aside for ceremonial presentations, but they varied considerably in size,
style and degree of finish, and some were indistinguishable from ordinary ‘work-axes’. This
variability was undoubtedly related to distance from the source, scarcity, and material quality but
also reflected different regional styles (Hughes 1977:160-168,176,212).

In summary, the ethnographic record provides valuable insights into how people procured and
supplied raw materials and products. The type of archaeological record that might be created by
these patterns of behaviour is, however, not so clear cut. White and Modjeska comment that
‘...while inter-group trade and exchange systems clearly control the numbers, kinds and sizes of
blades that arrive at a parish, none of these are likely to be determinable from the archaeological
data’ (1978a:285). The main reason for this is that archaeologists must use ‘...the evidence of
consumption to infer the character of exchange’ (Bradley and Edmonds 1993:8). Lass states that

The major difficulty…is that there is no simple straightforward correlation
between the spatial or archaeological patterning in the occurrence of various
raw materials and the complex or social processes that produced the

Indeed a striking comparison can be made between the fluidity of exchange systems as reflected
in the ethnographic record reviewed above and the somewhat rigid economic models often
employed to interpret the distribution patterns of artefacts in the archaeological record. The
spatial patterning of various imported materials across the archaeological landscape may be
adequate to describe what went where, but explaining the how and why poses a greater challenge.

The distribution of durable materials and products like pottery and stone tools are the mainstay
of archaeological studies identifying early trade and exchange patterns. Sourcing studies provide
the means by which materials found at sites can be traced to the areas they originally came from.
Analytic methods generally focus on the mechanisms of exchange. Renfrew’s ‘Law of
Monotonic Decrement’ or ‘Exponential Fall-off’ model has proved an effective device to this end
(Renfrew 1972,1977). Drawing on ethnographic studies like those discussed above, the quantities
of imported materials usually decrease with distance from the source and can reflect the
reciprocal neighbour-to-neighbour or down-the-line method of exchange. Production zones
where the use of a material is particularly abundant and where manufacture takes place, and
‘contact zones’ where products are consumed, can also be defined by the rate at which the
distribution curve falls off.

Problems of interpretation really arise when there are marked deviations from this pattern, for
example, when the fall-off curve resembles a series of ‘peaks and valleys’. Such a pattern has
perhaps been too hastily accepted as evidence of direct long distance exchanges and probable
central place redistribution (the peaks representing the centres of redistribution which manifest as
concentrations of imported products at considerable distances from the source). But simulation
studies have shown that similar patterns can be the outcome of different processes and vice-versa
(Bradley and Edmonds 1993:8,48; Cummins 1979; Hodder 1978:156; Hodder and Lane 1982;
Renfrew and Bahn 1991:325).

Patterns of distribution could also reflect problems with what is measured, that is, the nature of
samples used to plot fall-off curves, and what they represent. Torrence advises caution regarding
the ‘...assumption that the quantity of a material at a site is an accurate indicator of how
extensively it was used at that location’ (1986:22-23). For example, a core of obsidian can be
accepted as a unit of exchange but most cores are eventually reduced to piles of waste flakes and
discarded flake tools and it is these that commonly form the units found in the archaeological
record. The 48kg core found at Hurunui River Mouth could have produced something in the
region of 20,000 flake tools and waste flakes or more. It may also have taken some time for cores
of this size to be used up increasing the chance that flakes from one core will be found in a range
of different contexts and places. Thus the recovery of a large amount of obsidian flakes from one
source at a site will not necessarily indicate systematic and regular exchange and contact with the
source area. The same could be said for reworked adze flake assemblages. Curated stone tools
like axes and adzes, however, have the advantage that they can be considered as single units of
exchange. But, as addressed above, their curated status means that they may not be discarded in
the place they were originally acquired. Regarding British Neolithic axe studies, Bradley and
Edmonds (1993) are critical about the use of proportions to indicate the quantity of particular
sources represented at sites. This method disguises the actual size of the sample in which only a
few axes of a particular material may be represented. Again, their presence would not necessarily
indicate that an exchange network was in operation or that the imported axes reached the site by
anything more than an informal or random process (1993:47).

There are also problems concerning differential discard patterns and contexts for different types
of valuables (Hodder 1978,1982; Hodder and Lane 1982). For example, ceremonial goods may
have been produced, acquired, distributed and consumed in different ways compared to ordinary
goods. According to Hodder we might expect that prestige items of high value will ‘...cover a
wider area than objects of lesser value’ (1978:164), though the ethnographic studies above suggest that the reverse can also be the case. Thus the form, size and value of an item are important variables in any study of trade and exchange. Imported items and materials may also be treated differently to local products, i.e., set aside as ceremonial items, the premise being that the imported items must be of superior value to warrant the extra effort of acquiring them (Bradley and Edmonds 1993:8). Hodder also stresses the importance of the contexts in which items are found and what this can tell archaeologists about their symbolic meaning, for example, objects included in ritual contexts like burials. Thus it is ‘...necessary to examine variations in symbolic associations over space’ (Hodder 1982b:208). For example, the concentrations of axes associated with the causewayed enclosures and monumental earthworks of Neolithic Britain may not represent contexts of exchange and redistribution but contexts where axes were ceremonially deposited (Bradley and Edmonds 1993:51). In addition to determining whether the contexts from which samples are drawn are comparable, it is necessary to demonstrate that they are drawn from contemporary contexts; that materials and products were being exchanged between settlements that existed at the same time.

In summarizing their critique of archaeological approaches to trade and exchange, Bradley and Edmonds state that archaeological research ‘...should be geared to addressing articulation between social and economic processes’ (1993:8). But the social significance of exchange networks like the Kula Ring of the Trobriand Islands, which involved the continuous circulation of highly prized armbands and necklaces, might prove almost impossible to identify in the archaeological record, none the least because the physical evidence representing such networks might still, theoretically, be in circulation! (Weiner 1988:139-157).

Additionally, the ethnographic record stresses the interactive nature of production, distribution and consumption in exchange networks, whereas archaeologists tend to ‘...study systems of exchange through just one of its component parts’ (Bradley and Edmonds 1993:11), and assume that from one, the behaviour of other components of the exchange system can be determined. For example, standardization in the form, size, style and craftsmanship of an item has often been assumed to indicate the existence of specialists (for example, Leach 1993). Other aspects of production like high production rates and high skill levels are also seen as indicating the role of specialists (Cleghorn 1982; Witter 1985). Yet, as documented in Chapter Two, Three and Four of this thesis, functional requirements, raw material properties and manufacturing techniques may be primary influences on the degree of standardization, skill, production rates and strategies. Assumptions are also made regarding the existence of specialists. These often involve the use of modern economic concepts like ‘assembly lines’ and ‘mass production’, which in turn lead to
assumptions that some specific organised body existed by which these mass produced items were thereafter transferred or redistributed to consumers, for example ‘traders’ or ‘middlemen’ (Bradley and Edmonds 1993:43-45). It is, therefore, important to define the relationship between production, distribution or acquisition and consumption (Bradley and Edmonds 1993:17).

The model outlining the steps that need to be addressed in order to arrive at an understanding of the trade and exchange patterns that may have existed during early settlement of New Zealand was introduced in Chapter Five and further steps are introduced below.

Model for defining the distribution of early New Zealand Adzes

A. Context (see Chapter 5)

B. Production

The main issue concerning production when defining trade and exchange patterns is who had access to the stone source/s and who actually made the adzes.

Step One:
1. Who was involved in adze manufacture?
2. Did people distant from sources of adze rock make special trips to quarries and have direct access or did certain groups of people control the quarries?
3. Was adze production under the control of specialists?
4. Can production zones be defined?

Method of Analysis:
1. Examine the distribution and character of adze flakes - do these represent manufacturing stages or do they relate only to the reworking of broken finished adzes?
2. Examine the presence/absence of preforms and their state.
If production zones can be defined:

**Step Two:**

1. Are there indicators that production is geared to large scale supply outside production areas which might necessitate a trade and exchange system?

**Method of Analysis:**

1. Examine aspects of supply and demand. Reference to the experimental evidence on production rates that were described in Chapter Two is useful here. For example, the costs of adze production weighed up against benefits like a long use-life. Because production costs vary for different types of adzes, it is useful to attempt to identify the types of adzes that may have been most in demand. The functional experimental evidence described in Chapter Three can be used to address this matter.

2. Examine the size and extent of the production zone. Possibly more relevant than the amount of debitage at sources is the amount of debitage at sites. Replication experimental data can be used to provide estimates on the number of adzes produced, the size of the area and the number of settlements engaged in adze manufacture.

3. Examine how production was organized. Complex organisational strategies in place may indicate that constraints on manufacture required careful management in order to meet supply. Data on production times, drawn from replication experimental evidence, can identify manufacturing stages represented at sites, and identify the time and energy needs of each stage.

4. Examine whether adzes were moving over long distances in sufficient numbers to sufficient places to require an organised system of trade and exchange. Defining the scale and size of consumer zones can provide insights. Sources of information include the distribution of finished adzes outside production zones, the distances covered, the number of sites and regions where adzes from different sources were found and the quantity represented.
If a trade and exchange system can be established, identifying mechanisms of distribution can then be addressed:

C. Distribution

Step One:

This involves determining who was articulating with producers and how.

Methods of Analysis:

1. Examine whether the context of initial exchange with the production zone can be identified. Are all producers also suppliers or did only those on the boundaries of production zones interact with consumers? Observing the range and abundance of imported materials in production sites can indicate the number and range of contacts. This data can also inform on who was interacting with the production zone, i.e., were they immediate neighbours only or were there direct long distance contacts?

Step Two:

This involves identifying how adzes were distributed through the consumer zone. Mechanisms of trade and exchange (after Renfrew and Bahn 1991) include:

1. A series of down-the-line exchanges, for example, from neighbour to neighbour.
2. Middlemen - only a few groups articulate with producers and then redistribute to other groups or redistribute from ‘central places’.
3. Direct long distance exchanges.

Methods of Analysis:

Examine:

1. The distances adzes travelled and the number of adzes
2. The location and distances between sites and sources
3. The proximity of rival sources and sources of other essential materials
4. The mode of transportation and viable transportation routes,
5. The relative value of sources and identification of any selective factors in operation (for example, raw material quality).

Aspects of this model are now discussed in more detail below:

**Aspects of Production**

One of the first matters to be established regarding production is whether there was an actual exchange system in operation. The uneven distribution of valuable materials does not necessarily presuppose the existence of such a system. It must be determined whether a production zone or centre existed wherein only certain local groups controlled access and production or whether everyone had direct access to the source. Fortunately the character of manufacturing debitage at sites provides the means by which production zones may be defined (Turner and Bonica 1994).

Where a production zone and controlled access is identified, it is then necessary to determine the scale of production - was it of a level to require an organized exchange network to disseminate its products? Aspects of ‘supply and demand’ are central issues here. What was the nature of the product and was it essential to day-to-day needs? How often were replacements required? Was demand such that production had to be constant or even a ‘specialized’ full time activity for a certain number of people? Factors of supply are also relevant, i.e., how much time, effort, risk and skill was involved in raw material access and manufacture? The size of the production zone and the number of settlements involved provide additional insights on the scale of production and the degree of specialization. These factors may also influence how the product moves from the context of production to the context of consumption. For example, producers may be too busy producing to be additionally responsible for supplying. For products that were especially essential and valuable, producers had the advantage of having what others needed.

Having defined a production zone and its size, the boundary between this and the consumer zone can also be defined. Assemblages at sites in these areas may require close scrutiny because they may represent the initial context of exchange which may not have taken place at the source itself, as seems to have been the case in the New Guinea highlands. The range and abundance of imported materials at these sites may be indicative of the number of different contacts with outside areas, particularly if there is a sudden increase of imported materials at these sites compared to neighbouring groups within the production zone.
Aspects of Distribution

Only one study has attempted to use archaeological data to describe and understand early exchange and communication networks in New Zealand (Leach 1978). The large number of stone artefacts excavated from a 70m square at the Washpool site at Palliser Bay provided such an opportunity. Some 32 different sources of raw material were represented and the majority were imported - 8861 (80.6%) of a total of 10984 stone artefacts). Furthermore, some were imported from sources over 700kms away, including Northland and Central Otago. Leach (1978:399) organised the Washpool data according to:

i). The strength of the signal (the abundance of a source as indicative of the degree of interaction).
ii). The number of signals (the number of different sources represented).
iii). The direction of the signals (where materials were coming from).
iv). The length of the transmission line (the distance over which materials travelled to reach the site).

Three levels of occupation have been defined for the Washpool site (Level I - A.D 1180, Level II - A.D 1350 and Level III - A.D 1540 - K.Prickett 1979:173), and the study was primarily directed at discerning changes in the communication network over time rather than determining the mechanisms by which imported materials reached the site.

In Level I, the direction, number and strength of the signals pointed to a close contact with the north east coast suggesting that the Palliser Bay inhabitants may have originally come from the north (Leach 1978:399). At Level II, the range and abundance of imported materials increased and they were coming in from many different directions over greater distances. By Level III the number and abundance of imported materials had fallen below that of Level I, and there was a corresponding contraction in the distance and directions by which materials travelled. Contact was strengthened with the south and decreased to the north.

One of the problems with this study is that Leach used numbers of artefacts as the units of exchange. This meant that artefacts like obsidian and chert waste flakes (which dominated the assemblage) were given the same unitary value as curated tools like adzes. As discussed above, the reworked status of the adzes indicated that all could have been brought to the site at initial settlement thus could not be used to indicate rates of importation over time. There is a contrasting problem with the flake assemblages. Like the imported adze flakes (N=1749), the majority of
obsidian (N=3525) and chert flakes (N=3504) are minute - less than one gram (personal observation). Seven different sources of obsidian were represented at Washpool with Mayor Island obsidian dominant throughout the sequence (K.Prickett 1979:173). Had the flakes from each of the minor sources been weighed they would have amounted to, at best, one small core each with a couple from Mayor Island. The minor sources particularly could represent isolated ‘one-off’ exchange events and could even have been brought in with other sources for ‘novelty value’. They cannot be used to support the existence of flourishing exchange networks or continuous on-going contact.

Another problem is the inference that the Palliser Bay people had strong contacts with, and possibly originated in, the north, especially during the Level I occupation. This communication link was largely articulated via the high frequencies of obsidian. But like all the other sites south of the Bay of Plenty and central North Island, the Palliser Bay inhabitants had no choice but to import their obsidian from the north because this was the only area where it was found, and Mayor Island was the closest and most accessible source. The absence at Palliser Bay of other important stone resources from the Coromandel east coast/Tauranga area led Leach to comment:

‘The fact that neither Tahanga basalt or the sinter accompanied the Coromandel obsidian to Palliser Bay argues for some complexity in the overall exchange system, perhaps involving middle men specializing in particular materials’ (1978:404).

But a simpler and more logical explanation can be provided. The people at Palliser Bay had much closer sources of chert and adze rock to draw from, and the adze rock, Nelson/Marlborough argillite, was additionally of superior quality.

In summary, the Palliser Bay study highlights some of the variables that need to be addressed when attempting to understand communication and exchange networks as articulated through the study of archaeological remains.

The spatial relationship between sites and sources are likely to have played a major role in how products and materials were distributed:

1. The geographical location of sources and settlements - access and transportability. Coastal travel over water between settlements and sources may have seen a higher level of contact and communication over long distances than experienced by people living in inland areas. Water travel made direct long distance exchanges more viable and may have increased the amount of material going over long distances. Thus there may have been greater variability
exhibited in the way materials and products were distributed in coastal areas (Bradley and Edmonds 1993:45; Hodder 1978:162,163; Renfrew and Bahn 1991:324).

2. Site location relative to source location.
The distance between sources and settlements is likely to have influenced the choices and options available as seen above for Palliser Bay. It may also influence the way people obtained imported materials. We might predict that people would use the closest source. But people located centrally between two or more sources will have more choices available and may be placed fortuitously to pass on materials/products to those more remotely situated from sources. Others may be so remote from sources of important materials that adequate supplies could not be obtained via neighbour-to-neighbour exchange but by some other means like direct long distance contact with production zones or distant exchange partners. This might certainly be the case regarding the means by which many people in the South Island and southern North Island obtained obsidian.

3. Relative location and value of ‘rival sources’.
The use of one source may be constrained and reduced by the proximity of a superior rival source and influence the direction of exchange. The superiority and value of certain raw materials might also explain evident preferences especially where the frequency of imported products surpasses more local products. The size and orientation of consumer or contact zones are likely to be influenced by the location of other sources involved in producing the same product. McBryde noted both the presence of empty spaces between the distribution of axes from different sources and the overlapping of contact zones. These patterns were interpreted as the existence of distinctive but interconnected exchange networks (1979:122).

4. The source location of other essential materials.
As Plog asserted, understanding of an exchange network is limited if imported products or/and materials are studied in isolation (1977:129), none the least because the acquisition of one may be embedded in the acquisition of the other. The opportunity to acquire several valuable materials from one place may have influenced the choices people made about what resources they imported and who they had exchange relationships with. Regrettably the archaeological record is biased toward durable materials thus our ability to comprehend an exchange system in its entirety is limited.
5. The quantity of imported material/products found in sites, their relative frequencies, and the number of sites in which they are found.

These aspects will also provide information on the strategies that were employed in their distribution. Some of the problems identified above regarding the nature of the sample and the contexts they were derived from also need to be addressed, particularly in regard to adzes. Are some of the patterns identified in the ethnographic record apparent in the archaeological record and do they indicate similar patterns of exchange? For example, in the New Guinea Highlands, axes became progressively smaller over distance as a result of being used before being passed on. Conversely larger ones were retained closer to the source due to their relative scarcity and their value in ceremonial exchanges. Another question is whether imported adzes were treated and subjected to differential consumption compared to those made of local materials.

The Present Study

Production

From the analysis of flake and preform assemblages (Appendix A and Table 5.3), it is evident that only people living close to the source had direct access and ‘production rights’. Adze manufacturing flakes and rough, broken and reworked preforms have a limited distribution and are generally found at settlements in the vicinity of the source. Thus distinct production zones can be defined. The Tahanga basalt production zone extends along the coast from Great Barrier Island for approximately 200kms to Mt Maunganui at the eastern entrance to the Tauranga Harbour (see Figure 6.1). By merit of the extensive archaeological investigations conducted on the Coromandel east coast, a large number of contemporary settlements can be identified which were regularly spaced along the coast and on off-shore islands. All were involved in adze production and contain large quantities of Tahanga waste flakes and reject preforms.

The Nelson/Marlborough argillite production zone was more extensive involving all of the south west coast as far north as South Taranaki, and the top of the South Island from Farewell Spit to Wairau Bar (see also Challis 1991:120). The boundaries are less well defined due to the poor retention of adze manufacturing material. Wilkes and Scarlett (1967:196) noted that among the adze flakes excavated at Heaphy River Mouth there was an equal number of waste and grinding flakes suggesting that they were produced from reworking not adze manufacture, thus it does not
appear that the Nelson/Marlborough adze production zone reached this far on the South Island west coast. To the south east, adze production does not appear to extend beyond Wairau Bar. Preforms are found further south but they are generally complete well formed specimens in a ‘tradable’ state where the flaking stage has been completed. In contrast to the Nelson/Marlborough argillite and Tahanga basalt production zones, the area over which Motutapu greywacke adzes were manufactured is very localized, restricted to the central Hauraki Gulf islands and the adjacent coast. The minor sources also have very localized production zones. For some like the Northland basalt, evidence of an actual worked source area is unknown and evidence of mass manufacture is relatively invisible in the archaeological record compared to the extensive flaking floors at the Tahanga and D’Urville Island quarries. To some extent this reflects the nature of the source. For example, some sources like Motutapu greywacke, Northland basalt and Waikato basalt, are spread over a wide area as river and intertidal deposits. This may be compared to Tahanga basalt which is localised to only one volcanic deposit on Tahanga Hill.

Mindful that huge amounts of debitage do not necessarily indicate a full-blown specialised production system, aspects of supply and demand need to be examined.

It is clear from preceding chapters that adzes were tools that played an important functional role in early Maori society thus their primary value was likely to be a functional one. Probably every man (from ethnographic evidence it can be seen that adze/axe-making and use was almost exclusively the domain of men) would need one or two adzes and probably more (a back-up supply). But how often would adzes need replenishing? Chapter Three and Four discussed evidence that suggested adzes probably had a long use-life. Demand for new adzes would be targeted at large adzes and primary functional types, especially Type 1, which could not be replaced by reworking. It might also be necessary to consider the specialist aspect of adze use. Was every man involved in canoe/house building and tree felling or were there village specialists? It is likely that tree felling for large canoes and subsequent construction would require a group effort. Every man probably needed to have basic wood working skills and own a wood working tool kit so that they could provide for their own families needs as well as contribute to communal village efforts when required. Such a tool-kit would include timber chopping and timber dressing adzes - Type 1, Type 2 and Type 4 - the most common types recovered from early sites (Chapter 3). It is possible that there were experts for which certain more detailed tasks were reserved and who may have had a more elaborate range of tools (like the rarer Type 3 and Type 5 adzes for example).
Figure 6.1: Map showing Adze Production Zones, Exchange Networks, Serpentine Pendant Distribution and Obsidian and Chert Source Distribution.
Caches, particularly those comprising finished adzes, probably represent tool-kits. Type 1 and Type 2 adzes were the most common adzes found in caches, both those comprising finished adzes and those comprising unfinished adzes, and were found in 31 of 50 caches - see Appendix D for list of individual caches. Type 4 adzes were the next most frequently included (26 caches). Type 3, Type 5 and Type 6 adzes were less common with Type 3 present in 21 caches, Type 5 in eight caches and Type 6 in 16 caches. Combinations of functional types were quite varied, the most common combination being Type 1 and Type 4 (five caches, all from the North Island) and Type 1 and Type 2 (six caches). Only one cache (Port Underwood in the Nelson/Marlborough production zone) had all types included but these were all D’Urville Island argillite preforms. Other repeated combinations (in five caches each) were Type 1, Type 2, and Type 4, and all Types except Type 5 (South Island only). Though the sample of caches is small, caches reflect the pattern seen in the larger general samples - Type 1, Type 4 and Type 2 are the most common functional types and probably formed the basis of a man’s standard tool kit. Large primary adze types also dominate in caches reflecting the greater amount of time they spent in storage. Men would also have a range of reworked adzes that were used on a more frequent day-to-day basis, and they may have been stored or curated in a different way to more valuable primary tools set aside for special or major tasks like canoe building.

As discussed in previous chapters, the length of time a primary adze could be used before it broke is unknown though functional experiments suggest it could be considerable. Bad blade damage was probably a more immediate concern as a snapped blade corner could result in extensive modification which would render an adze unfit for its previous functional purpose.

Adzes were also set aside as burial goods though to what extent it is difficult to say. The large numbers deposited in graves at Wairau may be directly related to the site’s status as a production zone. The people of Wairau undoubtedly had more to spare and many were in a magnificently flaked but unfinished state. Additionally, as seen with the Duna (White and Modjeska 1978a), some adzes were probably acquired through inheritance. It is highly likely that some tool-kits outlived their owners (which may be why a number were left in the ground for archaeologists and others to find especially if death was a sudden and unexpected event). When too old to do heavy work a father may have handed down his tool-kit to his son when he came of age or promised it to him on his death.

In the final analysis, it is difficult to estimate how often new adzes would be required. A long-life span and careful curation might suggest that demand was steady but not enough to require mass production and distribution.
Directly related to this long-life span and careful curation, however, is the time and effort involved in production. Producers could have been manufacturing adzes on a full-time basis but not actually produce a large number per annum. Adzes were unlikely to have left production zones until the risky flaking stage was over (Turner and Bonica 1994). Production required the energy intensive brisk but risky processes of blank making and roughing out at the quarry, high skill, more time and very high risks and concentration in the final trimming process at villages, and the labour intensive and time consuming process of finishing by hammerdressing and grinding. The first two processes leave distinctive debitage in the archaeological record but the third is virtually invisible. Hammerdressing and grinding produce almost no debitage and the tools involved (hammerstones and hoanga) are multi-purpose tools used also to manufacture, repair, and rework other artefacts. Thus it is difficult to know if the production zone was also where adzes were finished. The Mercury Bay cache provides some insights. This cache is made up of eleven preforms (nine Type 1 and one Type 4 - one other has been mislaid) and a large hoanga. All the preforms are quite heavily hammerdressed and their association with the hoanga might suggest that grinding was the next intended step. Caches of preforms where more flaking was required have not been found outside production zones as documented in this research. Beyond production zones, the odd preform is occasionally found but these are usually exceptional examples (like the D’Urville Island argillite Type 2 adze found at Waihi Beach and the Type 1 adze from southern Hawkes Bay), often very large (over 300mm) and finely flaked. Preforms found in caches beyond production zones are similar and found with finished adzes, for example, the Motukarara (Lake Ellesmere), Hurunui River Mouth, Rakaia River Mouth and Heaphy River Mouth caches. Caches of preforms found within production zones also contain larger numbers than finished tool-kits. The hammerdressing evidence reviewed in Chapter Four showed that Nelson/Marlborough argillite primary adzes found in the northern half of the North Island displayed considerably less hammerdressing than their counterparts within the Nelson/Marlborough production zone who had lime garnet. This might suggest that adzes were imported in an unfinished state. An alternative explanation is equally possible - that imported adzes might tend to be those of the highest quality in terms of fine flaking, and thus would not need much hammerdressing. The adzes comprising the Mercury Bay cache, in contrast, were quite roughly flaked and required moderate to heavy hammerdressing to correct shaping irregularities. Thus only exceptionally flaked adzes may have been sent out of production zones in an unfinished state. The flaking skill exhibited on an adze was probably one of the most admired and appreciated aspects and may have contributed to their value and to the reputation of their makers. The unfinished state of these adzes would not devalue them as little grinding and
hammerdressing would be required to complete them. But apart from these exceptions, finished adzes would have had greater value than unfinished ones, and grinding and hammerdressing provided the means to turn rather rough preforms like those in the Mercury cache into symmetrical products. Thus it was probably the case as in the New Guinea Highlands that most adzes left the production zone in a finished state.

This point has been belaboured somewhat due to the problem of determining the specialist role of adze producers. The term ‘specialist’ is one I use reservedly, again due to the assumptions that are generally drawn. Different levels or types of specialists have been defined (Sahlins 1972) and each level has been correlated to a certain level of socio-political complexity. Lass (1994) attempted to draw a correlation between the rise of chiefdoms in Hawaiian societies and the development of adze specialists at quarries like Mauna Kea but found little evidence to support such a relationship. One of the major problems, as Lass also found (1994:31), is that the indicators of standardization (Costin 1991; Torrence 1986) employed to determine the degree of specialization are not useful when applied to adze production. As demonstrated in preceding chapters, technological features like production rates and stages, skill, standardization in adze form, size and style are influenced primarily by material quality, functional requirements and solutions to manufacturing problems. The best that Lass could determine was that the Hawaiian adze makers were ‘...community specialists based on differential proximity to adze-manufacturing sites’ (1994:48). The New Zealand adze makers would certainly fit this description but there is further evidence that may clarify their role.

The Mercury Bay cache was probably the successful output of one man’s session at the quarry and the adzes are of a very similar size, finish and style (all the Type 1 preforms are back-wider-than-front forms). The Opito burial adzes, again dominated by Type 1 adzes (fourteen adzes - twelve Type 1, two Type 4), also exhibit similar characteristics and were probably the output of the man (Olsen 1980) in whose burial they were found. These preforms, fresh from the quarry and in need of further fine trimming, might be the equivalent of one week’s work at the quarry (Turner 1992). Other smaller preforms were probably made during that time but may have been finished sooner while the larger ones were set aside due to the more prolonged and staged episodes of manufacture involved in finishing them. It could take a few months of sustained full time work for one man to finish all the preforms in the Opito and Mercury Bay caches (based on replication experiment data).

Additionally it is unlikely that any one man would need nine to twelve Type 1 adzes for their own use, thus these caches (notwithstanding that the future of the Opito cache was possibly altered by the sudden? death of the person who made them) can be seen as representing goods
intended for exchange. The similarity between the two caches in terms of the number of preforms and the types represented, particularly the large numbers of Type 1 adzes, suggests they may have been geared to meeting consumer demands and possibly indicate the average output of each adze-maker per quarry visit.

Previous research (Turner and Bonica 1994) indicated that the Tahanga basalt adze production complex operated at a high level of organisation and was geared to deal with manufacturing problems efficiently. If adze production was a fairly irregular leisurely and casual part-time activity we might expect problems to be accommodated less efficiently. For example, adze makers may have been able to spend more time at the quarry on fine trimming. The intensive preform reworking evident at many east coast Coromandel sites (and evident at Rotokura and Wairau and on D’Urville Island itself for those involved in the manufacture of Nelson/Marlborough argillite adzes) is also noteworthy in this respect. The strategy of making adzes as large as possible at the quarry meant that when many broke back home they could still be transformed into something ‘tradable’, for example, turning a broken 400mm long Type 1 adze into two smaller Type 2 adzes. The complex strategies developed in producing large adzes seem to suggest some struggle was involved in keeping up with demand.

Another source of information involves estimates of the numbers of adzes roughed out at the quarry or finished at secondary production sites (Cleghorn 1982). Such estimates are, however, difficult to establish and are likely to be speculative (Turner 1992:209-213). Quantitative data from replication experiments compared with an excavated sample from the Tahanga quarry, provide some data that may be useful (see Table 6.1).

Anderson suggests that an estimated 38.6 tonnes of flakes, mostly of Nelson/Marlborough argillite, may have been produced at the Wairau site and represent the manufacture of some 12,000 adzes (1989:124). Anderson does not say how he came up with this number of adzes but the replication experiment data in Table 6.1 indicates that it may be a serious under-estimation. Three processes are represented by the flakes at Wairau (as reconstructed from the flake, adze and preform evidence) - secondary adze manufacture, preform reworking and adze reworking, as well as the re-use of some flakes as tools. As seen in the flake assemblages from the sites within the Tahanga basalt adze production zone (Turner and Bonica 1994), flakes from the fine trimming manufacturing stage are in the majority so this experimental data set in Table 6.1 is most useful to calculate the approximate number of adzes produced at Wairau. Using these figures, 38.6 tonnes of debitage represents the production of over 40,000 adzes, though not all would have survived the fine trimming process. If we accept that Wairau was occupied for a similar time span to Shag River Mouth, i.e. 50 years, then some 800 adzes may have been
produced each year. Even considering that at least half may have suffered a transverse failure (many being subsequently reworked), this is a large number. If the occupation span of Wairau is extended to 100 years and we accept an annual production rate of 200 successful adzes a year this is still a high production rate (relative to the time and effort involved). Given that it probably took one man two or three months working full time to finish ten Type 1 adzes (depending on how successfully they were flaked), a significant proportion of the male population at Wairau must have been engaged in this activity on a regular if not full-time basis.

### Table 6.1: Production Estimates

<table>
<thead>
<tr>
<th></th>
<th>Number of preforms made</th>
<th>Total flake weight kg</th>
<th>Mean weight Gms</th>
<th>Weight Range Gms**</th>
<th>Total flake number +2gms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preform Rework Exp.</td>
<td>30</td>
<td>13.4</td>
<td>446</td>
<td>73-1515</td>
<td>626</td>
</tr>
<tr>
<td>Fine Trimming Exp</td>
<td>44</td>
<td>36.2</td>
<td>821</td>
<td>80-2040</td>
<td>2677</td>
</tr>
<tr>
<td>Roughing out Experiments</td>
<td>148</td>
<td>349</td>
<td>2358</td>
<td>120-19750</td>
<td>8825</td>
</tr>
<tr>
<td>Rework Adze</td>
<td>2</td>
<td>0.3</td>
<td>150</td>
<td>116-184</td>
<td>66</td>
</tr>
<tr>
<td>Quarry* Sample</td>
<td>91?</td>
<td>289</td>
<td>?</td>
<td>?</td>
<td>5373</td>
</tr>
</tbody>
</table>

*Tahanga working floor excavation T10/459 (Kronqvist 1991), from an area of four square metres and 25cm depth. Preform estimate derived from Roughing out experiments. 50 rejected broken preforms were also recovered from the excavation.

**Range per experiment:
- Fine trimming Range from 80gm for a Type 5 flake preform to 2040gm for a large Type 1 adze where shaping problems resulted in considerable reduction.
- Roughing Out range represents two processes - small number/weight of flakes due to an early transverse fracture during first 5 minutes of the experiment, and the very large heavy flakes produced from roughing out large core and cobble blanks for large Type 1 adzes. Preform reworking range reflects the same.

In keeping with their functional and manufacturing value, and the size of associated production zones, Nelson/Marlborough argillite adzes and Tahanga basalt adzes were also distributed over the widest areas. Tahanga basalt adzes were distributed in some number over distances of some 400kms and were found in almost all sites in the study area (Table 6.2). The consumer or contact zone for Nelson/Marlborough adzes was twice as large with considerable numbers reaching sites over distances of some 800kms or more. Nelson/Marlborough argillite adzes have been found in all early settlements throughout the country, even extending beyond to the Chatham Islands (Sutton 1982; personal observation). In contrast, minor sources were largely exploited to serve local needs. Motutapu greywacke adzes were not distributed in any great number beyond Tamaki and neighbouring regions.

In summary, for Tahanga basalt and Nelson/Marlborough argillite, the evidence discussed above supports that the demand and supply of adzes was of a level to require some sort of exchange network to facilitate their movement between producers and consumers. The people in the Tahanga basalt and Nelson/Marlborough production zones may reservedly be defined as ‘specialists’, but this may be primarily the consequence of the time-consuming nature of adze production. Concepts of mass and assembly line production are not appropriate in this case. Adze manufacture is best perceived as a well organised craft rather than a factory type industry. It would, therefore, be unwise to assume from this evidence that the exchange systems by which adzes from these production zones were distributed were equally ‘specialized’.

Distribution

The first matter to be addressed is the suitability of adze samples as ‘units of analysis’ to characterise the nature of interaction between settlements, and the identification of possible sources of bias.

1. Contemporary samples. For the purposes of studying patterns of distribution and interaction between early sites, the ideal would be to use only those adze assemblages from excavated sites that have acceptable and contemporary dates (Anderson 1991). But this would reduce the size of the sample to a critical degree, as well as introduce a bias toward broken and reworked pieces and, furthermore, as evidenced in Figure 5.11, remove large areas of the North Island completely. In most cases large adze samples from both dated and undated sites have been examined (for example, Mitimiti, Kaipara Heads, Manukau Heads, Te Horea, Tauranga Harbour, Porangahau) and share consistent early features. Also the range of raw materials from excavated dated sites is
generally consistent with the larger and more poorly provenanced area sample. The discussion above suggests that integrity and reliability will not be jeopardised by including a much wider sample.

Some adze samples are obviously not suitable for inclusion in a study of early period site interaction and exchange. This would include all the Hauraki samples, the samples from the Inner Kaipara, Manukau and Waitemata harbours, inland Waikato, Waitakere, West Coast Coromandel and the central North Island sample, all of which have high frequencies of reworked 2B adzes. Due to very uniform distributions of raw materials and adze states, the Aupouri central and Cape area samples can be combined, as can the samples from Ahuahu, Kuaotunu Peninsula, Mercury Bay and the rest of the east Coast Coromandel; plus Wanganui and Horowhenua. Thus 21 data sets remain that could feasibly be treated as discrete ‘units of analysis’ representing early settlements that were probably occupied at the same time (see Table 6.2).

2. The Effects of Curation. One of the major problems regarding the use of adzes as representative samples from early settlements is the problem of curation. The high level of reworking evident (Chapter Four) means that generally only adzes which had been accidentally lost and never recovered from storage, or those set aside as burial goods and heirlooms, entered the archaeological record in their original primary state. Reworking lengthened the use-life of early adzes to the extent that their use carried on into the late period and even into the early historic period. It is evident from the discussion above that reworked 2B adzes were not a feature of early settlement tool kits and thus should be excluded from any sample used to document interaction between early sites. But this may introduce a bias of another kind. Particularly for the Far North and Mid North on both the west and east coasts, but also in areas like the Eastern Bay of Plenty and East Cape, Nelson/Marlborough argillite adzes dominated among reworked 2B adzes, and among reworked adzes in general. The working properties of this stone probably surpassed all others with the exception of pounamu, and the superior flaking quality undoubtedly resulted in a higher reworking success rate. The generally greater length and thinner cross-sections of Nelson/Marlborough argillite adzes (see Chapter Four) would have also extended use-life and enhanced reworking success. The problem is, therefore, that if reworked 2B adzes and other reworked adzes are excluded then the sample could actually under-estimate the number of Nelson/Marlborough argillite adzes which were originally imported to areas like the Aupouri Peninsula (but by the same argument, over-estimate the number originally imported to the areas further south like the Bay of Islands). In any case the majority of early assemblages listed in
Table 6.2 have generally low reworked 2B adze frequencies and they are unlikely to alter the overall sample unduly.

While the higher levels of reworked Nelson/Marlborough argillite adzes in Northland could be interpreted as evidence that imported adzes were treated and discarded in a different way to local and closer sources, material quality appears to be the major influence. For example, among the Far North data, Tahanga basalt adzes were reworked with equal frequency but a larger number failed and this is a pattern repeated in the data for Northland basalt. There also appears to have been a higher reworking success with Motutapu greywacke adzes and this is probably due to the flakability of the stone (see Table 5.4). This does, however, result in differential discard patterns. Many more Nelson/Marlborough argillite adzes originally imported to the Aupouri Peninsula may have been taken away during the shift south and then later converted and preserved in the archaeological record (often on Pa) as reworked 2B adzes while more Tahanga basalt adzes were left behind in early middens as failed reworking attempts (see Table 5.4). In addition, if only adzes in early states are included, sample sizes would be reduced to a critical degree for some areas where early forms are artificially underrepresented (like the Northland east coast).

Another problem for comparative purposes is the bias introduced by large quantities of preforms in production zones (Hauraki Gulf, East Coast Coromandel). Their inclusion under-estimates the numbers of imported adzes. This can be remedied by including only samples of finished adzes (but including complete imported preforms where the flaking stage is finished as these were probably units of exchange).

In order to control for the wide variability in ‘adze states’ among adze samples the best solution may be, as stated above, to show a range (Table 5.3), and evaluate this according to the different sampling processes and settlement processes expressed.

3. Can a distinction be made between ceremonial and work adzes and can it be determined if they were treated differently in terms of production, distribution, consumption and discard? The matter of ceremonial adzes was discussed in Chapter Three and Four. From the evidence presented in those chapters, there appears to have been no special adze form reserved for ceremonial purposes in the early period. Even those most likely to fit the criteria, for example, the very large Patea and Grovetown adzes and several of the large notched argillite Type 2 adzes from Northland, had seen rigorous use resulting in bad blade damage, and in the Grovetown case, breakage and re-use. It is probable that the types of adzes most in demand to fulfil functional requirements were those most highly valued and also those most likely to be gifted on special ceremonial occasions. The value of a large Type 1 or Type 2 adze, for example, would relate
equally to considerable functional benefits, and the production costs and manufacturing skill invested and manifested. When the occasion for ceremonial presentations arose, such an adze would be the most appropriate to offer.

The context of ceremony is rarely identifiable in the New Zealand archaeological record, particularly for the early period. Death is one exception by virtue of the survivability of burial goods. It is difficult to discern the meaning behind these grave goods - were they the belongings of the dead person or offerings made by relatives? Do they signify the profession and status of the person? The best evidence by which to investigate these questions is the large adze sample found with the burials at Wairau. Adzes were recovered from 21 of 44 burials. The range of functional types found in individual burials showed no consistent correlation with the caches representing tool-kits. Furthermore, four female burials (Houghton 1977) contained adzes while two other burials with adzes had both male and female remains. A child burial also contained three adzes. Additionally, preforms were found with both male and female burials. While well made primary adzes and preforms were predominant among the burial adzes, for each individual burial a range in terms of state, functional type and aesthetic standards was evident including the wealthiest predominantly male burial area (Burials 1-7). Very large finely flaked Type 1 and Type 2 adzes were found alongside smaller rougher adzes and even several small expedient flake adzes. At Wairau, the burial goods appear to be offerings rather than the personal belongings of the deceased. Further information in support of this is provided by the five human burials found at Washpool, Palliser Bay. The finest and largest adze (Type 1) was found with a female burial while a male burial had a small reworked adze (Leach and Leach 1979b:205,208).

Regarding the presence of any ceremonial adze type found as burial goods at Wairau, none was detected. Type 2 adzes were the most common with nine graves containing large Type 2 adzes and eleven containing smaller 2A and 2C forms. Type 1 adzes were recovered from eight graves and Type 3 from six while Type 5 was represented by only one adze. Type 4 adzes were surprisingly rare, found in only five graves, and were the only type not found in any female burial. The fact that four of the burials containing Type 4 adzes were from the rich Burial 1-7 area led Anderson to suggest that this burial area belonged to an earlier period of occupation than the others, and was not simply the area where men of high rank were buried as Duff had previously asserted (Anderson 1989:125; Duff 1977:34). The idea, drawn from Simmon’s study of South Island adzes (1973), that Type 4 adzes were removed from tool-kits earlier than other forms appears to be without logic in light of the crucial role they played in wood-working. The evidence from excavated North Island assemblages does not support it either (for example, the Type 4 preform piece found in the upper layer at Pig Bay). No difference in technology or
standard could be detected among the adzes between different burial areas; those in Burial area 1-7 were distinguished only by the generally larger numbers included in individual burials. Only one female burial was found in the Burial 1-7 area but they were far more common in the other burial areas. While the absence of Type 4 adzes in female burials might just be incidental, it could also provide an alternative explanation for the differences between Burial 1-7 and the other burial areas.

In summary, while there was a bias toward well-formed primary preforms and adzes for burial offerings, there was no preference for any particular type. Burial goods may reflect the personal wealth of the person/s making the offering or the nature of their relationship with the dead person.

Nor is there any indication that a special exchange system for special or ceremonial adzes existed. There is some evidence that preferences existed for certain forms in certain materials but this was determined by local material availability and quality. For example, there is a clear pattern wherein minor sources were used locally for small Type 2 and sturdy Type 4 adzes while large Type 1 and 2 forms made of higher quality materials like Nelson/Marlborough argillite and Tahanga basalt were imported (Table 6.2).

A pattern wherein adzes became smaller over distance as a possible consequence of the use-then-pass-on method of exchange seen in the New Guinea highlands (Hughes 1977), or as a result of increased curation due to decreased availability (Hodder and Lane 1982:216) is not seen in the New Zealand data (see Chapter Three). Nor is there a pattern wherein clusters of large adzes are found in areas more distant from the source (Hodder 1978:164). The reason for this is clear. No matter where people were or how distant they were from an adze source, they needed large adzes like Type 1. Small adzes were made available through reworking, and local materials could often also suffice for their manufacture. Large adzes, in contrast, generally had to be imported from high quality sources. In New Zealand, furthermore, clusters of large adzes would not provide any significant insight into how adzes were distributed. Rather the preference for large adzes relates to functional requirements. The majority of adzes exported from production zones would have been over 200mm long primarily because these adzes were what consumers needed to meet wood-working requirements - there was no demand for small adzes. Size may not have been an important functional feature for axes in Neolithic Britain and the New Guinea Highlands, but in Polynesia this was not the case. Thus caution must be applied when using models like Hodder’s (1978) and drawing similar inferences based on size (as Lass (1994) attempted to do with Hawaiian adzes). As much as we need to be aware of the social context of exchange so do we need to consider more fundamental aspects like what the product was used for. Size also reflects
material quality (Chapter Three). Interestingly the five largest adzes (over 500mm) recorded in this research are all found within the Nelson/Marlborough production zone. One might imagine that the very large Horowhenua Type 2 adze would certainly make a spectacular and impressive gift in a ceremonial presentation, one hard to match in a future return exchange. Yet this adze may have stayed with the village in which it was originally made as if manufacturers reserved the best of what they made for themselves, or to present as (burial?) offerings to close kin. There is a possible implication that because they had direct access to the source and were producers they could afford to set aside more highly valuable adzes (Wairau Bar) than areas where they had to be imported.

Adzes over 500mm are exceptions, however, and very large (300-450mm long) Tahanga basalt and Nelson/Marlborough Type 1 and Type 2 adzes are found throughout their distribution zones (Table 6.2)

In conclusion, the distinction between ordinary work-adzes and ceremonial adzes is blurred. Large Type 1 and Type 2 adzes were of the highest value because of the skill and time required to make them and because they were essential for special wood working tasks like canoe-building. Because of this value they were likely to be the most appropriate for gifting in ceremonial presentations (death, bridewealth etc) but would also be the principle goal in ordinary exchanges.

**Mechanisms of Distribution**

As discussed above, there is no easy or straightforward means of identifying the context of exchange. Perishable goods may have been exchanged for adzes and thus leave no trace of the transaction in the archaeological record. Archaeologists therefore must seek answers from the durable materials that do survive. In New Zealand, stone tools and by-products assume this role. It is therefore important to examine closely the range of raw materials evident in sites and what this means. For example the range of different raw materials present at a site may indicate the number of outside contacts people had (Hodder and Lane 1982:214). Renfrew and Bahn suggest that ‘central places or ports of trade’ might be expected at the boundary between ‘supply’ (production) zones and contact zones (1991:325), not necessarily at the source itself. From the evidence of contact reflected by the range of imported materials it might be possible to determine whether exchanges between producers and consumers took place at all the villages within the production zone or whether there was a more formal arrangement wherein exchanges most commonly took place at sites on the boundary. It is possible that these sites were the focus and

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setting (venue) for large social gatherings and meetings where adzes changed hands among other social and economic exchanges and interactions, and where both producers within the region and groups from outside would congregate on particular occasions. It is likely that relationships with groups outside the production zone would be more formalized as those within the production zone were probably kin while those outside were not (for example, according to oral tradition, the people of the east coast Coromandel - Ngati Hei, and the original inhabitants of the Tauranga harbour - Ngati Marama, were related - Melvin 1960; Peter Johnston (Ngati Hei), pers.comm.).

The sites of Great Barrier Island and Tauranga Harbour, on the boundary of the Tahanga basalt production zone, demonstrate a wider range and increased frequency of imported adze materials compared with the other east coast Coromandel sites. Most notable is the sudden increase in the presence of Nelson/Marlborough argillite adzes (Table 5.4) and to a lesser extent, those of Motutapu greywacke. The increased presence of Motutapu greywacke is more apparent in the flake assemblage from Bowentown (see Appendix A) than among the adzes and suggests, curiously, that some flaking of Motutapu greywacke preforms even took place there (causing me to wonder whether the people at Tauranga, who were skilled in the flaking of Tahanga basalt, relished the opportunity to flake a more user-friendly stone).

Nelson/Marlborough argillite (with black Mt Ears argillite and Ohana argillite from D’Urville Island predominant) adze reworking flakes are also well represented. Among flake assemblages from east coast Coromandel sites, Motutapu greywacke and Nelson/Marlborough flakes are very rare. For example, of some 40,000 adze flakes from the Whitianga site, only eight are Motutapu greywacke and 63 are Nelson/Marlborough argillite. But in the Bowentown assemblage comprising some 12,000 adze flakes, 1391 Motutapu greywacke flakes and 749 Nelson/Marlborough argillite flakes are present. In both sites Tahanga basalt flakes, primarily from adze manufacture, make up the remainder. A Taranaki argillite adze and a few reworking flakes are also present in the Bowentown assemblage as well as several flakes (but no adzes) of a material identical to the distinctive veined Northland basalt. If a ‘central place’ existed from which many Tahanga basalt adzes were exchanged, then Tauranga Harbour certainly appears to fit the description. Regrettably the adze sample from Great Barrier is quite small, particularly for early forms, and thus may be more subject to bias. Nevertheless it is notable that among 19 primary finished adzes, seven (36.8%) are Nelson/Marlborough argillite compared to twelve (4.5%) of a total of 261 early forms from all the sites between Great Barrier and Tauranga Harbour. Additionally, both Great Barrier and Tauranga are geographically well placed for interaction with their neighbours to the north and south east coast respectively.
The evidence from the sites on the boundary of the Nelson/Marlborough argillite production zone is less clear due primarily to a dearth of data but Wairau Bar may have played a primary role as a place where interactions and exchanges with people to the south were made. While trying to bring together all the background information on the Waihi Beach/Bowentown settlement I was struck more than once by the impression that this settlement was the North Island equivalent of Wairau Bar in terms of evident wealth (for example: the large numbers of adzes and other artefacts removed from an area where many burials had been exposed by a collapsed bank, and the capacity of the site to satisfy the veracious appetites of a large number of fossickers over a long period of time). The range of stone sources at Wairau is also interesting. While Nelson/Marlborough adzes and flakes are dominant, there is a greater variety of other stone materials than seen at sites like Rotokura (Barber 1994), Tahunanui (Millar 1971) and The Glen (see Figure 5.10) (Walls 1979). Fifty-five adzes were made of basalt (8.8% of 619). From hand specimen they represent a number of different sources including Bank’s Peninsula, and nine may be Tahanga basalt. Adzes of Tahanga basalt have been found as far as Normanby near Timaru (Best 1975), thus their presence at Wairau may not be surprising. Apart from one complete hammerdressed Type 1 preform, all the basalt adzes were in a finished state and were not made at Wairau. But like the Nelson/Marlborough argillite and Motutapu greywacke adzes at Tauranga, the basalt adzes at Wairau were obviously not imported because they were needed. This is an important observation in that these adzes function more effectively as signals of contact, ‘calling cards’ signifying interactions with the people who may have travelled to Wairau and Tauranga because these settlements had what they required. They also indicate that exchanges were not only concerned with meeting material needs. If large villages like Tauranga and Wairau were important locations within the settlement and production system, then people from neighbouring villages may have been coming and going on a regular basis. When a visit from an outside group occurred, they were probably also involved in the ceremonies and exchanges that took place. Whether these sites should be defined as ‘ports of trade’ is questionable in that such a term may over-emphasize that one aspect of the interactions that occurred. As the ethnographic studies described above have stressed, material exchanges were also social exchanges, and gathering for a particular social event provided the opportunity and the context for such exchanges to occur. There would have been regular visits by those within production zones to the source also. For those outside the immediate area of Opito Bay, visits to make adzes at the quarry may have lasted a week or more and visitors probably stayed with their kin at Opito Bay for the duration.
While this evidence might suggest that sites on the boundary of production zones like Tauranga and Wairau were more often the venues for exchange than those within, it is less clear who precisely came to these sites or how the adzes reached people outside the production zones, i.e. whether people from areas near and far came directly to the production zone for exchange purposes or, for example, whether Motutapu greywacke and Nelson/Marlborough argillite adzes arrived at Tauranga via neighbour-to-neighbour exchange. The higher frequency of Nelson/Marlborough argillite adzes on Great Barrier Island and Motutapu greywacke adzes at Tauranga compared to the east coast Coromandel might be revealing in suggesting that there was long distance contact with these sites but not others.

An intriguing aspect of the Tahanga basalt production zone is that while most of the adzes were distributed to the north of the source, the majority of settlements involved in adze production are located to the south and much of the focus for initial distribution is centred at the Tauranga Harbour. The reason for this is likely to be strongly related to the opportunity to also obtain Mayor Island obsidian. People going to Tauranga could get not one but two valuable and essential items at once. This would have been a strong drawing card. It is likely, however, that just as the Tauranga people had direct access to the Tahanga quarry, the east coast Coromandel people probably had access rights to Mayor Island obsidian.

The next step is to consider how imported adzes moved through contact zones. From a glance at the fall-off curves for Nelson/Marlborough argillite and Tahanga basalt adzes (Figure 6.2), it is apparent from the ‘peaks and valleys’ that down-the-line exchange was not a major mechanism of distribution. But simply using distance from the source to discern distribution patterns may not be adequate for the New Zealand situation because it does not account for the direction of distribution or for the geographical features which were probably a major influence on the routes along which adzes and other materials travelled. It is therefore necessary to examine these features before considering possible distribution mechanisms.

1. Transportation and access

It is clear from Figure 5.11 that early settlements were primarily coastal and that all the major sources of adze rock and most of the obsidian sources were also coastal. A number of major sources were on offshore islands (D’Urville Island, Mayor Island). The ocean undoubtedly served as the main transportation route over which people, products, materials and information travelled in the early period. This allowed people to travel longer distances in much shorter times and with much less effort compared with overland travel. I disagree with Walter that
communication networks were predominantly inland via river systems and overland tracks from early times (1988:76). Walter’s conclusions were drawn from the ethnographic record which describes the communication networks in operation at the time of European arrival. Major changes in settlement and subsistence had occurred well before this time. As documented above, this involved shifts from predominantly coastal areas to more stable and empty inland areas. These changes were likely to have accompanied changes in how people moved around (including a decline in the use of ocean going double-hulled canoes) thus the ethnographic record is likely to be misleading. There are only two probable exceptions during the early period. One was a possible route through the central North Island area via major rivers like the Waikato that connected the west coast to the east. The other, probably of major importance, was the Tamaki portage, a strip of land no more than one kilometre wide, which connected the west and east coasts of the northern North Island. Walter also states that climatic conditions, particularly on the west coast, were too dangerous and unstable for sailing (1988:67,65). Considering the sailing skills required to manage the climatic conditions encountered on the journey from East Polynesia to New Zealand, I think it is fair to assume that the conditions met with in New Zealand were not an insurmountable challenge. According to Walter, wind was a major problem. Onshore winds are characteristic of the west coast and pose the greatest difficulties for sailors because they have to deal with higher swells and counteract ‘constant onshore drift’, whereas east coast winds are predominantly offshore which results in the opposite conditions, thus any coastal sea travel that did occur was likely to be limited to the east coast only (1988:74-75). Perhaps because the ethnographic record describes people going from village to village on their travels, Walter assumes that sailors hugged the coastline and did not stray too far out to sea. This may not have been the case in the early period. The people on the west coast could have avoided the problems of onshore winds by sailing further out to sea. In most cases along the New Zealand coastline, especially on the west coast, distances are increased considerably by sailing close to shore. This would depend on where you wanted to go, but for covering long distances between settlements and sources, it might be a significant variable. For example, it is unlikely that the south Taranaki people crawled along the coastline to reach D’Urville Island when they could cover the distance in half the time by going in a straight line (within sailing limits). The number and location of west coast settlements provides further evidence that climatic conditions were no impediment to coastal travel. Harbour mouth locations (for example, Hokianga, Kaipara, Manukau, Waikato) are also orientated toward ocean travel while providing conditions for sheltered anchorage.
2. Location of Adze sources

The two major sources, Nelson/Marlborough argillite and Tahanga basalt, take up complimentary positions in relationship to each other. They are distant enough from one another to suggest that the products of each may have been distributed through separate exchange networks. A notable feature is the centrality of the Nelson/Marlborough argillite sources which make them very accessible for people settled on the west and east coasts of both the north and south islands, and may be a contributory factor in the size of the production zone. D'Urville Island, in particular, is closer to the south west coast of the North Island than to most of South Island. While the Cook Strait is considered a major barrier for travel today, it was probably not perceived as such in the past (Belich 1996:40). Thus Nelson/Marlborough argillite was distributed in four directions - up the east and west coasts of the North island and down the west and east coasts of the South Island.

Tahanga hill at Opito Bay also occupies a central location on the northern east coast and adzes were distributed in three major directions; to the south and north along the east coast and up the north west coast, probably via the Tamaki portage. It is apparent that the distribution of Tahanga basalt adzes was offset on the south east coast by the Nelson/Marlborough argillite distribution network whose product was of superior quality. Similarly, it is likely that the distribution of Motutapu greywacke adzes would have been more extensive were it not for the close proximity of the superior Tahanga basalt source. The distribution of both to the north west coast was greatly facilitated by the Tamaki portage. Without this convenient route, the frequency of Tahanga basalt and Motutapu greywacke adzes on the west coast may have been considerably less. Again the distribution of both along the south west coast is constrained by the Nelson/Marlborough argillite network.

Very few settlements did not have a local source of adze quality rock (Kaipara Harbour and East Cape were about the only two areas without). Yet imported high quality adzes of Tahanga basalt and Nelson/Marlborough argillite dominate in all samples almost without exception (the one exception being the Motutapu production zone). The implication is that for most settlements importation of Tahanga basalt and Nelson/Marlborough argillite adzes was not strictly necessary but they could be acquired readily. There is some evidence to suggest that it was actually more cost-effective to import these adzes than to persist in trying to make them from inferior local materials. For example, in Tamaki the brittle hard nature of Motutapu
greywacke caused major problems in function and manufacture when it came to large Type 1 adzes. This problem was solved by importing Tahanga basalt and Nelson/Marlborough argillite Type 1 adzes instead. In other areas with a minor local source, this pattern is replicated. In Northland and Waikato, the local basalt was mainly used for the production of Type 2 and Type 4 adzes, as was the silicified limestone in southern Hawkes Bay and Wairarapa, whereas the majority of Type 1 and large Type 2 adzes in these regions were made of Nelson/Marlborough argillite and Tahanga basalt (Table 6.2).

3. **Location of non-adze stone sources.**

One other essential imported stone material, obsidian, has been found in varying quantities in almost every archaeological site throughout the country. It was probably the only other material that had a distribution range and demand similar to adzes. All of the obsidian came from sources in the northern half of the North Island (see Figure 6.1 for location of these – after Moore 1977), and in almost every site, Mayor Island obsidian is the most common source represented (Moore 1988; Seelenfreund and Bollong 1989:187). Seelenfreund and Bollong claim that the centrality of the source and its high quality explain the popularity of Mayor Island obsidian (1989:188). Other factors are accessibility and abundance. On Mayor Island, actual quarries where the stone was worked are rare or difficult to discern fromdebitage that may have been created by natural forces. This is not surprising as, unlike adze manufacture, little effort was required at the source. The aim would have been to remove large chunks or cores of obsidian and on Mayor Island this could be achieved in a short space of time. High quality obsidian could be found almost everywhere on the island, including large masses and boulders on a number of beaches (see Neve, Barker, Holroyd and Sheppard 1994:104, Figure 4). Large cores can be readily prised out or broken off an outcrop or boulder (personal observation), and judging from the amount of obsidian still in evidence on the island, there was no danger of depletion. Trips to Mayor Island from Tauranga and back (with a cargo of obsidian cores) could be made in a day. Other sources were generally not as abundant or accessible.

There are two important points to be made regarding the obsidian trade. One, as mentioned above, is that all the people south of the Bay of Plenty and Taupo had to maintain contacts with people in the north for supplies of obsidian, or contacts with people who did. The other point is that obsidian and adze exchange networks were likely to be tightly connected. Mayor
Island obsidian probably flowed along the same exchange routes as Tahanga basalt but was going further south on both coasts therefore moving in four directions. A fifth route may have been via the inland river systems of the central North Island in order to reach the west coast but in terms of distance, the route via the Tamaki portage is not much longer and may have been faster. The Taupo source was probably accessed via the Waikato River. This obsidian was difficult to source by XRF Spectroscopy at the time of Seelenfreund and Bollong’s study (1989). Since then, sourcing methods have improved (see Neve, Barker, Holroyd and Sheppard 1994) enabling a large core found at Ohana on D’Urville Island to be identified as coming from the Taupo source. This source also contained red obsidian. Red obsidian is found at only one other source and that is the Waimata stream inland of Waihi (Moore and Coster 1989) but red obsidian is very difficult to find there and only in small chunks compared with Taupo where it is still found in some abundance. While never common in sites, red obsidian is a consistent feature in south west coast site assemblages - from Waikato to Palliser Bay - but is rarely seen in east coast sites (for example, of some 5000 obsidian flakes from Bowentown, only one was red), and not at all in any of the assemblages I have examined from the north west coast (including Kaipara Heads, Hokianga and Matatuaulu). Mayor Island was not the only source available to the people of east coast Coromandel. From Great Barrier and at various places south of the Kuaotunu Peninsula, other sources of obsidian were found, but generally in the form of small nodules which were generally of an inferior quality compared to Mayor Island. Small quantities of Northland obsidian were also travelling over wide distances including to a number of South Island sites - Shag River Mouth and Waitaki River Mouth among them. Notably a small amount was also found at Harataonga on Great Barrier Island but has not been identified with any certainty from the east coast Coromandel sites (Seelenfreund and Bollong 1989:180,181).

Chert was another useful material. Sources are more evenly spread throughout the country (see Figure 6.1, after Moore 1977) thus may not have been distributed so widely. Chert flakes and tools found in sites are difficult to source because characterization studies have received little archaeological attention and because of the great variety in physical features (like colour and translucency) often within the same source (Moore 1977:51-52). The Waikato chert (not identified by Moore and a new record) is very distinctive and homogenous, however, and appears to have been the major source of chert utilized in south west coast sites, one of the few areas which had no local supply. A very small amount even made its way to Palliser Bay (personal observation). Best (1975,1977) has also sourced much of the chert found at Mt
Camel to the Kuaotunu Peninsula. These two examples appear to be the only known instances for the long distance distribution of chert (Davidson 1981:114).

Sandstone was another important stone material but appears to have been quite common throughout the country, though of variable quality (personal observation, replication experimentation). Nevertheless, the abrasive quality of sandstone with low quartz content could easily be improved by the addition of grit or sand.

Lime garnet hammerstones were also imported along with Nelson/Marlborough argillite adzes. Complete hammers and/or fragments are common in the Nelson/Marlborough argillite production zone but have also been found at Te Horea (Bird Collection) Southern Hawkes Bay and northern Wairarapa sites (Simcox Collection).

Serpentine from the Nelson/Marlborough area (often found in contact with the argillite) was also distributed widely in the form of pendants and reels (see Table 5.1 and Figure 6.1). Their distribution mirrors that of Nelson/Marlborough argillite adzes although the number of serpentine reels found in at least four different sites along the Coromandel east coast, as well as Tauranga, is interesting (and the two found at Oruarangi may originally have come from this area also).

From the evidence reviewed above it is apparent that some areas, particularly those in the northern half of the North Island, were virtually self-sufficient in stone materials. Northland had all four stone materials - adze-rock, chert, obsidian and sandstone, and Waikato had all but obsidian. Yet, as much, and usually more, of the stone material found at early sites in these areas is imported.

The east coast Coromandel/Tauranga Harbour area was probably the richest area in New Zealand in terms of the range, abundance and quality of the stone materials found there. Two were major exports. This means that visitors from the south might collect an adze of two of Tahanga basalt along with the main material they wanted - Mayor Island obsidian - and they may have left Nelson/Marlborough argillite adzes and serpentine ornaments behind in exchange. Visitors from the north may have been more interested in Tahanga basalt adzes but did not waste the opportunity to obtain some Mayor Island obsidian cores while doing so, particularly if they were well positioned to pass them along to their neighbours. For example, the people of Matatuahu, located at the entrance to the Tamaki portage, may have found it well worth their while to go directly to the Tahanga basalt production zone and obtain enough Tahanga basalt adzes and Mayor Island obsidian cores for themselves and to send to their
neighbours at Kaipara (Tahanga basalt adzes and Mayor Island obsidian) and Waikato (Mayor Island obsidian). From their Kaipara neighbours they may have received some of the high quality chert (generally superior to the Tamaki sources), and possibly in return for obsidian, via Waikato’s connections with the south west coast, they received items like the serpentine twin-lobed pendant. People from Northland and Tamaki may have brought a few samples of their own local materials and products with them because there was likely to have been an interest and curiosity regarding foreign materials. These materials appear to have played a minor role in exchanges beyond the local region, however, but the archaeological record yields almost no other information on what other products were involved. Regarding wealthy regions like the east coast Coromandel and Tauranga it is difficult to imagine what they would have needed in return. One possible other import was moa-bone for industrial purposes, but even this was likely to be a material that the Coromandel people supplied (i.e to the Hauraki Gulf) rather than received. Nevertheless, the principle of reciprocity, almost universal among traditional societies including Maori, would have given the Coromandel and Tauranga people considerable advantage in accruing mana or status, an aspect of exchange that may have been just as important as material benefits.

For settlements in regions with few or no valuable sources of stone, their geographical location or ‘centrality’ may have provided compensations and influenced their role in exchange systems. An example was given above - the location of the Matatuahu settlement at the entranceway of the Manukau Harbour through which the Tamaki portage and access to the east coast was gained. Palliser Bay may have been well-placed to articulate with producer/suppliers on the boundary of the Nelson/Marlborough argillite production zone and to send quantities of adzes further south up the east coast, receiving in return quantities of Mayor Island obsidian and some cores of Northland and Coromandel obsidian ‘passed on’ by the people of Tauranga. The obsidian would be much appreciated by people to the south, for example, the inhabitants of Wairau and those of the North Island south west coast. For the latter, Taupo obsidian was also available, and it is likely that through interaction with these people, the Palliser Bay inhabitants received the odd core or two and a sample of the Waikato chert.

The differences perceived above between Mt Camel on the east coast and the rest of the Aupouri peninsula may reflect different connections - Mt Camel to the east coast and Aupouri to the west coast. The frequencies of certain materials may reflect these ‘outside’ connections while the range of materials may reflect subsequent local exchanges and interactions. From
Table 6.2 it is evident that most sites had adzes from a variety of sources, and a similar range of obsidian.

Having identified some of the likely influences on exchange systems I now return to the adze data to see if some of these patterns are evident.

**Mechanisms of Exchange**

Figure 6.3 shows fall-off curves organised according to the direction and number of exchange routes.

**The Tahanga basalt exchange network** (see Figure 6.1).

The distribution of Tahanga basalt falls off rapidly to the south east coast due to the distribution of superior quality Nelson/Marlborough argillite adzes. Very few Tahanga basalt adzes are found beyond Gisborne which effectively marks the boundary of the Tahanga basalt contact zone to the south east. The people of east Bay of Plenty were probably going directly to their neighbours at Tauranga for adzes and Mayor Island obsidian. For most people on the south east coast, the primary interest would have been to obtain obsidian, thus without quantitative data on the frequency and amount of Mayor Island obsidian in these sites it is difficult to identify the mechanism by which it, along with a few Tahanga basalt adzes and a few samples of obsidian from other sources, were moved along this coast. If all were going directly to Tauranga for obsidian, we might expect more Tahanga basalt adzes to be collected as a consequence. Thus the people at Gisborne may have been responsible for articulating directly with the people of the Bay of Plenty - probably Tauranga, and then for redistribution of obsidian to their neighbours further south.

To the north east, the people of Tamaki and the Mid North probably obtained Tahanga basalt adzes and Mayor Island obsidian through contact with their neighbours on Great Barrier Island. Further north, the Mt Camel people were almost certainly making direct long distance journeys to the Tahanga basalt production zone, possibly even to the source area itself at Opito. Mt Camel may represent a rare and thus unique instance where these visitors were given access to the quarry. This implies a strong kinship relationship between the two areas which is not evident for those in between. The people of Mt Camel, thereafter, probably exchanged basalt adzes and Mayor Island obsidian with their neighbours in the Far North. The people of Manukau Heads
Figure 6.2: Fall-off Curves for Tahanga Basalt and Nelson/Marlborough Argillite based on Distance.
Figure 6.3: Fall-off Curves for Tahanga Basalt and Nelson/Marlborough Argillite based on Water-travel Distance.
probably also made direct journeys to the Tahanga basalt production zone, though probably not to the people at the quarry itself as they were receiving finished adzes and finely flaked preforms and were not involved in their manufacture. They may have made contact with the people at Great Barrier or possibly Tauranga. In order to travel to the Tahanga basalt production zone they had to pass through the Hauraki Gulf and it is unlikely that they did this without interacting with the people involved in Motutapu greywacke adze manufacture. The areas of Tamaki, Manukau, Hauraki Gulf and down the east coast Coromandel to Tauranga, appear to form the hub of an exchange network where products and materials were coming and going in a number of different directions. Within this area some groups appear to have had different roles. Some like those of the Hauraki Gulf and east coast Coromandel were primarily producers, while others were more actively involved in supply. The suppliers - Manukau Heads, Great Barrier and Tauranga - form a triangle enclosing the central exchange area and were probably responsible for controlling much of the exchange in major items like Tahanga basalt adzes and Mayor Island obsidian cores, while also disseminating other minor products within the area like Motutapu greywacke adzes, and imports from outside the area like Nelson/Marlborough argillite adzes and Northland obsidian. Great Barrier Island may have been the major link with the north east coast, Tauranga to the south east and Manukau Heads to the west coast. This is not to assume that these people (some of whom were also producers) performed the role of ‘middle-men’. For example a trip to Great Barrier or Tauranga organised by the people of Manukau Heads may have included representatives from their neighbours at Kaipara and en route they could have collected a few of their Waitemata and Hauraki Gulf neighbours as well. All may have had different objectives regarding the type and frequency of products they wanted, i.e. the Manukau Heads people may have needed to return with enough obsidian for themselves and for their neighbours to the south at Waikato, and enough Tahanga basalt adzes for themselves and for the Kaipara people if the latter did not accompany them (which would be one motivation to make a direct journey to the Tahanga basalt/Mayor Island suppliers, rather than be dependent on receiving enough of both through the trickle-down effect of down-the-line exchange). The people of Hauraki Gulf and Waitemata may have wanted only Type 1 Tahanga basalt adzes and Mayor Island obsidian. These collective journeys may have been punctuated by visits to exchange partners both en route to, and returning from, Tauranga/Coromandel during which outside products like Nelson/Marlborough argillite adzes were given, say, by the people of Manukau Heads to the people of Waitemata. Generally, however, the Manukau Heads people have weak links to the south west compared to the north west. The range and frequency of imported adze materials is very similar for Manukau Heads and Kaipara Heads, and both settlements have very high
frequencies of Mayor Island obsidian. But between Manukau Heads and the Waikato Harbour Mouth settlements there is a marked change in the range and frequency of adze materials. Tahanga basalt adzes dominate in the Manukau and Kaipara assemblages. In the Waikato assemblages, Tahanga basalt and Motutapu greywacke adzes are rare, Nelson/Marlborough argillite adzes dominate, and the local basalt was used quite extensively. Both the sites at Matatuahu and Te Horea have a wide range of materials represented:

**Matatuahu** - Tahanga basalt, Motutapu greywacke, Nelson/Marlborough argillite and serpentine, Taranaki argillite, Waikato basalt, Mayor Island obsidian and probably other sources, Kaipara, Waikato and Motutapu chert and probably a more local source. Signals (frequency of materials) are strong with the north east coast and relatively weak with the south east coast.

**Te Horea** - Nelson/Marlborough argillite, lime garnet and serpentine, Tahanga basalt, Motutapu greywacke, Waikato basalt, Taranaki argillite, Waikato chert, Mayor Island obsidian, Taupo obsidian and probably other sources. Strong signals with the south west coast and relatively weak to the north east coast.

These two areas, Waikato and Manukau, probably mark the boundaries of two separate exchange networks. The frequency of certain materials indicate where their closest and most frequent contacts lie but the range of materials suggests that these two areas played an important role in articulating between the two networks. It is likely that the demand for Mayor Island obsidian provided an important link between them.

The relationship between Kaipara and the Hokianga region also appears to be weak. The frequency of Tahanga basalt and Motutapu greywacke adzes drops sharply after Kaipara, again to be (surprisingly) replaced by Nelson/Marlborough argillite.

**The Nelson/Marlborough argillite exchange network** (see Figure 6.1).

Nelson/Marlborough argillite adzes dominate in large numbers in all of the southern North Island sites. The northern boundary is marked by Waikato on the west coast and East Cape on the east coast. The southern boundary of the Nelson/Marlborough argillite contact zone in the South Island is at the Waitaki River Mouth settlement. Like Mt Camel on the east coast, the Aupouri and Hokianga people on the west coast appear to be making direct long distance contact with those in the Nelson/Marlborough argillite production zone, possibly Taranaki which, in a direct
off-shore line, is only 500kms away. Visible links are rather weak between the two areas but at
least one Taranaki argillite adze has been recovered in the area from Mitimiti and a small amount
of Northland obsidian was identified from the site of Hingamotu, near Kaupokanui (Seelenfreund
and Bollong 1989:180-181). The observation that the Far North people do not appear to be
receiving either Tahanga basalt or Nelson/Marlborough argillite adzes through neighbour-to-
neighbour exchanges might suggest that they were too remote from the central hub of exchange.

The pattern on the North Island south east coast is most likely related to the demand for, and the
supply of, Mayor Island obsidian. It is not impossible that in return for Mayor Island obsidian,
Nelson/Marlborough argillite adzes were received. Thus an interesting situation existed where
two products of high value were going in opposite directions and over long distances and
complemented precisely the needs of the other. The main players in this exchange process are
difficult to discern primarily, as mentioned above, because data on obsidian distribution is
lacking, particularly along this coastline. But from Tauranga near the Mayor Island source to
Palliser Bay just outside the Nelson/Marlborough argillite production zone, a consistent fall-off
curve suggesting down-the-line exchange is evident (Figure 6.3). The Palliser Bay people may
not have been producing Nelson/Marlborough argillite adzes but they were well placed to have
regular contact with those that did and to act as suppliers of Nelson/Marlborough argillite adzes
to the east coast. If in return they received Mayor Island obsidian, some could be passed on to the
people of the South Island and south west coast in exchange for more adzes and so on. The wide
range of imported stone materials at Palliser Bay may reflect this role. They include
Nelson/Marlborough argillite (major), Silicified limestone, North Island and South Island east
coast chert (major), Waikato chert, Mayor Island (major), Northland and Taupo obsidian. This
range reflects both west and east coast contacts. Precisely which producers the Palliser Bay
people were articulating with is unclear – The Wairau people may have fulfilled this role but
probably also the south west coast and Wellington Harbour people. As discussed above, the
intensively reworked nature of the largely excavated sample from Palliser Bay is not suggestive
of a major exchange network role. This is a sampling bias, however, reflecting the midden
context from which much of the sample was drawn. Both primary adzes and well flaked large
Type 1 and Type 4 preforms are well represented in private collections (see, for example,
B.F.Leach 1979:78).

On the west coast, there are strong contacts between the Waikato and Taranaki people. The
Waikato people were probably sending Taupo obsidian and were definitely supplying the south
west coast with chert. Almost as many early Taranaki argillite adze forms have been found in
Waikato than Taranaki itself, and those found at Waikato sites are the only early forms known
outside Taranaki. In return the Waikato people were receiving an abundant supply of Nelson/Marlborough argillite adzes. A few may have been passed on to the people at Manukau Heads but as noted above, there is a sharp drop in adzes from this source beyond Waikato. It is interesting to note, however, that if Nelson/Marlborough argillite adzes were distributed via the Tamaki Portage, they would reach north east coast sites like Waitemata, Mid North and Great Barrier Island, over a much shorter distance than if sent straight up the south east coast via down-the-line exchange. If this was the case, however, we would expect the Manukau Heads people to have retained a higher number of these adzes (given their superior quality over Tahanga basalt and Motutapu greywacke) than is apparent in the existing assemblage. Instead Tahanga basalt adzes dominate in all states and functional types. Of note, though, is that the frequencies of Nelson/Marlborough argillite adzes in the aforementioned north east coast areas are relatively consistent with Manukau Heads. Furthermore, it is possible that people in areas like the Mid North and even Great Barrier could have received Nelson/Marlborough argillite adzes from three different directions - from Waikato via Manukau Heads and the Tamaki portage, from the Far North via secondary down-the-line exchanges, and from the south east coast via Tauranga/Mayor Island’s south east coast connections.

Conclusion

In summary, a southern exchange network and a northern exchange network can be identified. The southern exchange network involved the distribution of Nelson/Marlborough argillite adzes, Taupo obsidian and Waikato chert as the main products being supplied and circulated, in addition to minor ones like Waikato basalt, Taranaki argillite and silicified limestone adzes, lime garnet hammerstones and serpentine ornaments. The northern network involved the distribution of major products like Tahanga basalt adzes and Mayor Island obsidian cores in addition to minor products such as Motutapu greywacke adzes, and Northland, Great Barrier and Coromandel obsidian. Major products and materials tended to be traded beyond the network while minor products and materials were circulated mainly within the network. Possibly because the Far North people were so remote from both they made direct long distance journeys to these areas. Given that people were relatively self-sufficient in stone materials, the impetus to be involved may have been stimulated by social as much as material interests. The exchange of major products and materials, especially Mayor Island obsidian and Nelson/Marlborough argillite
adzes, served to connect the two networks and the people on the boundaries were most likely to have functioned as suppliers. Exchanges between networks tended to target particular resources like Mayor Island obsidian (thus explaining the lack of Tahanga basalt at Palliser Bay, for example). Within networks a range of ‘rival products’ were more likely to be seen (Motutapu greywacke adzes in the Tahanga basalt production zone, for example).

No one particular mechanism for distribution appears to have been in operation. The way people acquired adzes and other essential materials like obsidian, and the role they played, depended a great deal on where they were located relative to sources and other settlements. Systems of exchange were probably organised to the extent that, in the case of the Manukau Heads, Waitemata and Hauraki Gulf people, it might have been more efficient to go collectively to Coromandel/Tauranga to acquire adzes and obsidian than to go individually. Alternatively or additionally, groups may have taken turns to collect materials on the others behalf - in effect, taking turns to play the role of ‘middle-man’. People on the south east coast may have organised themselves in a similar way on journeys to acquire obsidian.

People in certain areas may have been receiving the same products and materials from different directions, particularly in the northern half of the North Island, thus they were not dependent on one particular source or group. The people in the southern half of the North Island had less choice as to where and who they obtained their obsidian from but had a major advantage in having access to the highest quality adze material - Nelson/Marlborough argillite, and the opportunity to acquire adzes of this material, particularly large Type 1 and 2 adzes, was obviously appreciated by the people further north.

In conclusion, this study can only suggest some of the ways by which people communicated and who they had close relationships with. It also inevitably over-emphasises the role of stone tools in defining the nature of the exchange and communication networks which may have once existed. It must be said, however, that few other products and materials in early New Zealand prehistory were so essential, valuable and above all, unavailable to many people and their settlements. Thus while many other products and materials were undoubtedly involved in exchange systems, stone materials and products may have been a guiding force in determining the direction and nature of exchange. Understanding of these networks, therefore, would be aided by further studies, especially concerning the distribution of obsidian.
CHAPTER SEVEN: CONCLUSION

The major aim of this thesis was to gain information concerning the function design and distribution of New Zealand adzes. Methodology included functional and manufacturing replication experiments with skilled adze maker and user Dante Bonica, and extensive data analysis of almost 12,000 archaeological adze specimens now housed in museums and private collections throughout the country. Methodology was guided by technological organization theory and a model defining this was presented in Chapter Two. The basic premise of this theory states that technological strategies reflect human behaviours, particularly interaction with the environment. Artefacts like adzes are physical manifestations of the strategies employed by people to overcome problems posed by environmental and resource conditions. The design of the tool, the tasks it was designed to perform, the raw materials and techniques required to make it as well as its condition or state and context at the time of entry into the archaeological record are therefore all considered important aspects of artefact study. The value of applying this theory is that new ways of studying artefacts like adzes are made available with the potential of producing new insights and knowledge that goes beyond description to actual explanation of the choices made. This thesis aimed to demonstrate how this could be done.

In New Zealand archaeology, adzes and related stone by-products and manufacturing tools are important by merit of their durability, abundance and importance in wood working – a major medium and occupation for Maori in prehistory. Ethnographic and archaeological knowledge has, however, remained uneven and patchy. Archaeological studies first concentrated on formal typologies which described the various adze forms found but failed to identify the influences on form (Duff 1950; Skinner 1974). Later technological studies concerned with manufacturing techniques and raw material sources and quality emerged to provide some explanations for what may have been major influences on adze form or ‘type’. Most of these studies overlooked or undermined what may have been the major principle guiding adze design – function – the reason why the adze came into existence in the first place. Undoubtedly this was related to the difficulty in accessing this type of information. As proved to be the case in the research undertaken for my M.A research (1992), replication
experimentation provided a valuable source of information to solve this problem. Although
not all conditions could be reconstructed in the manufacture of a *kumete* (outlined in Chapter
Three), enough valuable information was obtained to enable new methods of analysis to be
applied in the examination of the large archaeological adze sample. This included identifying
the significant design attributes of an adze and the importance of recognising the state of an
adze when it entered the archaeological record. Variability in adze morphology was
discovered to be the outcome of ongoing technological adjustments to a range of conditions
that were constrained by a set of functionally defined parameters. Both manufacturing and
functional information were drawn together to define the functional parameters and
technological adjustments and how these were modified or constrained by environmental
conditions like the range, abundance and quality of raw materials.

Chapter Two outlined and reviewed the information regarding adzes and adze studies to date
and summarized the nature of the raw materials and manufacturing techniques used drawing
heavily on replication experimentation results. Strategies employed at adze quarries were also
outlined. Design attributes were discussed in detail. These are blade edge or bevel angle, blade
curvature and width, the size and general dimensions of the adze, symmetry, cross-section
shape and the manner by which the adze was hafted.

Chapter Three presented the description of functional tests combined with detailed data
analysis of archaeological adze specimens. Experimental results demonstrated that there were
distinct combinations of design attributes that consistently formed four basic functional adze
types:

A. **Timber Dressing Adzes**: These adzes were consistently used with a low angle of attack
and moderate to gentle force. They had a low bevel angle combined with a thin cross-section
and a wide blade relative to length. Adzes designed for dressing flat or straight surfaces had
relatively straight blades. Adzes designed for trimming and shaping curved surfaces had
curved blades and convex fronts. The former adzes correspond to Duff’s Type 2 category thus
this description ‘Type 2’ has been retained. Similarly Duff’s Type 3 category has been
retained for the latter curved blade adzes.

B. **Wood Splitting and Chopping Adzes**: These are large wide-bladed heavy thick-
sectioned adzes used with a high angle of attack and designed to withstand use with
considerable force. The thick cross-section relative to length and the high bevel angle
provides the adze with the necessary strength to withstand being used at a high angle of attack
and with maximum force. These adzes are defined as ‘Type 1’ corresponding loosely to Duff’s original description of these adze types.

C. Gouges and chisels for making deep narrow incisions, scarfs and grooves: These adzes have narrow blades with high bevel angles and are very thick relative to width. For heavy roughing out work these adzes are large and heavy and correspond to Duff’s Type 4 category. They are used at a very high angle of attack and with maximum force. For more refined and precise work, sometimes in confined spaces, these adzes are lighter, narrower and smaller with size varying according to the nature of the task. With some adjustments, these adzes correspond to Duff’s Type 6.

D. Side-cutting adzes for trimming in confined spaces: These are side-hafted adzes with an asymmetrical bevel and a generally very wide curved blade for maximum wood removal.

All archaeological specimens examined for this thesis were able to be categorized according to this functional typology and statistical data demonstrated a high level of consistency. With some modification (as indicated above) but for ease of description, Duff’s original adze types have been retained to briefly describe the functional types recognised in this research. But functional experiments highlighted those attributes that were significant and those that were not in terms of function. In Duff’s typology and others since, there has been a preoccupation with cross-section shape and presence or absence of a tang in adze type definition. These attributes did not, in our experiments, prove to be functionally significant in identifying different adze types though both played a general role in maximizing design ideals. For example, a definite trend was observed wherein the larger and heavier an adze was the more likely it was to have butt modification to assist stable hafting. But raw material quality and the nature of manufacturing tools were also influential on the presence/absence of tanging. For example, Southland adzes were more likely to have butt modification and more elaborate and well-defined butt modification by merit of there being a very effective hammer-dressing material (hydrogrossular garnet) available to create these, and tough adze materials that could withstand vigorous hammerdressing. A similar situation exists with cross-section shape. A four-sided adze gives stability and balance in terms of weight distribution to wide bladed adzes designed for adzing flat surfaces, especially large heavy adzes. So both timber dressing and chopping adzes are likely to have this cross-section shape. But a major functional thus significant difference is not so much the shape but the thickness relative to length and blade
width. Thus timber-dressing adzes are generally rectangular while chopping adzes are quadrangular. Again raw material quality and manufacturing tools and techniques (technological adjustments) can result in much cross-section variability. For example hammerdressing produces more rounded contours than flaking so where hammerdressing is the major method of manufacture, cross-sections might be oval in shape rather than quadrangular. This is a subject that needs further study with particular regard to adzes from other Polynesian island groups where adzes exhibit a generally narrow cross-section shape range (Hawaii, for example) and in late period New Zealand where four-sided adze cross-sections prevail.

Bevel angle was discovered to be extremely important in determining how an adze could be used. Adzes with low-angled bevels are too delicate to use with a lot of force and with a high angle of attack; they are designed for a true low angled adzing stroke. In keeping with this function, archaeological specimens were consistently matched to thin cross-sections. In contrast adzes with high bevel angles are best suited to a chopping action and archaeological specimens always exhibited thick cross-sections.

Chapter Three also demonstrated that, within functional parameters, raw material quality (not only of adze materials but also manufacturing tools) explains variability in adze size, form and finish and is a major influence on the methods employed in their manufacture. With the highest quality materials like D’Urville Island argillite, design ideals could be realised. A composite hafted 2B adze, a Southland 1D adze and a Tahanga basalt 1A adze are all functionally indistinct; that is they are all designed to remove excess wood and are all heavy high bevelled tools. Differences in their morphology as detected by typologists like Duff are design solutions to different raw material problems.

Variability in adze form and finish is a notable feature of New Zealand adzes, both over time and through space. Much of this variability can be correlated to the wide range of raw materials available both for adzes and for making them in this country. Experimentation with new rock types also inspired the development of new techniques or, more commonly, more extensive use of some techniques. Hammerdressing, for example, became the most prominent technique for manufacturing adzes in Southland from early times. This choice not only reflects the rather poor flaking but tough quality of most local materials but more importantly the availability of an extremely efficient hammerdressing stone (hydrogrossular garnet). From this experimentation, it would have become evident that hammerdressing was actually a faster more economic method with softer materials and certainly a safer method of shaping adzes. The hammerdressing technology also allowed the use of previously under-utilized materials
such as coarse-grained rocks which were far more readily available and abundant in the environment. Some limitations of the technique, such as greater shaping restraints, prompted further design adjustments, for example, transferring the hafting device to the wooden component of the adze. The latter example is an illustration of another problem adze typologists have confronted when attempting to explain adze typology and correlate different ‘types’ to different functions. For some Polynesian Island groups, adze morphology reflects a very limited variability while others changed over time from one of considerable to limited variability. Again, as explained above, this problem was generally the outcome of looking at the wrong attributes like cross-section shape and presence/absence of a tang, instead of functionally specific attributes like bevel angle. But also we have generally overlooked the probability that some attribute variables like size, weight and butt modification could be present on the stone portion or the wooden piece (the haft which only rarely endures in the archaeological record). Taking these factors into account, future adze studies in other island groups and for the latter period of New Zealand prehistory may reveal a functional variability that is consistent throughout.

Such studies will also be valuable in testing further the influence of raw material quality as the primary factor in explaining adze morphology within functional parameters and that certain styles and trends, if they existed, were not random, unconnected features.

Understanding the constraints functional requirements placed on adze design also provided information on the nature of their value. Their high status is demonstrated by their frequent presence as grave goods and by the extensive reworking and curation they received throughout their use-life. This was particularly the case for the early period adzes and primarily relates to the very high costs involved in their manufacture. Indeed these costs were so high that reworking of both preforms and adzes was an integral part of the technological organisation of adzes. Design features such as length, blade width and symmetry enhanced durability and use-life and maximized reworking options when the adze broke or became badly damaged. Experimentation in the reworking of adzes may have also enhanced innovations that would later be incorporated into primary adze design like solving hafting problems on very truncated broken adze portions.

Clues as to why rival products are often found in areas with their own source of stone were also revealed by the data examined for this thesis. Some materials were just not tough or workable enough for some functional adze types. For example, Motutapu greywacke was not tough enough for Type 1 adzes so these were usually made of tougher materials like Tahanga basalt or Nelson/Marlborough argillite. For some functions, toughness was not quite so
important; for example, timber dressing adzes, thus most local materials could be used for this type of adze. With one type of adze particularly – Type 4, toughness is imparted by the design so again, constraints on material quality were lower for this type that for others like Type 1.

Functional studies such as this emphasize rightly the fundamental role of the adze as a tool designed for use, and, in the New Zealand case at least, even the largest most spectacular specimens represented design ideals and most had seen use that went beyond ritual or ceremonial application. For example, functional experiments demonstrated the importance of symmetry especially for large adzes.

Chapter Four investigated the use-life of adzes. The intensive use that the majority of archaeological specimens had experienced highlighted another major problem with existing adze typologies like that of Duff’s – that constant use, repair and reworking means that only a small sample of adzes are representative of original designs or ‘types’. Chapter Four demonstrated that the majority of adzes had had long use-lives and had seen enormous morphological change as a consequence of use. For many, the process of use, repair and reworking had totally obscured the original shape and form of the adze. Significantly, function would have changed dramatically as the adze progressed through the use-life trajectory. Thus, in any study of adzes, the state of an adze when it entered the archaeological record should not be overlooked, especially as reworking and repair strategies introduced other major causes of variability in adze form and ‘type’. Because none of the adzes broke during functional experiments, despite enormous stresses being placed upon them at times, the causes of breakage and bad damage were difficult to identify as was the length of time an adze could be used before it broke. Experiments certainly suggested that adzes could be subjected to great force over long periods of time if handled correctly. The motivation to handle them well and store them carefully was likely given their high manufacturing costs. That the majority of adzes examined had seen intensive use and breakage shows that eventually breakage did occur and that it may have been as unpredictable as breakage during manufacture – possibly the culmination of many minute fractures and stresses over time.

Five states were identified together with a category where state could not be identified generally because these were small fragments of broken adzes. The five identifiable categories were: ‘primary’ adzes that had seen little or no use and thus represented original designs, ‘repaired’ adzes, ‘modified’ adzes where changes in form and sometimes function were occurring, and two stages describing adzes that had suffered breakage – ‘reworked attempt’ which did not result in a successful outcome in terms of a useable adze, and
‘reworked’ which did. Again the original design of the adze and the raw material it was made of influenced repair and reworking strategies. The more flakeable materials like Nelson/Marlborough argillite resulted in higher reworking success rates than poorer quality flaking materials like Tahanga basalt. Type 5 adzes rapidly lost their original shape and function after a number of episodes of repair and modification and this may partially explain their rarity in the archaeological record.

Furthermore, some adze ‘types’ like Duff’s 1B and 2B may have originated as reworked forms. Lateral butt reduction, the main characteristic of 1B adzes, was an ideal way of providing hafting security to dramatically shortened pieces especially for adzes with thin cross-sections. The form does not appear to be a primary one during the early prehistoric period.

Surprisingly, the reworked 2B form proved to be the most common form recorded among the major stone materials used during the early period in the North Island – Tahanga basalt, Motutapu greywacke and particularly Nelson/Marlborough argillite. It was this form that suggested that reworking technology also changed over time, involving more intensive reworking strategies and employing safer less wasteful techniques like hammerdressing. None of these distinctive reworked forms have been found in early contexts or sites but are commonly recovered from parts of both prehistoric and proto-historic age. These adzes provide further evidence for the longevity, intensive curation and value of adzes. There is dating information to suggest that quarries like Tahanga and Mt Ears on D’Urville Island had ceased operation around 1500 A.D, yet the much reworked products from these quarries appear to have still been in use several hundred years later.

The technological changes reflected in these reworked forms mirror the technology of later adze forms and it is difficult to identify whether the reworked 2B form or the primary form came into existence first. It is likely that technological adjustments and experimentation during reworking resulted in new ways of solving functional problems, for example, transferring weight and length from the stone piece to the wooden haft.

New insights into the nature of reworking and the interaction of raw materials and manufacturing techniques provide some means of explaining changes over time in adze technology. There may not have been one major impetus for change and it may not have been sudden. Certainly replication experiments have shown that the hammerdressing and grinding of coarse-grained tough rocks was markedly easier, quicker and safer than the flaking, hammerdressing and grinding of tough fine-grained rocks. Coarse-grained rocks were additionally common and could generally be acquired locally and in water-rolled forms that
were suitable sizes and forms. But the later technology was not as flexible as the earlier one –
it imposed constraints on shape and size. This is where lessons learnt during reworking would
have been valuable. It is more probable that the form of later adzes reflects technological
adjustments rather than functional changes, and again this reflects the major influence of raw
materials used. It is likely that future research will expose similar variability in later adze
forms in terms of the functional attributes identified for the early forms in this thesis.
Change may have been a matter of choice rather than one enforced by circumstances.
Increasing political unrest and depletion in the abundance of high quality materials at quarries
were but two contributing factors that may have increased manufacture and distribution costs
to a critical degree but they were probably anticipated and solutions were at hand.
Having defined the principles that influence adze morphology, it was then possible to address
the nature of the contexts in which adzes were found and to apply another principle of
technological organization theory – to use adzes as ‘analytical units of comparison’ (Nelson
1991:86). In New Zealand little is known about how imported materials and products were
distributed. As units of comparison, ones that are highly valued and leave complex records of
their manufacturing and use-life processes in the archaeological record, adzes have the
potential to provide information on site function and interaction. This was the topic of
Chapter Five and Six.

A model for defining the distribution of early North Island adzes was introduced in Chapter
Five describing the importance of defining the context in which adzes are found, and for
identifying production and distribution strategies. Chapter Five then focused on the first issue
of context while Chapter Six dealt with the latter two issues.

The first aim of Chapter Five was to determine the location, chronology and function of the
sites from which the adze assemblages, used in Chapter Six to investigate trade and exchange
mechanisms, were derived. This was undertaken in some detail as the status and function of
early settlements in terms of their sedentary nature was still unclear. Some early sites like
Waitaki River Mouth and Mt Camel are still considered by some scholars to be temporary
camps rather than permanent villages (Anderson 1989; Shawcross 1972). The degree to which
a culture is highly mobile or sedentary can play a major role in how they acquire raw materials
and products. For example, highly mobile groups can incorporate the gathering of raw
materials from various places in their seasonal round thus acquiring them via trade and
exchange mechanisms is not always necessary. Adzes, however, by their curated nature and
by recognising the implications of their state, proved valuable in helping establish the
permanent nature of early settlements in New Zealand and where these were located. Chronological information was collated to identify key settlements or settlement locations where reliable and sizable adze assemblages were available. Chapter Five also established the reliability of the adze samples that would be used to define distribution patterns.

Chapter Six provided a review of trade and exchange studies, both ethnographic and archaeological. Aspects of production and distribution for the New Zealand situation were then discussed. Production strategies were seen to have been a major influence on distribution strategies. For example, important aspects of production concerned identifying the location of the stone sources or quarries; who had access to them, who actually made the adzes, and whether supply and demand was sufficient to warrant complex production and distribution or exchange systems. It was established from distribution patterns of adze manufacturing debitage that only local people had access to valuable sources of stone and actually made the adzes, thus distinct production zones were able to be recognized. Complex organisational strategies were in place that suggested manufacture required careful management in order to meet demand, a demand that went beyond serving local needs in several cases. For the North Island two complex production and distribution systems or networks were identified on the basis of the abundance of adzes found outside production zones, the number of places where adzes from these sources were found and the distances travelled from the place or zone of production. These networks were the Tahanga basalt adze network centred on the northern half of the North Island and the Nelson/Marlborough adze network which was focused on the southern half of the North Island. Both networks involved the distribution of other major and minor materials. Major materials and products tended to be traded beyond the network while minor products and materials were circulated mainly within the network. For example the distribution of Tahanga basalt was probably closely connected with the distribution of Coromandel and particularly Mayor Island obsidian. People could acquire two major superior quality products at the same location or from the same supplier. Other materials distributed and/or produced by the northern exchange network were Motutapu greywacke adzes and Northland obsidian. The Southern exchange network included the distribution of Taupo obsidian, hydogrossular garnet hammerstones and Waikato chert. Exchanges between the two networks appear to have involved particular products of major importance and high quality like Mayor Island obsidian and Nelson/Marlborough argillite adzes, and in this respect the two networks were geographically and geologically complimentary to one another.

No one particular mechanism of distribution appears to have been in operation. Influential factors included where people and raw materials sources were in relation to one another and
the mode of transportation. In New Zealand almost all early settlements and the majority of valuable raw materials (including all the major sources) were coastal thus ocean and occasional river transportation greatly facilitated the distribution of materials and products. Furthermore, due to the existence of geographical phenomena like the Tamaki portage which linked the west and east coasts of the northern North Island, people could receive products from different directions thus lessening their dependence on one particular source or group. The location of settlements relative to sources was important in influencing the roles people played in distribution as well as production. For example, those on the periphery of the production zone may have been initial suppliers, while those on the periphery of the major exchange networks may have more commonly served a ‘middle-man’ role. Some settlements, for example, those of the Far North, may have been too remotely placed for reliable down-the-line exchange and so may have made direct long-distance journeys to source areas like the east coast Coromandel.

Because these networks involved the distribution of a range of products and materials, and because this study has only looked in detail at the distribution patterns of one, adzes, a fuller understanding of the nature of trade and exchange in early New Zealand prehistory could be gained by similar studies of other durable materials in the archaeological record. The distribution pattern of Mayor Island obsidian, for example, rivals that of Nelson/Marlborough argillite adzes, both of which were distributed throughout the country. Interaction and exchange patterns for the South Island and between the North and South Islands remain to be identified also.

In the final analysis, this thesis has demonstrated how a range of information can be derived from one artefact type, especially when methods of research such as replication experimentation are employed, that is, attempting to understand items of material culture from the perspective of the people who made and used them. It is hoped that others will be inspired to apply similar methods of study to other artefact types both here and further afield.
Appendix A: Flake Assemblages referred to in this Thesis

<table>
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<th>Site</th>
<th>Stone*</th>
<th>N =</th>
<th>Adze Manufacture %</th>
<th>% Preform Reworking</th>
<th>% Adze Reworking</th>
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* See Chapter 2 for Stone abbreviations
# Local rocks include basalt and argillaceous rocks

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Appendix A continued: Comparison of Motutapu Greywacke Flake Assemblages. %

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Appendix B: Location of Adzes examined for this Thesis

Total examined = 11,886: 9711 from the North Island, 2175 from the South Island.

Museum Collections

1. Auckland Institute and Museum (AKM). N = 3861 (includes 15 from the South Island). Major individual collections include Brambley (Matatuhui and South Mamakau Head, Tamaki), Mizzen (Ahuahu), Avery, Hammond, Bell, Hovell (Hauraki Plains and Coromandel) and the majority of adzes found in the Tamaki and Coromandel regions and from excavations undertaken in these regions.

2. Te Amorangi Trust Museum, Rotorua (ATM). N = 2 from Rotoiti.


5. Far North Regional Museum, Kaitaia (FRM). N = 127. Collections include the Gleave Collection from west coast Aupouri Peninsula.


7. Golden Bay Museum, Takaka (GDM). N = 18 (including four from Bay of Plenty, North Island Pa). Collections include the Richards Cache from Big River.


10. Mercury Bay District Museum, Whitianga (MBM). N = 71. All are local to Mercury Bay except one adze from Tairua.


12. Museum of New Zealand/Te Papa, Wellington (MONZ). N = 1344 (1294 from the North Island and 50 from the South Island). Includes adzes from the Paremata, Paekakariki and Palliser Bay excavations, Golson’s Pig Bay and Sarah’s Gully excavations. Plus Bollons Collection, Mair Collection from Katikati, Adkin, Beckett, Christie and others collections from Horowhenua and Wellington Harbour sites. 16 adzes from Wairau Bar surface collections.


20. Porirua Museum (POM). N = 100. Includes the Tovey Collection from Mana Island and local west coast.

21. Paeroa and District Museum (PRM). N = 84. Mainly the Ted Duffy Collection from East Coast Coromandel sites and Waikato Coastal sites (especially Taharoa).


24. Te Awamutu District Museum (TAM). N = 1. Majority have no provenance.

25. Thames Historical Museum (THM). N = 43. Mainly local collections and Waihi Beach.

26. Thames School of Mines (TSM). N = 282. Mainly from East and West Coast Coromandel sites found by local collectors including Hammond and Claxton.


28. Taupo Museum of Art and History (TPM). N = 3 including a lugged Type 1 adze from Stewart Island.


33. Wanganui Regional Museum (WNM). N = 154 including one adze from Temuka, South Island. Mainly local collections.

34. Whakatane Museum and Gallery (WTM). N = 349. Includes the Fletcher collection from Pilot Bay, Mt Manganui, and recent excavation material from Tokitoki, Okiwa Harbour.

Total adzes from Museums = 10,061.

Other Museums visited but no adzes recorded: Waihi Arts Centre and Museum, Cambridge Museum, Kawhia Regional Museum Gallery, Opotiki Museum.

Private Collections and other Repositories

1. Auckland University Anthropology Department (AU). N = 881. Includes assemblages from recent excavations such as R10/497 Administration Bay, Motutapu Island and T10/940 Opito Bay. 41 from the South Island including four adzes from Wairau Bar. These collections will probably be placed with the Auckland Institute and Museum eventually.

2. Bird Collection, Te Horea, Raglan (KBC). N = 194. Surface collection from deflated sand dune sites at Whaingaroa North Head.
3. **Booth Collection, Kerikeri (BHC).** N = 75. Surface Collections from Far North east and west coast sites including Mitimiti, Bay of Islands and Whangaroa Harbour.


5. **Grace Collection, South Kaipara Head (GC).** N = 121. Surface collection from site Q09/529.

6. **Harsant Collection, Cooks Beach (HHC).** N = 67. Collection mainly from Hahei but includes other east coast Coromandel sites.

7. **Hamilton Collection, Whitianga (JHC).** N = 12. From Whitianga sites.

8. **Klaricich Collection, Hokianga (KLC).** N = 20. Surface collections from sand dune sites from North and South Hokianga Heads including the Long Point Midden Collection.

9. **Murdoch Collection, Hikutaia (MDC).** N = 190. Collections mainly from Hauraki sites including Oruarangi and Koputarahi but also include adzes from Gisborne and Coromandel areas.


11. **Port Fitzroy Department of Conservation, Great Barrier Island (PFDOC).** N = 45. Collections from different sites on the island including Harataonga.

12. **Sunde Collection, Auckland (SDC).** N = 20. From Mitimiti and various Aupouri Peninsula sites.

13. **Waller Collection, South Kaipara Heads (WC).** N = 20. From site Q09/529.

14. **Miscellaneous Private Collections and Records (PC).** N = 159 includes 43 South Island adzes.

**Total Private Collections and Other Repositories** = 1825.
Appendix C: List of Known New Zealand Side-Hafted Adzes

** Drawing/Photograph seen only
# New Record – not previously published.
b = Broken
L/B/L/W/P/W/TH = Length/blade width/poll width/thickness in mm.
5AR = right sided
5AL = left-sided
For Stone abbreviations – see Chapter 2
For State abbreviations – see Chapter 4
For Repository abbreviations – see Appendix B

Order of Information:
Type/Provenance/Stone/State/Measurements/Repository/Catalogue Number

North Island Records

1. 5AR Tom Bowling Bay TB MOD 146/60/30/34. Booth Collection.
2. 5AR Scott Point, Far North TB REP 171/59/35/39. FNM Gleave Collection.
3. 5AR Bluff, Aupouri Pen TB PA 220/90/50/49. NRM SF187/41.
4. 5AL Bluff, Aupouri Pen TB REP 175/77/50/37. NRM SF187/42.
5. 5AR Henderson Bay, Aupouri TB REP 143/64/30/32. FNM. Hensley Coll.#
6. 5AR Long Point, Hokianga TB RWA 50/41/39/25. Klaricich Collection. #
7. 5AL Purereua, Bay of Islands NMA? REP 190/85/47/?. Paterson Collection.**
8. 5AL South Kaipara Heads MGW RWA 80/48/42/38. Grace Collection. #
9. 5AR Kaipara TB PA 176/77/59/33. AKM 37959.#
10. 5AR Matatuahu, Manukau TB 207/74/52/36. AKM AR6918 Brambley Coll.
11. 5AR Matatuaulu, Manukau MGW PF 251/93/45/40. AKM AR6941 Bramley Coll.
12. 5AR Matatuaulu, Manukau MGW PF 185/88/32/34. AKM AR6922 Bramley Coll.
13. 5AR Parau, Manukau TB REP 160/62/32/33. AKM 47249.
14. 5AR Waiheke Is, Tamaki MGW REP 143/61/50/34. AKM 49852.#
15. 5AR Emu Bay, Motutapu Is. MGW RPFb 101/58/34/47. AKM AR6452a.#
16. 5AR Te Horea, Raglan WBA PA 166/61/30/39. Bird Collection.#
17. 5AR Raglan DUA REP 141/71/36/25. AKM 33625.
18. 5AR Kawhia WBA REP ??/??/?? Barwick Collection. **
19. 5AL Omata, Taranaki DUA MOD 170/75/46/45. TRM A78.889.
20. 5AR Cape Colville TB REP 149/69/34/28. AKM 27664.
21. 5AR Opito Bay, Coromandel TB PA 202/62/28/32/ WTM – cast.#
22. 5AR Opito Bay, Coromandel TB RPF 187/72/22/44. Murdoch Collection.#
23. 5AR Opito Bay, Coromandel TB RPF 170/71/31/36. AKM Jolly Collection.
24. 5AR Opito Bay, Coromandel TB RPFb 66/59/55/38. AAU T10/940. #
25. 5AL Sarahs Gully, Coromandel TB RPFb 150/84/63/52. AKM 42406.#
26. 5AR Tamawera, Ahuahu TB REP 141/50/36/21. AKM 48855/1 Mizzen Coll.
27. 5AR Whitianga, Coromandel TB PA 206/65/35/30. McDougall Collection.
28. 5AR Mercury Bay, Coromandel TB PA 200/82/47/48. PRM 584 Duffy Coll.#
29. 5AR Hotwater Bch, Coromandel TB MOD 133/49/30/37. AKM AR2521.
30. 5AR Opoutere, Coromandel TB RWA 72/59/58/36. AU.#
31. 5AL Whitipirorua, Coromandel TB RPFb 75/48/38/30. TSM.#
13. 5AR Wharenui, Marlborough DUA REP 190/78/34/32. CTM E138/1227c.
14. 5AR Kaikoura NMA PF 224/82/26/32. CTM E138/314.
15. 5AR Kaikoura NMA PA 243/92/42/45. AKM 21684/1.
16. 5AR Conway Flat, Canterbury NMA PF 269/95/36/46. CTM Y1019.
17. 5AR Hurunui, Canterbury DUA PA 276/97/34/35. Gillanders Coll.**
18. 5AR Hurunui, Canterbury OA PA 197/58/25/30. Gillanders Coll.**
19. 5AR Redcliffs, Canterbury OA PA 146/69/38/29. CTM E162/447.
20. 5AR Waitaki River Mouth DUA PA 253/100/46/42. NOM W83 Willetts Coll.
21. 5AR Waitaki River Mouth DUA PA 225/78/39/34. NOM W522 Willetts Coll.
22. 5AL Waitaki River Mouth LBAS REP 195/66/40/36. NOM W82 Willetts Coll.
23. 5AR Waitaki River Mouth DUA REP 185/76/36/34. NOM W474 Willetts Coll.#
24. 5AR Waitaki River Mouth PN PA 220/95/50/25. NOM Willetts Coll. #
25. 5AR Waitaki River Mouth OA REP 186/84/37/40. OTM D30/738.
26. 5AR Waitaki River Mouth NMA REP 172/74/32/39. OTM D30/739.
27. 5AR Shag Valley, Otago DUA REP 235/92/44/36. OTM D65/476.
28. 5AR Waikouiti, Otago SLV MOD 166/60/37/40. OTM D23/470.
29. 5AR Murdering Bch, Otago GW REP 171/65/43/39. OTM D20/720.
30. 5AR Murdering Bch, Otago GW REP 144/71/40/28. OTM D54/64.
31. 5AL Wickcliffe Bay, Otago SLV REP 216/65/30/34. OTM D55/774.
32. 5AR Clutha River Mouth OA REP 175/66/30/34. MONZ ME5701.
33. 5AR Pounawea SLA PF 253/91/60/50. OTM D39/1362a.
34. 5AL Papatowai SLV PF 223/75/33/56. OTM Z2990.#
35. 5AR Invercargill SLA REP 290/92/26/37. SLM B77/468.
36. 5AL Tiwai PT, Invercargill SLA RPF 168/70/45/33. SLM.
37. 5AL Tiwai Pt, Invercargill SLA RPF 179/75/32/44. SLM.
38. 5AL Tiwai Pt, Invercargill SLA RPF 171/80/26/36. SLM.
39. 5AR Southland SLA PF 235/87/50/42. SLM.
40. 5AR Southland SLA MOD 212/62/29/32. OBM.#
41. 5AL Stewart Island SLA REP 184/74/38/34. OTM D30/1029.

Other South Island Records on Moore, Keyes and Orchiston’s (1979) List (not included in the data for this thesis):

1. Puponga, Marlborough DUA NLM. Not Type 5.
2. D’Urville Island DUA NLM E286.65. Not Type 5.
3. Wairau Bar DUA CTM E50.47. Not Type 5.
4. Waipapa Bay NMA CTM. Not Type 5.
5. Glenorchy, Otago, two specimens, OTM. Neither are Type 5.
6. Lake Te Anau, OTM. Not Type 5.
7. Tiwai Point SLM. Not Type 5.
8. Waimea West NMA, NLM E592/65. 5AL? – much modified – may or may not have been Type 5 originally but no longer Type 5 design.
10. Conway River Mouth CTM – duplicate record - same as No.16 above.
14. White Hills, Ohai, SLM – not relocated.

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A total of 90 Type 5 adzes included in the analysis for this thesis. 
Including other adzes on Moore, Keyes and Orchiston’s (1979) list that were not seen = 102 Records.
Appendix D: New Zealand Adze Caches

For Repository abbreviations – see Appendix B
For Stone abbreviations – see Chapter 2
For State abbreviations – see Chapter 4

Order of Information: Provenance, Repository, Catalogue Number, Functional Type, Stone, State, Length in mm.

North Island Caches = 16

1. The Bluff, Aupouri Peninsula NRM
SF187/40 2C TB PA 156
SF187/41 5AR TB PA 220
SF187/42 5AL TB REP 175

2. Muriwai Beach, Tamaki AKM
17022/1 4 TB PPF 237
17022/2 4 TB REP 203
17022/3 4 TB PA 230
17022/4 1 TB MOD 161
17022/5 1 TB MOD 153 Lugs

3. Matatuhu, Manukau AKM (Bramble Collection)
AR6902 2C TB MOD 120
AR6897 1 TB MOD 132
AR6899 4 DUA MOD 117

4. Te Horea, Raglan (Bird Collection)
N64/19/1 4 WBA PA 205
N64/19/2 1 WBA PA 216
N64/19/3 5AR WBA PA 166
N64/ 19/4 3 WBA PA 244 from rough cobble

5. Kawhia, Waikato AKM
27983 6 OA PPF 247
27984 1 OA PPF 287

6. Opie Bay, Great Barrier Island WNM
Type 1 DUA PA 310 lugs
Type 4 DUA PA 293.

7. Mercury Bay, Coromandel MONZ (Bollons Collection)
* found with Hoanga. One adze missing.
3540BC 1 TB PPF 270
3541BC 1 TB PPF 285
3542BC 1 TB PPF 292
3543BC 1 TB PPF 250
3544BC 1 TB PPF 275
3545BC 1 TB PPF 240
3546BC 4 TB PPF 260
3547BC 1 TB PPF 264
3548BC 1 TB PPF 336
3549BC 1 TB PPF 322

7. Whiritoa, Coromandel 1 AKM
AR1200/1 4B TB REP 188
AR1200/2 5AL TB PA 176
AR1200/3 3B TB PA 205
AR1200/4 6 TB PA 240

8. Whiritoa, Coromandel 2 (Murdock Collection – see Figure 4.3)
398 Type 1 TB PA 278
399 Type 2C TB PA 186

9. Putere, Southern Hawkes Bay HBM (Simcox Collection)
66/156 1 NMA PA 172
66/161 1 DUA REP 255
66/167 2A OA PA 150
66/168 6 PN PA 117

10. Pakuru, Southern Hawkes Bay HBM (Simcox Collection)
66/159 1 DUA RW 149
66/160 2A DUA MOD 170
66/170 2A TB REP 123

11. Kiritaki, Southern Hawkes Bay Private Collection
Type 1 DUA PA 273
Type 4b DUA PA 225

12. Patea, South Taranaki AKM
Z4506A 1 DUA PPF 351
Z4506B 1 DUA PPF 336
Z4506C 1 DUA PPF 272
Z4506D 2A DUA RPF 187

13. Glen Orroua, Manuwatu MWM
74/369/1 Flake NMA MOD 142
74/369/2 2 DUA REP 244
74/369/3 2 NMA MOD 171
74/369/4 6 DUA PA 260

14. Palmerston North MWM
D71/17/1 1 TB RW 218
D71/17/2 4 TB MOD 243
15. Tongue Point, Wellington MONZ
7974/2 1 NMA PPF 282
7974/3 2 DUA RWA 114
7974/4 2 NMA RPF 194
7974/5 1 NMA PRF 244
7974/5 1 DUA RPF 284
7974/6 1 GW MOD 201
7974/7 4 GW PPF 333

South Island Caches = 34

1. Greville harbour, D’Urville Island OTM
D35/68 1 DUA RWPF 100
D35/69 2 DUA RPF 150
D35/70 2 DUA RPF 114
D35/71 3 DUA PPF 117
D35/72 2 DUA RPF 104
D35/73 1 DUA RWA 120
D35/74 2 DUA RPF 107
D35/75 2 DUA RPF 115
D35/76 3 DUA PA 136
D35/77 6 DUA PPF 240
D35/78 6 DUA PPF 189
D35/79 6 DUA PPF 195
D35/80 6 DUA PA 158
D35/81 6 DUA PPF 131
D35/82 6 DUA PPF 131

2. Rotokura, Marlborough NLM
198/L4 1 DUA PPF 240
200/L4 1 DUA PPF 340

3. Monaco, Nelson NLM
E2394/75 4 DUA PPF 272
E2395/75 4 DUA PPF 200

4. Big River, North West Coast GDM
Type 5AR DUA PPF 338
Type 5AL DUA PPF 225
Type 1 DUA PPF 315
Type 1 DUA PPF 340 Incipient Lugs
Type 2 DUA REP 339
Type 2 DUA REP 316
Type 1 NMA PPF 375
Type 1 DUA PPF 388

5. Heaphy River Mouth 1 CTM
E162/176 1 DUA PPF 323
E162/117 2 DUA REP 201
6. Heaphy River Mouth 2 CTM
E162/55 2 NMA REP 137
E162/56 3 DUA REP 154
E162/57 6 DUA PPF 199

7. Owen River, North West Coast NLM
E95/70 1 NMA REP 303
E96/70 2 NMA REP 183
E97/70 CR GW RW 127

8. Port Underwood, Marlborough CTM
E139/20 1 DUA PPF 219
E139/20 2 DUA PPF 202
E139/20 2 DUA PPF 195
E139/20 2 DUA PPF 173
E139/20 2 DUA PPF 195
E139/20 2 DUA PPF 153
E139/20 2 DUA PPF 165
E139/20 2 DUA PPF 169
E139/20 2 DUA PPF 164
E139/20 2 DUA PPF 140
E139/20 2 DUA PPF 166
E139/20 2C DUA PPF 170
E139/21 4 DUA PPF 268
E139/21 4 DUA PPF 186
E139/21 4 DUA PPF 211
E139/21 4 DUA PPF 198
E139/22 3C DUA PPF 150
E139/22 3C DUA PPF 184
E139/23 5AL DUA PPF 197

9. Wairau Bar 1 CTM
E47/177 4 DUA PPF 230
E47/178 4 DUA PPF 232
E47/179 4 DUA PPF 215
E47/180 4 NMA PPF 295
E47/181 2 DUA PPF 200
E47/182 2 DUA PPF 141
E47/183 2 DUA PPF 155
* E47/184 – not identified
E47/185 2C TB? PA 206
E47/186 2C DUA PA 142
E47/187 2 DUA PA 138

* There were some inconsistencies between Jim Eyles' 'W' catalogue numbers and corresponding Museum 'E' numbers. Some adzes do not have both numbers. Most caches were identified from Jim Eyles' notes which refer to his 'W' numbers only.
10. Wairau Bar 2 CTM
E163/450  4 DUA PA 201
E163/451  2C DUA PA 162
E163/452  2C DUA PA 197
E163/453  2C DUA MOD 180
E163/454  4 DUA PA 283

11. Wairau Bar 3 CTM
E163/455  6 DUA PPF 143
E163/456  6 DUA RWPF 103
E163/457  6 DUA RWPF 170
E163/458  6 DUA PPF 143
E163/459  6 DUA RPF 110
E163/460  3 DUA PPF 192
W1483  3 DUA RPF 190
W1484 5AL DUA PA 220
W1485  3 DUA PA 137

12. Wairau Bar 4 CTM
E159/845  1 DUA RPF 250
E159/846  1 DUA RPF 233
E159/847  1 DUA RPF 229
E159/848  1 DUA RPF 230
E159/849  1 DUA RPF 180
E159/850  2 DUA RPF 174
E159/851  2 DUA RPF 147
E159/852  2 DUA RPF 142
E159/853  2 DUA RWPF 122
E159/854  1 DUA RWPF 121
E159/855  3 DUA MOD 117
E159/856  2 NMA PPF 184
E159/857  4 DUA PA 225

13. Wairau Bar 5 CTM
E163/316  2 DUA RPF 126
E163/317  2 DUA RPF 117
E163/318  6 DUA RPF 130
E163/319  3 DUA PPF 184
E163/320  6 NMA RW 164

14. Wairau Bar 6 CTM
E163/91   4 DUA PPF 200
E163/92   2 DUA PPF 242
E163/93   1 DUA PPF 259
W651 3 NMA PPF 252

15. Wairau Bar 7 CTM
E164/745  2 DUA PPF 428
E164/746  2 DUA PA 340
E164/747  1 DUA PA 276
E164/748 4 DUA PA 299
E164/749 3 DUA PPF 195

16. Wairau Bar 8 CTM
E171/318 3 NMA PPF 271
W37 2 DUA PPF 335

17. Wairau Bar 9 CTM
E163/388 2C DUA RPF 109
E163/389 2 DUA MOD 138
E163/390 2 NMA SFW 86

18. Wairau Bar 10 CTM
W1312 2 DUA RW 104
W1313 2 DUA RW 71

19. Grassmere, Marlborough MLM
Type 2 DUA PPF 425
Type 2 DUA PPF 355
Type 2 DUA PPF 244

20. Waipapa Bay, Marlborough CTM
E181/1097 2B DUA RW 52
E181/1098 Quad DUA RW 84

21. Hurunui River Mouth (Private Collection)
E144/39 1 DUA PA 284 Lugs
E144/40 1 DUA PA 254 Lugs
E144/41 1 DUA PA 260
E144/42 1 DUA PA 355
E144/44 4 DUA PA 292
E144/45 4 DUA PA 230
E144/46 6 DUA PA 245
E144/47 6 DUA PPF 155
E144/48 3 DUA PA 315
E144/49 3 DUA PA 210
E144/50 5AR DUA PA 276
E144/51 5AR DUA PA 197

22. Motukarara, Canterbury (Private Collection)
E139/87/1 1 DUA PA 287
E139/87/2 1 DUA PPF 291
E139/87/3 1 DUA PPF 255
E139/87/4 1 DUA PPF 234
E139/87/5 1 DUA PPF 223
E139/87/6 1 DUA REP 201
E139/87/7 1 DUA REP 202
E139/87/8 1 DUA REP 193
E139/88/1 2 DUA PA 222
E139/88/2 2 NMA PA 210
E139/88/3 2 DUA PA 200
E139/88/4 2 DUA PPF 193
E139/88/5 2 NMA PPF 194
E139/88/6 2 DUA PA 156
E139/88/7 2 NMA REP 135
E139/88/8 2 DUA PA 144
E139/89/1 4 DUA PPF 279
E139/89/2 6 DUA PPF 275
E139/89/3 6 DUA PPF 270
E139/89/4 4 DUA PPF 232
E139/89/5 4 DUA PPF 226
E139/89/6 4 DUA PPF 223
E139/89/7 6 DUA PPF 203
E139/89/8 6 DUA REP 161
E139/89/9 6 DUA PA 149
E139/90/1 3 DUA PA 198
E139/90/2 3 DUA PPF 187
E139/91 3 DUA PA 187
E139/92 6 DUA PA 188
E139/93/1 2 DUA PA 216
E139/93/2 2 PN PA 144

23. Rakaia River Mouth  OBM
23853 4 DUA REP 280
23854 4 DUA PPF 267
23855 4 DUA MOD 223
23856 1 DUA PA 174
23857 1 DUA PA 176
23858 3 DUA PPF 191
23859 6 DUA PA 120 broken
23860 2 DUA RWA 109
23861 2 GW REP 100 broken

24. Cave, South Canterbury  CTM
E146/178 3 DUA RW 86
E146/179 3 DUA RW 111

25. Pareora River Mouth, South Canterbury  OTM
D25/1671 6 DUA PA 212
D25/1672 2 DUA PPF 359
D25/1673 3 DUA PA 260
D25/1674 2 DUA PA 296
D25/1675 4 DUA PA 280
D25/1676 4 PN PA 219
D25/1677 2 DUA PA 229

26. Waitaki River Mouth  NOM
W96 6 DUA PA 296
W97 1 DUA REP 337
W98 4 DUA PA 297
27. Waitaki River Mouth 2 NOM
W90 1 NMA MOD 202
W91 2 DUA REP 278
W92 1 DUA REP 195
W93 2 DUA REP 206
W94 4 SLA REP 268
W112 1 DUA MOD 163

28. Allday Bay, North Otago CTM
Type 4 DUA PA 250
Type 2 DUA REP 198

29. Pounawea, Otago OTM
D39/1360 1 SLA PPF 313
D39/1360a 4 SLA PA 214
D39/1361 1 SLA RWPF 235
D39/1361a 2C SLV PA 155
D39/1362 4 SLA PPF 260
D39/1362a 5AR SLA PPF 253
D39/1363 4 SLA PPF 279
D39/1363a 1 SLA PA 226
D39/1364 4 SLA PPF 266
D39/1365 1 SLA RPF 191
D39/1366 4 SLA REP 210

30. Papatowai, Otago OTM
Z2992 4 SLA MOD 223
Z2994 6 SLA RW 180
Z2995 1C SLA PA 210
Z2996 4 SLA RPF 241
Z2997 1B PN PA 198
Z2998 3 SLV PA 254

31. Clifden, Southland OBM
398/1648 1C PN PA 197
398/1698 1D GW PA 376
398/2115 2 SLA PA 243

32. Tupatereri, Southland SLM
B67/323 4 SLA REP 344
B67/324 3 SLA PPF 350
B67/325 2 SLA REP 367
B67/326 4 DUA REP 277
B67/327 1 DUA REP 371
B67/329 3 SLA MOD 143
B67/330 6 DUA REP 208
33. Haast River Mouth 1 OTM
D30/822 1 DUA PA 297
D30/823 1 DUA PA 298
D30/824 1 DUA REP 259
D30/825 1 DUA PA 241
D30/826 2 DUA REP 275
D30/827 2C NMA PA 212
D30/828 1 DUA REP 239
D30/829 2 NMA PA 178
D30/830 3 DUA PA 235

34. Haast River Mouth 2 OTM
D38/295 6 DUA REP 175
D38/296 6 DUA REP 141
D38/297 6 NMA RW 75
D38/298 6 DUA RW 130
D38/299 3 NMA RW 106
D38/300 2 NMA RW 108
D38/301 6 DUA MOD 130

Total Adze Caches included in this thesis = 50
Appendix E: Details on Adze Figures shown in Chapter 3 and 4

Note: Cross-hatching indicates cortex.
For Repository abbreviations – see Appendix B
For Stone Type abbreviations – see Chapter 2

Order of Information: Provenance, Repository, Catalogue Number, Stone Type, Other.

Chapter Three Figures

Figure 3.28: Type 1 Primary Adzes
A. Tongapororutu, Taranaki, TRM A78.590 NMA
B. Bayswater, Tamaki, AKM 53070 MGW
C. Taranaki, TRM A78.593 TARG

Figure 3.29: Southland Duff 1D Adzes
A. Groveburn, Southland SLM Z3868 SLV
B. Riverton, Southland OTM D22.750 SLA

Figure 3.30: Southland Type 1 Adzes
A. Ashburton, South Canterbury, CTM E154.91 SLA
B. Wyndham, Southland, OTM D64.33 SLA
C. Blue Mountains, Southland, CTM E137.83.2 SLA

Figure 3.31: Type 1 Adzes with Lugs
A. Te Kuiti, Waikato, AKM 35912 DUA
B. Parapara, Marlborough, NLM K479.73 DUA Knapp Collection
C. North Brunner, Westland, CTM E144.135 DUA

Figure 3.33: Southland Type 1 Adzes
A. Riverton, Southland, MONZ ME12756 SLA
B. Riverton, Southland MONZ ME12755 SLA

Figure 3.34: Type 1 Primary Preforms
A. Raglan, Waikato, AKM 7841 WBA
B. Maungatapu, Nelson, OTM D26.1081 DUA

Figure 3.35: Tahanga Basalt Type 1 Adzes (back wider than front form)
A. Hokianga, Far North, NRM 41/67
B. Mahurangi River, Mid North, AKM 34790

Figure 3.36: Tahanga Basalt Type 1 Primary Adzes
A. North Island, GBM 54/671A
B. Mercury Bay, Coromandel, AKM 10274

Figure 3.37: Southland Tanged Type 2 Adzes
A. Riverton, Southland, MONZ 3008 SLA
B. Otago Peninsula, OTM D59.57 SLA
C. Southland, OTM D132.1657 SLA
D. Levells Valley, Southland, CTM E145.255 PN
E. Wakapatu?, Southland, CTM D121.685 SLA

**Figure 3.39: Primary Type 2 Adzes (Duff 2A)**
A. Mt Camel, Far North, AKM AR8366 MGW
B. Farewell Spit, Tasman Bay, NLM E158.70 Soper Collection DUA
C. Kuaotunu Peninsula, Coromandel, WKM 1964/189/1 DUA
D. Kuaotunu Peninsula, Coromandel, Harsant Collection TB

**Figure 3.40: Primary Type 2 Adzes (Duff 2C)**
A. Scott Point, Aupouri Peninsula, FNM 165 Gleave Collection NBA
B. Mt Camel, Far North, WGM no number, TB
C. Pounawea, Southland, OTM D39.136 1 a SLV part of cache
D. Waipu, Mid North, AKM 29300.1 TB
E. Kaikai’s Bay, North Otago, OTM D18.443 Basalt

**Figure 3.41: Tropical East Polynesian Adzes**
A. Pitcairn Island, AKM 31191 Basalt.
B. Samoa, AKM A16/17 Basalt

**Figure 3.42: Chin-Ridge Type 2 Adzes**
A. Kaiteriteri, Nelson, CTM E165.743 NMA
B. Sandhill Point, Otago, OTM D81.3932 SLA
C. Levin, West Coast North Island, MONZ ME15534 NMA

**Figure 3.43: Large Type 2 Adzes**
A. Waipare, East Cape, HBM no number DUA
B. North Island, WKM 1967/202/25 TB

**Figure 3.44: Large Type 2 Adzes**
A. Pouto, Kaipara Heads, AKM 21448 DUA
B. Pukearuhe, Taranaki, TRM No number DUA, Traditional name is ‘Poutama Whiria’.

**Figure 3.45: Very Large Type 2 Adzes**
A. Patea, South Taranaki, WNM 51/630 DUA
B. Grovetown, Marlborough, CTM E153.179 DUA

**Figure 3.46: Large Southland Type 2 Adzes**
A. Chinaman’s Flat, Beaumont, Southland, OTM D64.83 SLA
B. Waimate, North Otago, OTM D33.1438 PN

**Figure 3.47: Tropical East Polynesian Adzes**
A. Tahiti, OTM D27.896 Basalt
B. Hawaii, OTM D24.412 Basalt
C. Makatea, Society Islands, OTM D53.4336 Basalt
D. Pitcairn Island, AKM 30141.1 Basalt
Figure 3.48: Primary Type 3 Adzes
A. Westland, South Island, OTM D18.663b SLA
B. Aohanga, North Wairarapa, HBM no number Simcox Collection, TB
C. Mt Camel, Far North, WGM 5664 TB

Figure 3.49: Type 3 Adzes and Preforms
A. Taipa, Doubtless Bay, CTM E147.4, MGW
B. Grovetown, Marlborough, CTM E153.201 DUA
C. Mt Camel, Far North, WGM no number, TB preform
D. Greville Harbour, D’Urville Island, NLM E158.65 Soper Collection DUA

Figure 3.50: Primary Type 3 Adzes
A. D’Urville Island, MONZ ME 10616 DUA
B. Pomui Island, Hauraki Gulf, AKM 23473 MGW
C. Gisborne, East Coast, GBM 56/1488 TB
D. Waimai, Waikato Coast, AKM 19779.11 WBA
E. Taranaki, TRM A78.694 DUA

Figure 3.51: Southland Type 3 Adzes
A. Hampden, North Otago, OTM D21.42 SLA
B. Te Wae-wae Bay Southland, SLM D67.189 SLV
C. Southland, OBM no number, SLA
D. Hindon, Taieri River, OTM D51.170 SLV

Figure 3.52: Large Primary Type 4 Adzes
A. Sumner Estuary, Canterbury, CTM E124.25 PN
B. Morven, North Otago, OTM D57.208 DUA

Figure 3.53: Type 4 Adzes
A. Centre Island, Southland, OTM D21.572 GW
B. Waiheke Island, Hauraki Gulf, AKM 50061 TB
C. Tapunui, Moa Flat, Southland, OTM D55.378 SLA
D. Temuka, South Canterbury, CTM E103.11 PN

Figure 3.54: Large Primary Type 4 Adzes
A. Southland, SLM D46.220 SLV
B. Parengarenga, Aupouri Peninsula, AKM 16212 NBA
C. Mangatawa, Tauranga Harbour, THV 1689/85 TB

Figure 3.55: Large Type 4 Adzes
A. Whiritoa, Coromandel, Murdoch Collection, TB preform
B. Whangaparaoa, Mid-North, AKM 47107 MGW
C. North Cape, Aupouri Peninsula, MONZ 7992BC Bollons Collection NBA

Figure 3.56: Primary Type 6 Adzes
A. Opunake, North Taranaki, WNM no number DUA
B. Monck’s Bay, Canterbury, CTM E155.75 DUA
C. Whatipu, Manukau Heads, AKM 53534 DUA
D. Glen Oroua, Horowhenua, MWM 74/369/4 DUA – part of cache
E. Bay of Islands, Far North, AKM 14593 MGW

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Figure 3.57: Type 5 Adzes
C. Maraetahi, Gisborne, GBM 88.103 TB
D. Te Horea, Raglan North Head, Bird Collection, WBA – part of cache.

Figure 3.58: Primary Type 5 Preforms
A. Left and Right Sided Type 5 adzes from the Big River cache North West Coast, South Island, GDM, Richards Collection, DUA.

Figure 3.59: Type 5 Adzes
A. Invercargill, Southland, SLM D77.468 SLA
B. Pounawea, Southland, OTM D39.1362 SLA – part of cache
C. Wairarapa, HBM no number, TB

Figure 3.60: Tahanga Basalt Adzes from Bowentown, Tauranga Harbour Mouth

Figure 3.61: Adzes from Wairau Bar
A. CTM E143.3, Found in spoil heap, DUA lugged preform.
B. MLM Burial 39. DUA preform
C. CTM Burial 32 DUA
D. CTM W1484 Cache 3 DUA
E. CTM E163.304 NMA

Figure 3.62: Adzes from Waitaki River Mouth
All from the Willetts Collection NOM
A. No number DUA
B. No number Basalt
C. No number GW

Figure 3.63: Adzes from Waitaki River Mouth
All from the Willetts Collection NOM
A. W9 DUA
B. No number SLA
C. W13. SLA
D. W83 DUA

Chapter Four Figures

Figure 4.1: Experimental Reworked Adzes and Preforms
A. Tahanga basalt broken Type 1 preform – bevel half, back and front (AA and AB) showing position of Type 4 preform made from it (AB), and cross-section (AC) showing sequence of flakes removed using the broken surface as the striking platform.
B. Type 4 preform reworked from A piece.
C. Type 4 reworked adze finished
D. Flake (No 1) removed during reworking of Type 1 bevel portion then used to make a small flake adze.
E. Flake (No.6) removed during reworking of Type 1 bevel portion then used to make a small flake adze.

Figure 4.2: Experimental Reworked Adzes and Preforms
A. Tahanga basalt broken Type 1 preform – butt piece of same preform shown in Figure 4.1, back and front showing position of reworked quadrangular preform.
B. Finished reworked quadrangular preform made from Type 1 butt end (A).
C. Flake (No.4) from Type 1 bevel portion in Figure 4.1a
D. Gouge made from Flake shown in Figure C
E. Before and after manufacture of a small adze from waste flake
F. Before and after manufacture of a small adze from a waste flake
G. Before and after manufacture of a small gouge from a waste flake

Figure 4.5: Repaired and Modified Type 1 Adzes
A. Gisborne, GBM 70/140 TB Repaired
B. Clevedon, Tamaki, AKM 29313.2 TB Modified
C. Kaipara Harbour, CTM E166.660 TB Modified

Figure 4.6: Adzes with Badly Damaged Blades
A. Waitara, North Taranaki, TRM A78.585 NMA
B. Waitau Bar, CTM E163.299 NMA
C. Houhora, Far North, WGM 4714 DUA
D. Taranaki, TRM A79.380 NMA

Figure 4.7: Modified Type 1 Adzes
A. Ocean Beach, Whangarei, NRM 326 Frazer Collection MGW
B. Hauraki Plains, Murdoch Collection 415 TB
C. Waitaki River Mouth, NOM no number Willetts Collection Cache 2, NMA
D. Kirikinoa, Wanganui, OTM D24.938 NMA

Figure 4.8: Modified Type 2 Adzes showing Side Reduction
A. Te Puru, Hauraki Plains, AKM 28165 TB
B. Pohue Creek, Coromandel, AKM 49425 NMA
C. Tiritiri Island, Hauraki Gulf, MONZ 5687BC Bollons Collection MGW
D. Dargaville, Mid-North, AKM 26669.1 TB
E. Matakania Island, Bay of Plenty, AKM 50639 DUA
F. Stratford, Inland Taranaki, AKM 46292 DUA
G. Houhora, Far North, NRM SF187/117 Aupouri Forestry HQ Collection, DUA

Figure 4.9: Modified Type 1 Adzes
A. Taranaki, AKM 50.685 DUA
B. Moturoa, Taranaki, TRM A80.212 NMA
C. Rawhiti, Hokianga Harbour, MONZ 5845BC Bollons Collection, DUA

Figure 4.10: Modified Large Type 2 Adzes
A. Ruakaka, Mid-North, AKM 16440.1 DUA
B. Pukearuhe, Taranaki, TRM A79.367 DUA
C. Devonport, Tamaki, AKM 6071 DUA

Figure 4.11: Modified and Damaged Type 4 Adzes
A. Opito Bay, Coromandel, MONZ 8019BC Bollons Collection, MGW
B. Wairau Bar, CTM E142.200 NMA, reworked attempt that resulted in an Outre Passe fracture
C. Puketutu Island, Manukau Harbour, AKM 19379.1 MGW
D. Tokerau Bay, Far North, AKM 50267 MGW
E. Mercury Bay, Coromandel, Murdoch Collection 149 TB
F. Waihi Beach, Bay of Plenty, THM 3600168 TB

Figure 4.12: Modified and Reworked Type 3 Adzes
A. Southland, OBM Mitchell Collection, Basalt, reworked bevel portion
B. Pahia, Southland, SLM no number SLA, reworked bevel portion
C. Mt Camel, Far North, AKM 6621 MGW, modified
D. Mahia Peninsula, East Cape, AKM 42060 NMA, reworked after lateral fracture
E. Pig Bay, Motutapu Island, MONZ 21/21 17 MGW, modified — not Type 5
F. Waipapa Bay, Marlborough, OTM D33.983 DUA, reworked — not Type 5

Figure 4.13: Modified Type 3 and Type 5 Adzes
A. Waitaki River Mouth, NOM no number Willetts Collection, PN, Type 5
B. Tom Bowling Bay, Aupouri Peninsula, Booth Collection 72T97 TB, attempt to modify a damaged Type 5 adze
C. Waimea West, Nelson, NLM E592.65 NMA, Modified — may have been Type 5 originally but modification has obscured original form
D. Hot Water Beach, Coromandel, AKM AR2521 TB, Modified Type 5

Figure 4:14: Reworked Type 1 Adzes
A. Oruarangi, Hauraki Plains, Murdoch Collection M428 TB
B. Ahuahu, Coromandel, AKM 48856.1 Mizzen Collection, TB
C. Whangaruru, Northland, AKM 16817.4 TB
D. Patutahi, East Cape, GBM 59/1880 DUA
E. Karekare, Waitakere Coast, Tamaki, AKM 53538 TB
F. Wairau Bar CTM E153.213 NMA

Figure 4.15: Reworked Type 1 Adzes
A. Panmure, Tamaki, AKM no number, DUA
B. Kauruenga, Hauraki Plains, Murdoch Collection, TB
C. Otaki, Horowhenua, HPM 82/A DUA
D. Hikutaia, Hauraki Plains, AKM 44607 Avery Collection TB
E. Aupouri Peninsula, Sunde Collection NBA

Figure 4.16: Reworked Quadrangular Adzes
A. Hahei, Coromandel, Harsant Collection 017 TB
B. Coromandel Harbour, AKM 3178.119 TB
C. Wharepoa, Hauraki Plains, Murdoch Collection 144 TB
D. Whangara, East Cape, GBM 58/1726 NMA
E. Mt Camel, Far North, WGM 5665 NMA
F. Taranaki, FNM no number, DUA
G. Levin, Horowhenua, MONZ ME12591 NMA

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Figure 4.17: Reworked Type 2 Adzes
A. Gisborne, GBM 55/1108/1 TB
B. Hicks Bay, East Cape, GBM 54/239/A NMA, broken butt end not reworked but probably like Figure A before reworking
C. Shag River Mouth, North Otago, OTM D29.1454 NMA
D. 90 Mile beach, Far North, NRM SF187/30 Aupouri Forestry HQ Collection, TB
E. Scott Point, Aupouri Peninsula, FNM 178 Gleave Collection TB
F. Greville Harbour, D’Urville Island, OTM D35/73, DUA, part of cache – reworking not complete
G. Te Horea, Raglan, Bird Collection, DUA
H. Opito Bay, Coromandel, MONZ 6860BC Bollons Collection TB
I. Between Pinnerton and Paremita, Kapiti Coast, MONZ 8004 DUA
J. Taylor’s Hill, Tamaki, AKM AR7608 MGW
K. Taranaki, TRM A79.851 TB

Figure 4.18: Reworked 1B Adzes
A. D’Urville Island, AKM 33878 DUA
B. Kaipara harbour, AKM 6100 TB
C. Waitaki River Mouth, OTM D30.627 SLA
D. Pouto, Kaipara, MONZ 8051BC Bollons Collection NMA
E. Muriwai, Tamaki west coast, AKM 17012 MGW
F. Taiaroa, Otago Peninsula, MONZ ME10841 DUA
G. Kaupokanui, Taranaki, TRM A78.890 DUA
H. Riwaka, Nelson, NLM E444.65 DUA

Figure 4.19: Reworked Type 2 Adzes and small Flake Adzes
A. Otama, Coromandel, AKM 243295. DUA
B. BlackHead, South Hawkes Bay, MONZ ME12531 NMA
C. Opotiki, Bay of Plenty, AKM 34630 DUA
D. Hahei Pa, Coromandel, Harsant Collection 060 TB
E. Aohanga, North Wairarapa, OTM D47.82 SL, flake adze
F. Pilot Bay, Bay of Plenty, WTM MP566 TB flake adze
G. Te Kopunga Pa, Okaiawa, Taranaki, TRM A79.050 DUA, reworked adze in the style of Taranaki agillite ‘pebble’ adzes
H. Opito Bay, Coromandel, AKM 217975 TB reworked flake adze
I. Paekakariki, Kapiti Coast, OTM D31.563 DUA
J. Avondale, Tamaki, AKM 977 TB
K. Spirits Bay, Aupouri Peninsula, AKM 333777316.3 NBA, flake adze
L. Glorit, Kaipara Harbour, AKM 44956 DUA
M. Taiaroa, Waikato, PRM 538 Duffy Collection DUA
N. Coromandel, AKM 29889.5 TB flake adze
O. Seatoun, Wellington, MONZ ME12836 DUA
P. Owhiti, Waiheke Island, AKM AR8222 MGW
Q. Kaipara Harbour, AKM 361c TB
R. South Kaipara Heads, AKM 17030.3 MGW
S. Wairau Bar, CTM E164.521 basalt
T. Paremata, Porirua Harbour, POM – no number, DUA
U. Waihi Beach, Bay of Plenty, AKM 29880.3 TB flake adze
V. Oeo, South Taranaki, TRM A79.482 DUA
W. Opito Bay, Coromandel, AKM 21830.1 TB
X. Te Tii, Bay of Islands, Booth Collection 61T14 DUA
Y. White Rock, Wairarapa, MONZ ME5171.3 DUA
Z. Te Horea, Raglan, Bird Collection DUA
AA. Parengarenga Harbour, Aupouri Peninsula, AKM 16519.10 MGW
BB. Wairau Bar, CTM E163.337 NMA
CC. Ponui Island, Hauraki Gulf, AKM 26739 MGW flake adze

Figure 4.20: 2B Adzes
A. Miranda, Firth of Thames, TSM no number, MGW, primary adze
B. Kaitangata Pa, Taranaki, TRM A74.406, Taranaki argillite pebble adze
C. Manaia Pa, Taranaki, TRM A78.866, Taranaki argillite pebble adze
D. Oakura Bay, Far North, AKM 16473 DUA reworked 2B
E. Raglan, Waikato, AKM 1214 DUA reworked 2B
F. Oruarangi, Hauraki Plains, Murdoch Collection M423 TB reworked 2B
G. Moa-bone Point Cave, Canterbury, CTM E157.154 basalt, reworked 2B
H. South Kaipara Heads, Grace Collection, DUA unfinished rework attempt to make a 2B adze
I. Waipapa, North Canterbury, CTM E181.1097 DUA, reworked adze found with J
J. Waipapa North Canterbury, CTM E181.1098 DUA reworked 2B
K. Kawhia, Waikato, PRM 110 Duffy Collection, MGW reworked 2B
L. Oue Pa, east Tamaki, AKM no number, TB reworked 2B
M. Mt Wellington, Tamaki, AKM 176 MGW pebble 2B
N. Papatowai, Southland, SLM 43/24 DUA reworked 2B
O. Okiwi, Great Barrier Island, AU excavation 1994, DUA reworked 2B
P. Okiwi, Great Barrier Island, AU excavation 1994, MGW reworked 2B
Q. Poverty Bay, Gisborne, AKM 34412.2 MGW reworked 2B
R. Pigeon Mountain, Tamaki, AKM 26720.5 MGW reworked 2B
S. Ruatoria, East Cape, GBM 55/1278 DUA reworked 2B
T. Whakatane, WTM MP530 TB reworked 2B
U. Pawarenga, Whangape Harbour, Far North, FNM 2393 TB reworked 2B
V. Ohawharo, Kaipara, AKM 558e DUA reworked 2B
W. Rotoiti, Rotorua, AKM 33493 TB, double bladed reworked 2B
X. Ohaeawai, Bay of Islands, OTM D29.938 DUA reworked 2B

Figure 4.21: Reworked Type 3 Adzes
A. Pakuru, Southern Hawkes Bay, HBM 66/145 Simcox Collection DUA, attempt to rework a butt end
B. Waitati, North Otago, OTM D29.5107 SLV, double bladed
C. Kauangaroa, Wanganui, MONZ ME12872, DUA
D. Waihau Bay, East Cape, WTM MP903 DUA, broken but not reworked – shows typical Type 3 cross-section
E. Cape Farewell, Tasman Bay, NLM E450.65 Soper Collection, DUA

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F. Cave, Canterbury, CTM E146.178 DUA cache found in paua shell with sawn pieces of pounamu
G. Cave, Canterbury, CTM E146.179 – other adze found in same cache as F
H. Palliser Bay, MONZ ME930 NMA
I. Titahi Bay, Kapiti Coast, POM 1990.67 DUA
J. Bowentown, Tauranga Harbour Mouth, AKM 897.23 Mair Collection TB reworked preform
K. Wairau Bar, Burial 25, CTM E145.305 DUA reworked preform

Figure 4.22: Reworked Type 4 Adzes
A. Opito Bay, Coromandel, MONZ 8020BC Bollons Collection TB
B. Wairau Bar, CTM E?? basalt
C. Aotea, Waikato, WGM 4690 MGW
D. Hikutaia, Hauraki Plains, AKM 44541 Avery Collection, TB
E. Cape Reinga, Aupouri Peninsula, FN996b NBA
F. North Cape, Aupouri Peninsula, AKM 47228 NBA
G. Whangaparaoa, Mid-North, AKM 37787.2 TB
H. Motiti, Ohiwa, Bay of Plenty, AKM 42859 DUA

Figure 4.23: Chisels and Gouges
A. Palmerston North, MWM D71/17/1 TB reworked from Type 1, part of cache
B. Haast, Westland, OTM D38/298, DUA, part of cache 2, reworked
C. Raumati, Kapiti Coast, MONZ 8391 DUA, reworked
D. Oakura, North Taranaki, MONZ ME12564 NMA reworked
E. Wairau Bar, CTM E163.346 NMA reworked
F. North Taranaki, MONZ 7651 TB reworked
G. Spirits Bay, Aupouri Peninsula, MONZ ME11141 MGW flake adze
H. Pollock, Awhitu Peninsula, Tamaki, AKM 20671 TB reworked
I. Wairau Bar, CTM E163.346 NMA reworked
J. Wairau Bar, CTM E163.396 DUA reworked
K. Oeo, South Taranaki, TRM A79.027 DUA reworked
L. Papamoa, Bay of Plenty, PRM 698 Duffy Collection, TB flake adze
M. Papamoa, Bay of Plenty, PRM 698 Duffy Collection, TB flake adze
N. Te Horea, Raglan, Bird Collection, DUA reworked
O. Putere, Southern Hawkes Bay, HBM 66/140 Simcox Collection, DUA reworked
P. Papanui, Wanganui, WNM T80, DUA reworked
Q. Papamoa, Bay of Plenty, PRM 698 Duffy Collection, TB flake adze
R. Te Horea, Raglan, Bird Collection, NMA reworked
S. Papanui, Wanganui, WNM T80, DUA reworked
T. Oeo, South Taranaki, TRM A79.147 DUA flake adze
U. Amodeo Bay, Coromandel, AKM 3156.8 TB reworked
V. Waimarama, Hawkes Bay, MONZ 894 DUA reworked
Appendix F: Adzes recorded with Lugs.

Order of Information: Provenance/Repository*/CatalogueNumber/Functional Type/Raw Material/State/Lug Type.

* See Appendix B for abbreviations.

**North Island Type 1 Adzes**

1. Mt Camel AKM A13/2B Tahanga Basalt failed Rework Attempt Incipient.
5. Muriwai AKM17022/5 Tahanga Basalt Modified Well-defined.
6. West Auckland MWM D86/96/1 D’Urville Island Argillite PA Well-defined.
7. Mt Cambria, Devonport DVM 81/80 D’Urville Island Argillite Repaired Incipient.
8. Tiritiri Is, Hauraki Gulf AKM 42868 Tahanga Basalt Repaired Incipient.
9. Te Kuiti AKM 35915 D’Urville Island Argillite Primary Well-defined.
10. Te Kuiti MONZ ME4058 D’Urville Island Argillite Primary Well-defined.
11. Nimaru, Great Barrier Is, Private Collection D’Urville Island Argillite Repaired Incipient.
16. Bay of Plenty AKM 30335 Tahanga Basalt Repaired Incipient.
17. Tolaga Bay MONZ ME13444 Tahanga Basalt Reworked Incipient.
18. Hawkes Bay MONZ 2041/17 Nelson/Marlborough Argillite Primary Well-defined.
20. Turangi MONZ ME13416 D’Urville Island Argillite Primary Well-defined-3 lugs.

**South Island Type 1 Adzes**

23. Big River, Tasman Bay GDM No Number Nelson/Marlborough Argillite Preform Incipient.
25. Harvey Bay, Marlborough NLM E3135/8 Nelson/Marlborough Argillite Primary Well-defined.
26. Wairau Bar MLM No Number D’Urville Island Argillite Preform Well-defined.
27. Wairau Bar, Burial 6 CTM E142/204 Local Basalt Preform Incipient.
29. Wairau Bar, Burial 2 CTM E142/167 D’Urville Island Argillite Preform Well-defined.
30. Wairau Bar CTM E143/3 Nelson/Marlborough Argillite Preform Well-defined.
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>32. Wairau Bar CTM E164/746</td>
<td>D'Urville Island Argillite Primary Well-defined.</td>
</tr>
<tr>
<td>33. Wairau Bar CTM E164/747</td>
<td>D'Urville Island Argillite Primary Incipient.</td>
</tr>
<tr>
<td>34. Wairau Bar CTM E163/58</td>
<td>D'Urville Island Argillite Prefom-broken butt Well-defined.</td>
</tr>
<tr>
<td>35. Heaphy River CTM E162/176</td>
<td>D'Urville Island Argillite Prefom Incipient.</td>
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<tr>
<td>37. Lake Brunner,Westland CTM E144/134</td>
<td>D'Urville Island Argillite Repaired Well-defined.</td>
</tr>
<tr>
<td>38. Blaketown,Westland CTM E143/135</td>
<td>D'Urville Island Argillite Primary Well-defined.</td>
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<tr>
<td>40. Hurumui River Mouth Private Collection E144/39</td>
<td>D'Urville Island Argillite Primary Well-defined.</td>
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<tr>
<td>41. Hurumui River Mouth Private Collection E144/40</td>
<td>D'Urville Island Argillite Primary Well-defined.</td>
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<tr>
<td>42. Sumner CTM E109/17/13</td>
<td>Local Basalt Primary-broken butt Well-defined.</td>
</tr>
<tr>
<td>43. Moabone Point CTM E166/546</td>
<td>Local Basalt Primary-broken butt Well-defined.</td>
</tr>
<tr>
<td>44. Redcliffs CTM E138/88</td>
<td>D'Urville Island Argillite Primary Incipient.</td>
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<tr>
<td>45. Ellesmere Spit CTM E131/18/1</td>
<td>Local Basalt Primary Well-defined.</td>
</tr>
<tr>
<td>46. Rakaia River Mouth CTM E191/111</td>
<td>D'Urville Island Argillite Primary Incipient.</td>
</tr>
<tr>
<td>47. Rakaia River Mouth CTM E70/57/?</td>
<td>Nelson/Marlborough Argillite Primary Incipient.</td>
</tr>
<tr>
<td>48. Waitaki River Mouth NOM W103</td>
<td>Local Basalt Repaired Well-defined.</td>
</tr>
<tr>
<td>49. Waitaki River Mouth NOM W102</td>
<td>Nelson/Marlborough Argillite Prefom Incipient.</td>
</tr>
<tr>
<td>50. Otago OTM D24/779</td>
<td>Southland Basalt Repaired Well-defined.</td>
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<tr>
<td>53. Wyndham,Southland OTM D64/33</td>
<td>Southland Argillite Repaired Incipient.</td>
</tr>
<tr>
<td>54. Waikawa,Southland SLM D47/42</td>
<td>D'Urville Island Argillite Repaired Incipient.</td>
</tr>
<tr>
<td>56. Te Waewae Bay,Southland OTM D35/1285</td>
<td>Southland Volcanic Repaired Incipient.</td>
</tr>
<tr>
<td>57. Centre Island,Southland OTM D21/539</td>
<td>Southland Argillite Prefom Incipient.</td>
</tr>
<tr>
<td>58. BlueMountains,Southland CTM E137/832</td>
<td>Southland Argillite Repaired Well-defined.</td>
</tr>
<tr>
<td>59. Stewart Island TPM 151</td>
<td>Southland Basalt Primary Well-defined.</td>
</tr>
<tr>
<td>60. Stewart Island SLM D86/333</td>
<td>Southland Argillite Modified Incipient.</td>
</tr>
<tr>
<td>61. New Zealand AKM 21729</td>
<td>D'Urville Island Argillite Primary Well-defined.</td>
</tr>
<tr>
<td>62. Greenhills,Southland OTM D30/1190</td>
<td>Southland Basalt Primary Well-defined 1C.</td>
</tr>
<tr>
<td>63. Southland CTM E138/86</td>
<td>Greywacke Primary Well-defined - Duff 1D.</td>
</tr>
<tr>
<td>64. Southland MONZ ??</td>
<td>Greywacke Failed Rework Attempt Well-defined Duff 1C.</td>
</tr>
<tr>
<td>65. Southland MONZ ??</td>
<td>Southland Volcanic Primary Incipient Duff 1C.</td>
</tr>
</tbody>
</table>

34 with Well defined lugs (9 North Island, 25 South Island).
Type 2 Adzes with Lugs

1. Wairau Bar, Burial 5 CTM E142/201 D'Urville Island Argillite A Primary Well-defined.
2. Banks Peninsula CTM E138/238 D'Urville Island Argillite Primary Well-defined.
3. Makihikihi, South Canterbury OTM D25/481 Local Basalt Primary Well-defined.
5. Lower Portobello OTM D49/481 Pounamu Primary Well-defined.
7. Taieri Beach OTM D36/750 Southland Argillite Primary Well-defined.
8. Kaitangata, Southland OTM D64/141 D'Urville Island Argillite Primary Incipient.
10. Riverton MONZ ?? Southland Volcanic Primary Incipient Rectangular 1C.
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Abbreviations

AA  American Antiquity
AINZ Archaeology in New Zealand (formerly NZAA Newsletter)
APAO Archaeology and Physical Anthropology in Oceania
BAR British Archaeological Reports
JAA Journal of Anthropological Archaeology
JAR Journal of Anthropological Research
JFA Journal of Field Archaeology
JPS Journal of the Polynesian Society
JRSNZ Journal of the Royal Society of New Zealand
NZAA New Zealand Archaeological Association Newsletter
NZJA New Zealand Journal of Archaeology
RAIM Records of the Auckland Institute and Museum
RCM Records of the Canterbury Museum.
TNZI Transactions of the New Zealand Institute


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