AXE MAKERS OF THE WAHGI

Pre-colonial industrialists of the Papua New Guinea highlands

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Except where the contributions of others are acknowledged, this thesis is the result of my own original research.

John Burton

for Catriona

ABSTRACT

Before the first Australian patrol to Mt Hagen in 1933, stone axes were in daily use in the Papua New Guinea highlands and were widely traded, often in the context of ceremonial exchange. Many occurrences of hard rocks suitable for axe making were exploited, but only at a few centres was the manufacture of axes carried out on a large scale. In recent times, a group of axe factories located in the Wahgi and Jimi Valleys accounted for the bulk of production.

In this thesis I look at how the communities of axe makers organised quarrying expeditions, how they extracted the stone and made it into axes, and at the kinds of economic relations which existed between themselves and their neighbours. I focus on the Tuman quarries, in the central Wahgi Valley, Western Highlands Province, and the organisation of Tuman society with special reference to quarrying and axe making. I introduce the quarries of the Jimi Valley, also in Western Highlands Province, and the Dom language area, in Simbu Province, for comparative purposes. I also report on the use of geochemical methods and visual inspection to identify axes in ethnographic and archaeological collections from the highlands.

My findings are twofold. Firstly, that the type of production at each quarry was shaped by the balance of three factors: the geological disposition and mechanical properties of the axe stone, the ideology of the axe makers, and the ceremonial competitiveness of the economy in which they exchanged the axes. I argue that the scarcity or abundance of rocks suitable for quarrying was less important than the ability of a given community to respond to socio-economic forces, develop an effective system of quarrying and sustain production at a high level. The second finding is that axe stone from the modern quarries can be identified in rockshelters in levels dated to 2500-1500 years before the present. Bearing in mind the close relationships that I describe between social organisation, the wealth economy and quarrying methods, I conclude that this is one of the markers of the emergence in the highlands of a society of essentially modern aspect.

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ACKNOWLEDGEMENTS

This thesis is the outcome of two periods of research in Papua New Guinea, from July 1980 to November 1980, and from May 1981 to November 1981, as a research scholar with the Department of Prehistory, Research School of Pacific Studies, Australian National University.

A large number of people helped me during fieldwork and while I was writing this thesis. Above all I wish to thank Jack Golson for my introduction to research in Papua New Guinea, and I thank both Jack and Jim Allen for their supervision of my project.

I gratefully acknowledge the Research School of Pacific Studies for its financial support; the Department of Anthropology and Sociology, University of Papua New Guinea, for hosting me while in PNG; the National Museum and Art Gallery of Papua New Guinea for granting an excavation permit and post-fieldwork facilities; and the governments of Western Highlands, Simbu and Enga Provinces for permitting me to carry out research in the areas of their jurisdiction.

In AUSTRALIA, many individuals contributed knowledge, practical assistance or hospitality - or all three - and I thank them warmly. At the ANU I was greatly helped by pre- and post-fieldwork discussions with John Chappell, Robin Hide, Ian Hughes, Jack Golson, Mary-Jane Mountain and Marie Reay. At the University of Sydney, Pawel Gorecki provided me with essential information at the start of my project.

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Figures 1.2, 2.1, 3.8, 3.9, 9.1 and 9.2. Figure 1.2 was originally drawn by Winifred for Mary-Jane Mountain, Figure 10.1 is based on a map prepared by O.A. Christensen and Figure 10.2 is based on a map prepared by Pawel Gorecki. I am greatly indebted to Jack and Maureen for their marathon spells of proof-reading and sub-editing, but, I hasten to add, the errors that remain are my responsibility alone.

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I made use of geological samples collected at the Mbukl quarry by Ronald Lampert in 1975; I thank him for his foresight. I also acknowledge The Australian Museum, Sydney, for the loan of the Kafiavana axe-adze finds.

I spent nearly a year in PAPUA NEW GUINEA, during which time I stayed for two months in 1980 and for six months in 1981 at Temek, a Tungei hamlet near the Tuman River. Many names spring to mind, but Ap, Dorum, Duri, Gelu, Ken, Kongua, Kunjin, Malimbe, Mila, Oura, Sike, Wandaki, and Wule were especially kind to me. I would also like to thank Councillor Munung for his approval of my project.

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In Mt Hagen, I would like to thank Ruth Blowers, Bruce Blowers, Lee Eby, Ken Logan, Dan Leahy - who was kind enough to discuss the 1933 Mt Hagen patrol with me - John Pun, Neil Ryan, Roey Berger, Gabriel Waipek, and Wamp Nga Motors. At Minj, I am grateful to the District Officer, Jo Mangi, Michael Mangi and John Muke. I was very glad to have Jo and John in the field and I hope they had as good a

time as I did. In Wabag, I would like to thank Watu Lopo and Akii Tumu of the Enga Cultural Centre, for permitting me to examine the Brennan axe collection.

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NOTES ON ORTHOGRAPHY

I did not achieve any measure of competence in the Tuman language Ek Nii until the closing weeks of fieldwork in 1981; my interviews were therefore held almost entirely in New Guinea Pidgin, relying on younger people to interpret for men and women over the age of about 60 years. However, Bruce Blowers, Ruth Blowers and Lee Eby, Nazarene missionaries who lived at Temek in the 1960s, kindly gave me access to their Ek Nii language materials. Mrs Blowers also permitted me to record her card file on 35 mm film, from which I was able to produce a sizable Ek Nii dictionary in time for the 1981 period of fieldwork.

The orthography of Ek Nii used in this thesis is that given by Bruce Blowers (1975) for the neighbouring language, Middle Wahgi (Ramsey 1975), and adopted by Ruth Blowers for Ek Nii. Note that in this thesis vernacular words - but not names - are represented in **boldface.** The following is a simplification of the Blowers-Ramsey scheme:

Vowel sound	English example	Nii examples
Short **a**	"cat"	**nam, amb**
Long **a**	"Ma"	**ka, mane**
Short **e**	"bet"	**ep**
Long **ei**	"eight"	**kei, pei**
Closed, short **i**	"bit"	**sik, ninem**
Closed, long **i**	"feet"	Wiimbe
Open, long **i**	"feet"	**eki, kundi, ngi**
Short **o**	"pot"	**mon, ond, to!**
Long **ou**	"owe"	**toue**, Pou
Short **u**	"put"	**dup, mum, wu**
Long **u**	"boot"	**ku**, Tun

In some words, the sound represented by /**ei**/ varies, possibly due to the influence of Middle Wahgi. Thus the tribe name 'Tungei' may be said 'Tungei' or 'Tungai', or halfway between the two.

Consonant	English example	Nii examples
t/r (allophones)	"tub","rub"	**tui**, Tuman
Initial/medial **j/nj**	"jump", "enjoy"	**jiki**, Kunjin
Final **nj**	"cents"	**enj**, **pinj**
lt	"well done"	**goltem**, Kiltei
Medial **ɬ**	"juggler"	**kuɬem**, **kapɬe**
Final **ɬ**	"tackle"	**noɬ**, **aɬ**

Note that /**t**/ can be sounded either as 'r' or 't'. This is hard for an English-based orthography to cope with, as it has led in the past to the confusion of 'Rungei' and 'Tungei' in official documents and, worse still, 'Dongai'. Other Nii consonants approximate to English ones.

In the Dom area of Simbu Province and the Jimi Valley, I noted down technical terms as best I could; Colin Lamb, of New Tribes Mission, supplied some written answers to my queries about Dom terms, but local terms outside the Nii language area are generally included for the sake of documentation, and at the risk of inaccuracy.

CONVENTIONS

1. I made tape recordings at many of the formal interviews I held with Tungei and Goroku informants. One set of cassettes is archived with the Department of Prehistory, Research School of Pacific Studies, Australian National University, and another with the National Museum and Art Gallery of Papua New Guinea. In the interests of documentation, textual footnotes indicate which interviews have a bearing on the current discussion. My records of each interview (also archived with the above institutions) indicate which tapes relate to which interviews. These may be of interest to future students from the Tuman and Dom areas.

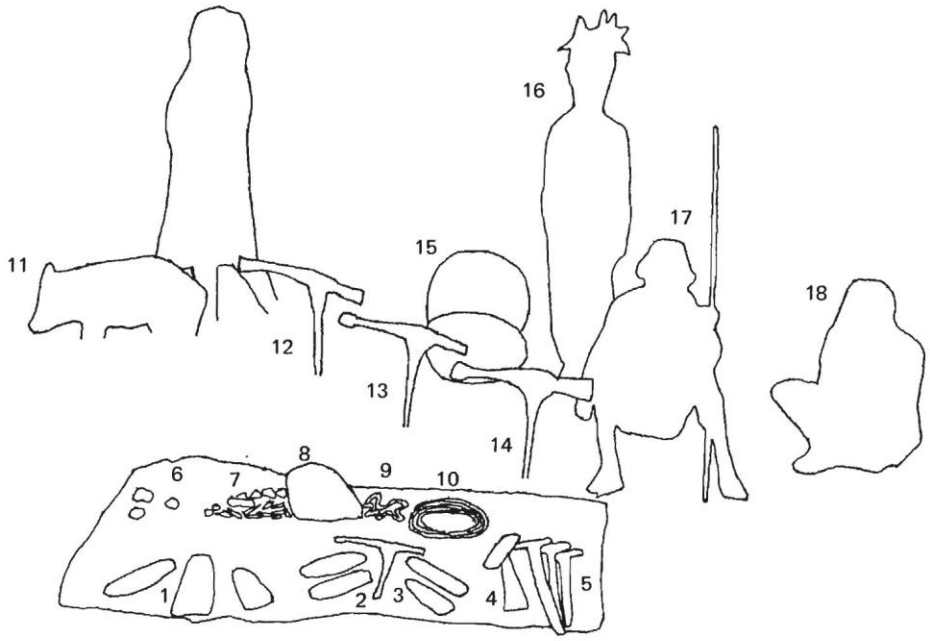
2. Map references of the form XY 001001 are Universal Grid References taken from the Papua New Guinea 1:100,000 series topographic survey maps.

3. I use the term 'highlands' as a geographical term, while reserving 'Highlands' for use in the names of administrative provinces.

4. I mention informants and some of their ancestors by name. These are their real names; only in one case did an informant ask me not to reveal the names of his forebears. In the case of the Tungei quarrymen, whom I knew better than any others, I have reasoned that their names should not slip into obscurity; on the contrary, they should be remembered.

5. Note that, as in the point above, much of my discussion assumes that axe makers and quarry workers were men. This was always the case. As a consequence, I received most information from old men. However, the term 'informants' is often used loosely; it can be assumed that this does not exclude informants who were also women.

6. The abbreviation PR in bibliographic citations means 'patrol report'.



Key: 1. Axe roughouts 2. Axe blades 3. Woodworking adze (*tui ongka*) 4. Wooden crosspiece (*kaple*) 5. Wooden handle (*else*) 6. Hammerstones 7. Pile of flakes (*tui win*) 8. Grindstone (*ku tukum*) 9. Vine for binding handle (*kan minimb*) 10. Weaving cane (*kan wieng*) 11. Pig, raised by Muk, a symbol of the goods exchanged for stone axes 12. Finished axe (Nat. Mus. E8386) 13. Duri's axe 14. My axe 15. Quarryman's baskets (*grenj kon*) 16. Girl, Margaret Ap, a symbol of the brideprices paid in axes 17. Quarryman — Malimbe 18. Haft maker — Duri.

AXE MAKING AT THE TUMAN QUARRIES

Frontispiece

Chapter 1

INTRODUCTION

In the early 1930s a handful of stone axe quarries supplied the large population of the Papua New Guinea highlands with axe blades. Stone axes were highly valued and widely traded both in the wealth economy of the highlands and as part of a lower level trade in domestic goods. The principal aims of this thesis are to reconstruct the manufacturing systems of several of the recent axe making communities and to throw light on the development of stone axe making and trading in the context of the last 10,000 years of highlands prehistory.

The traditional archaeological techniques of survey, excavation and classificatory analysis form a basis for preliminary statements about the quarries and axes of the region, but much of the new information presented here has been obtained by other methods. These include oral historical interviews, practical experiments in making axes and comparisons of the social organisation of the axe makers with the published ethnography of the highlands.

Some of the traditional axe makers are still alive - whether their overall number should be reckoned in tens or in hundreds is unknown - but they are elderly and become fewer as each year goes by. The study of a traditionally important craft industry like axe making is therefore an urgent one; no younger generation of Papua New Guineans can replace the unique memories of their elders or authentically duplicate their craftsmanship. In wider terms, the accomplishments of the axe makers are of an era long forgotten in many parts of the world; it is possible that an insight into their methods can enlighten the study of prehistoric quarrying operations elsewhere.

STONE AXE MAKERS AND THE MODERN WORLD

The economy which supported axe making has been radically transformed by rapid economic development and axes ceased to be made by the early 1940s. Published eye-witness descriptions of axe making from the 1930s and 1940s exist, but they are few in number and the early observers do not appear to have been aware of the Tuman quarries, the quarries with the largest output in the highlands, until about 1950 (see Chapter 2). The geographical extent of trade, however, was always known to be broad (Chinnery 1934; Moyne and Haddon 1936; Ross 1936). Since the 1940s, knowledge about the sources of stones axes has increased greatly and the ethnographic literature of the highlands has grown enormously, permitting a good, if retrospective, understanding of the cultural setting within which the axe makers and traders operated.

It remains true, however, that stone axes went out of use in Papua New Guinea as a whole during the early stages of the development of anthropology and archaeology as formally constituted disciplines. This did not pass without the comment of at least one interested archaeologist. Two decades ago J.G.D. Clark wrote what is still the best general review of stone axe studies, in the course of which (1965:18) he remarked:

> Among the first [Pacific stone tools] to attract detailed attention from ethnographers were those of the small Melanesian islands immediately east of New Guinea. Even so, when Seligman described the axe trade in 1906, iron tools had already displaced stone axes for some thirty years and when Malinowski contributed his essay on this topic...in 1934 it was hardly any longer even a living memory.

In point of fact when Malinowski was living on the island of Kiriwina, from 1915 to 1918, the axe makers of the Wahgi Valley, then unknown to the outside world, still had 15-20 years of full production ahead of them. Their economy was to remain uninfluenced by the industrialised world for the whole of this time.

An ethnographer of the 1930s, or even the 1940s and 50s, would naturally have been well placed to study the making of and trading of stone axes in the interior of the island and some made use of this opportunity (e.g. Blackwood 1950, 1978). In comparison, the 1980s - when I began fieldwork - would seem to have few merits over these earlier decades. However there were some advantages. In 1980 I was able to avoid lengthy ethnographic enquiries in terra incognita and I could afford the luxury of testing specific hypotheses about axe making; this would have been difficult in, say, 1950.

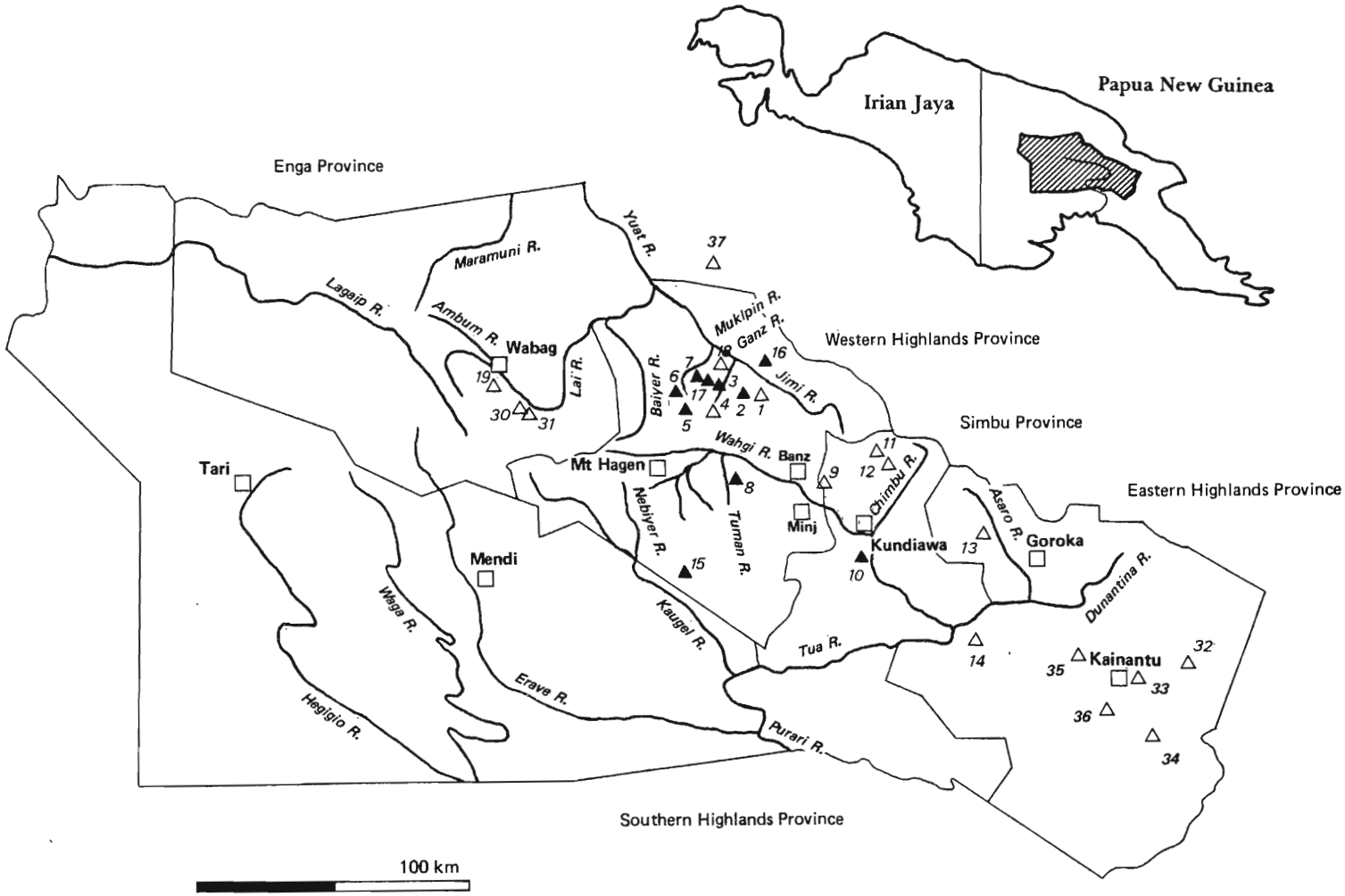
Clark wrote that the first anthropologists to stay in the highlands generally neglected the study of material culture, concentrating instead on social organisation and kinship (1965:19). This was an understandable bias, however, given the theoretical direction of social anthropology during the 1940s and 1950s. But even with a strong focus on society, at the expense of technology and economy, longer term socio-economic trends relevant to my 1980-81 inquiries could not have been foreseen or detected. I give an example of this in Chapter 7, when I carry out an analysis of the marriage patterns of the Tuman axe makers and their neighbours; with the hindsight of many years of marriages since the demise of the axe trade, an effect can be demonstrated that would have been invisible in earlier decades.

Another point in favour of the 1980s is that archaeology has moved away from its former preoccupation with the material trappings of society and its narrow interest in the evolution and dispersion of 'types'. archaeologists today try to bring theory to bear on society itself and are beginning to have a better understanding of change in human societies. The questions which a contemporary archaeologist chooses to ask are vastly different to those which would have been thought important a generation ago.

Hand in hand with theoretical changes have come practical advances in scientific methods. Modern geochemical techniques are not able to solve every problem connected with the sourcing of archaeological finds, but there is a greater range available and a better chance of success. The two techniques used here for sourcing stone axes - infrared spectroscopy and X-ray fluorescence - illustrate both the strengths and weaknesses of modern sourcing studies (Chapter 10).

QUARRIES OF THE STUDY AREA

The highlands of Papua New Guinea comprise the Provinces of Enga, Southern Highlands, Western Highlands, Simbu, Eastern Highlands, and parts of Madang Province. In this vast area, with a contemporary population of one million people, many sources of axe stone are known to have been exploited (Fig. 1.1; Table 1.1). The most productive, with an overall output that is likely to have run into hundreds of thousands of axes per century (see Chapter 4), are confined to the Wahgi and the Jimi Valleys. A total of twenty sites to the east of Mt Hagen has been documented by Chappell (1966), Hughes (1977a) and Radford and Radford (1980).



PAPUA NEW GUINEA HIGHLANDS known and suspected stone axe sources *(refer to Table 1.1 for site key)*

Figure 1.1

▲ traditional source within study area
△ suspected or modern source, source outside study area

NO.	NAME	PNG SITE CODE	GRID REFERENCE	LOCATION	REFERENCES
1	Maegmul/Tsau			Jimi Valley	
1a	*Maegmul	MML	BP 322777		3,†
1b	*Yenglimb		BP 327838		†
2	Tsenga	MMM		Jimi Valley	
2a	Tingri		BP 237822		2,3,4,†
2b	Gaima		BP 237822		2,3,4,†
2c	Yambina		BP 232822		†
2d	Kukla Kukli		BP 242821		†
2e	*Lipaldi		?BP 235825		3,4,†
2f	*Kupan		?BP 258810		4,†
3	Ganz River	MAA/MNN		Jimi Valley	
3a	Ketepukla		BP 173842		1,2,3,4,†
3b	Røngeglp		BP 173842		6,†
3c	*Waspi		?BP 160820		†
3d	*Rukmimb		BP 176873		†
4	*Mala Gap	MMO	BP 143757	Sepik-Wahgi Divide	3
5	Mbukl	MMP	BP 047780	Sepik-Wahgi Divide	2,3,†
6	Pukl	MMQ	BP 030816	Sepik-Wahgi Divide	2,3,†
7	Yambina/Kraep	MMR	BP 105875	Jimi Valley	2,3,†
8	Tuman quarries	MMS		Wahgi Valley	3,†
8a	Kunjin	MOO	BP 250493		
8b	Ngumbamung	MOP	BP 252493		
8c	Yesim	MOQ	BP 247495		
8d	Mela	MOR	BP 268492		
8e	Gapinj Aka Nui	MOS	BP 239499		
8f	Gapinj	MOT	BP 242499		
8g	Apiamb	MOU	BP 243497		
9	Kerowagi	NOG	?BP 625475	Wahgi Valley	3
10	Dom gaima	NOH/PBB	BP 677258	Wahgi Valley	1,3,5,†
11	Yendegle Mauglwa	NOI	?BP 760515	Mt Wilhelm	3
12	Kumanigl	NOJ	?BP 820500	Chimbu Valley	3
13	Kafetu	NOK	?CP 080330	Asaro Valley	3
14	Mopa		?CN 070980	Mt Michael	4
15	Dabiri		?BP 050160	Southern Kubors	4
16	Repeng/Golum	MCZ	BP 352953	Bismarck Range	NM,†
17	Apin		BP 122869	Jimi Valley	2,†

* indicates non-traditional site

Table 1.1 (continued overleaf)

NO.	NAME	PNG SITE CODE	GRID REFERENCE	LOCATION	REFERENCES
18	Unknown Palke quarries			Jimi Valley	
18a	Rumna	MOV	?BP 131909		2,6,†
18b	*Mendama	MOW	?BP 155901		3,†
18c	*Wendama				4,†
19	Sambe			Luanda River	7,9,†
20	Alokai			?Luanda River	7,9
21	Molokea			?Luanda River	7,9
22	Apina			?Enga	7,9
23	Enapola			?Enga	7,9
24	Kokwa			?Enga	7,9
25	Kyowaka			?Enga	7,9
26	Mongalo			?Enga	7,9
27	Nambi			?Enga	7,9
28	Pakenane			?Enga	7,9
29	Wasa			?Enga	7,9
30	*Langgamaili			Tsak Valley	5
31	*Milikini			Tsak Valley	5
32	Puntibassa			Kainantu District	8
33	Isenamumpa			Kainantu District	8
34	Awasera			Kainantu District	8
35	Finentegu			Kainantu District	8
36	Ontenu			Kainantu District	8
37	Dusin/Tsengapi			Simbai	10

* indicates non-traditional site

Key to references :

1. Vial (1940)
2. A.M. Strathern (1965)
3. Chappell (1966)
4. Hughes (1971)
5. Hughes (1977a)
6. Gorecki (n.d.)
7. Brennan (1979)
8. Radford and Radford (1980)
9. Sillitoe (1982)
10. Gorecki pers. comm. 1983

NM Site recorded in National Museum

† Information in this thesis

Table 1.1 (continued)

A range of minor sites is also known from Enga Province, to the west of Mt Hagen, through the collection of their products by P. Brennan (1979:5; Sillitoe 1982:36). As far as is known the Enga sites have not been visited by archaeologists or, at least, have not been described and sampled petrologically. Enga axe names are unknown eastwards and Enga axes, such as the distinctive **sambe** (see page 5), are never identified in Western Highlands collections. Even in Enga the dominant sources were those of the Western Highlands, not those of Enga itself.

An adjacent area that remains comparatively unknown from the point of view of stone axe sources is Southern Highlands Province. Glasse (1968/69) says that the Huli had no quarries and, according to Sillitoe (1982:21), the Wola had none either. Both groups of people relied on trade from the north and east of their region, their axes originating at the Western Highlands sources. Further west, a unique outcrop of glaucophane schists in the upper Leonhard Schultze area has been visited by geologists; three axes made from this rock have been found in the Hagen area (Ryburn 1977). Judging from several small collections in the National Museum, sources like this one were more important in the far western parts of the highlands than those mentioned above.

A source which is important to the peoples of the Indonesian border area is located just east of the Om River near its junction with the Strickland River. The oval-sectioned adze blades from this source are called **mok** and its ownership lies with the Duanmin and Sugamin (B. Craig, pers. comm. 1980; cf. Hughes 1977a:169). Further west into Irian Jaya, a number of publications describe axe quarries; the most notable description is that of Harrer (1964) who visited one of the quarries with a party of axe makers and saw the rock being quarried (see also Verhofstad 1966; Mitton 1972).

In this thesis I am able to deal only with the quarries of a small part of inland New Guinea: an area in and around the Wahgi Valley. The quarries in this study area fall into three complexes: the Tuman River quarries near Aviamp and the quarries of the Sepik-Wahgi Divide and Jimi Valley, in Western Highlands Province, and the Dom **gaima** quarry in Simbu Province. Each complex consists of a range of physically separated quarrying places, or, in the case of the Dom **gaima** site, a quarrying area into which independent working parties sank adjacent mineshafts. Though the Jimi and Sepik-Wahgi (Chapter 8) and Dom (Chapter 9) quarries both merit separate chapters in the text, I am mainly concerned with the Tuman quarries - by a long way the largest

source of axes in the highlands - and the history of Tungei tribe who exploited them in recent times.

Within the group of quarries located by Chappell (1966) I have passed over the Eastern Highlands site of Kafetu and I cannot begin to resolve the complexities of axe making in that Province (cf. Wise 1981). On the Western Highlands-Simbu border I have omitted the sites of Yendegle Mauglwa, Kumanigl and Kerowagi; they were minor sources and their usage was probably similar to sites of comparable output that I did visit.[1]

I was unable, also, to visit the source of the most distinctive Enga product, a mottled axe called **sambe**. The quarry is located at the head of the Luanda River near Wabag. But even in Enga, **sambe** was a minor source of axes; it accounts for only 1-2% of the Brennan collection of over 800 blades (Chapter 10).

PREVIOUS RESEARCH ISSUES

In relation to the use and manufacture of stone axes, research has followed a number of avenues. Firstly, details of the manufacture, distribution and classification of stone axes in the highlands have been provided by anthropologists and geographers interested in traditional patterns of highlands trade and exchange (A.M. Strathern 1965; Chappell 1966; Hughes 1977a), and by archaeologists applying themselves to taxonomic studies (Lampert 1972; White et al. 1977a).

Ground stone axes have been found in archaeological excavations throughout the region, providing the basis for chronological statements about axe making (White 1967; S. Bulmer 1975). Noting the lack of information on the functional life of stone axes and the manner in which they enter the archaeological record, A.M. Strathern (1969), White and Modjeska (1978a, 1978b) and Steensberg (1980) are among those who have sought to document patterns of use and cultural formation processes.

A second theme is provided by time-and-motion studies and experiments with stone axes. Most of the studies were carried out to clarify

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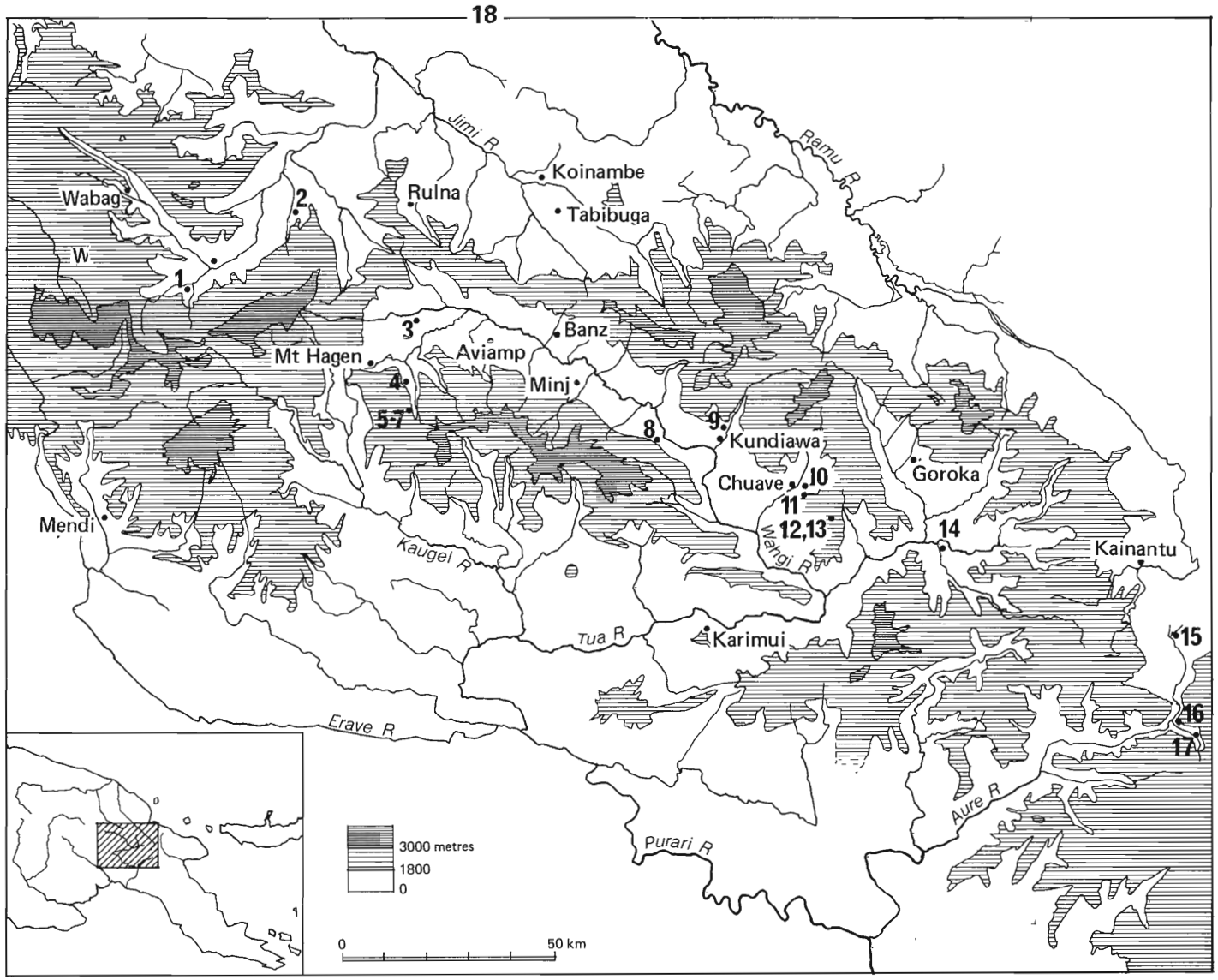
[1] In the course of inquiries along the north Wahgi, the Kerowagi source was not mentioned by informants. Yendegle Mauglwa, the high altitude source found by Chappell on Mt Wilhelm, seemed unknown to middle-aged men on the upper Chimbu River at Gembogl. Hughes, however, says he heard all of Chappell's quarries except Kumanigl (1971:265).

findings emerging from disciplines other than archaeology. Some of the authors would have described themselves as human ecologists, while others attempted, from no explicit standpoint, to measure the changes to the lifestyle of highlanders brought about by the introduction of steel tools. Examples can be found in the work of Salisbury (1962), Clarke (1971:175-6), Godelier with Garanger (1973), Sillitoe (1979) and Steensberg (1980).

The studies have yielded important insights into the nature of neolithic technology and great progress has been made on the basic issues of where the quarries were, what the products of each looked like and how they were used. It is fair enough to say, however, that the authors who contributed to this success did so from a variety of theoretical standpoints, some of which made conflicting assumptions about the reasons for axe manufacture, trade and exchange.

One of the early concerns was with the origin of ground stone axes and specifically with the origin of the flat-sided blades known as 'quadrangular' or 'planilateral' axes, like those made recently in the study area (Adam 1953). Stone axe materials have since been found in stratified and dated archaeological sites in the Papua New Guinea highlands (Fig. 1.2), most of which are rockshelters; the earliest dates are about 9000 BP for the cutting edge of a ground stone axe in Level IX at Kafiavana (White 1972:Fig. 18j) and about 6000 BP for two small axes in Level 21 at Manim (Christensen 1975:31). One of the first findings was that 'lenticular' axes, that is to say axes with a lens-shaped cross-section, are found in stratigraphically lower positions than 'planilateral' ones (S. Bulmer 1964:267; Bulmer and Bulmer 1964:73). At the site of Yuku (S. Bulmer 1975:Table 2), 'lenticular' axes are also said to occur in the same levels as the generally earlier 'waisted blades', an artefact type known from 26,000 BP at the Pleistocene site of Kosipe (White et al. 1970) and comparable with a few finds from Pleistocene Australia (Lampert 1981:162-4). The dating of the Yuku levels with both artefact types is not clearcut, but lies in the range of 6700-4500 BP (S. Bulmer 1975:30).

Most relevant to the present discussion is the question of whether the pieces of 'lenticular axe' found in the sites can really be considered representatives of an archaeological 'type'. The total quantity of stone axe materials from excavations in the highlands is not great - Kafiavana is the only rich site from this point of view - and of the sites which lie squarely within the study area, none has been published in detail.



1 Tsak Pumakos
2 Yuku
3 Kuk
4 Manim
5 Kamapuk
6 Etpiti
7 Tugeri
8 Anbannigl
9 Omkombogo
10 Kiowa
11 Nombe
12 Lemouru
13 Uweka
14 Kafiavana
15 Aibura
16 Batari
17 NFX
18 Wanlek

ARCHAEOLOGICAL SITES OF THE PAPUA NEW GUINEA HIGHLANDS

(courtesy M–J. Mountain)

Figure 1.2

Bulmer, however, has been drawn to speculate on the manner in which a hypothetical toolkit containing lenticular axes was replaced by a toolkit containing planilateral axes. She suggested that traces of a possible trade route for the flat-sided axes from Southeast Asia to the highlands might someday be found in the coastal and lowland districts of Papua New Guinea (1964:267; cf. S. Bulmer 1975:45).

A comparable attempt to fulfil the needs of culture history was made by Bellwood (1978:237), who found 'parallels' for the prehistoric presence of ground stone axes in the highlands in the Hoabinhian sites of Southeast Asia. And in a paper on the cultural sequence of the latter, Hayden (1977) came very close to saying that quadrangular stone axes were an improvement on what had gone before. He certainly cited the development of quadrangular axes there as evidence of 'cultural evolution' (1977:101).

THEORETICAL BASIS OF THIS STUDY

Few of the statements that I have cited were made in the attempt to explain the emergence and eventually huge output of the Western Highlands and Simbu axe quarries. Separate attempts have been made to account for the needs and necessary adaptations of highlands societies (e.g. Brookfield and Brown 1963; R. Rappaport 1968; Clarke 1971), but these have primarily been related to the ecology rather than to the material culture of highlands societies. Equally, prehistorians have tended to borrow informal assumptions about stone axe use from the archaeology of related problems in other parts of the world. In my reading of the literature, these assumptions have two main defects. Firstly, there has been a strong, and perhaps misplaced, emphasis on trade. In the highlands, as in many areas of Melanesia, goods are seen to change hands continually in a never-ceasing traffic across the region. However, there is a danger of adopting a 'just so' mentality when confronted with this seemingly perfect picture of adaptation to a diverse environment. Trade, of course, solves human problems. The task of finding out what those problems are lies ahead: they cannot simply be assumed.

In the second place - and a criticism of archaeology in general - a great emphasis has been placed on artefacts as representative either of 'types' or of classes of tools which it is the job of the archaeologist to learn about through replication and use. Systems of manufacture in a wider sense have been given much less attention, possibly

because it is assumed they are inaccessible aspects of the archaeological record: this is not so.

Broadly, the two following positions contrast an impression I have gained from a range of contributors to this subject with an alternative view that I propose to work with in this thesis:

1. Existing, informal model. Initially of unstandardised manufacture and variable shape, ground stone axes evolved to become the leading component of a subsistence technology finely tuned to the needs of tropical agriculture in rainforest conditions.

   Specialised quarries and a developed trade in axes emerged in the mature phase of this technology as part of a general trend towards increasing intensification (a concept not further explored in early papers).

2. Alternative model. Axes were obtained from many casual sources at a low intensity of exploitation for some thousands of years. Localised trading was quite sufficient to meet the demands for work tools in different parts of the region.

   Later, changes in the social organisation and ceremonial economy of highlands societies made large-scale quarrying and the centralised manufacture of axes a viable proposition. Two communities in the core area (Tuman and Dom) and a number on its margin (Jimi), followed this developmental path, but most were preoccupied with participation in systems of competitive exchange, in which, among other things, they obtained axes. Standardised (= planilateral) axes of a greater size, uniformity and higher quality than seen previously came to acquire an intrinsic value as wealth objects.

   One consequence of the wealth-driven production system, was a huge increase in the output of work axes at a reduced number of quarries. Most of the casual sources previously in use were abandoned in favour of axes acquired in trade from the central factories, except in the Eastern Highlands, where the old system prevailed until contact.

Hypotheses deriving from either model may be tested in a variety of ways, including by further excavation, more refined sourcing programs and geological survey. Note that neither statement makes any particular assumption about the emergence of ground stone technology. The second model, which is framed in a living socio-economic context, can also be subjected to the scrutiny of contemporary ethnography. My suggestions about the role of the wealth economy in stimulating axe production might receive the objection that I have simply rephrased the issue of adaptation and the purpose ('function') of quarrying and trade. Naturally, almost any argument can be used to justify

functionalist explanations, but here I am attempting to make a valid distinction between needs generated by the nexus of gardening, housing and adaptation to the environment, on the one hand, and those generated by the nexus of values, prestige and socio-political interactions, on the other.[2]

Not all these things can be attempted here, but I introduce relevant arguments in Chapters 3, 4, 7, 8, 9 and 10. I also include, in Chapter 11, a critique of the widely held assumption that the axe trade was necessary because of a scarcity of suitable rocks in the highlands.

DEVELOPMENT OF THE THESIS

An accurate reconstruction of axe production at the Tuman quarries lies at the centre of this thesis and is divided among Chapters 2-7. In Chapter 2, the overflight of the Wahgi Valley by the Taylor-Leahy patrol in 1933 is described in some detail. Apart from being a symbolic Rubicon between the taim bipo and the modern period, the sighting of the patrol's aeroplane by the most recent owners of the Tuman quarries, the Tungei, serves the narrow interests of this thesis because it is vividly recalled by Tungei informants, who were on their last quarrying expedition at the time. There are otherwise few points of reference to our system of calendrical dates in the oral history of the Wahgi.

Chapter 2 introduces the Tungei as a typical, small-scale highlands society and provides a short outline of Tungei organisation from an anthropological point of view. The intention of this is to permit the direct comparison of the Tungei with other Wahgi Valley groups already well known from the ethnographic literature, for example Melpa-speaking tribes of Mt Hagen (Vicedom and Tischner 1943-48; A.M. Strathern 1972) and the Dei Council (A.J. Strathern 1971, 1972), groups of Middle Wahgi language area like the Kuma at Mitj (Reay 1959a) and tribes of the Kuman language area of Simbu around Kundiawa (Brookfield and Brown 1963).

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[2] It could just as easily be argued that military spending is 'functional' because its heavy investment in electronics has enabled citizens to afford digital watches and pocket calculators. But this illustrates the difference between a 'consequence' of something and its 'function'.

I initially gave high priority to the excavation and dating of one, if not several, of the highlands quarries and during August and September 1980 I began excavations at the Tuman quarries. No dating materials were recovered before 26 September, when a dispute broke out between Tungei and Sikeing tribes following a road accident in which a Tungei man was killed. No further work was possible in 1980 and in 1981 it was not possible to recruit excavators at all because of the continuing crisis; men were reluctant to use bush paths for fear of ambush and this precluded the use of bush camps at the sites.

The layout of the Tuman quarries, their labour requirements and implied scale of operations are the subjects of Chapters 3 and 4 and it should be clear that the small-scale sample excavations originally contemplated would not have provided quick or satisfactory answers. The large size even of long-abandoned, prehistoric workings meant that the excavation of just one of them would have consumed all my resources. Other sites in the study area were either too diffuse (in the Jimi Valley), or posed even greater technical difficulties (the Dom **gaima** quarry).

The actual methods used in manufacturing axes are tackled in Chapters 5 and 6. In Chapter 5 I give some details of Tuman knapping techniques, although I was unable to get first-hand experience of them for a variety of reasons (explained there) and thus cannot accurately describe the reduction sequence. The main part of Chapter 5 is a debitage analysis designed specifically to throw light on the spatial organisation of knapping - what kinds of knapping were carried out at what parts of the axe makers' territory - and to provide a means of comparison with the fully prehistoric quarries encountered elsewhere by archaeologists.

Chapter 6 is divided into two parts. The first part contains an account of the sharpening of an axe roughout on a grindstone and a short analysis of the labour requirements of the sharpening process. In the second half I am able to show, with the help of the Tungei haft maker Komnemb Duri, how handles were put onto the finished axe blades. Men like Duri were specialists in a restricted sense of the term and I include here a short discussion of the role and status of specialists in this society.

The Tungei made stone axes primarily for exchange in the Wahgi Valley wealth economy. Chapter 7 presents a detailed analysis of Tungei marriage patterns over the period 1900-81, which I argue map out the first steps of the trade in stone axes and permit some assessment

of the social as well as economic consequences of owning an extremely valuable source of wealth.

In Chapters 8 and 9 two of the other axe making systems of the highlands are described, those used in the Jimi Valley and at the Dom **gaima** quarry. Both may be contrasted with the Tuman quarries in terms of scale and type of output and geological disposition of the axe stone.

The products of all three places, together with axe blades from minor quarries elsewhere and local sources like streambeds, are found in ethnographic collections of axes from various parts of the highlands. The accurate identification of the axes in the collections gives a good idea of the regional importance of each quarry and I present the results of a sourcing program based on hand examination, infrared spectroscopy and X-ray fluorescence in Chapter 10. This chapter also re-examines finds of axe fragments made up to the present in rockshelter excavations to obtain an estimate of the antiquity of the major quarries of the study area. This is the first time that particular quarries, rather than axe types, have been given dates in the Western Highlands or Simbu Province.

Chapter 11 draws in the major findings of the thesis with a critique of past views about the functions of axes and quarries. I conclude with a review of the consequences of my findings for the prehistory of the Papua New Guinea highlands.

Chapter 2

METHODOLOGY AND ETHNOGRAPHIC CONTEXT

The Tungei, the principal subjects of this study, stopped quarrying for axe stone at the time when white men first came to the Wahgi Valley. In fact they say that they were at the quarry sites when the first Australian patrol arrived, at which point they finished work, carried axe stones to their houses, and later gave up the business of axe making. This apparently sudden abandonment was in hindsight not a surprising action, given the way the axe makers operated. Over the next six chapters I will give a full account of Tungei axe making, beginning here with an introduction to the societies of the Wahgi Valley, the Tungei and the methodology of research.

WHITE MEN FIRST SEEN BY THE TUNGEI

It is possible to fix the first sighting of Europeans with absurd precision; at the same time it is important to emphasise that the meeting of cultures in question - that of Wahgi society with Australian colonialism - did not come about through creeping contact after decades of frontier trading, as may have happened elsewhere in the world. It took place at the instant when an aircraft carrying a government patrol officer, Jim Taylor, a surveyor, Ken Spinks, and two gold prospectors, Mick and Dan Leahy, was flown from Bena Bena, near Goroka, into the Wahgi Valley and back. This happened on 27 March 1933. No previous air flight had been made over the valley; no literate visitors had ever

entered it on foot.[1] Details of the trip recorded in Jim Taylor's diary (J.L. Taylor, 1933 patrol diary, 27 March 1933) make it possible to reconstruct the flight path:

> I had arranged with Mr O'Dea of Holdens for a reconnaissance flight along the southern side of the Bismarcks in the direction which we proposed going. One difficulty was that the District Officer could only allow £10 for the flight, and this would take us no distance. But thanks to Mr O'Dea who was just as anxious as ourselves to see the country, and to ensure the success of the patrol, we were able to go much further. With Mr O'Dea as pilot and Messrs M.J. and D.J. Leahy, K. Spinks and myself as passengers a start was made at 9.34.30 a.m. in fine but cloudy weather. A course of 270 degrees was flown until 9.55.30 a.m., a distance of 38.5 miles being covered. The course was then changed to 300 degrees, and the flight continued until 10.26 a.m. when the machine (De Havilland 50) was turned for home. The average speed flown was 100 miles per hour. On the outward journey we passed out of the Garfuku valley at 9.48 .a.m, and a grass valley was observed in the distance ahead, running from the south-east to the north-west. Timbered hills extended to the north and south of us. At 9.55 a.m. the grass valley was beneath us and a new type of garden, the chess board, could be seen below. We were now flying at an altitude of about 12,000 feet, and on either side of us were ranges with peaks about 14,000 feet high. Below was a fine river, and perhaps 50 miles of river flats, but at first it was impossible to tell in which direction it was flowing. On the return journey the pilot brought the machine down as low as practicable, so that it was possible to see that the river was running south-east, and also to see bridges spanning the river. Bena Bena was reached at 11.18 a.m., 51 minutes after the turn back. We had been 1 hour, 43 minutes in the air, and reached a point 85 miles distant from our base. The remainder of the day was spent in preparation for tomorrow. Mr O'Dea stayed the night.

The impression made on highlanders by their first sight of an aeroplane was understandably strong and it was an event witnessed by almost everybody in the community. Highly relevant to the reconstruction of events in Tungei, then, is the fact that the probable

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[1] A previous flight had been made by the Leahys on 8 March 1933, as described by Mick Leahy and Maurice Crain (1937:122-3). The duration of the flight was shorter, only 40 minutes flying time from Bena Bena (Simpson 1954:18). From information in the Taylor patrol diary, specifically that the same pilot, Grabowsky, in a 'Foxmoth', took 65 minutes to reach Mt Hagen from Bena Bena on 27 April 1933, the flight probably turned back 25 minutes flying time from Mt Hagen, or (at 100 mph, 160 kph) about 67 km to the east. This would have been over Kup, on the present Western Highlands-Simbu Province border.

'footprint' of the flight can be placed over their territory with some certainty, with simple calculations of airspeed and direction (Fig. 2.1).[2] Accordingly the plane would have appeared over Tungei territory at 10.15 am, to within a minute or two. It comes as no surprise to learn from informants that a strange noise was heard - it was thought to be a cassowary or some kind of reptile nearby - followed by the passage of an object in the sky overhead, travelling in the direction of Mt Hagen. But the key to my reconstruction is the fact that Tungei informants consistently describe the sighting as being made from the elevated vantage point of the three major quarries, Kunjin, Ngumbamung, and Yesim (see Chapter 3). The panoramic view of the Wahgi Valley from Ngumbamung may be seen in Plate 2.1 and, at around 2100 m, 7000 ft, altitude, the sites were only 5000 ft below the aeroplane. The wife of Aip of Menjpi clan gave birth to a son at the time the plane came; the parents saw the plane and named their son Tau, after **kum tau**, a kind of sorcery.[3] Other men, from Mengka and Mamelka tribes, and from Wałpi said they saw the plane from various points around their territories, but never from the quarry sites. Men of these politically defined groups (see page 18) claim to have worked the sites at some time prior to 1933, but at the instant of the plane's passing overhead only the Tungei were working at the quarries and only the Tungei held territory along the Tun valley above which the quarries were situated (Fig. 2.2).

Setting out from Bena Bena on 28 March the Taylor-Leahy patrol made its tenth camp on 6 April at Kerowil near Minj. The subsequent path of the patrol is plotted in Figure 2.1. After a short stay at Kerowil, where a temporary airstrip was constructed, the patrol arrived

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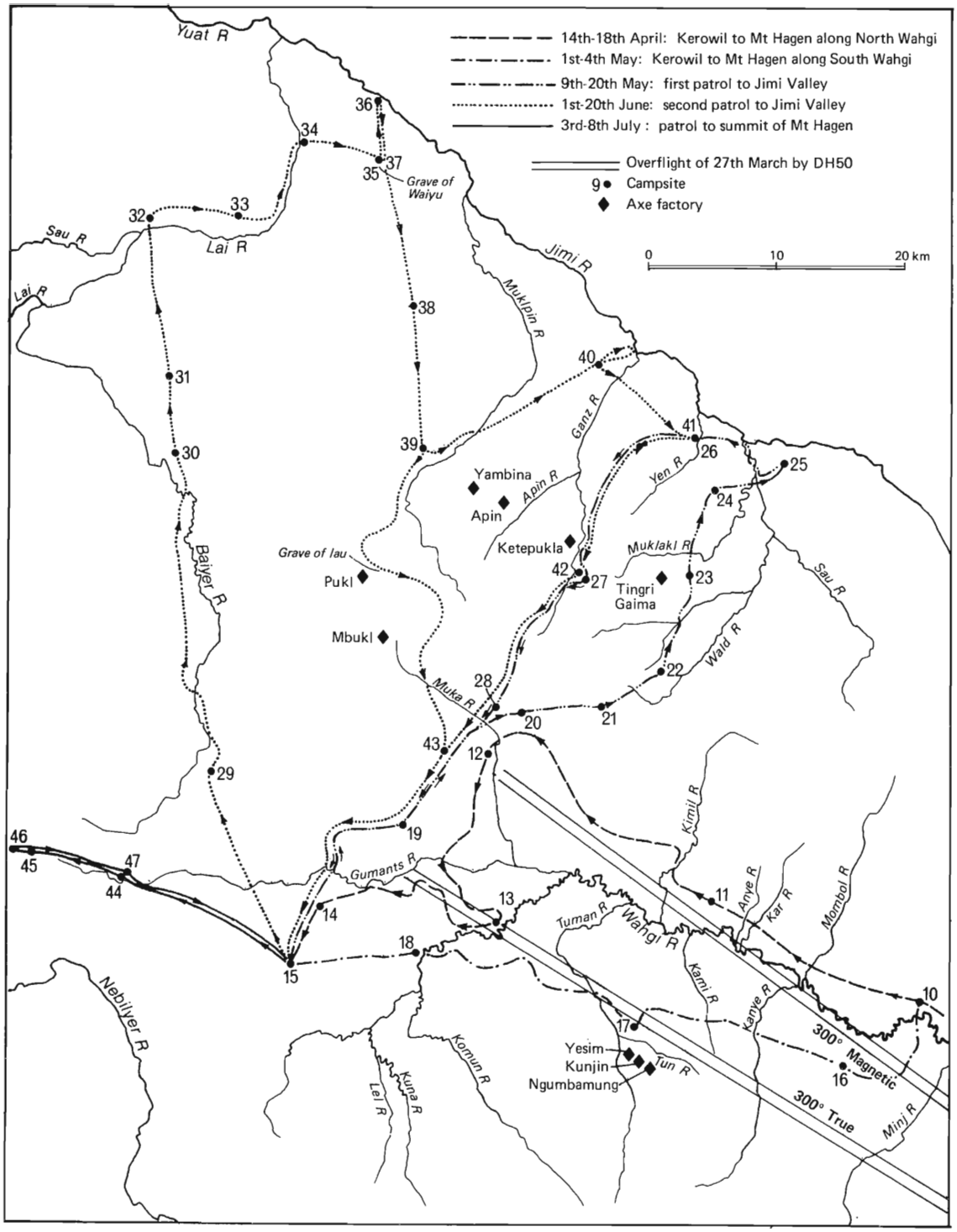
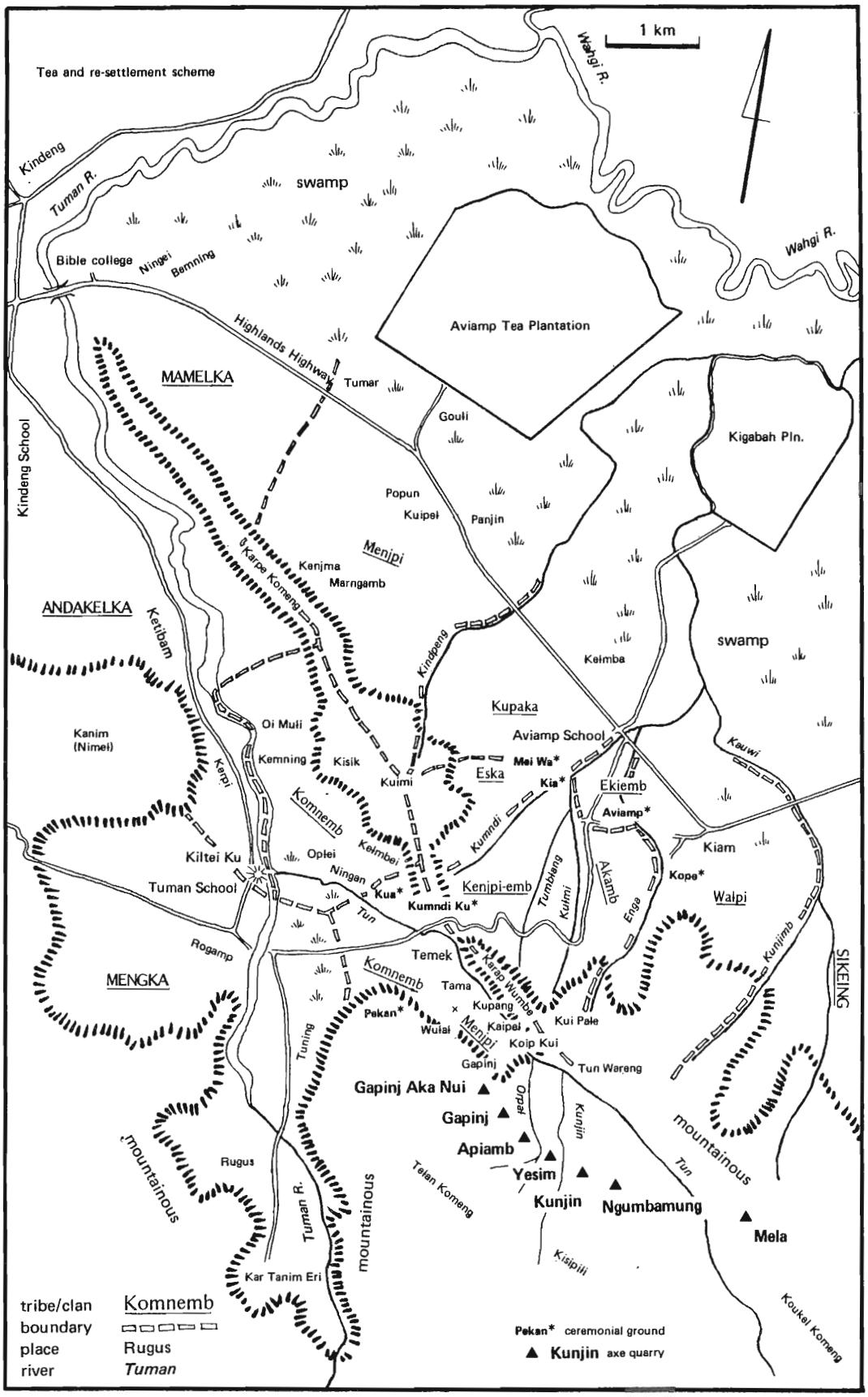
[2] The plane flew on a heading of 270° due west, for 21 minutes at between 100 mph and 110 mph, 160-176 kph (Taylor says they travelled 38.5 miles in this time, but he also says the average speed flown was 100 mph, which is a little slower). It would then have been over the Dom area of Simbu, at approximately BP 715230 - or if the heading was magnetic, BP 719285. It turned onto a new heading of 300° and continued along it for 30 mins 30 secs. This would have taken the plane another 50.8 miles, 81.3 km, or beyond the north Wahgi swamp and Kotna, if it flew so far to the north, or as far as Kuk Agricultural Research Station, if it flew further south.

[3] Interview 35-81.



TAYLOR–LEAHY PATROL 1933 routes followed and path of aerial reconnaissance

Figure 2.1



TERRITORY OF THE TUNGEI MONGKA placenames and clan boundaries

Figure 2.2

at Mt Hagen on 18 April where a base camp (Camp 15) was set up and a more permanent airstrip laid out. A small party of police, however, remained at Kerowil and on 29 April Jim Taylor returned there by air to lead it to Mt Hagen.

Taylor, who was now accompanied by Dan Leahy, took a route back to Mt Hagen along the south wall of the Wahgi Valley (Plate 2.2), crossing the river by means of a vine bridge between Kerowil and Minj (Plate 2.3). After resting the carriers at Kudjip, at a readily identifiable sandstone gorge on the Kanye River (Plate 2.4), the patrol (J.L. Taylor, 1933 patrol diary, 2 May 1933) crossed into Sikeing territory just east of the Tungei, entered Tungei territory and made camp at a place named Kuimi, on the ground of Eska clan, specifically at the house site of Eska Alsap Wu:

> Forward at 11.45 over grass spurs and numerous streams dividing them. Halted at the top of a spur at 1.5 p.m. People here very pleasant, and after a breather here we descended again at 2.5, through gardens and plantations of casuarina, and over many spurs (having crossed the Norkilger at 1.45 and Norgami at 1.55). Crowds of people were about. They are mostly men, and unarmed and friendly. We then crossed grass flats again, some of them swampy, and many streams, reaching Aviamp at 3.40. From here we continued north-westerly through large gardens and across a grass swamp to the end of a spur. Just here the people appeared very timid and a few spears were seen, but everything went well. We then ascended the spur and continued westerly, reaching Kwimi at 5.15 p.m. Altitude 6,153. Camp was made here. Beautiful views were obtainable from this camp - Mt Hagen being visible in the distance. To eastward lay a beautiful cultivated valley, a part of which we had just crossed, and below westerly flowed the Tuman - one of the Wahgi's largest tributaries.
>
> The natives here were very pleasant and the chief man of this part a quiet-spoken fellow - one of the nicest I have ever met. He wore one bamboo bar on his chest similar to that of the Hagen area. This is the first of these we have observed so far east.

The date was 2 May 1933 and the event is well remembered by the Tungei.[4] Many living men themselves went to Kuimi to see the **wu kundi**, the 'red men' (i.e. white men), and a black man identified as 'Pup'.

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[4] The rivers and streams mentioned in this and other patrol reports are often identifiable. 'Norgami' is the stream **noł** Kami, 'water' Kami in Ek Nii. **Noł** 'Kilger' is unknown to me but presumably lies 10 minutes walk to the east.

They say Taylor demonstrated his rifle by shooting off the branch of a Nothofagus (**ond kesił**). When the patrol moved on, the Eska men excavated his latrine pit and prepared a war magic potion, **ope asamb**, mixing the contents with chopped pig's liver. By doing this they believed they would acquire the power of the 'red men' and their firearms.[5] The Tungei, like other Wahgi Valley dwellers, believed the Australians to be **yenge yenge** spirits: dead ancestors in some form returned as humans. The Wałpi at Kiam were not involved with mining at this time, and Pam Wu of Tumamb clan said people had heard of the coming of the patrol and kept torches alight at night to avoid incurring the displeasure of the spirits. When the patrol actually came, some Wałpi men were given cowrie shells in exchange for sugarcane. This behaviour was so unusual, the men held the shells all night long in the palms of their hands to see if they would magically multiply.[6]

Taylor's diary mentions a number of rifle-shooting demonstrations, but the nearest to Kuimi is recorded as having been held in the territory of the neighbouring Onembe tribe on the morning of 3 May - the day after camp was made at Kuimi. Perhaps Taylor failed to note down the demonstration at Kuimi and, hurrying to regain the patrol base at Hagen, where his party arrived on 4 May, wrote up his diary a couple of days later. He may have confused the dates.

Patrol Records After 1933

The first written record of the Tuman axe sites - discounting the inaccurate statements of Ross (1936:347, 353) that Mogei work axes were obtained from the 'Pim' (Pin) River at Kuli, 8 km west of Tun - is found in a patrol report (A. Timperley and B. Corrigan, PR, Hagen No.1 of 1950/51) following a routine administrative visit to the Tuman area in 1950:

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5 Interviews 1-81, 14-81.

6 Interview 3-80.

> From AVIAMP we climbed steeply to the south west and ascended the ridge overlooking the TUMAN River. The height was 5,500'. Descending the well-graded road we crossed RUN Creek and at noon arrived at TUMAN. At the head of RUN Creek is a stone axe factory similar to that which we had seen in the GANZ River area.

No axe or axe making demonstration was seen.[7] In 1956 a patrol officer was sent to investigate the economic situation at Aviamp. He recorded some details about axe manufacture - clearly from verbal descriptions only - adding that he 'regretted that no axe could be obtained from AVIAMP as a sample' (R. Hill, PR, Minj No.3 of 1956/57). In contrast, on the Ganz River - near the traditional factory mentioned in the Timperley/Corrigan report - axes of traditional quality continued to be produced as a source of cash income well into the 1970s. This is known from eye-witness reports (see Chapter 8).

THE WAHGI VALLEY TODAY

At a general level, the peoples of the Wahgi region follow local variations of the same lifestyle (e.g. Brookfield and Brown 1963). They are primarily horticulturalists depending on the staple crop, sweet potato. Pigs are raised, but more as part of the wealth economy than as a means of daily sustenance. The region can be divided into three broad ecological zones: the Jimi Valley, an area of low altitude settlement descending from about 2000 m on the northern side of the Sepik-Wahgi Divide to 400 m at the Jimi River (Plate 2.5), the Wahgi Valley from the Hagen Range to the central part of Simbu Province (Plate 2.6), and the Kubor Range, a sparsely populated massif rising to over 4000 m (Plate 2.7). Linguistically, the region is diverse and socio-politically the societies of the area conform to several organisational patterns (Rubel and Rosman 1978).

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[7] 'Run' is referred to in this text as 'Tun' (see Notes on Orthography).

Political Organisation

Depending on historical factors, societies of the region are organised into exogamous clans, and at higher levels into tribes or phratries or both. Clans are always based around a core of agnates, but to a lesser or greater extent non-agnates settle with clansmen or women and eventually become accepted as full clan members (cf. A.J. Strathern 1972). Some anthropologists, heeding a call from Barnes (1962), have shied away from lineage-oriented terms like 'clan', and have instead written of 'ceremonial groups' (Criper 1967), or 'large families' (Sillitoe 1979:32-4).

The term 'tribe' is taken to mean a political and military alliance of clans all or most of whom share the belief of a common origin (cf. Brown 1960). Contrasting with this, the term 'phratry' means an aggregate of clans who share a common origin belief, but who are politically disunited. A phratry is named (for example 'Kuma') but the named entity has no military or political function nor rule of exogamy (Reay 1959a:25-7).

In general, phratries may be assumed to reflect relict political groupings, now fragmented or re-aligned. Reay (1971:178) states that the North Wall of the Wahgi Valley was still organised into tribes based on phratries or part-phratries at the time Europeans first came to the area, and that the South Wall phratries, now disunited and physically dispersed, have a tradition that they were also war-fighting, territorial groups at one time.

A similar process of political fragmentation does not seem to have happened among the Melpa, and several large tribes have managed to maintain a political identity despite having dispersed land holdings and populations up to ten times that of typical Middle Wahgi groups (A.J. Strathern 1971:Appendix A).

Five tribes, by the above definition, live in the Nii language area (Fig. 2.3). They are Kelaka, to the north of the Wahgi River, and Tungei, Mengka, Mamelka and Sikeing to the south. While the four southern tribes all had access to various of the Tuman quarries at one time or another in remembered times, only the Tungei and Sikeing held territory containing axe quarries at the time of the Taylor-Leahy patrol in 1933 (Fig. 2.2). Other groups known to the Tungei in traditional times are also shown in Figure 2.3.

The Tungei, whose full name is Tungei Mongka, have an origin myth

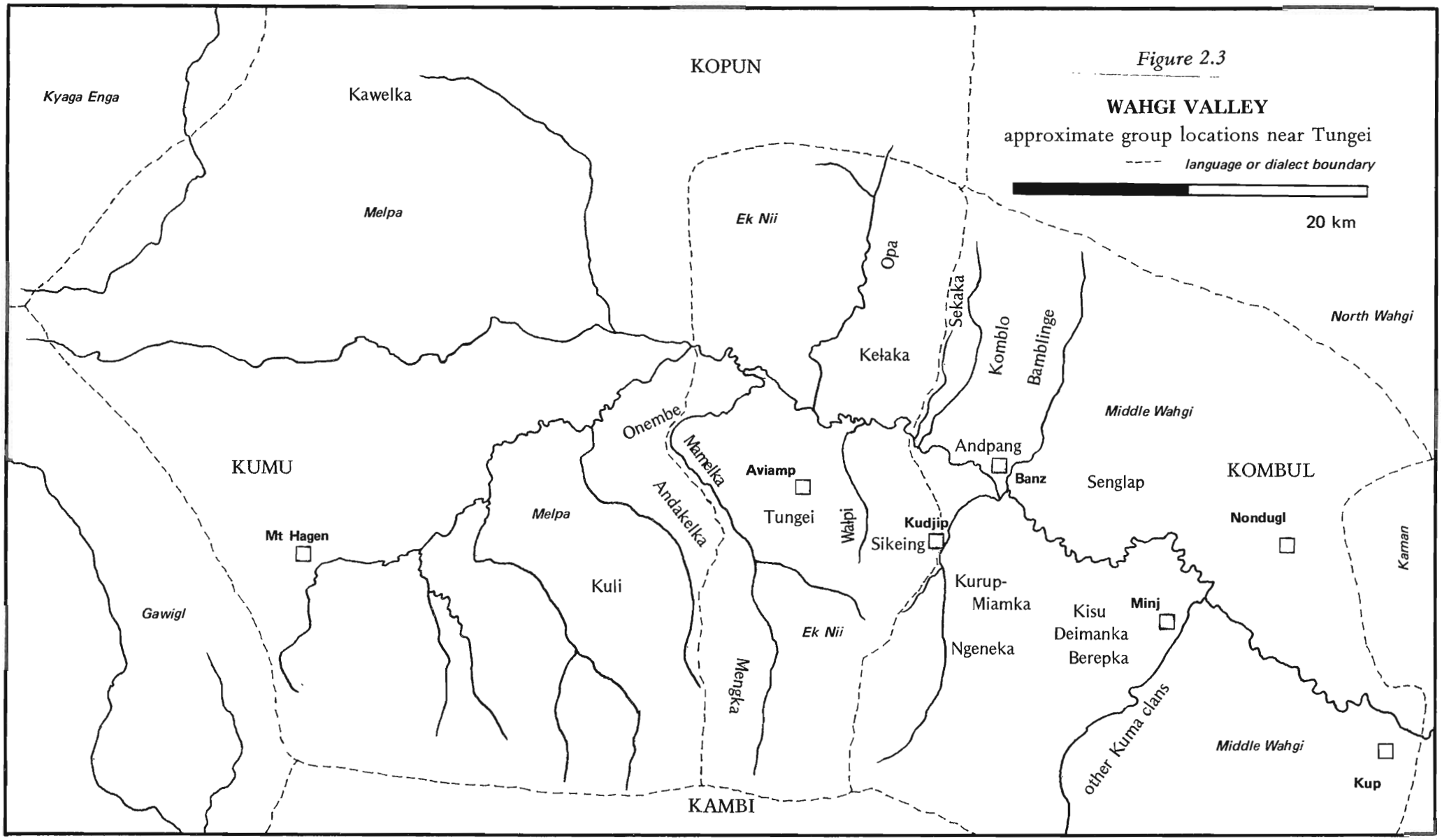


Figure 2.3
WAHGI VALLEY
approximate group locations near Tungei
language or dialect boundary
20 km
KOPUN
Kyaga Enga
Kawelka
Melpa
Ek Nii
Opa
Sekaka
Kełaka
Komblo
Bamblinge
North Wahgi
Middle Wahgi
Onembe
Mamelka
Andakelka
Aviamp
Tungei
Wahpi
Andpang
Banz
Senglap
KOMBUL
Nondugl
Kaman
KUMU
Mt Hagen
Melpa
Kuli
Kudjip
Sikeing
Kurup-
Miamka
Ngeneka
Kisu
Deimanka
Berepka
Minj
Gawigl
Ek Nii
Mengka
other Kuma clans
Middle Wahgi
Kup
KAMBI

stating that they arose with Mengka and Mamelka at Kiltei Ku, a small knoll now on Andakelka ground on the left bank of the Tuman River (Plate 2.8). Evidently the Mengka, the Tungei Mongka and the Mamelka may have at one time been more closely linked than today, and they might be considered a phratry; but if so it is unnamed (Fig. 2.4). Brown (1960:29) describes a similar situation for Central Chimbu:

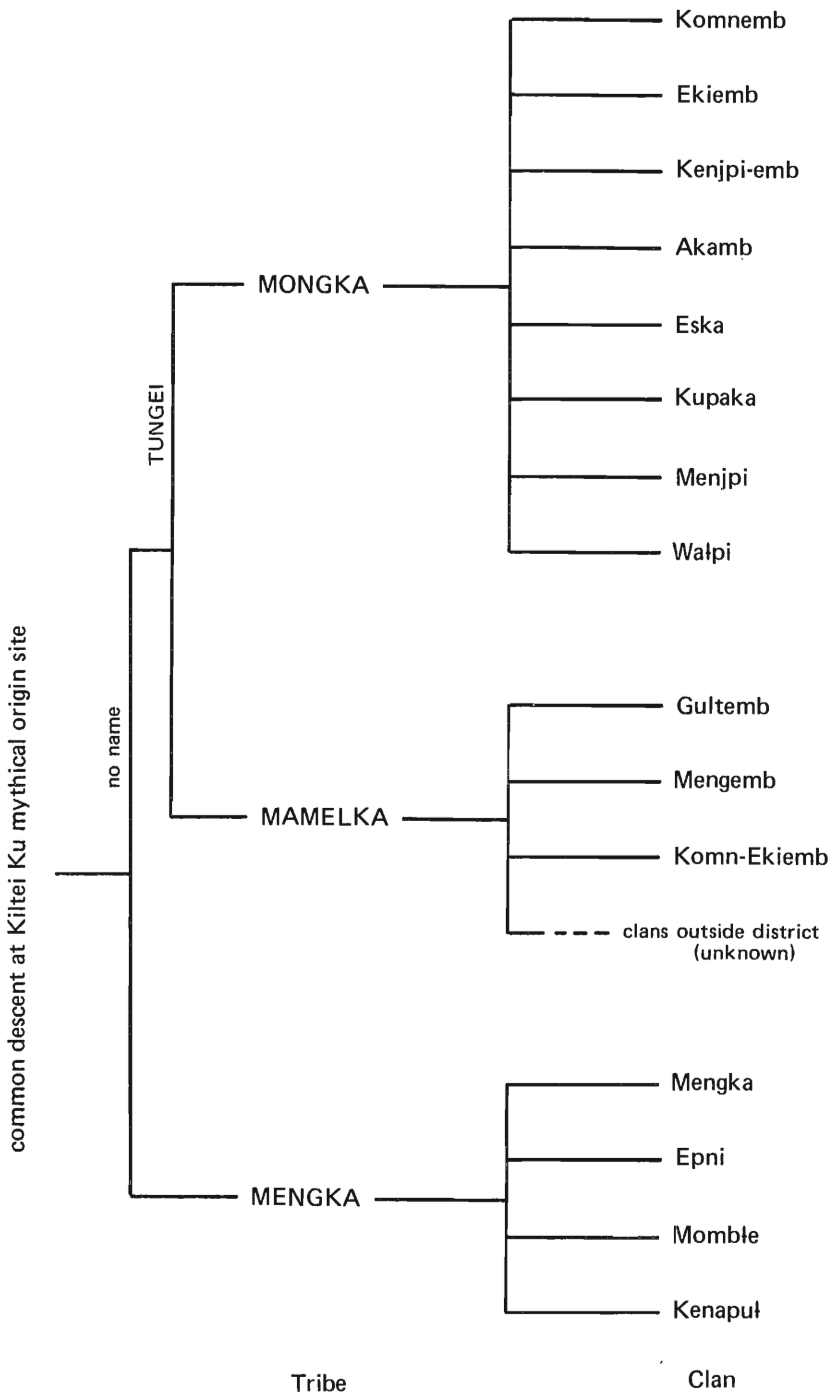
> we often find that the core of a tribe is a group of clans forming a phratry. Frequently, a part of the phratry migrated at some time in the past, so that the tribal core is in fact a local part-phratry

Some trace of their former association is provided by anomalous marriage prohibitions: Tungei Mongka Komnemb clan may not marry girls from Mamelka Gultemb clan, and vice versa, though Mongka and Mamelka intermarry freely as a rule.

Tungei is a term which can be defined at several levels, stressing the use of the name to describe a widening political alliance. Six clans comprise the 'old' Tungei (Fig. 2.5) - Komnemb, Ekiemb, Kenjpiemb, Akamb, Eska, and Kupaka, and are the ones believed to have arisen at Kiltei Ku. Their ancestral couple, Jimbe and Doimbe, is credited with the discovery of the axe quarries (Appendix A). Narrators conceive of lines of men descending from them, ultimately reaching living people. The sub-clan is the present-day representative of such a line of men.

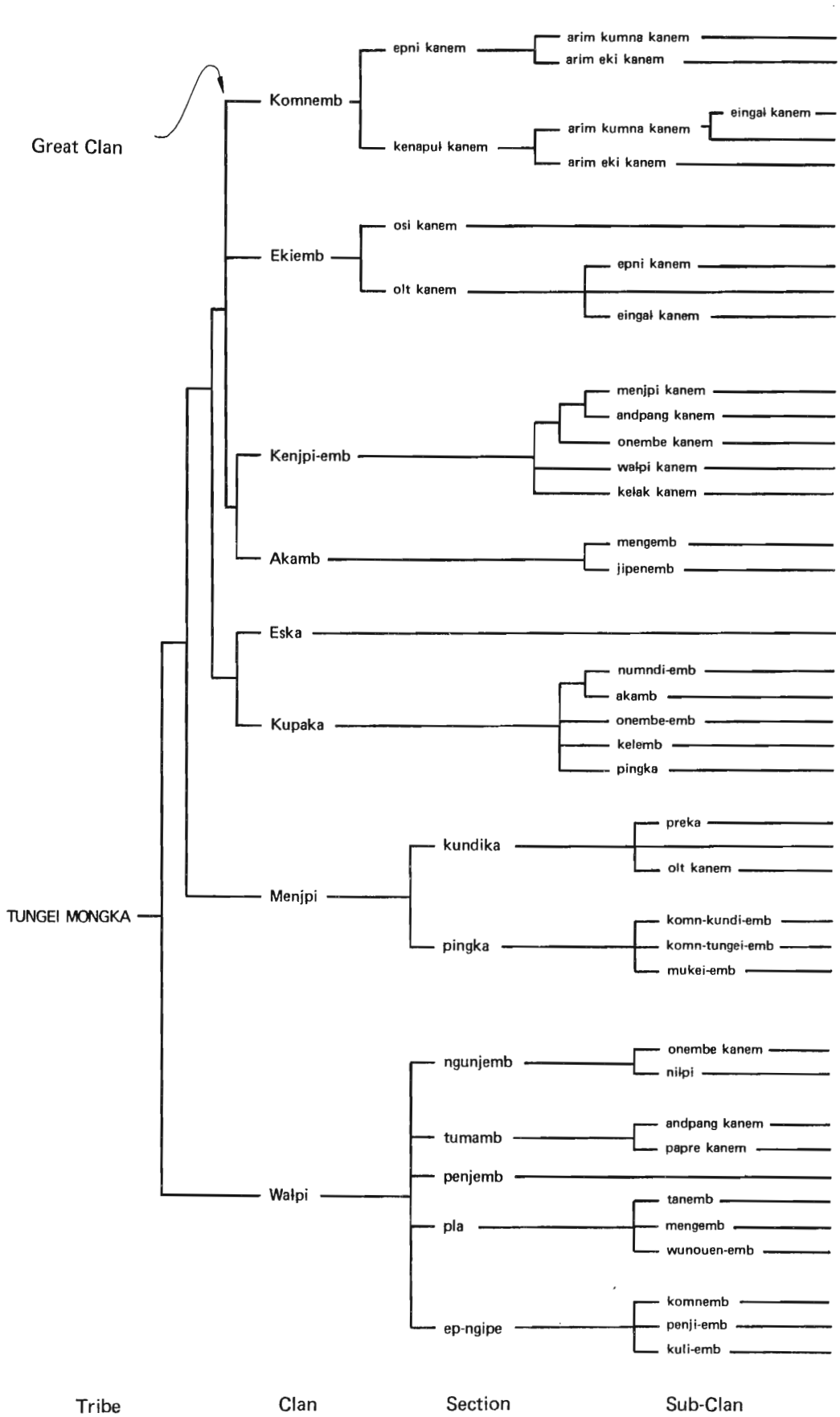
The Menjpi origin myth describes a migration from a Hagen place Num Kala (Appendix A) and the modern Menjpi are still considered brothers of the Hageners who remain there, the Kime Menjpi. Older Menjpi men, especially, often refer to the six clans named above as 'the Tungei', if they do not wish to include themselves. But today Menjpi are inseparably Tungei and were axe makers in 1933, owning one of the quarries (Yesim). This inclusive political unit may be called the 'axe making Tungei' for present purposes.

Waɬpi origins are less clear to me and seem to be interlinked with their easterly neighbours, the Sikeing, as well as the Tungei. Their territory has shifted significantly this century and they fought a major war with the remainder of Tungei about 1934, Waɬpi sustaining some six fatalities in the last hostilities of the colonial period. Early census references to Waɬpi show them listed separately from 'DONGAIMONKA' as 'WAREPI', with separate <u>luluais</u>, Menjpi Nui and Waɬpi



UNNAMED TUMAN RIVER PHRATRY groups sharing origin myth

Figure 2.4



TUNGEI MONGKA modern pattern of segmentation

Figure 2.5

Asip. The patrol post was the same for both, at Aviamp.[8] Nevertheless, Waɨpi are full members of the present-day Tungei, with one local councillor for all. They bore the brunt of renewed fighting between Tungei and Sikeing in 1980-81.[9]

At a higher level, men will often use terms 'Tungei Mongka' and 'Tungei Mamelka' to mark the perception of Mongka and Mamelka as a tribe-pair. At any rate, Mamelka are politically part of the Tungei today, though they fought against each other a couple of years before the Taylor-Leahy patrol. One of the earliest administration reference to both groups, at the census in February 1953, records both names 'DONGAI-MONKA' and 'DONGAI-MAMALKA'; 841 Mongka and 349 Mamelka were counted, showing disparity in size between the two groups (B. Corrigan, PR, Minj No.3 of 1952/53).[10]

Geography

The Tungei classify the points of the compass, and the people who live in each direction, in relation to the Wahgi River (Fig. 2.3). As this flows west to east, the terms **mer**, **ei**, **wuɨ**, **aɨ** have the same value as European north, south, west and east. The areas indicated by the cardinal points are **Kumu**, or Central Melpa, **Kopun**, or North Melpa

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[8] A later report which recorded Tungei clan and sub-clan names accurately made note of the fact that while 'WAGLPI' were sometimes referred to as 'DONGAI-WAREPI', it was more correct to list them on their own, because of their separately claimed origin (C.A. Buttner, PR, Minj No.3 of 1968/69).

[9] Due to the circumstances of fieldwork it was not possible to investigate the relationship of the Waɨpi sections Ngunjemb, Tumamb, Penjemb, Pla, and Ep-ngipe to each other. The segmentation given in Figure 2.5 is believed to be correct, but these five groups may well intermarry.

[10] A.J. Strathern (1971:Appendix 1) lists both 'Rungøi' and 'Dongai' as groups living in what was then known as Hagen Sub-District and south of the Wahgi River. Both refer to the Tungei Mamelka, who were subsequently censused in that Sub-District. In 1973 Mamelka Mengemb, Gultemb and Komn-Ekiemb clans elected to rejoin the Wahgi Council area (M.J. Deasy, PR, Minj No.2 of 1972/73). See Notes on Orthography, Appendix B and A.J. Strathern (1971:Appendix 1, Footnote [a]).

(A.J. Strathern 1971:6; A.M. Strathern 1972:331), **Kombuł**, or the Middle Wahgi east of Minj and the Kuman[11] language area of Simbu Province, and **Kambi**, or the far side of the Kubor Range (East Kambia). There is no particular term reserved for the Tuman area; each territory within it is referred to by speaking of the group who live there - for example Mamelka **kone**, the Mamelka's place - while the people as a whole call themselves **emb wumb** ('root, or planted, men and women'). This is identical to Vicedom's term **mbo wamb** for Hageners (Vicedom and Tischner 1943-48). In this fashion the Tungei call Hageners **kumu wumb** ('Central Melpa people').

While access to and from many of these areas was not traditionally possible because of constant fighting, men did have a reasonable knowledge of groups and territories at some distance from their borders, and they were able to obtain wives from as far as three groups away. Beyond this, men would have been reasonably knowledgeable, but only from hearsay.

Some areas, however, were not visited for reasons to do with physical access. Two geographic features contained social traffic along the South Wall of the Wahgi Valley. The valley floor was the first of these.

Cane suspension bridges, **noł poł**, spanned the Wahgi River in various places (e.g. Plate 2.3), including the border between Tungei and Kelaka. But communications on a north-south axis were not well developed at all and there was virtually no contact between the Tungei and the north Wahgi Kelaka, for example, yet they share a common border and had no history of antagonism. Little intermarriage is recorded this century (Chapter 7) and no Tungei warriors are known to have died at the hands of the Kelaka - another means of gauging the degree of contact.

Two Kelaka men were recalled as having taken up Tungei residence status before 1933, one of whom, Wan Eki, became a Kenjpi-emb big-man and sub-clan founder (Fig. 2.11). Wan Eki must have lived in the nineteenth century A.D. A song (Appendix C) records the death of the Kelaka big-man Geltang in an ambush at the place Kełmba, on Tungei ground. Geltang was attacked by his enemies as he visited Tungei men to trade for axes.

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[11] Note that Kuman itself is not a language name, but a local directional term equivalent to the Nii **Kumu** ('westward').

Whether the difficulty of keeping open paths through the 3-5 m high cane grass of the low-lying land, in the absence of cultivation, was a factor limiting this cannot be said. Gardens were definitely being made in other parts of the flatlands in 1933, in the immediate vicinity of Kuk (J.L. Taylor, 1933 patrol diary, 16 April 1933), but the Tungei did not utilise the extensive tracts of similar ground between Aviamp and the Wahgi (Fig. 2.2, Plate 2.2). A dwarf spirit, **gui wał**, was believed to occupy the area and cause sickness there; today younger informants suggest that the latter may have been malaria.[12] The swamp has been reclaimed commercially in two places, at Gouł̄i for Aviamp Tea and at Keł̄mba for a coffee plantation, while a resettlement scheme has seen highlanders from Simbu and elsewhere opening up land at Kindeng.

The second important geographical feature was the northern margin of the Kubor Range. The highest peaks attain 4000 m, including Angł̄imb (Plate 2.7) to which some Tungei clans, together with the Mengka clans Epni and Mombł̄e, lay territorial claims. Unlike the low-lying swamps, it actually facilitated communications between groups living along its northern flank. The Kuma clan-pair Kurup-Miamka, Tungei allies living on the Kanye River, had a narrow border with Tungei at Koukel Komung deep in the mountains. This enabled Kurup-Miamka men visiting the Tungei to skirt hostile territory lying along the direct route. The Kisu and Deimanka at Kurumul and, even further away, one of the Kondika sub-clans from Minj, living at five groups from the axe makers, also found safety in the mountains. Normally travel was hazardous over such a distance, because men could never rely on a safe passage through densely populated but unknown territory.

Beyond the Kubor Range, the area known as **Kambi** is much less well known. Legend has it that Komnemb clan, who at one time lived at Rugus, further up the Tuman, suffered a defeat at the hands of their enemies. One day they were preparing earth ovens to cook pigs and

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[12] Ross (1936:363) mentions this malevolent spirit from the Mt Hagen area: '**kur wag**, the water ghost, a bad spirit of a former man.' Gitlow (1947:52) extends Ross' description: '**kur wag** - the water ghost. A bad spirit of a former man. He is believed to cause all sorts of calamities, such as sickness, death, war, and failure of crops. It is believed that he goes abroad at dusk, making a squeaking noise like a rat in fear.' See also A.J. Strathern (1970:Fig. 2).

without warning a marsupial, **ka melka**, fell out of a tree and was killed in the fire being used to heat up cooking stones. Following this omen the Komnemb split up, one party eventually coming to live at Pekan and Kemning, and the other following the Tuman to its source and crossing into East Kambia, where they are presumed to live today. The legend, while it relates to events many generations ago, has a contemporary postscript, since I was assured that in the mid-1970s men of the **Kambi** Komnemb made their way along the Highlands Highway inquiring for the Tungei Komnemb.

Language

The Tungei classify the languages spoken around them into several **ek** (literally: 'speech'). Hageners, living west of the Tuman and Kimil Rivers, speak **ek nam**, or Melpa. The Tungei speak Ek Nii, together with their neighbours the Mengka, Mamelka, Kelaka and Sikeing, a total of about 10,000 people. In addition, two out of five clans of the nominally 'Hagen' tribe Andakelka speak Ek Nii; the situation on the Kimil River is unknown, but it may be similar where the two groups Opa and Kelaka have a border. The Middle Wahgi language, called by its speakers **yu wei** 'speech true' (Ramsey 1975), is referred to by the Tungei in Ek Nii as **ek ngał**. Beyond this, the Simbu Province Kuman language is referred to as **ek sira**. Wurm (1978) and Wurm and Shiro Hattori (1981) classify these languages into the Central Family of the East New Guinea Highlands Stock (Fig. 2.3).

The Minj and Banz dialects of Middle Wahgi are recognised to be different and the speech of the Sikeing, **ek nap**, is felt to be at least a Nii dialect, if not fully intermediate between Nii and Middle Wahgi. The Kelaka speak another form of Ek Nii, which the Tungei call **ek bei**.

Language marks a culturally defined boundary in this area. Hageners, the Melpa speakers, transact live pigs in an investment system called **moka** (A.J. Strathern 1971), while Middle Wahgi men hold pig festivals once a generation, at the climax of which they kill thousands of pigs at once (Luzbetak 1954a, 1954b). Dress styles are different, both ceremonially and in everyday life. Hageners blacken their faces and dance in swaying lines, decked with Raggiana (Paradisaea raggiana) bird of paradise plumes and eagle feathers (Strathern and Strathern 1971); Wahgis put on resin-backed wigs and the

tall, black plumes of the Princess Stephanie (Astrapia stephaniae) and Black Sickle-Bill (Epimachus fastosus) birds of paradise, and they dance in stomping phalanxes. Sandwiched between the two, Ek Nii speakers share features of both culture areas. Like Middle Wahgi speakers, they do not make **moka**, a custom which stops on the west bank of the Tuman River. The river, incidentally, is no barrier; it flows in braided channels and is rarely more than knee-deep (Plate 2.9). On the other hand the Tungei do not use the Bolim and Geru cults practised by many Middle Wahgi groups at their festivals (Luzbetak 1954b:103-11; Reay 1959a:152-62).

The processes of language formation in the area are probably complex; it is sufficient to say that, as Ek Nii speakers, the Tungei lie on a dialect chain. Neighbours could understand each other, but not speakers at one remove from them. Because Ek Nii, a 10 km wide strip of language in the narrowest part of the Wahgi, is so small a language community in relation to its neighbours, it is not surprising that speakers there think of themselves as linguistic middlemen with a privileged ability to communicate up and down the valley. But this may be illusory, or of no practical significance.

There was little risk of encountering traders from such a distance that their speech could not be understood, since 'free' trade was slight in importance and most men making trade with each other were already acquainted or related by marriage (Chapter 7). I found some evidence that differences in language and custom affect the willingness of men to offer their daughters in marriage across cultural borders (see Chapter 7), but there certainly are cases where a Tungei man with three wives has one from each of the Melpa, Nii and Wahgi language areas. The fact that the Ek Nii-speaking axe makers were able to freely converse with men from the Simbu border to the Nebilyer Valley cannot have harmed their chances of success as purveyors of axes, but it would not have granted them a monopoly.

Tungei Tribal Segmentation

Within the Tungei, 'clans' are not the largest units that are exogamous. They are the largest named units that are exogamous. Higher level, but unnamed, groupings of clans are in fact the exogamous units, with antigamy between the clans they comprise. Examples can

also be found in nearby societies where the locally important group, which holds territory and in general 'acts as one' within a tribal federation, is not the maximal unit of exogamy. I propose to call the latter a 'great clan', following Vicedom and Tischner (1943-48, II, 24) and R. Bulmer (1960:201). The Tungei clans Komnemb, Ekiemb, Kenjpi-emb and Akamb, none of whom inter-marry, are therefore a 'great clan.'

The Tungei great clan may be compared with the units which Ryan (1959:276) termed 'clan clusters':

> ...a group of two or more clans which either share the same, or occupy contiguous territories, which act together in most inter-clan contexts, between which exist many ties of kinship (with total or partial antigamy), and finally, between whose members a constant and regular social intercourse is maintained...

These Mendi clan clusters were only named in one case, and in Mendi there were no higher level groups like tribes or phratries as are found in the Wahgi Valley (cf. Sillitoe 1979:Chapter 2). R. Rappaport (1968:8) also called the Tsembaga high-level groupings 'clan clusters'; again there were no 'tribal' polities in this society.

The clans comprising a clan pair or a great clan are said to be **angam angam** ('brother brother'). An outsider might say that Komnemb and Menjpi were **angam angam**, meaning they were both Tungei clans, both on good terms and had, over a period of years, made many marriages. But within the Tungei, **angam angam** would not be used this way. It would be reserved for the clans which do not inter-marry because of their genealogical closeness. This is contrary to Reay's (1959a:61) use of the expression:

> Nearly every clan is associated with at least one other with which constant and intensive intermarriage takes place...they are 'as brothers' (**angam angam**) to each other.

Perhaps it would be more accurate to say that **angam angam** implies that two things are identified with each other so closely that they are considered to be paired with each other.[13] Eska and Kupaka clans form an exogamous pair known as Es-Kupaka; they are also considered to be **angam angam**.

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[13] Species in the natural world are also classed together as **angam angam**. For example **kei eimbał** and **kei parke**, the Lesser (Paradisaea minor) and Raggiana birds of paradise, are 'brothers'.

Figure 2.5 shows that clan segmentation is hierarchical in nature, but it is imperfectly so. For example, Ekiemb clan is divided into two unequal sub-clans called Osi Kanem and Olt Kanem ('short kind' and 'long kind'). Olt Kanem has two founding brothers, Nui and Wembe, and has been sub-divided. One branch comprises the large lineage descended from one of Nui's wives, natally of Mengka Epni clan, and is called Epni Kanem. But the main stem, consisting of Wembe's descendants and those of Nui's other wives, remains Olt Kanem. This is typical of the other clans' experience; Tungei segmentation is not that of a uniform cladistic tree.

In the mythical past it is said that the Menjpi sections, Pingka and Kundika, fought each other, actually in battle formation with shields and spears. I think this suggests the useful distinction of 'clan sections' and 'sub-clans' within the Tungei. The autonomy of sections is more marked and the segmentation is more ancient. In Komnemb clan, men of Epni Kanem and Kenapuɨ Kanem, segments similar in size to Pingka and Kundika, often discussed their joint ancestry with me in terms of traceable lines of men. Pingka and Kundika men only referred to their mythical ancestors, Ben and Esemb, the equivalents among the remainder of the Tungei to Jimbe and Doimbe (see Appendix A).[14] At a still lower level of segmentation, Tungei sub-clans may comprise two or more 'sub-sub-clans' or 'men's house groups'. Technically, sub-sub-clans are named lineages within sub-clans, while men's house groups are more fluid aggregations of men; the two may or may not coincide (Plate 2.10).

In discussing the Tungei in terms of its constituent clans I have paid little attention to the concept of descent as a criterion of membership of the clans themselves (Barnes 1962). In fact the Tungei do not stress descent as a prerequisite for becoming, say, Komnemb as opposed to Menjpi or Waɨpi but, by comparison with the Northern Melpa Kawelka, rates of agnation are high. This is very probably related to the fact that the Tungei have been militarily successful and have been able to maintain the integrity of their territory, while the Kawelka were forced to migrate in the early part of the century (A.J. Strathern 1972:36-9; Gorecki 1982:26-8).

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[14] Naming etymologies are a notoriously unreliable guide, but Pingka ('black **ka**') and Kundika ('red **ka**') are also notable for having the highest level suffix **-ka** normally reserved for clans or tribes.

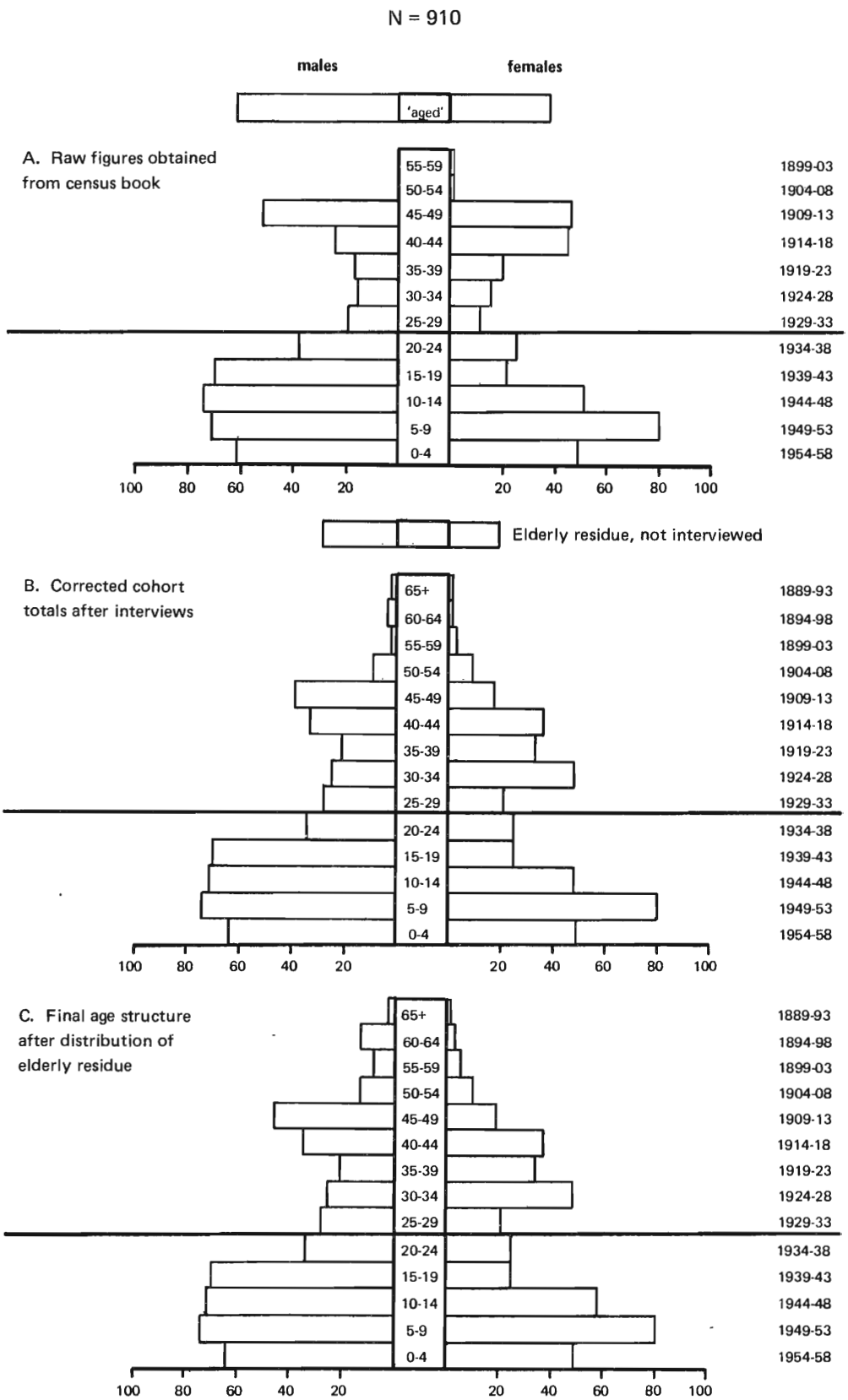
ORAL HISTORICAL METHODOLOGY AND INTERVIEW TECHNIQUES

The Tungei do not belong to a culture with a tradition of reckoning genealogies or narrating historical sagas. A man will know the identity of his paternal grandfather and his brothers, but he may not know anything of earlier ancestors unless they were important lineage founders. Similarly, events are remembered just so long as those immediately connected with them are alive, so that the majority of oral accounts are reminiscences rather than ancient 'texts' handed down from generation to generation.

My reconstruction, in Chapter 4, of the axe making operations of the Tungei is founded on a schema of remembered events and on a corpus of sub-clan genealogies. The means of obtaining these was through interviews with older members of the Tungei in conjunction with the analysis of two early village census books, compiled in 1958 and in 1968. By means of cross-comparisons and other systematic age corrections, which I will not detail in this thesis, I was able to construct age-sex pyramids for both censuses; these are shown in Figures 2.6 and 2.7. Each diagram is in three parts. The top part displays the raw tabulations of people from the census books, where it can be seen that an age in years was not usually estimated for the members of the population judged to have been over 50 years of age. These people were listed simply as 'aged' (Fig. 2.6).

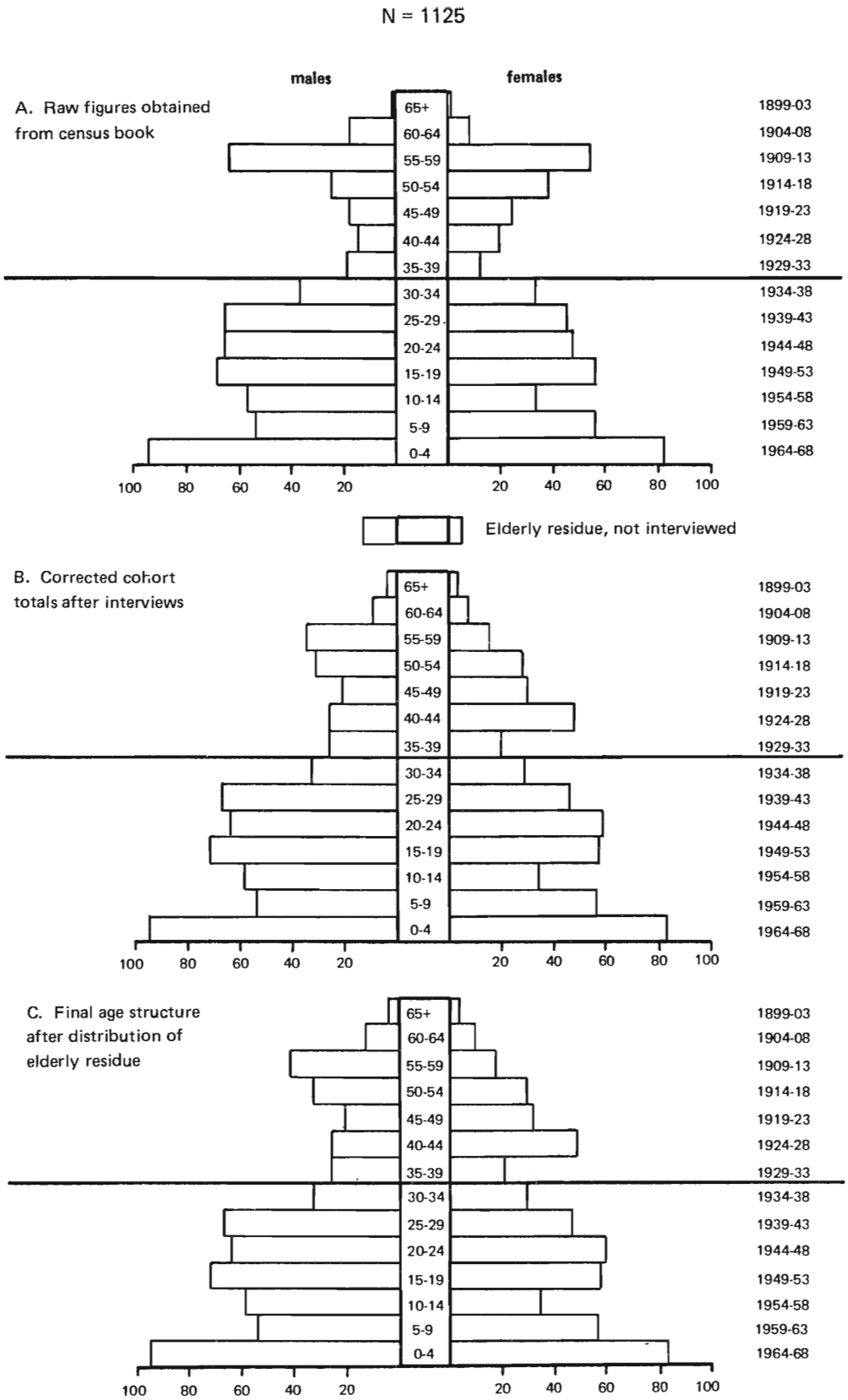
Approximately half of the 'aged' were either closely related to other living people or were alive in 1981, in which case I interviewed them or asked after them. I was able to estimate their ages with reference to the arrival of the Taylor-Leahy patrol, the birth of children and other events of personal significance (middle parts of each diagram). This still left a number of old people whose age I could not estimate directly. I distributed them among the top four age groups with the frequencies I observed when interviewing the survivors of their cohorts (lower parts of each diagram).

The first book provided a useful starting-point for more detailed inquiries and, as can be seen from Figure 2.6, I was fortunate in that the cohort of men who would have been in the 20-24 age group in 1933 was a large one. This is the cohort aged 45-49 in 1958 and 55-59 in 1968. Life expectancy has been high among the Tungei and many of these men - and those older still - were alive in 1981 when they were 60-90 years of age. In contrast, Jimi Valley health patterns and longevity



TUNGEI MONGKA population pyramid in 1958

Figure 2.6



TUNGEI MONGKA population pyramid in 1968

Figure 2.7

were quite different, and I had difficulty in finding men of age 55 years and above when I went there to hold interviews.

Among the men I worked most closely with, two were notably much older than the average. Komnemb Malimbe was twice married before 1933 and he had one small son at the time Jim Taylor arrived on patrol. I believe he was then about 29 (b. ?1904).[15] Menjpi Kandeɨ was three times married before 1933 and he also had one small son. His next younger brother was also married and his last brother was about 20 years of age, with a sister in between them. Kandeɨ's seniority is widely acknowledged; I believe he must have been 35 in 1933 (b. ?1898).

Other informants were also very old, like Kenjpi-emb Geri, his sister Nun, and Waɨpi Pam Wu. Kenjpi-emb Aus, of the same sub-clan as Nun, was about 16 in 1933. He said Nun was the same age as his own father, Kupaɨ (d. ?1922). This is a possibility; on other grounds she may have been slightly younger and in her early 80s (b. ?1900). Her eldest living son is in his 60s. Geri was said to be her contemporary.

Pam Wu worked at Gapinj Aka Nui a couple of decades before 1933; his age can be judged by the fact that his great-grandson was born in 1964, according to the 1958-68 village census book. The village book estimate of his son's date of birth is 1920, while the estimate of his son's daughter's date of birth is 1944 - she bore the great-grandson. Following guidelines suggested by an analysis of village book figures (see page 32), an estimate of Pam Wu's date of birth is 1895. But his son was preceded by a daughter and he may well have been born earlier still. I think he was, at about 90 years of age, the oldest man I interviewed.

Mnemonic Devices

In non-literate societies, it is necessary to find mnemonic devices around which oral history may be structured: songs which encode actual words or phrases, landscape features around which legends arise, or artefacts that record events of chronological significance (Vansina 1973:36-9).

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[15] He is the man of whom Chappell (1966:105) wrote 'only one man was met in the course of the whole field study who was impressive...who could consistently identify...and explain all his reasons for his identifications.'

The Tungei and their neighbours certainly maintain a corpus of legendary exploits and actual deeds in story and song, and in the notable form of **ope ek** ('war speech') oratory (Reay 1959a:118-9; A.J. Strathern 1971:Appendix 7). Unfortunately the study of oratory is linguistically so demanding that it is too specialised for general ethnographic purposes. Much use is made of archaic language and deliberately obscure metaphorical forms in **ope ek** and the speaker may 'encode' his message: only those 'in the know' understand what is being put across.

Longer term historical processes, particularly knowledge about tribal origins and migrations, are typically cast around mythical characters acting out legend in the real, physical landscape. How reliable this kind of history is as chronology is questionable, but regional patterns in legends of tribal origin have occasionally proved useful in mapping present-day territorial holdings (Brookfield and Brown 1963:Map 7).

There are many artefacts of symbolic importance in the Wahgi region, but few encode chronological information. An exception is the Hagen **omak** and related ceremonial tallies. They are discussed by A.J. Strathern (1971:189-90). The bamboo slats of a man's **omak** record his success over the years in investing pigs (and formerly shells) in **moka** exchanges - but no central system notes the sequence of the **moka** festivals themselves.

Formal mnemonic systems, then, are neither chronologically rich in the Wahgi, nor necessarily easy for the culture holders to read. Fortunately life in the Wahgi Valley in the early part of the century was far from monotonous and an average person's experience encompassed war, territorial displacement and the shifting of political alliances, as well as ceremonial life, marriage and the birth of sons and daughters. An ordering of these events indeed provides the basis of a chronology of Tungei history (see Appendix B).

Preliminary Interviews

An initial series of interviews was broad in scope and designed to establish, as quickly as possible, the framework for more detailed enquiries. I asked knowledgeable informants to discuss aspects of quarrying with me, concentrating on three particular problems: whether

work was continuous or episodic (and how frequent), which clans worked at which site (and whether they worked independently of each other), and how many men of each clan, by men's-house-group, worked at once.

From the descriptions of operations at the sites I was soon left in no doubt that quarrying took place in the form of 'expeditions'. This may be considered to be a major finding in its own right and it predicated all kinds of further inquiry. I was careful to continue to challenge it as often as possible; the arguments in Chapter 4 make no sense if the 'expedition' concept is invalid. Fortunately some of the accounts I was given contain details which only fit in with the expedition hypothesis; an example is the description, given by women, that they stormed the quarrymen's camps and burnt their huts down when work at the quarries was over (see Chapter 4). This would tend to falsify a hypothesis of continuous quarrying.

Expeditions were never named, or sponsored by particular men, so far as I could discover. They were not tied in to the ceremonial system (see Chapter 7), so that the question of how frequently the Tungei made quarrying expeditions must be answered by reference to individual experience. I have attempted to link the separate testimonies of 16 former quarrymen in Figure 2.8; on balance I think expeditions took place every 4-7 years during the earlier part of the century.

I also found that clan proprietorship of the sites was quite specific: Kenjpi-emb, Akamb, Komnemb and Ekiemb worked only at Kunjin, Eska and Kupaka worked only at Ngumbamung, and Menjpi worked at Yesim. Menjpi also owned minor sites - these are discussed further in Chapter 3 - at Apiamb [sic], Gapinj and Gapinj Aka Nui, but had not worked them 'recently'. Waɨpi were not in possession of any quarry site in 1933, but had worked in various locations in the known past, for example, at Gapinj Aka Nui, according to Pam Wu, at Banem Alsa (Epngipe only), at Aɨame (Pela and Epngipe) and at Gapinj (Tumamb and Ngunjemb).[16] Most important is the fact that the three main sites were worked together, that all clans joined in, and that all able-bodied males participated in mounting a quarrying expedition. In Chapter 4, where I expand on labour organisation and the methods used in quar-

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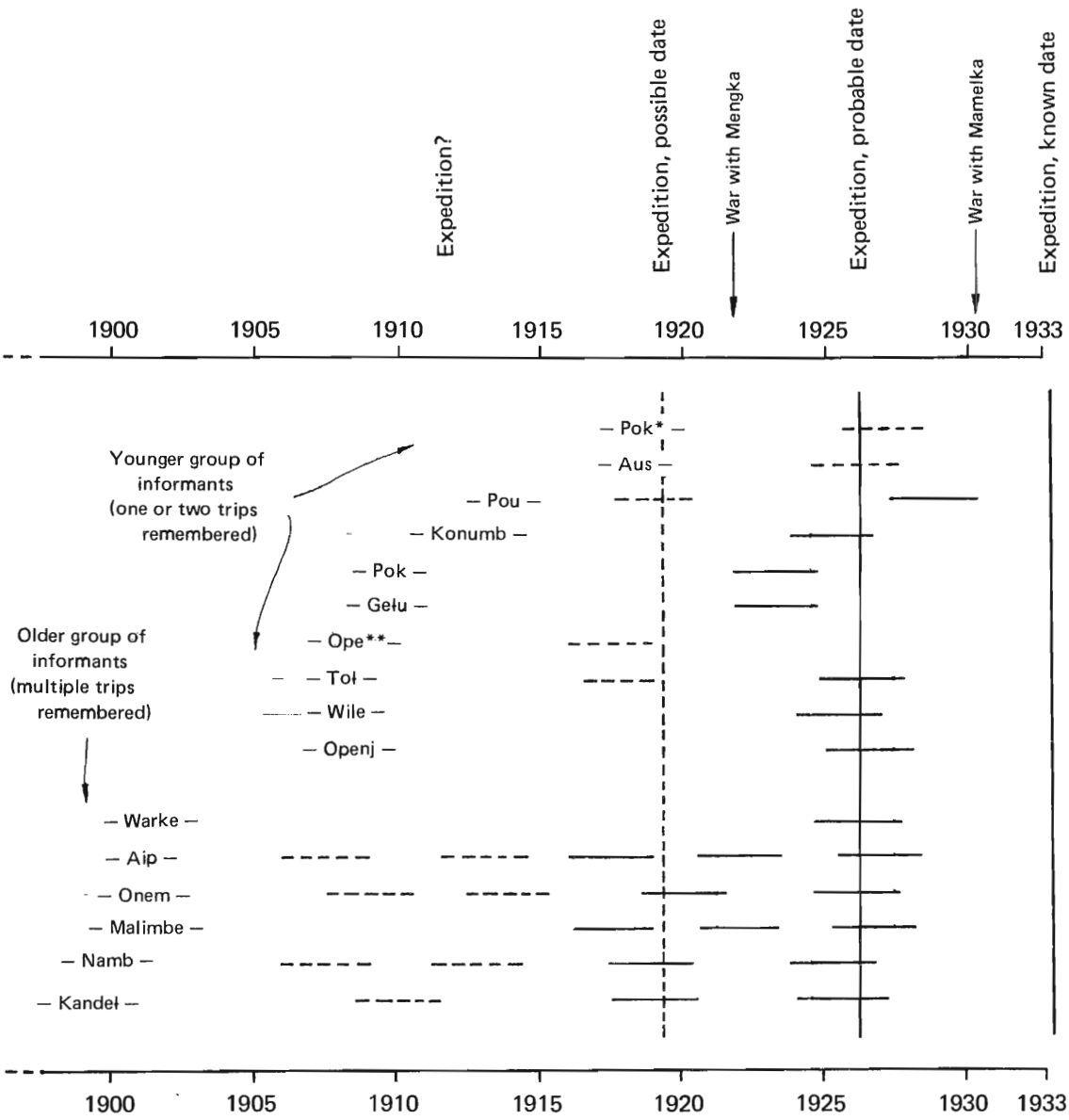
[16] Interviews on ownership 3-81, 4-81, 5-81, 7-81, 12-81. Interviews with Waɨpi 3-80, 11-81, 54-81.



*remembers this as last expedition of Walpi to Ałame
**remembers this as last expedition of Mamelka to Kunjin

watched the men go on an expedition
participated in an expedition himself

– Openj – approximate date of birth

TUMAN QUARRY EXPEDITIONS dating related to individual life histories

Figure 2.8

rying, these basic factors - the expedition system and ownership by clans - are treated as assumptions.

Genealogical Interviews

In a second interview series, I attempted the construction of sub-clan genealogies for each axe making clan. This task was made considerably easier by the survival to the present day of the 1958 and 1968 compilations of the Aviamp village census book. Census-taking began at Aviamp in 1949 and was repeated at an average interval of one year and three months during the 1950s.

Many criticisms have been made of the bias inherent in patrol-type census work (e.g. van de Kaa 1971), but I believe the 1958 village book compilation at Aviamp represents the period when villagers were most keen to have their names taken and patrol officers most efficient in recording them. For the present purpose most of the systematic biases need not be countered; it is merely important that the book recorded the names of all the Tungei then living. I did not myself learn of agnatic Tungei whose names were absent.[17]

The census books recorded the names of Tungei men, their wives and children; I sorted these into sub-clans. I then sought out one or two of the elders of each sub-clan and traced the connections between the families, filling in the names of the known ancestors and checking to see who would have been alive in 1933. Among the older generation, I was able to find out how many of the men were boys at that time, or grown men, or married men with children. A good number of the men of this generation had already died, of course.

Information was incomplete for some men, but it proved possible to estimate their ages by adjusting the various branches of the sub-clan genealogies. In fact age estimation was the most important part of the work, as the object was to arrive at a full list of the men who would

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[17] This is in marked contrast to the latest book, compiled in 1972 and used in the 1980 census. This was simply copied out from the 1968-72 book, which in turn was a copy of the 1958-68 book (used here) with revisions. Clerical error resulted in the omission of several pages of Komnemb clan (Epni Kanem, Arim Kumna Kanem), or some 60 names. I did not check the other clans.

have been working at the quarries in 1933, together with the younger boys who may have helped them.

Many of the older generation, both men and women, were already listed as 'aged' in the 1958 census, 23 years before the time of fieldwork. However, the age estimates of the children, and in many cases the actual birth registration of the grandchildren, added corrections to the estimates I arrived at on the basis of individual life histories. Births and deaths registered between 1958-72, the period covered by the village books I had access to, showed at which age men and women tend to have children and how many years apart these are spaced. The median age at which men fathered first children during the period was 25.5 ± 4.4 years (n = 119); the median age for women was 20.3 ± 1.8 years (n = 41); the mean spacing of further children was 3.7 ± 1.4 years (n = 223).

Chagnon (1977:10-13) describes a society which has very stringent name taboos; deceased person's names cannot be spoken in any but the most affronting circumstances, making genealogical work impossible. With the Tungei this proved to be less of a problem than the practice of substitute naming. Men, at least, avoid using a person's real name in a variety of relationships. The general term is **pak jik sak ni-** , 'change-name thus say', while of the 'food names' two friends give each other more or less as nicknames it is said **ep nui niłbeł**, 'something eaten they-two say'. Thus two men may eat a certain food on their first acquaintance and call each other after it, e.g. 'banana man' etc. (I was 'curry-sweetcorn man' (**kari-kanape wu**) to Menjpi Toł for example.)

A man would be careful not to call his brother-in-law by his real name - he would probably feel obliged to pay him a small reparation if he did - but this did not prove to be an obstacle when dealing with an outsider like myself. An interesting case arose where an old man named his long dead father as Konj ('new'). Another clansman indignantly pointed out that this was quite untrue and gave the real name. However, Konj is the name the patrol officer took down 25 years or more ago from the son. Other long-standing, alternate names like this were: Wening Wu, 'new man', Osi, 'short', Olt, 'tall', Kan Embił Wu, 'vine bones man' (for a man called Gełu - a type of strong vine), Nginmał Wu, 'stick fight man', Kanand Wu, 'dancing man', and Por Embił Mong Wu, 'hip bone man'. I was generally able to get help with identifying

these men against census records, but in the cases of Kupaka clan and Waɨpi I was unable to hold a sufficient number of genealogical interviews to sort out the names.

Kupaka Kelemb sub-clan moved from Tungei ground to live among the Mamelka at Ningei, probably between 1933 and 1953. They were therefore not censused at Aviamp, but across the Tuman River on Hagen Sub-District registers. The remainder of Kupaka were censused in Minj Sub-District with the rest of the Tungei. Administrative boundaries have since changed and the nearest equivalent to Sub-Districts are Census Divisions. The relevant parts of Hagen and Minj Sub-Districts are now Angalimp and South Wahgi Census Divisions. I was unable to find the appropriate village records and therefore to construct a Kelemb sub-clan genealogy. Two other Kupaka sub-clans, Akamb and Pingka, are almost extinct, so I had to be content with a simple roll of the names of sub-clan members in 1933. In fact different informants concurred on a figure of 15-18 men for Kelemb in 1933, 2 for Akamb, and 1 for Pingka.

The corpus of lineages is summarised in Figures 2.9-2.36, representing the ancestry until 1933 of the 910 Tungei censused in 1958 at Aviamp. No genealogical interviews were held with Waɨpi who, as I have said previously, were not in possession of an axe quarry in 1933. Italic type is used to represent the names of persons who had died by 1933, while roman type shows those who were then alive. Those who were still living in 1981 are shown in bold roman type; an asterisk marks those whom I interviewed.

I used an additional piece of information to complete this retrospective census exercise. It proved feasible to ask men whether they were grown men, adolescent boys, small boys, or infants at the time of the Taylor-Leahy patrol. (I asked them to compare themselves with children of various sizes near the place of interview.) For this purpose 'men' were at least 18 years old (i.e. post adolescent); thus the 'men' in the genealogies were all born before about 1915. They are shown with a fully blocked-in symbol. Adolescent boys were taken to be about 13-17 years of age and are shown with a half blocked-in symbol. Small boys, 5-12 years of age, and infants, 0-4 years of age, were recorded but are not listed by name in the diagrams.

A head count by sub-clan (Table 2.1) shows that a total of 119 men and 27 adolescent boys were members of the 'great clan' consisting of

CLANS QUARRYING AT KUNJIN

	MEN	BOYS
KENJPI-EMB	28	11
Menjpi Kanem	3	2
Andpang Kanem	6	3
Kełak Kanem	8	3
Onembe Kanem	5	3
Wałpi Kanem	6	0
AKAMB	15	2
Mengemb	9	2
Jipenemb	6	0

	MEN	BOYS
KOMNEMB	46	12
Epni Kanem		
Arim Kumna	8	2
Arim Eki	9	4
Kenapuł Kanem		
Eingał Kanem	6	1
Arim Kumna	9	2
Arim Eki	14	3
EKIEMB	30	2
Osi Kanem	11	0
Olt Kanem	6	1
Eingał Kanem	2	0
Epni Kanem	11	1

CLAN QUARRYING AT YESIM

	MEN	BOYS
MENJPI	37	11
Kundika	24	3
Preka	4	0
Dua-Seka Kupam	12	2
Olt Kanem	8	1
Pingka	13	8
Mukei-emb	1	2
Komn-Tungei-emb	5	3
Komn-Kundi-emb	7	3

CLANS QUARRYING AT NGUMBAMUNG

	MEN + BOYS
ESKA	11
KUPAKA	38
Numndi-Akamb	13
Onembe-emb	6
Kelemb	18
Pingka	1

SUMMARY	MEN	BOYS	TOTAL
KUNJIN	119	27	146
YESIM	37	11	48
NGUMBAMUNG	(49)		49
Grand Total			243

TUNGEI MONGKA census of men and adolescent boys in 1933

(breakdown of clans and sub–clans follows Figs 2.9–2.36)

Table 2.1

Kenjpi-emb, Akamb, Komnemb and Ekiemb, 37 men and 11 adolescents belonged to Menjpi clan, and 49 men and boys to the clan pair Es-Kupaka. The first two sets of figures are more accurate than those for Es-Kupaka for the reasons already stated.

Of the 156 men in the first two groups, I interviewed 23 of the 36 (23%) still alive at the time of fieldwork. Of the 37 adolescent boys, I interviewed 12 of the 28 (76%) still alive.

A Tungei Chronology

The Tungei provide many of the components of history - accounts of battles, stories about famous men and descriptions of quarrying - but no dates. I have made an attempt to rectify this by placing in sequence various happenings of the early twentieth century, in the hope that what I have to say about quarrying does not fall into an eventless vacuum. The sequence is summarised in Appendix B.

Much of this 'history' describes war and deaths of men at the hands of their enemies. I find it bears a striking similarity to William Buckley's account of the 32 years he spent living with Australian Aborigines near present-day Melbourne (Morgan 1979). Like Buckley, the elderly men I asked to recount their early lives were unable to mark the passing of time with the changing of the seasons or with 'ordinary' events. Most of the events vivid enough to serve as points of reference which different individuals could relate to were killings and movements to new places of settlement (refer to placenames in Fig. 2.2). Some are given more formal recognition than other, by virtue of the fact that they are recorded in song lyrics (Appendix C).

Although the Tungei have 'traditional' relationships of friendship and enmity with various of their neighbours, there have in fact been substantial changes during this century. The most important concern the Nii-speaking tribes, Mengka and Mamelka.

Before 1920, Tungei and Mengka land holdings were interspersed in the Tun Valley and they lived amicably together. They also shared the use of the axe quarries. However a major war broke out sometime between 1920 and 1925 and Mengka were routed by the Tungei from their settlements at Temek, Kupang and Gapinj to the places Tuning and 'Kar Tanim Eri' ('car turn do') at the head of the Tuman River (see Malimbe's song in Appendix C). They have remained enemies ever since.

Around 1930 or 1931, the Mamelka fought with the Tungei and were driven from the places Kisik, Keɨmbei and Kemning to Ningei and the Wahgi flatlands, where they live now. Unlike Mengka, Mamelka and Tungei have since become friends again and Mamelka have rejoined the Tungei alliance-tribe.

Other wars were fought, even inside Tungei, but none is thought to have resulted in territorial change, nor did they result in permanent changes to the rights of men to visit the Tuman quarries (which was certainly the outcome of Mengka's flight from Tun). Wars fought between neighbours of the Tungei - between Andakelka and Kuli, between Andakelka and Mengka, between Mamelka and Onembe, and between Sikeing and Kurup-Miamka - all affected the Tungei to some extent. Occasionally Tungei men took sides and were killed; sometimes they even faced each other on the battlefield.

Some light on the life expectancy of Tungei men serves as a footnote to this grim portrayal of life before the coming of the white man. I asked how men died before 1933 and have indicated in Figures 2.9-2.36 whether they died of 'natural causes' (**wi kuɨjeng**, 'nothing they-died') or in combat, where this is known to me. It is salutary to consider that in traditional times two men out of five Tungei men met violent deaths. Meggitt's Enga statistics are closely comparable; they show that fully one third of his sample of Mae men were killed outright or died of wounds (Meggitt 1977:Table 6). Meggitt was also able to conclude that a disproportionate number of men were killed at between 20 and 30 years of age (1977:110). Unlike Meggitt, I have not been able to estimate the ages at death.

ECONOMIC CHANGES AND THE TUNGEI TODAY

In common with other groups in the Wahgi Valley, the Tungei have been through the experience of rapid economic change over the past 50 years. The period from 1933 to the outbreak of the Pacific War in 1941 saw the introduction of steel tools for those groups living along important patrol routes or near airstrips. Above all, large quantities of shell valuables were flown into the major centres of the highlands, like Hagen, to pay for local food and the labour needed in the construction of base camps and airstrips. The major traditional shell types may be seen in Plates 2.11-2.14.

This huge injection of valuables into the highlands wealth economy caused rapid inflation and all the shells lost some of their initially high purchasing power (Hughes 1978). The relative values of the different shell types were also affected and ultimately only the pearlshell, Pinctada maxima, survived as a high-value wealth item given away in brideprice payments and other exchanges of the ceremonial economy. Pearlshells remained in circulation until the late 1960s in the Mt Hagen area (A.J. Strathern 1971) and even later in less developed areas such as Southern Highlands Province (Sillitoe 1979).

During the Pacific War, civil administration was withdrawn and the highlands came under the military control of ANGAU, the Australian New Guinea Administrative Unit. The ANGAU period was one of crisis for the highlands, because the large movements of troops and indentured labourers into and out of the coastal war zone had the eventual effect of spreading disease inland. An epidemic of dysentery broke out in Simbu and Eastern Highlands Province in November 1943 and quickly spread into the Wahgi Valley (Burton 1983). The Tungei were among those groups affected by the disease, but the death rate does not appear to have been high. In compiling sub-clan genealogies, I only found four adult men who died of dysentery, **enj miem** 'faeces blood'. Three were from the Komnemb sub-clan Kenapuɨ Kanem, Arim Kumna Kanem; they were Asip, Kumbe and Parke (Fig. 2.18) and their lineage was renamed Eingaɨ Kanem or 'obscured kind' because of the number of members it lost.[18] It is certain that many more small children died, but their numbers were quickly made up in the postwar period.

The 1950s were a time of consolidation for the Australian administration. The first censuses were made in most areas; the first count of the Tungei Mongka was made in 1949 and of the Mamelka in January 1953. Census patrols were thereafter held at approximately two year intervals until the late 1960s. A new cash crop, coffee, was introduced to the highlands in the 1950s (Finney 1973) and initiated a period of relatively fast economic growth for those highlanders whose land lay at suitable altitudes. The Tungei were among the fortunate in this respect and their land also lay in the path of the Highlands

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[18] **Eingaɨ** is used to describe the haze which makes it difficult to see the other side of the Wahgi Valley in the afternoon and also for graininess on the surface of a stone axe.

Highway, a road which is today tar-sealed and provides easy access to the produce markets of Mt Hagen, Kudjip and Banz.

Unlike the Melpa-speaking peoples immediately to the west of the Tuman River, who have adapted the **moka** exchange system to new economic media (A.J. Strathern 1981:145), the Tungei have not been particularly active in holding large exchange ceremonies. The traditional Tungei festivals were **opał**, a produce-giving ceremony of the 'food pile' type common to the Middle Wahgi and Simbu Province (Reay 1959a:86-9; Criper 1967; Brown 1970:103-4),[19] and **kung ngi**, 'pig house', the pig festival held by all clans simultaneously at their own ceremonial grounds (cf. Luzbetak 1954a, 1954b). Pig festivals, however, have been very rarely held, none occurring this century until around 1934; another was held in 1962. **Opał** festivals have been much more common; they do not characteristically involve more than two clans, one giving to the other. The last **opał** made by Komnemb clan, for example, was held in about 1972; a payment of vegetable produce, pigs and cattle was assembled and given to Andakelka clansmen.

Today women actively use the pearlshells which were formerly so valuable to men. Pearlshells form part of a young woman's trousseau - the set of decorations she wears to get married in. The Tungei now wear traditonal dress on one further occasion. Young men, accustomed to the idea that traditional warfare disappeared before they were born (in fact around 1934), recently found themselves at war; they immediately took steps to acquire the traditional men's fighting attire of bark belt, woven apron, Cordyline leaves and (formerly magically treated) dark face paint or charcoal.

Apart from shells, some trade items of traditional importance still have a value. Salt from traditional springs is still marketable, as demonstrated by the Enga trader I saw at Mt Hagen in 1981 (Plate 2.15; cf. Meggitt 1958:326). Plumes (Healey 1980; Heaney 1982) and other animal products like marsupial pelts can be readily converted into cash. Prices range from K10-15 for the currently less popular plumes like those of the Raggiana, Lesser, Blue (Paradisaea rudolphi) and King of Saxony (Pteridophora alberti) birds of paradise to K40-60 for Princess Stephanie's and the Black and Brown Sickle-Billed

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[19] This is known in the Middle Wahgi as **wupał** (Ramsey 1975:294). Reay gives this as **wubalt** (1959a:86).

(Epimachus fastosus and E. meyeri) birds of paradise. Whole pelts of the Silky Cuscus Phalanger maculatus, such as the one in Plate 2.16, fetch between K12 and K20.[20]

Missions entered the area in the 1950s; initially a Catholic Mission was located at Aviamp but this was later abandoned. Around 1961 or 1962 Nazarene missionaries began working from Kudjip and a mission station was set up at Temek. Eventually this was also dismantled and the church at Temek is now run by a locally trained pastor. A Nazarene Bible College situated at Ningei runs, among other things, an Ek Nii literacy program. Tungei children are nowadays enrolled at the government-run primary schools at the Tuman River (Rogamp) and Aviamp (Fig. 2.2) and quite a number have gone on to secondary and tertiary education since the early 1970s. Some have also published papers on Tuman oral history (Wanjal 1975; Nou 1976).

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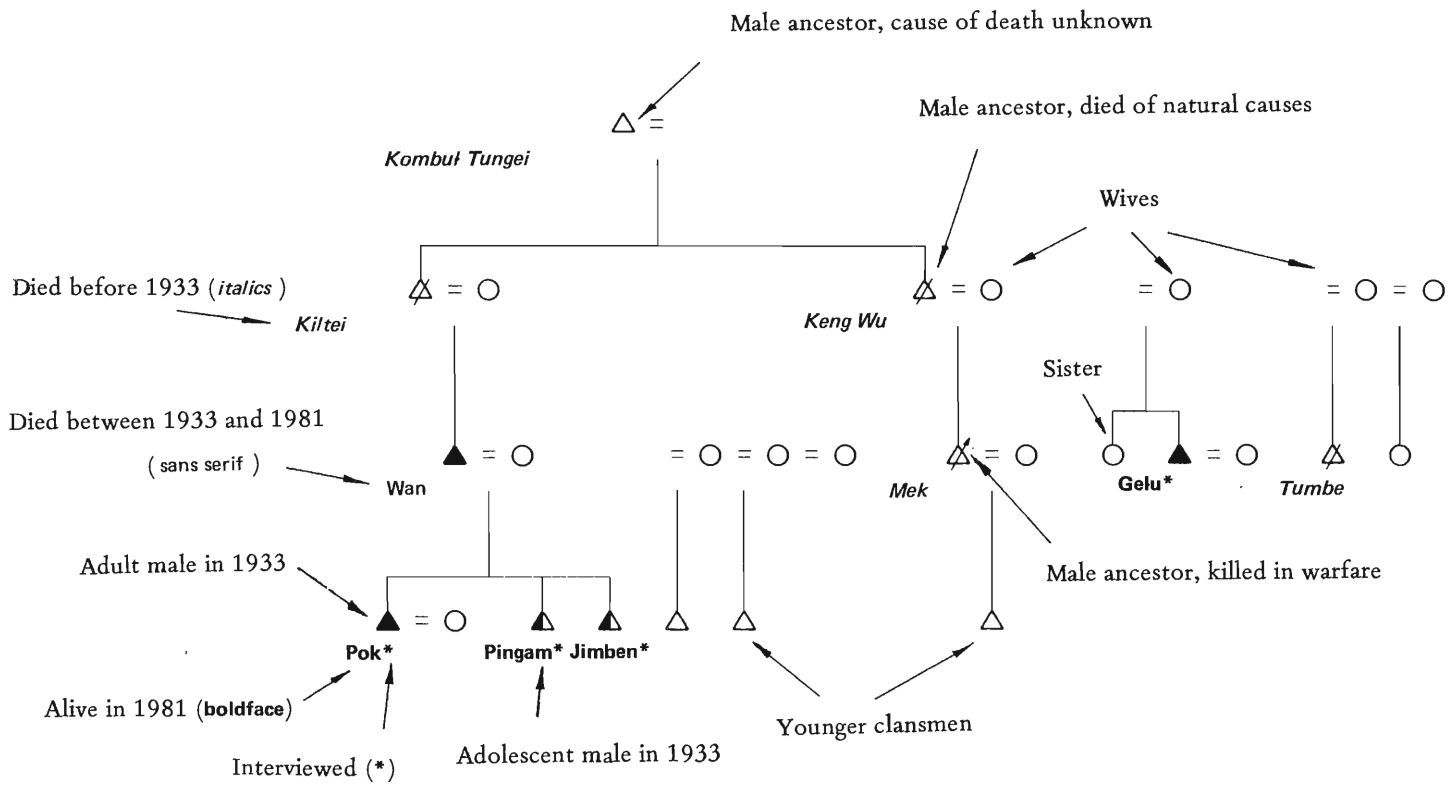
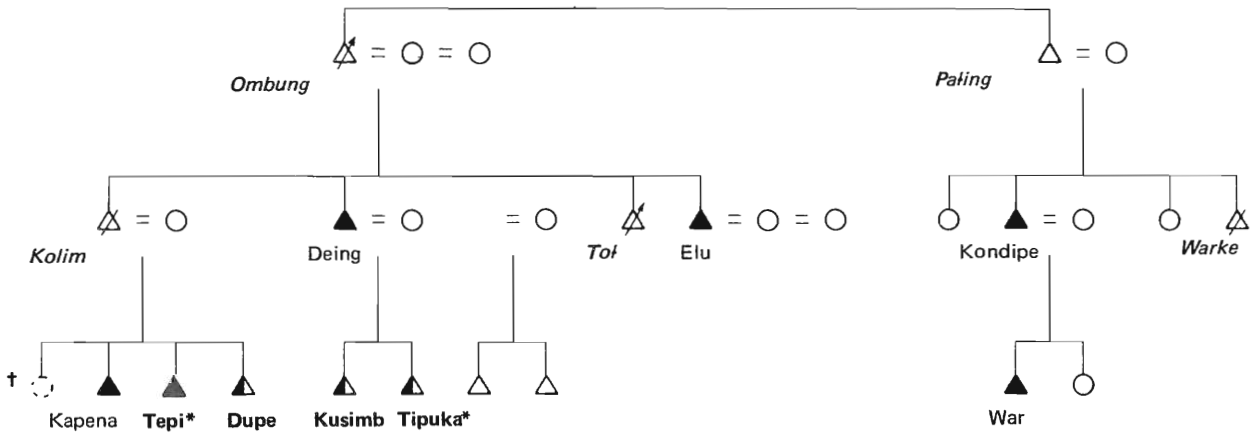
[20] Prices given in Kina. One Kina (K1) was worth approximately A$1.30 in 1981.



KENJPI–EMB, Menjpi Kanem

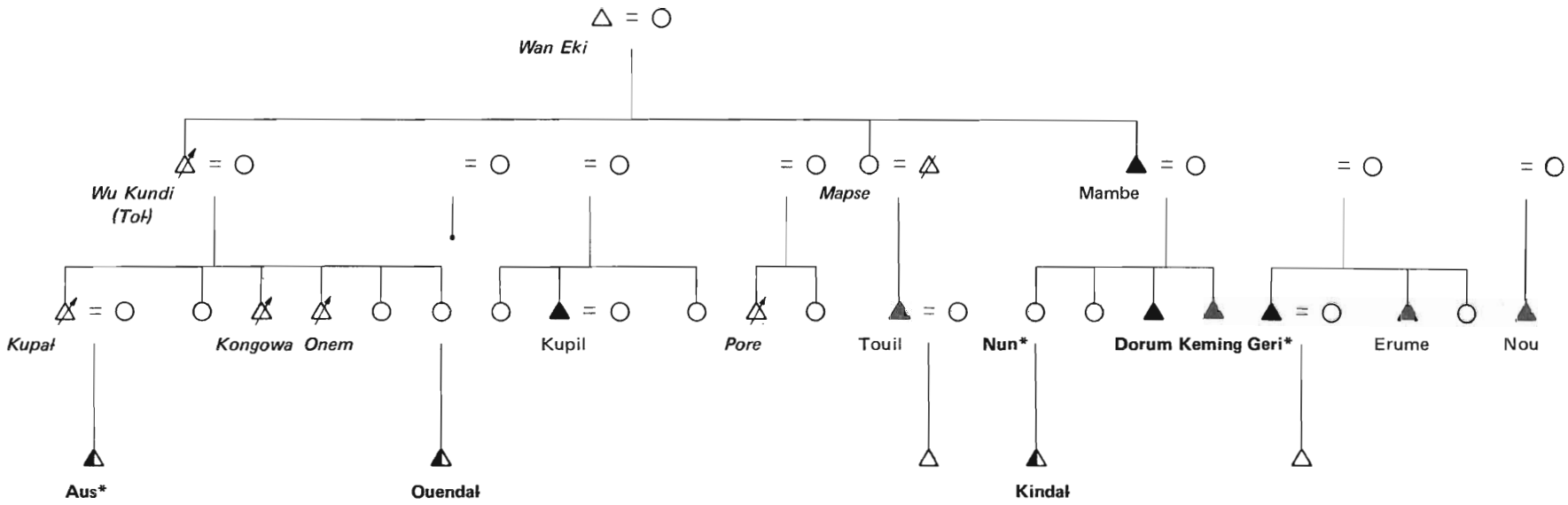
Figure 2.9 *(with key to the interpretation of all the sub–clan genealogies)*



† (**Gol***) see Menjpi Pingka: komn-kundi-emb

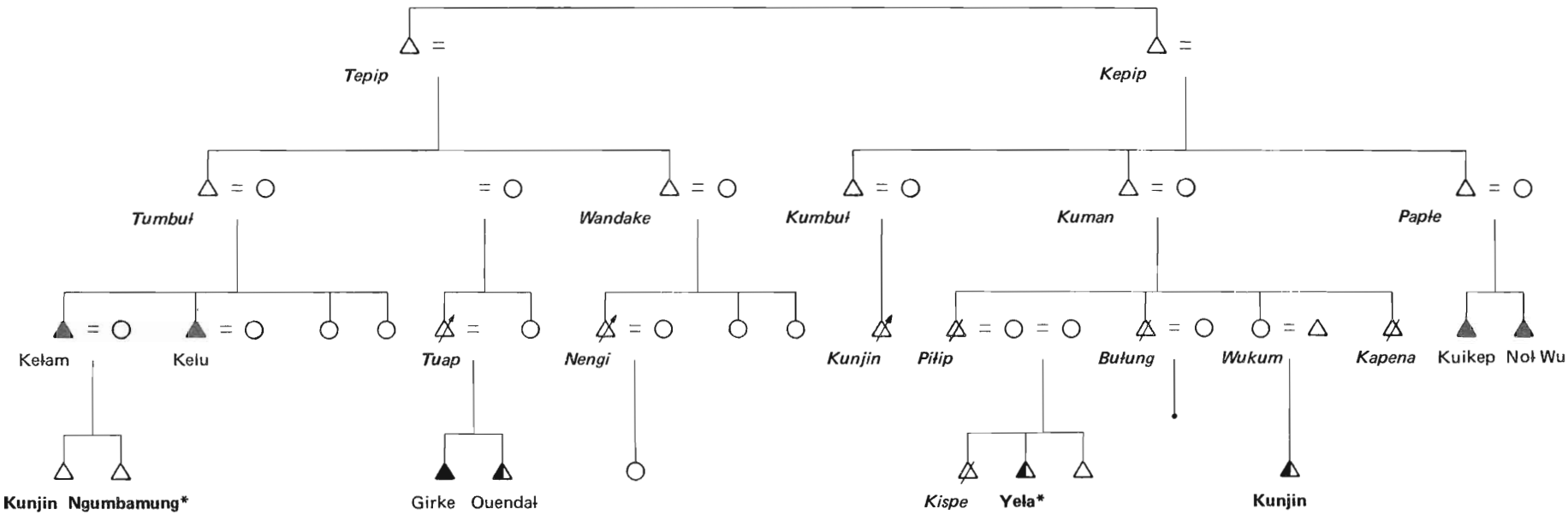
KENJPI–EMB, Andpang Kanem

Figure 2.10



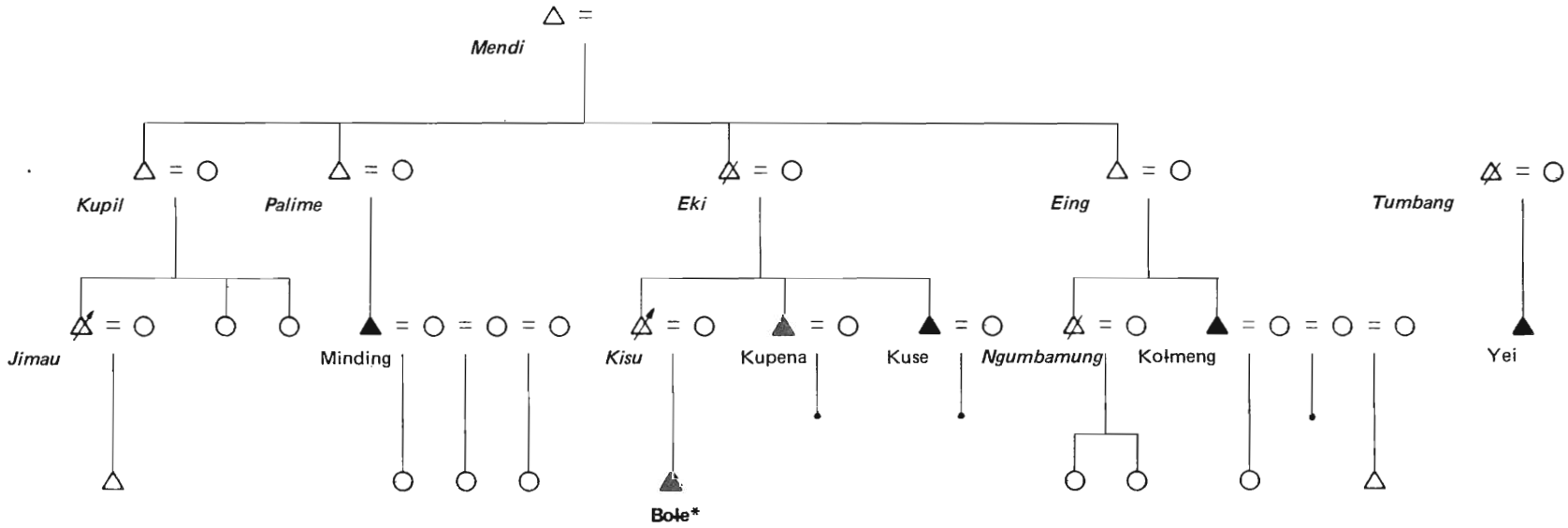
KENJPI–EMB, Kełak Kanem

Figure 2.11



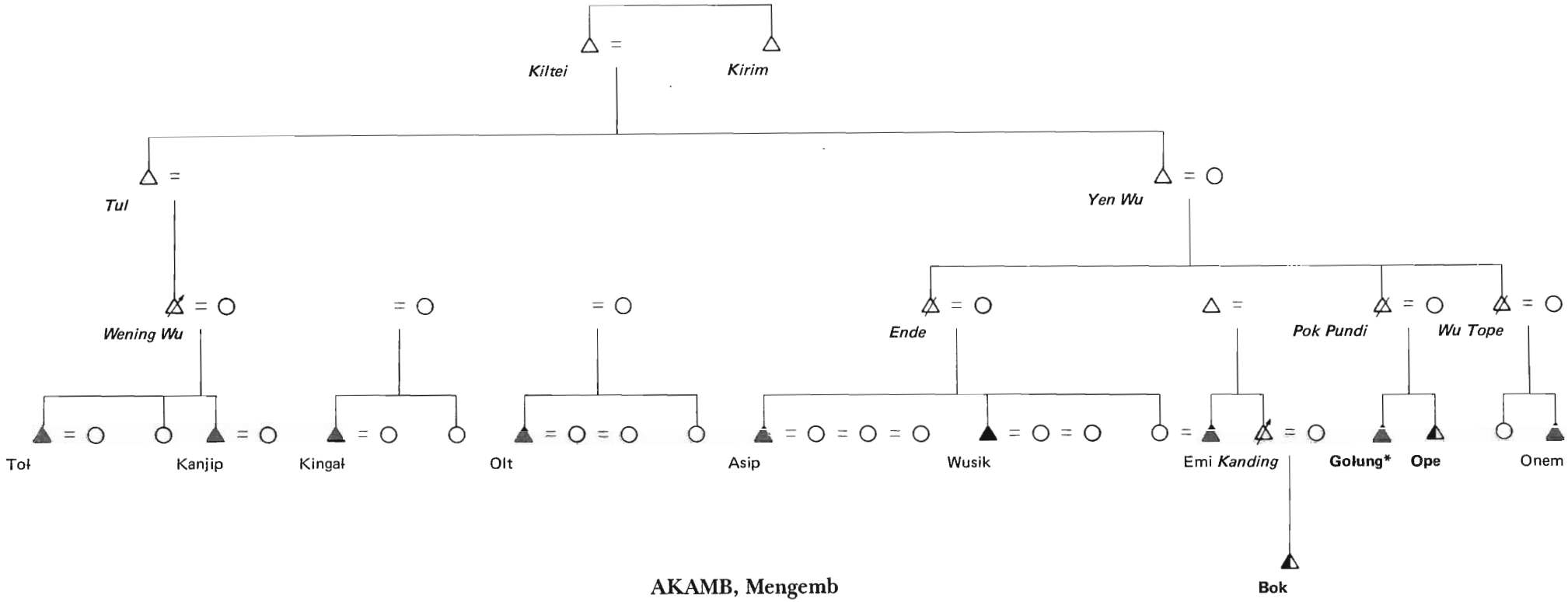
KENJPI–EMB, Onembe Kanem

Figure 2.12



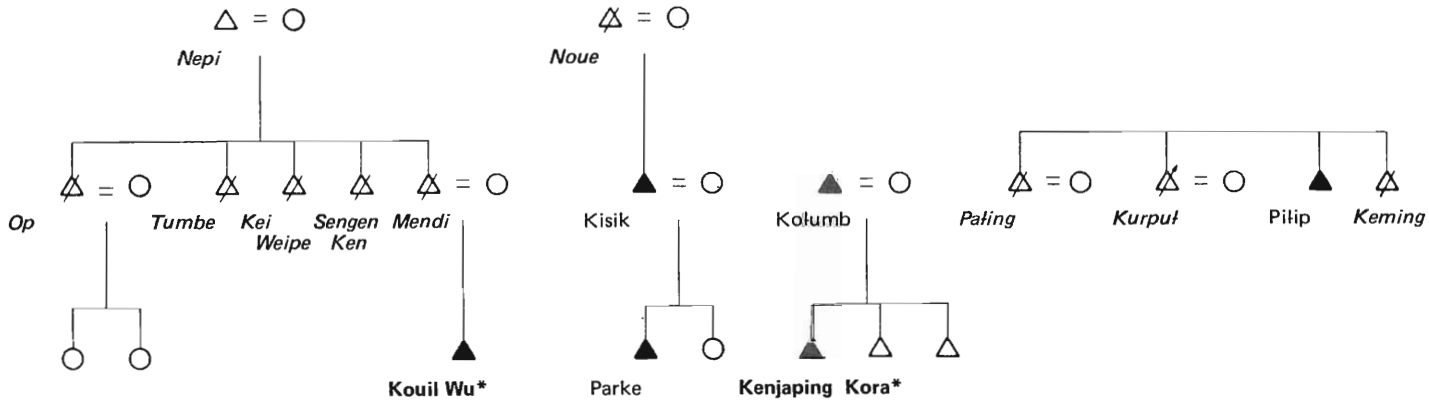
KENJPI–EMB, Wałpi Kanem

Figure 2.13



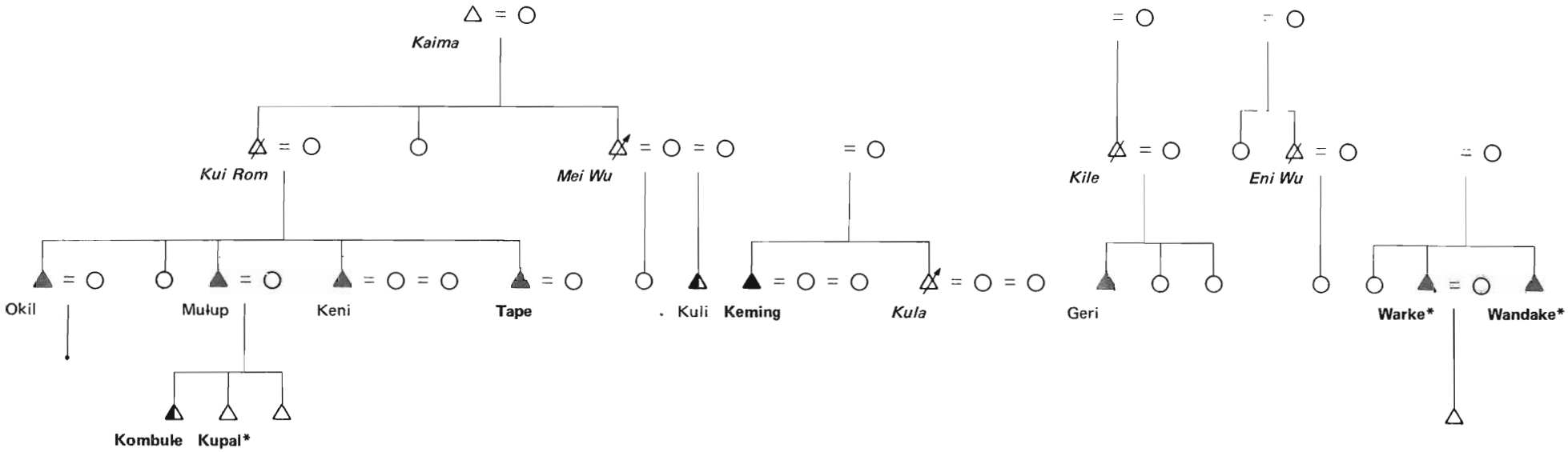
AKAMB, Mengemb

Figure 2.14



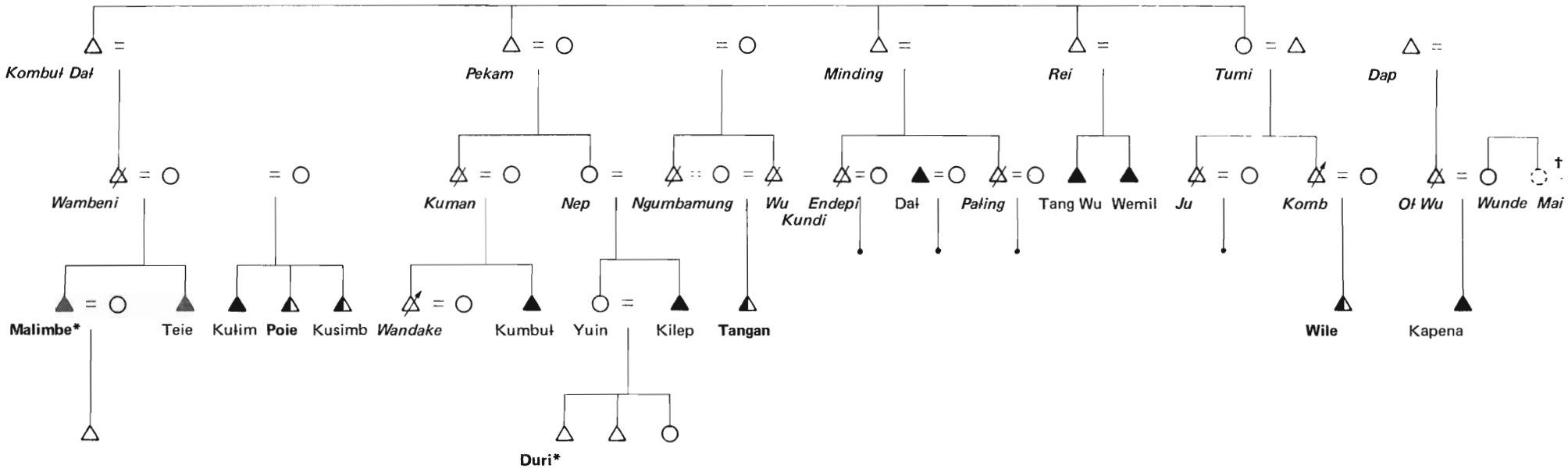
AKAMB, Jipenemb

Figure 2.15



KOMNEMB, Epni Kanem, Arim Kumna Kanem

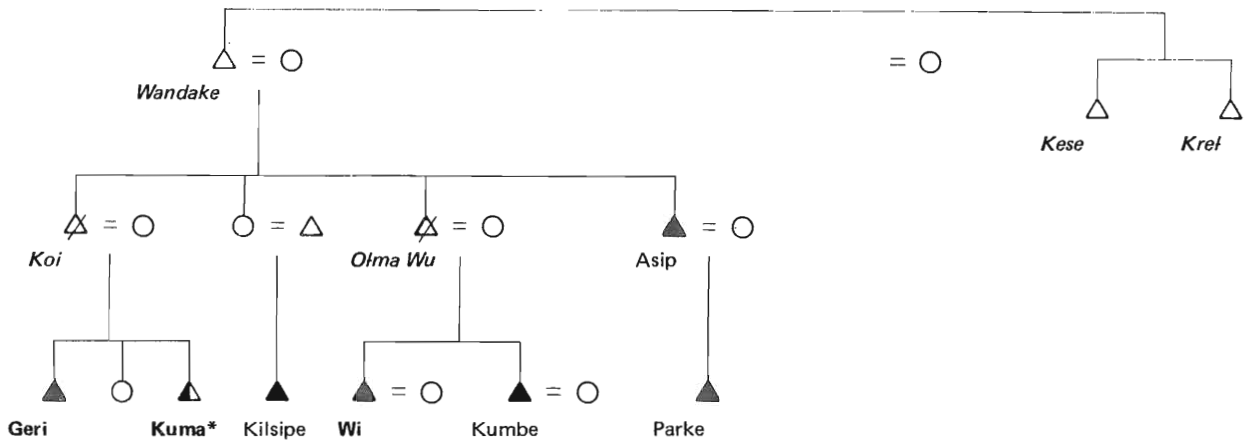
Figure 2.16



KOMNEMB, Epni Kanem, Arim Eki Kanem

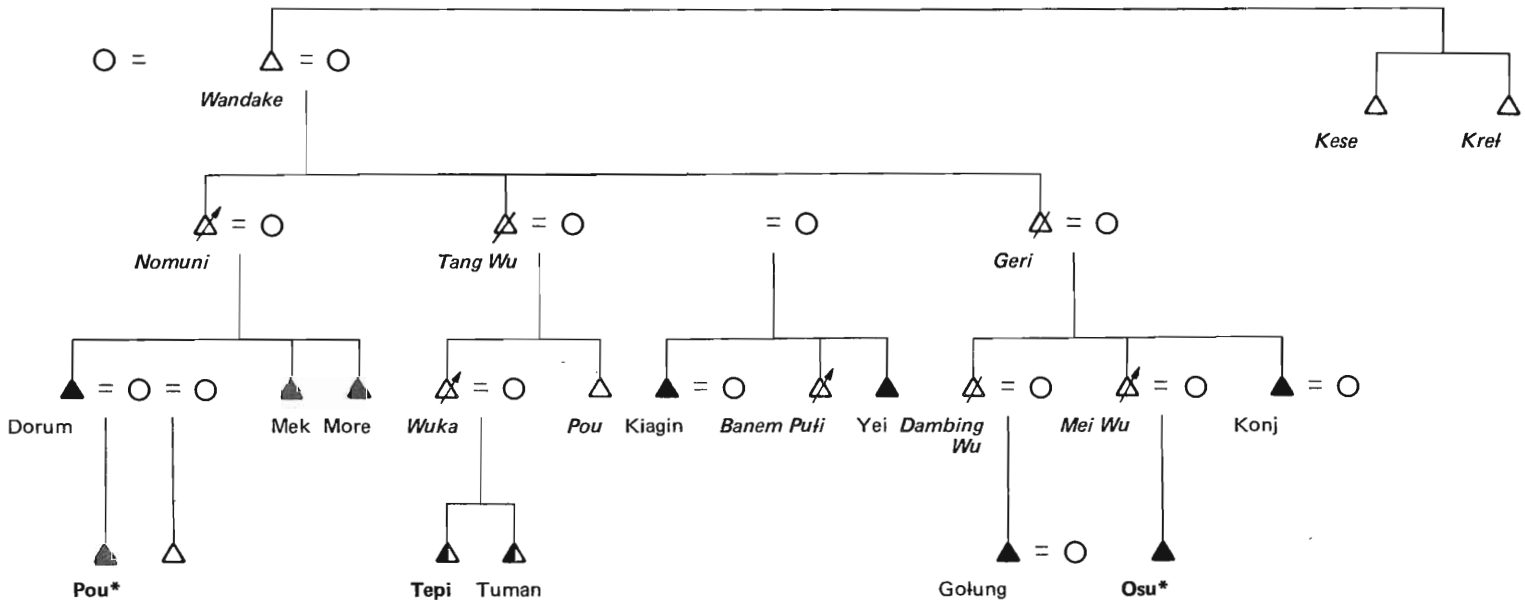
Figure 2.17

† *Dap, Wunde, Mai* all non-agnates; linked to Komnemb by Mai's marriage to Mei Wu (Kenapuł kanem, arim kumna kanem)



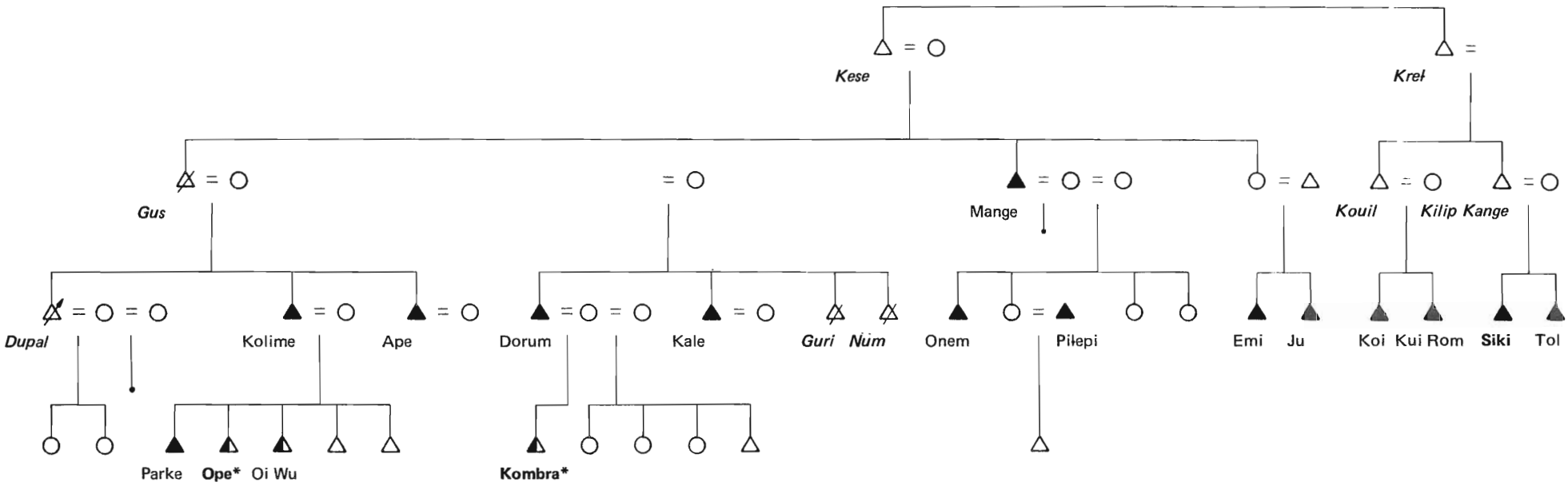
KOMNEMB, Kenapuł Kanem, Arim Kumna Kanem (Eingał Kanem)

Figure 2.18



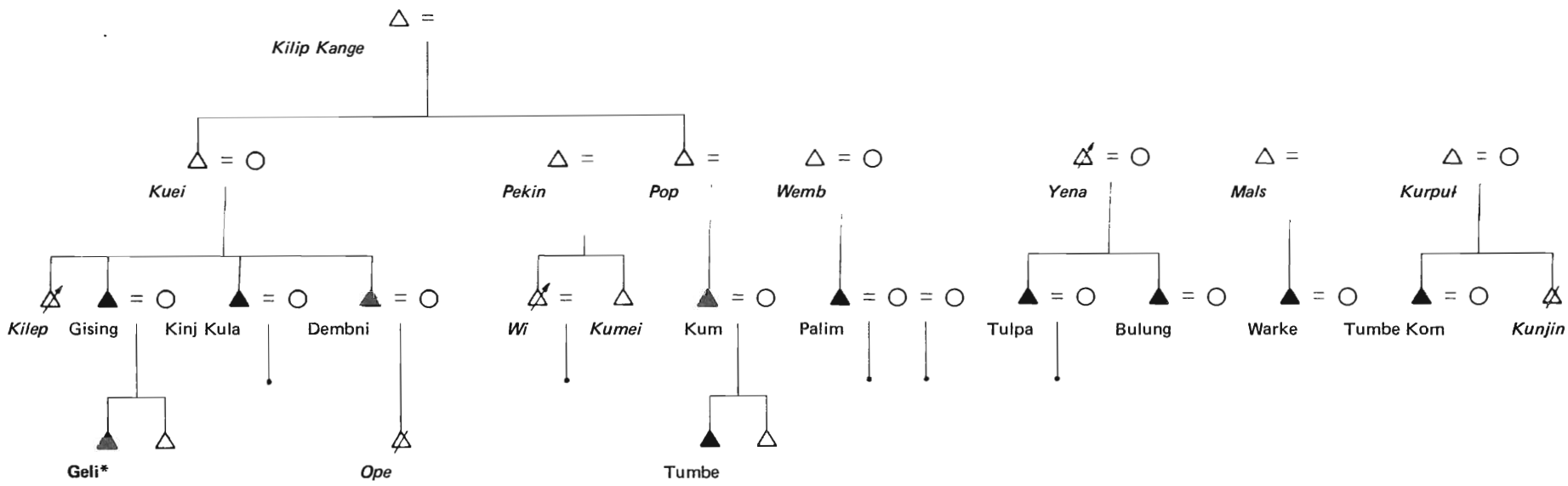
KOMNEMB, Kenapuł Kanem, Arim Kumna Kanem

Figure 2.19



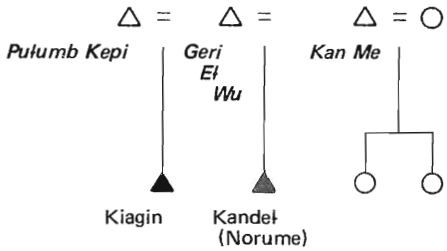
KOMNEMB, Kenapuł Kanem, Arim Eki Kanem

Figure 2.20



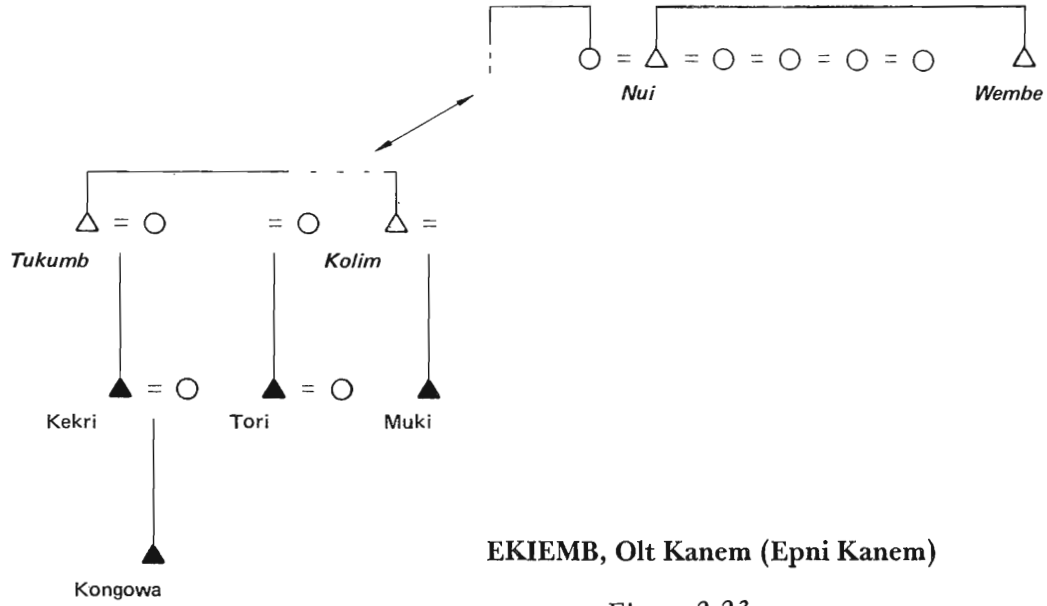
EKIEMB, Osi Kanem

Figure 2.21



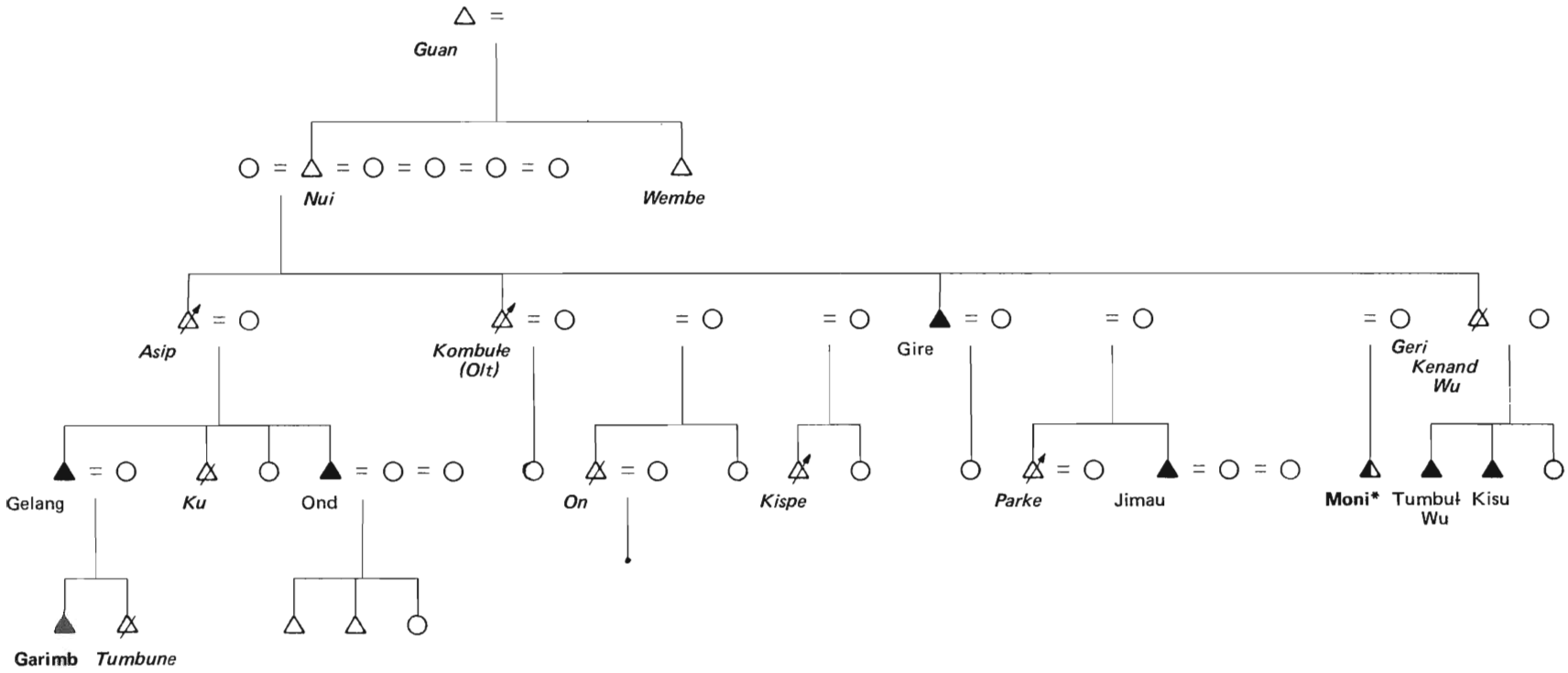
EKIEMB, Olt Kanem (Eingał Kanem)

Figure 2.22



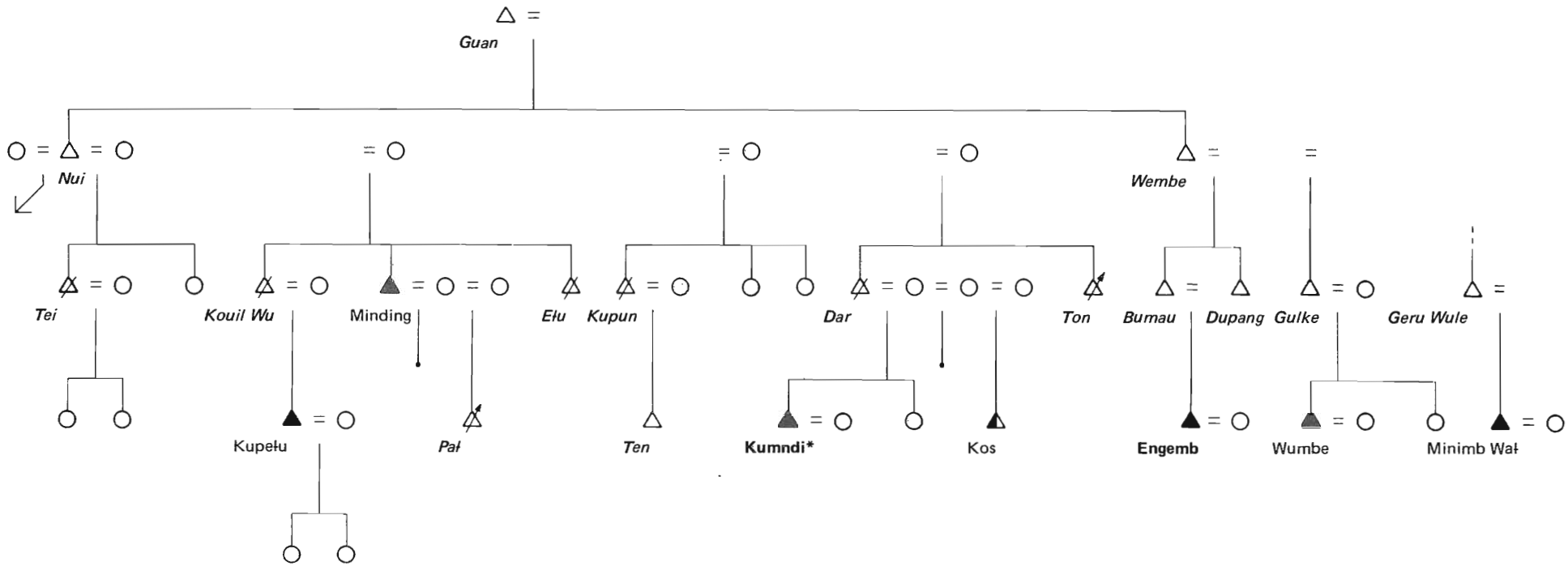
EKIEMB, Olt Kanem (Epni Kanem)

Figure 2.23



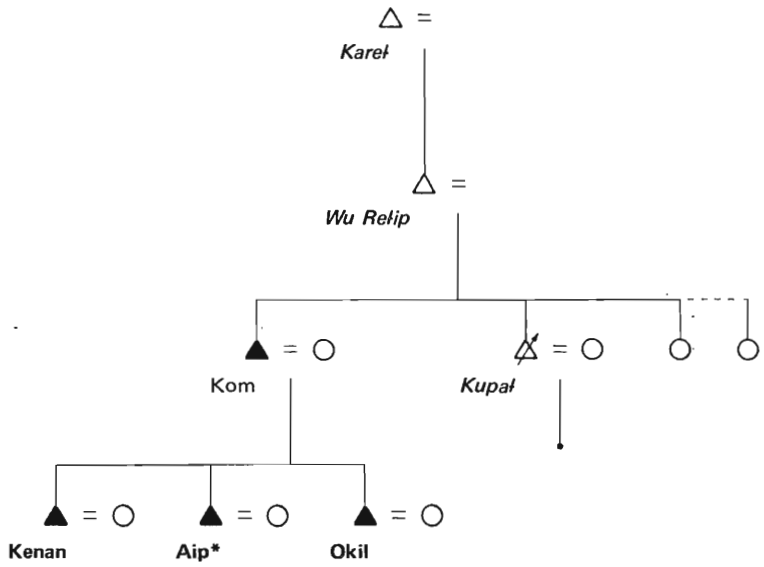
EKIEMB, Olt Kanem (Epni Kanem)

Figure 2.24



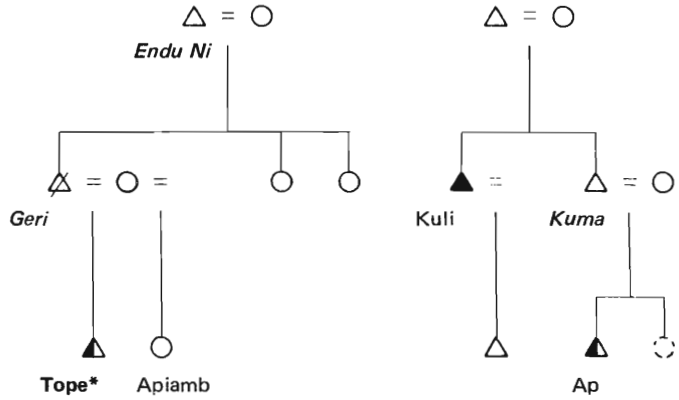
EKIEMB, Olt Kanem

Figure 2.25



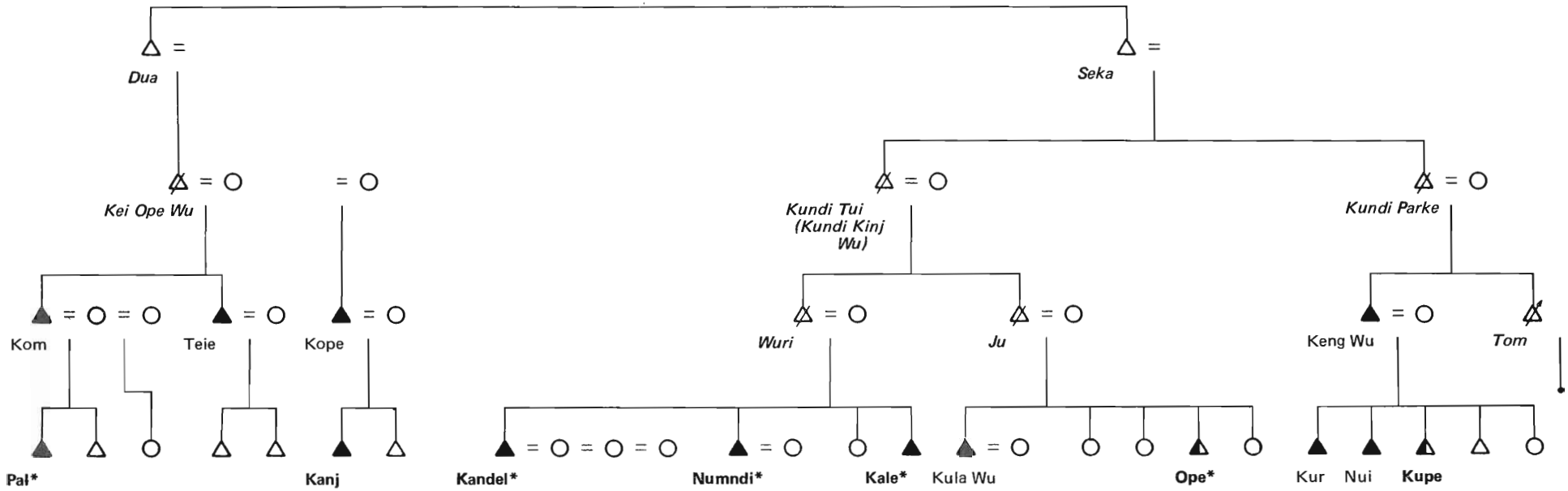
MENJPI, Kundika, Preka

Figure 2.26



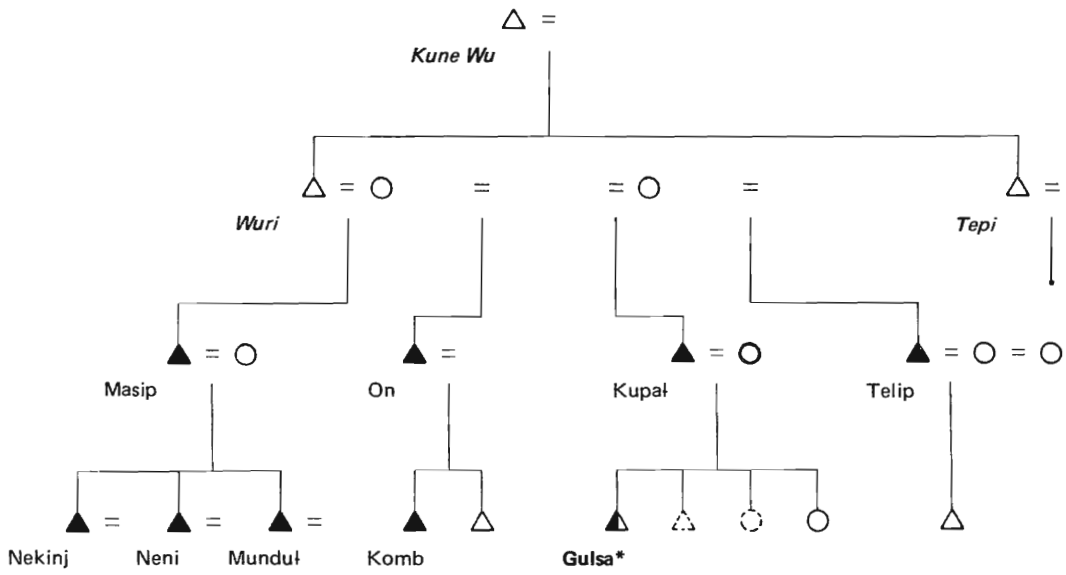
MENJPI, Pingka, Mukei–emb

Figure 2.27



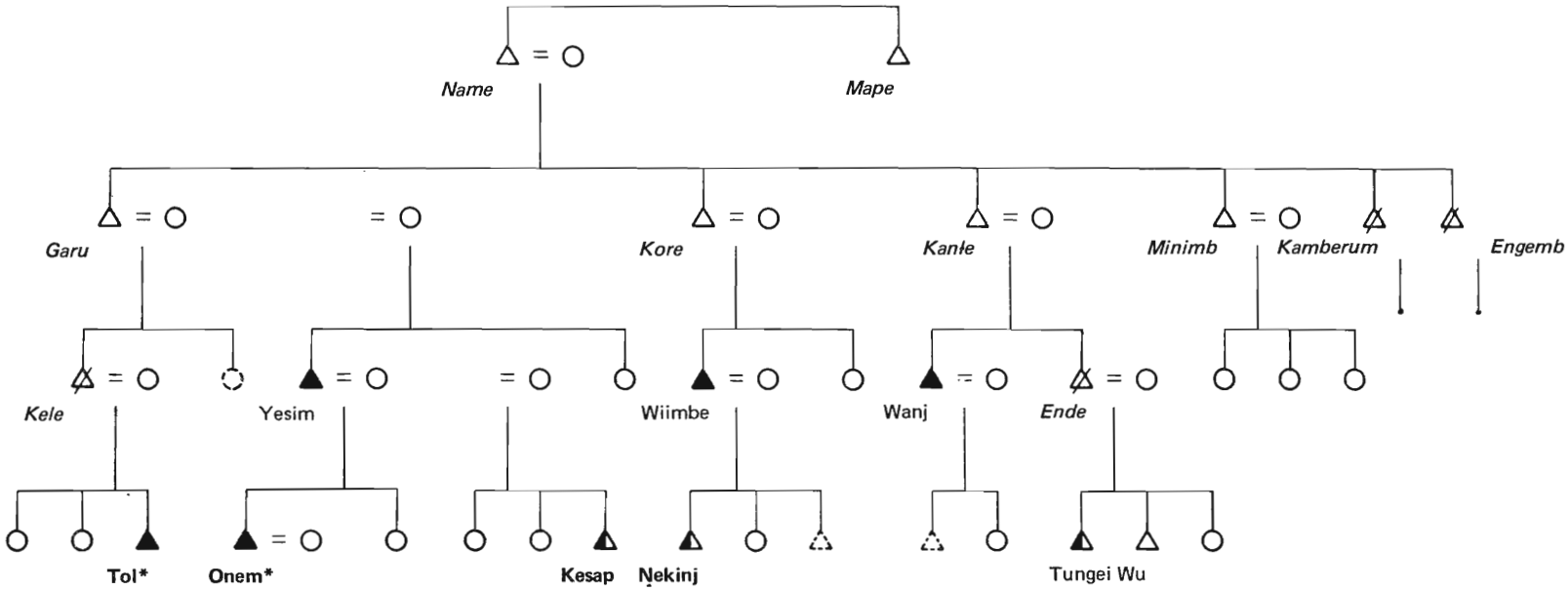
MENJPI, Kundika (Dua–Seka Kupam)

Figure 2.28



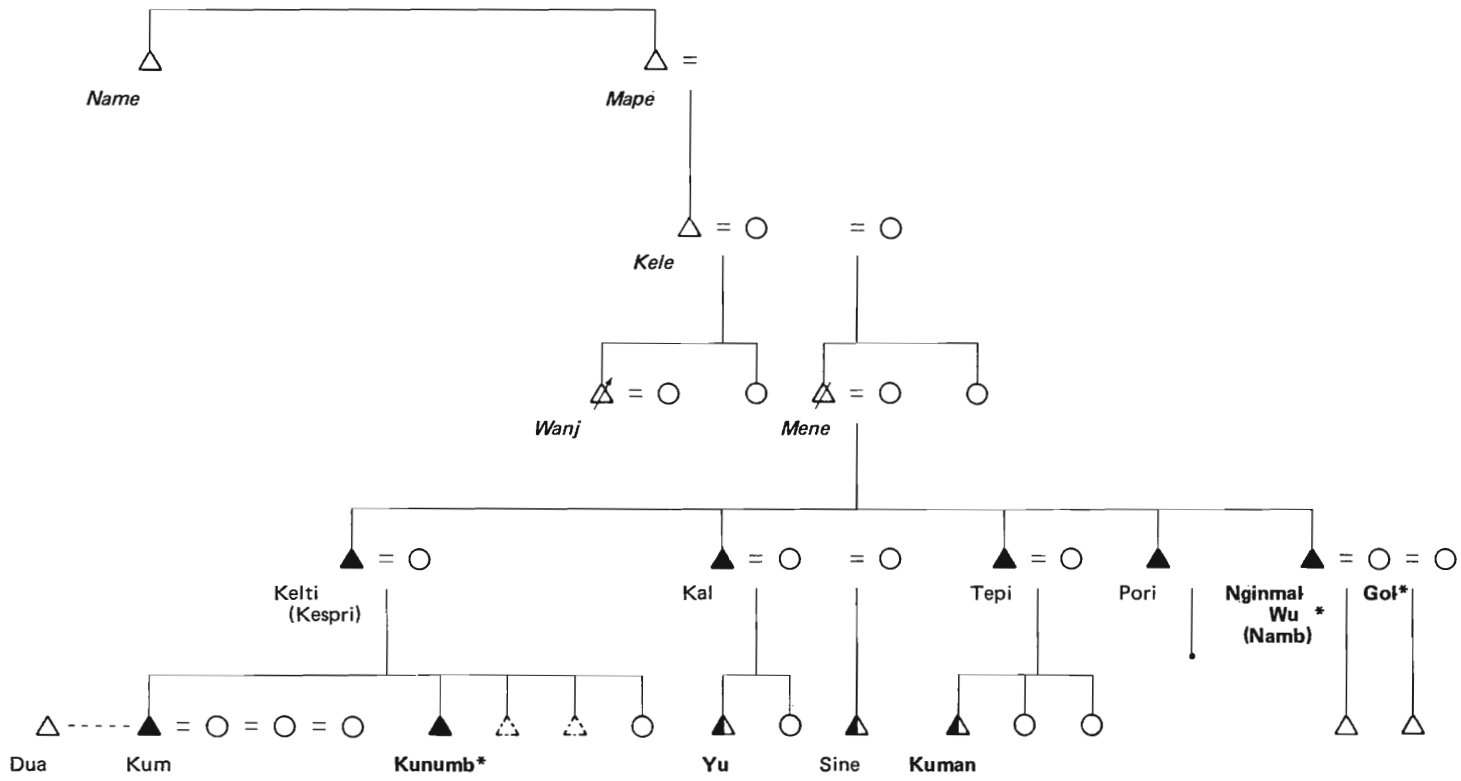
MENJPI, Kundika, Olt Kanem

Figure 2.29



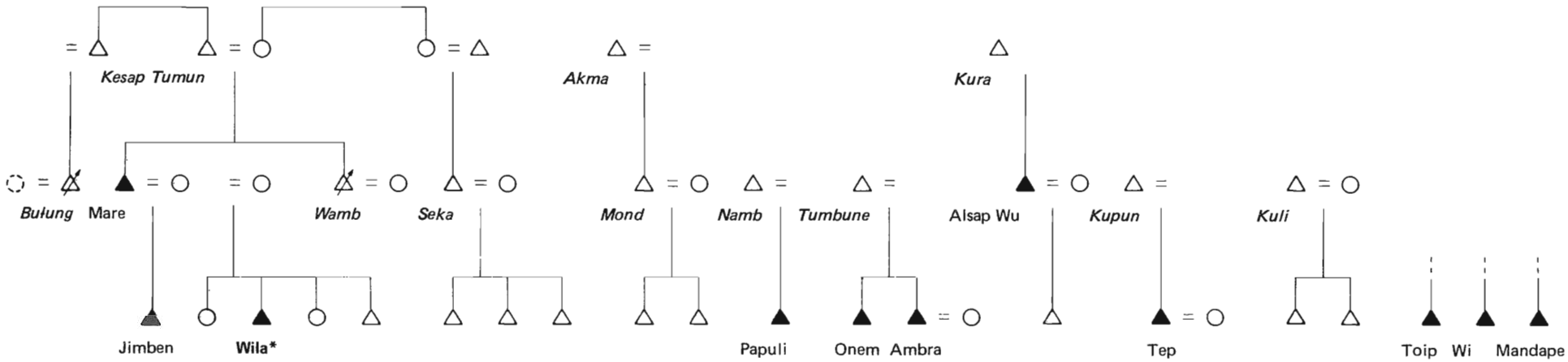
MENJPI, Pingka, Komn–Tungei–emb

Figure 2.30



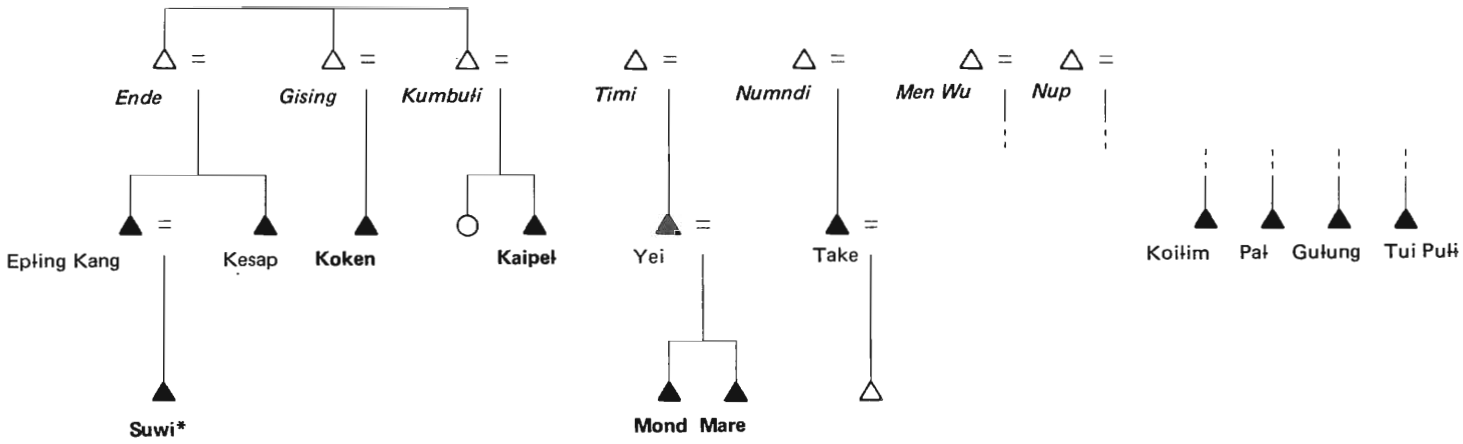
MENJPI, Pingka, Komn–Kundi–emb

Figure 2.31



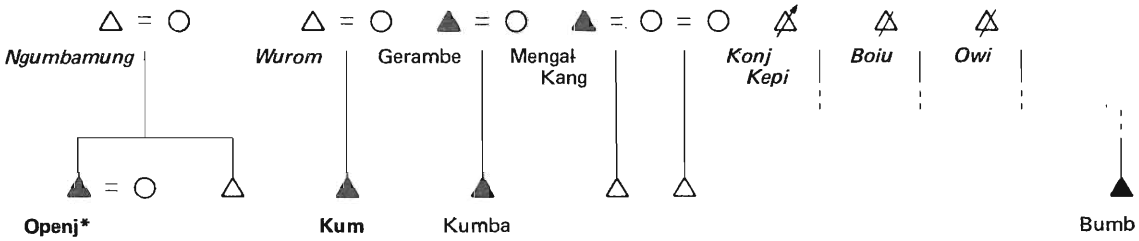
ESKA

Figure 2.32



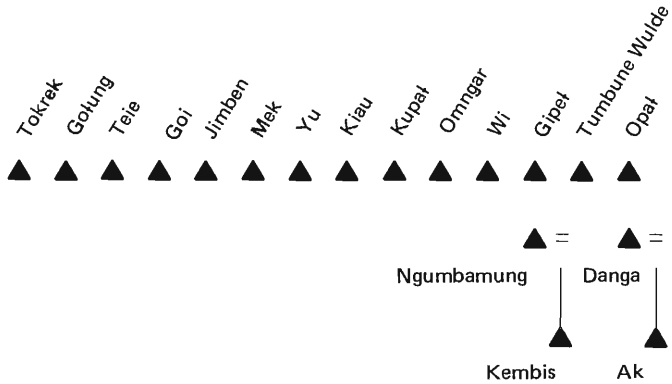
KUPAKA, Numndi–emb (includes **Akamb**)

Figure 2.33



KUPAKA, Onembe–emb

Figure 2.34



KUPAKA, Kelemb

Figure 2.35

KUPAKA, Pingka

Figure 2.36

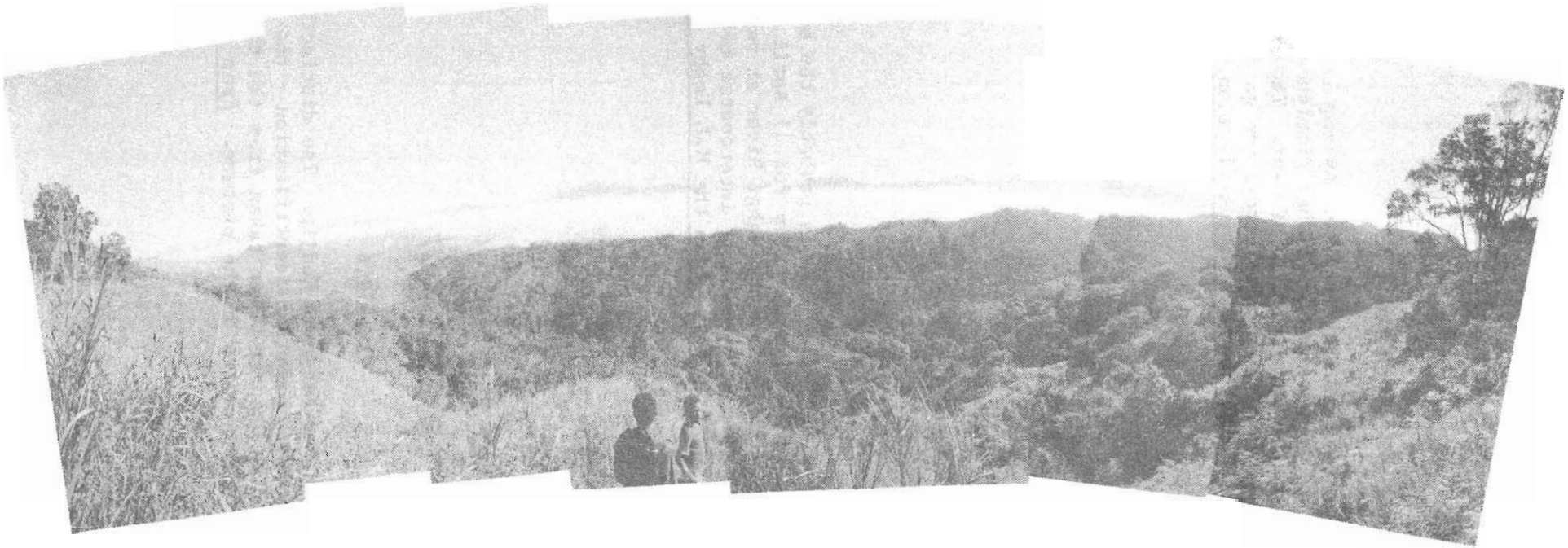


Plate 2.1

North-looking panorama of the Tun and Wahgi valleys from a point above Kunjin and Ngumbamung. The westernmost Ngumbamung pits are located at lower right. The peak at the mouth of the valley (centre left) is Mt Kanim. Foreground: Komnemb Mila and Wandaki.

THE WAHGI VALLEY IN 1933

Plate 2.2

View across the Wahgi Valley in 1933. Aviamp lies in the foreground of the picture and the Wahgi flatlands extend into the distance in the direction of Banz. The route of the modern Highlands Highway cuts across the garden land in the foreground. From the M.J. Leahy collection.

Plate 2.3

Wahgi bridge below Kerowil. This is probably the bridge described in Jim Taylor's diary entry for 11 April 1933. Bridges like this one spanned the Wahgi River at regular intervals and were the sole means of intercourse between north and south Wahgi groups. From the M.J. Leahy collection.

Plate 2.4

Crossing on the River Kanye at Kudjip. The distinctive rock formation makes this a certain identification - one of the grindstones used in Chapter 6 was taken from the top of the sloping shelf in the centre of the picture. From the M.J. Leahy collection.

Plate 2.5

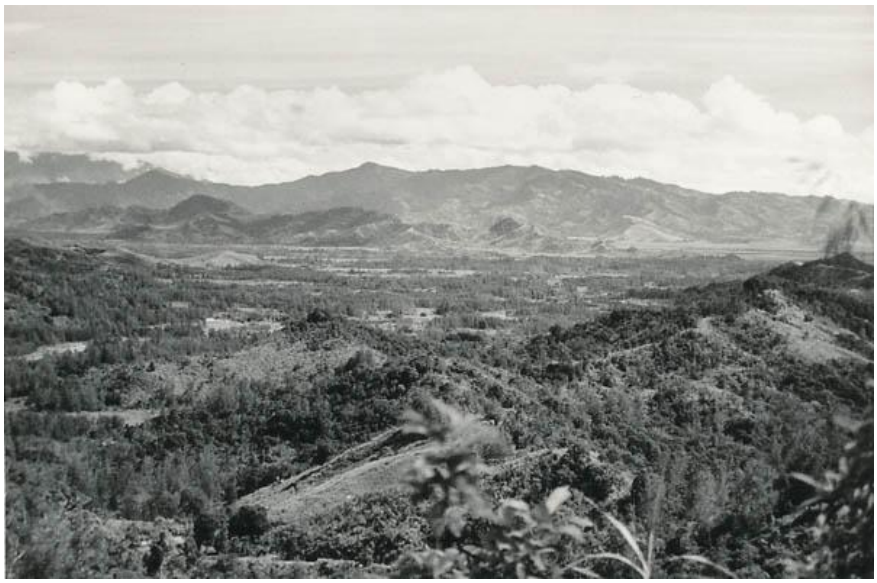
Palke territory in the Middle Jimi Valley. The view, from 1000 m altitude, is northward towards the Jimi River, lying at approximately 300 m asl in the background, and Simbai, in the Bismarck Range.

Plate 2.6

The Wahgi Valley, a northward view from the Tuman River to North Melpa. Ep Ridge (1962 m) is the low range in the middle distance, overshadowed by the Sepik-Wahgi Divide (Mt Jaka: 2945 m). Plate 2.5 was taken from a point beyond the horizon at centre.

Plate 2.7

The Kubor Range, looking north. Angɨmb (Angalimp), 3826 m, is the steep peak at centre right and the Wahgi Valley lies beyond the range in the middle distance. Angɨmb lies partly within Tungei hunting grounds, but it is rarely visited. The Kubor Range carries little population and most southward trade was channelled through populated valleys to west and east. Plate 2.6 was taken from a position beyond the horizon at centre left.



THE TUNGEI: A TUMAN RIVER PEOPLE

Plate 2.8

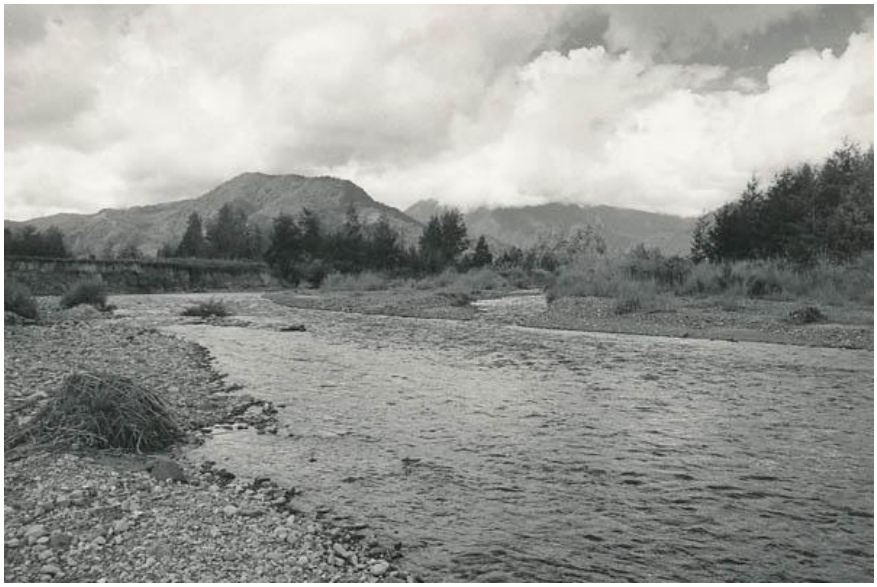
Kiltei Ku, the mythical creation site of Mongka, Mengka and Mamelka tribes. The mound lies on the left bank of the Tuman and is of unknown origin.

Plate 2.9

The Tuman River near Kemning. The view is south towards the Kubor Range with Tungei ground to the left and Andakelka ground to the right. The river can be waded.

Plate 2.10

Seven men of the Komnemb (sub-)sub-clan Epni Kanem, Arim Eki Kanem, together with a man from another Komnemb sub-clan, share an afternoon meal of roasted bananas. The seven men described themselves as ngi tape ende, 'one men's house'.



SHELL VALUABLES OF THE 1930s

Plate 2.11

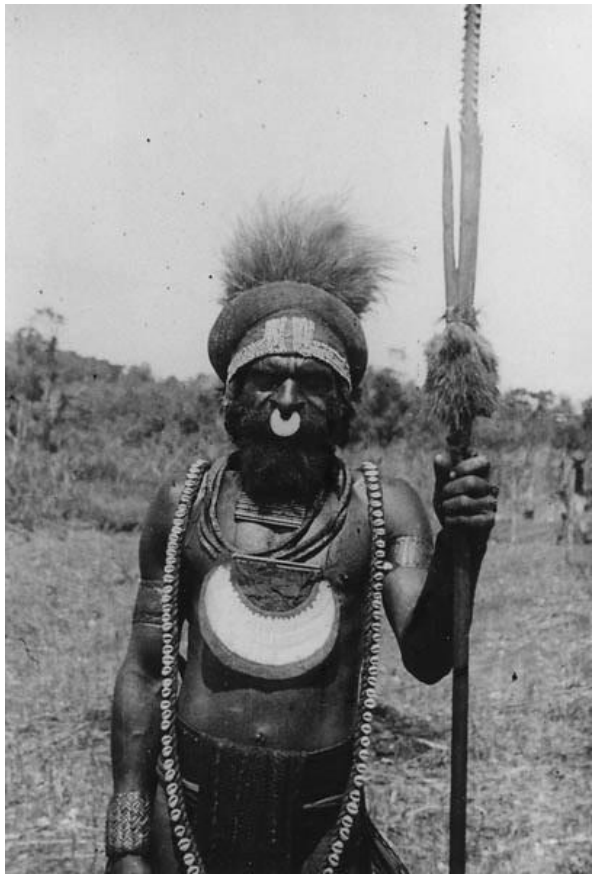
Hagener with ceremonial 'wig'. The shell decorations are a necklace of cowries, possibly strung with some pearlshell fragments, and a baler shell breast-piece. Note the head of a steel hatchet at lower left. From the M.J. Leahy collection.

Plate 2.12

Hagener with Nassa shell headband. Note the fragments of greensnail shell hanging as side-flaps, the cowrie necklaces, the small piece of baler shell at the breast and the omak consisting of cane rods strung into a short bib denoting prowess in making moka. From the M.J. Leahy collection.

Plate 2.13

Hagener with pearlshell and spear. The man is wearing a short omak, a resin-backed pearlshell crescent, a cowrie 'bandolier', some form of Nassa headband, and a Conus disc through his nasal septum. He carries a carved jimben spear. From the M.J. Leahy collection.



VALUABLES STILL IN USE TODAY

Plate 2.14

Komblo Bamni with a pair of Nassa headbands. This kind of wealth item has an importance to ceremonial dress above its exchange value. A skeuomorph called bis geram, made from tradestore beads, is worn today.

Plate 2.15

Enga salt trader at Mt Hagen market, October 1981, selling 10 toea twists of salt from a pack weighing about 20 kg. Ap Toul of Tun at left.

Plate 2.16

Michael Mangi with sine pelt. Pelts of this marsupial, Phalanger maculatus, are usually worn as fur hats. Widely bought and sold today.


maxell
Batteries

Chapter 3

THE TUMAN QUARRIES

The Tuman quarries, the largest in the Papua New Guinea highlands, are located above the Tun River, a major tributary of the Tuman River in South Wahgi Census Division, Western Highlands Province. Note that in this text the name 'Tuman quarries' will be used in preference to 'Abiamp', which was given wide currency by the report of Chappell (1966), who followed Reay's earlier mention of the axe factory (1959a:105). The placename 'Abiamp' appeared in patrol reports from time to time (e.g. K.A. Wallace, PR, Minj No.8 of 1965/66) but the spelling 'Aviamp' - the original spelling given by Jim Taylor - is now preferred; it refers to the area around Aviamp School (Fig. 2.2). A place of the same name in the Tun valley is the site of a minor stone axe quarry; for this I prefer the orthographically more correct name 'Apiamb'.[1]

In the Wahgi Valley itself, there is no covering name for the many quarries in the Tun valley, but the Tuman axe names are widely known (e.g. Kunjin or Ngumbamung) and it also known that they are located in the headwaters of the Tuman River.

AXE NAMES AND SITES

There are seven known quarry complexes, each containing up to a dozen separately worked pits; they are visible as obvious landscape features (Plates 3.1-3.3) or as strings of pits on the heavily forested and sloping hillsides of the Tun valley (Fig. 3.1). There may yet be a few more small pits to be located underneath slumping

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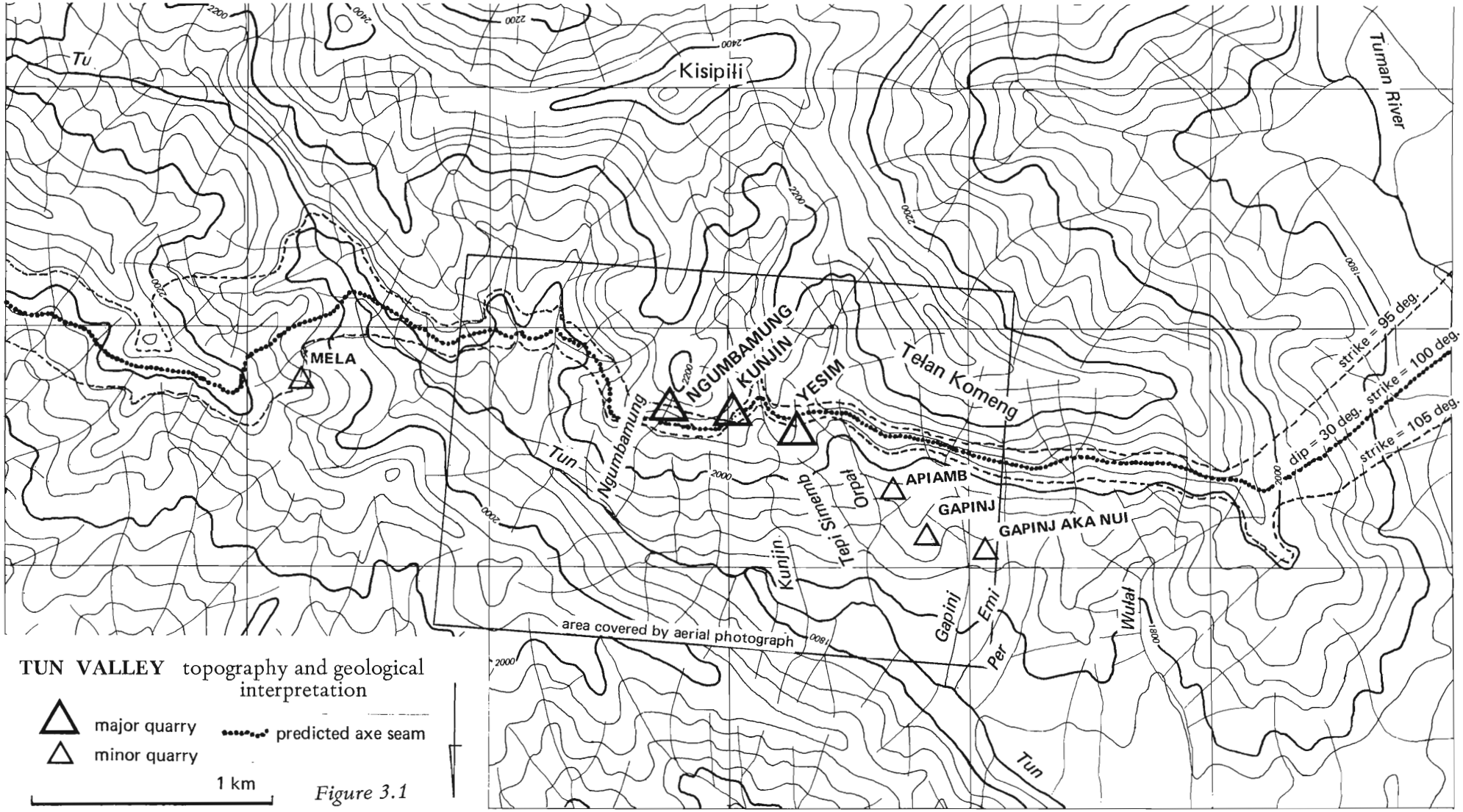
[1] An etymology may be from **nunj apiamb**, a red-leafed stinging nettle, and a variant pronunciation, mainly used by older men, is **opiemb**.



TUN VALLEY topography and geological interpretation

Figure 3.1

features around the quarried areas or the spoil heaps of the larger pits. The named sites are, on the south side of the Tun valley, from west to east: Gapinj Aka Nui, Gapinj, Apiamb, Yesim, Kunjin, and Ngumbamung; a further site, Mela, is located on the north side of the valley. The southern quarries all presently lie on Tungei ground, while Mela, or Mela **mur** ('Mela deep-place'), is owned and was most recently used by Sikeing Meka clan.

Chappell (1966:102-3) recorded these names slightly differently. He visited three sites, naming them as Wui, Kujn and Umbamn. I found no quarry called Wui, but equate this with Yesim. Chappell's guide was Komnemb Malimbe who may not have been willing to say 'Yesim', this being the personal name of his mother's brother, a former Menjpi big-man. The nearest to Wui is **tui**, also pronounced **rui**, or 'axe'. When I knew him, Malimbe would not normally say 'Kunjin', instead referring to **ei kone**, 'that southern place'.

Gapinj, Kunjin and Ngumbamung are the names of streams which flow into the Tun and are generally used as placenames. Yesim is purely a name, the quarry is also referred to as Tepi Yesim, after the stream **noł** Tepi whose head is at Yesim. Gapinj Aka Nui lies close to sweet potato (**aka**) gardens; the name means 'Gapinj sweet potato eaten' (cf. Appendix A).

The three major sites are Kunjin, Ngumbamung and Yesim (Fig. 3.2). The most recently worked quarries, according to informants, are the three massive rock-cut pits at these sites; each is over 10 m in depth, not including the rock fill which covers the pit bottoms, and more than 30 m wide (Plates 3.4 and 3.5). Many smaller pits lie alongside them. At the minor sites - Gapinj Aka Nui, Gapinj, Apiamb and Mela - there are no pits of comparable size. They are made up of strings of small pits and drives; only at Gapinj are there surface indications of shafts that are likely to have been more than 5 m deep. According to Sikeing informants, Mela was worked by damming and sluicing, a technique described on the Ganz River by Vial (1940: 159). Features having the appearance of wash-outs cross the site. I suspect that this technique was used at one end of the Gapinj site too.

In addition to these known sites, I heard four 'archaic' site names in interviews.[2] They were Am Banem, Banem Alsa, Ałame and Wi

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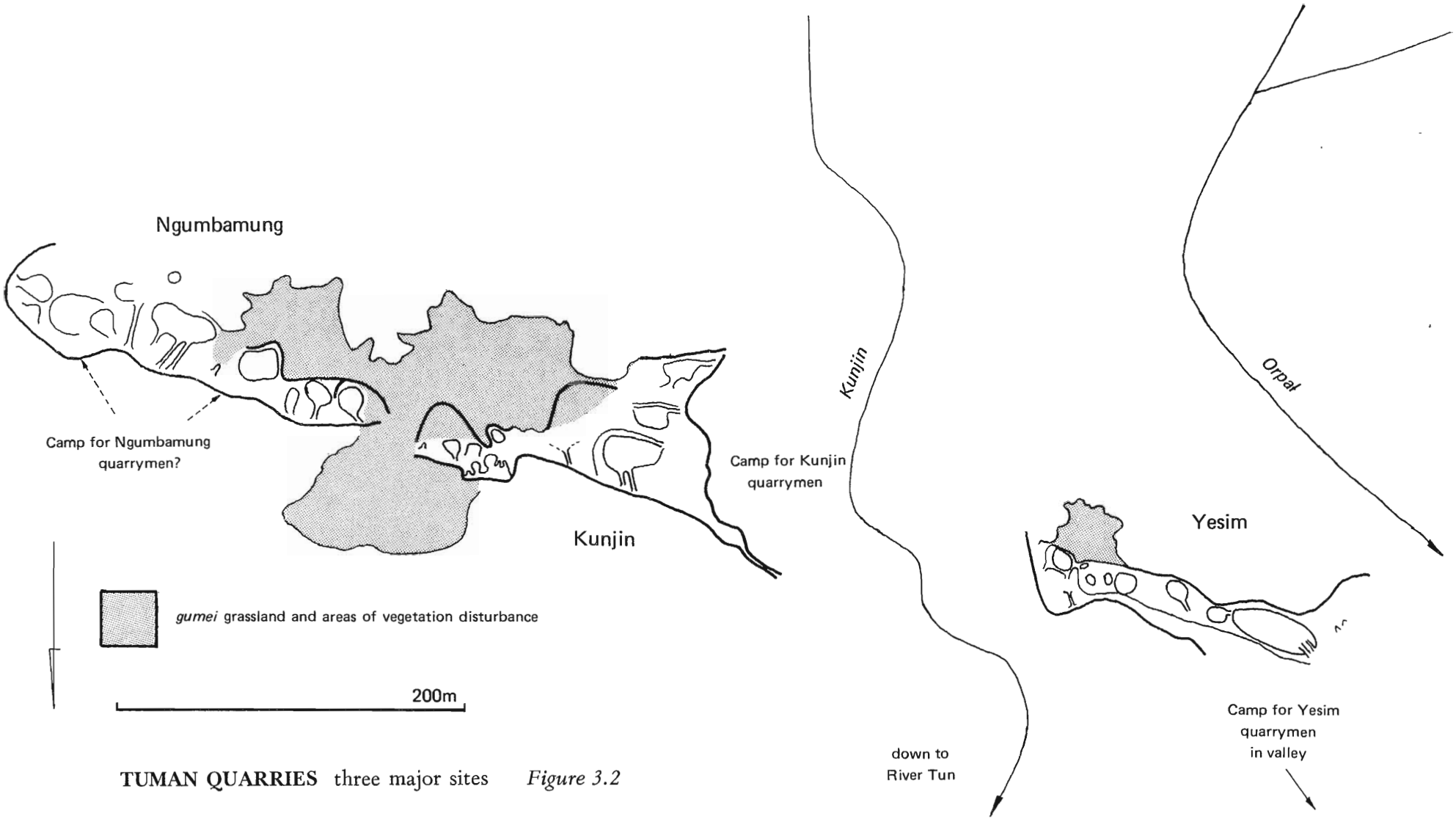
[2] Interviews 7-80, 11-81, 22-81, 52-81, 54-81.



TUMAN QUARRIES three major sites *Figure 3.2*

Pendi. The names of the first two derive from a stream called Banem; I did not find this, but I believe it to lie between the Kunjin and Ngumbamung streams. It is possible that some more small pits could be found there. Ałame means 'to cover in a pit and cook' and Wi Pendi 'nothing lain' or 'it lies there "nothing"'; these two apparently refer to disused pits at either Kunjin or Ngumbamung. Men who had themselves worked at Kunjin or Ngumbamung had no precise knowledge of their locations or who had used them. It seems likely that the sites were used and abandoned in the 1800s. I should add that most of the more than 50 pits that I located in the whole valley were unnamed.

I surveyed and excavated at two of the Tuman sites, Kunjin and Gapinj Aka Nui, in 1980, and was able to map the sites of Ngumbamung and Yesim in 1981.

GEOLOGICAL ENVIRONMENT

As described by Chappell (1966:102-3, 105-7), the workings parallel the contact of a granodiorite intrusion with fine-grained 'tuffaceous greywacke sandstones and siltstones'. The Tuman quarries were also visited by D.E. Mackenzie and placed in the Omung Metamorphics, where the 'only known occurrence of actinolite-epidote-albite hornfels...sufficiently hard (6 on Moh's scale) for the manufacture of axes' was exploited (Bain et al. 1975:104). These rocks are late Palaeozoic and, according to the recent 1:100,000 Geological Series 'Minj' sheet, older than 242-217 Myr. Unfortunately the newer mapping revises the geology of the Tun area and places the exposure of the Omung Metamorphics a kilometre or so to the south of the sites, putting them instead in the Kana Volcanics. A series of faults pass to the south, but without apparently affecting surface exposures in the vicinity of the axe sites.

At each of the sites the axe stone is found in one of two forms: as a seam or lens in a planar layer of country rock, or in the form of hard nodules distributed throughout a softer substrate. The latter form is rare at the major sites of Ngumbamung, Kunjin and Yesim. As indicated by Chappell (1966:105-7), the axe stone is slightly hornfelsed; in hand specimen the rock is bluish-grey and very fine grained. It is distinguished from unusable rock in the same layers by virtue of the fact that it is free from blemishes and cracks and is

more completely indurated. When the axe stone is ground in the process of axe manufacture, a range of sedimentary structures is made visible in the form of stripes, mottles and grainy patches; however, axes are never found broken in two along a junction between two phases.

The quarry pits are strung out along a line which trends 105° west to east, as is evident from both aerial photography (Plate 3.1) and tape-and-compass surveys of the three main sites (Fig. 3.2). Exposures occur at increasing altitudes on the spurs between major tributaries of the Tun river as the line of pits trends from west to east. Informants have a very good idea of where the axe stone should outcrop, but I believe this differs in subtle respects from the way in which a geologist would look for it.

The quarrymen believe that occurrences of the axe stone follow a straight line along the side of the Tun valley, much as suggested by the myth of the origin of the axe stones related in Appendix A. The line begins at about 1800 m on the valley floor near Gapinj Aka Nui and rises to 2100 m at Ngumbamung. Informants have no difficulty in projecting the line from one spur to the next along the hillside. However, two questions are posed by this empirical prospecting rule. Firstly, are the occurrences of axe stone exploited at each site part of the same seam? The alternative is to believe that the quarrymen were simply lucky and actually exposed different layers of similar axe stone.

The second question is whether the quarrymen understood the influence of topography on the surface outcrop of a layer of rock. Assuming a layer is planar and not folded in any way, it will only outcrop in a straight line on flat ground or a smoothly inclined slope. In an area like the Tun valley, which has a corrugated topography, a surface outcrop should follow a sinuous course.

If the answer to the first question is 'yes', then the implication is that the quarrymen found the only possible exposures, which were thus constrained to lie where they are. Predictably, it would make geo-chemical finger-printing easier and more reliable, if over the whole valley the quarry pits had sampled the same bed of rock.

In a few places the pits are demonstrably at different stratigraphic levels. For example, at Kunjin, the axe stone in Pit 2 can be shown to lie some 12.5 m above that in Pit 1 - at least the

lowest visible parts of the working faces in each pit, below which point the axe stone is found, are this far apart (see page 46). And at Yesim, the line of pits follows a steep rise from Pit 1 to Pit 2 (Plate 3.6).

Informants recognise this in part - several pointed out to me that the stone in Pit 2, which was not worked within living memory, was either 'Ngumbamung' or one of the topmost stratigraphic sub-types, **buneng guk** (see page 61). The site Ngumbamung as a whole is said to lie 'above' Kunjin, though without an accurate theodolite survey this cannot be confirmed. (The main limitation on field mapping in 1980-81 was time. Even so, an ideal survey linking in all the sites would have been difficult to achieve in rainforest conditions, had this been attempted.)

Perhaps the clearest comparison of the quarrymen's model and geological reality is found by mapping the theoretical outcrop of a perfectly planar seam over the whole of the Tun valley, given that it must be exposed at Kunjin Pit 1.

I measured the dip and strike at Kunjin Pit 1 to be 30° to the north and 100° approximately. Using these figures to project the outcrop, it can be seen from Figure 3.1 that the major quarry pits are roughly aligned in the 'correct' positions. However, Ngumbamung lies above the Kunjin seam with these assumptions, and Yesim lies below Kunjin. The minor sites at Gapinj and Apiamb - which primarily exploited a nodular material - are not positioned anywhere near the seam. Stratigraphically they may be 100 m or more below it. Maintaining the dip at 30°, but allowing the strike to take values 5° either side of the 100° I recorded, gave the dashed lines in Figure 3.1. This shows that if exactly the same layers of rock were not exploited at Ngumbamung and Yesim as at Kunjin, they were stratigraphically quite close to each other. The same cannot be said of Apiamb, Gapinj and Gapinj Aka Nui, however.

It is interesting to see that the quarrymen had many opportunities to find axe stone that they did not exploit, even if the seam did not behave quite as predicted here. It clearly runs along Tełan Komeng in an almost horizontal outcrop and it is cut there by at least four major stream lines to the west of Orpał: Gapinj, Emi, Per and Wułał. Eastwards there are numerous opportunities to prospect before, 1.5 km beyond Ngumbamung, the outcrop reached the valley floor and

crossed to the north side. Topography dictates here that the outcrop should make a right angle turn to ascend the north wall. Although I was not able to fix the position of Mela very accurately in the course of a single visit in 1980, the predicted outcrop of axe stone passes through the approximate location. At least the model explains why there is a quarry to be found on the north side of the valley and it shows that that the Sikeing quarry exploited axe stone in roughly the same beds as the quarries on the south side.

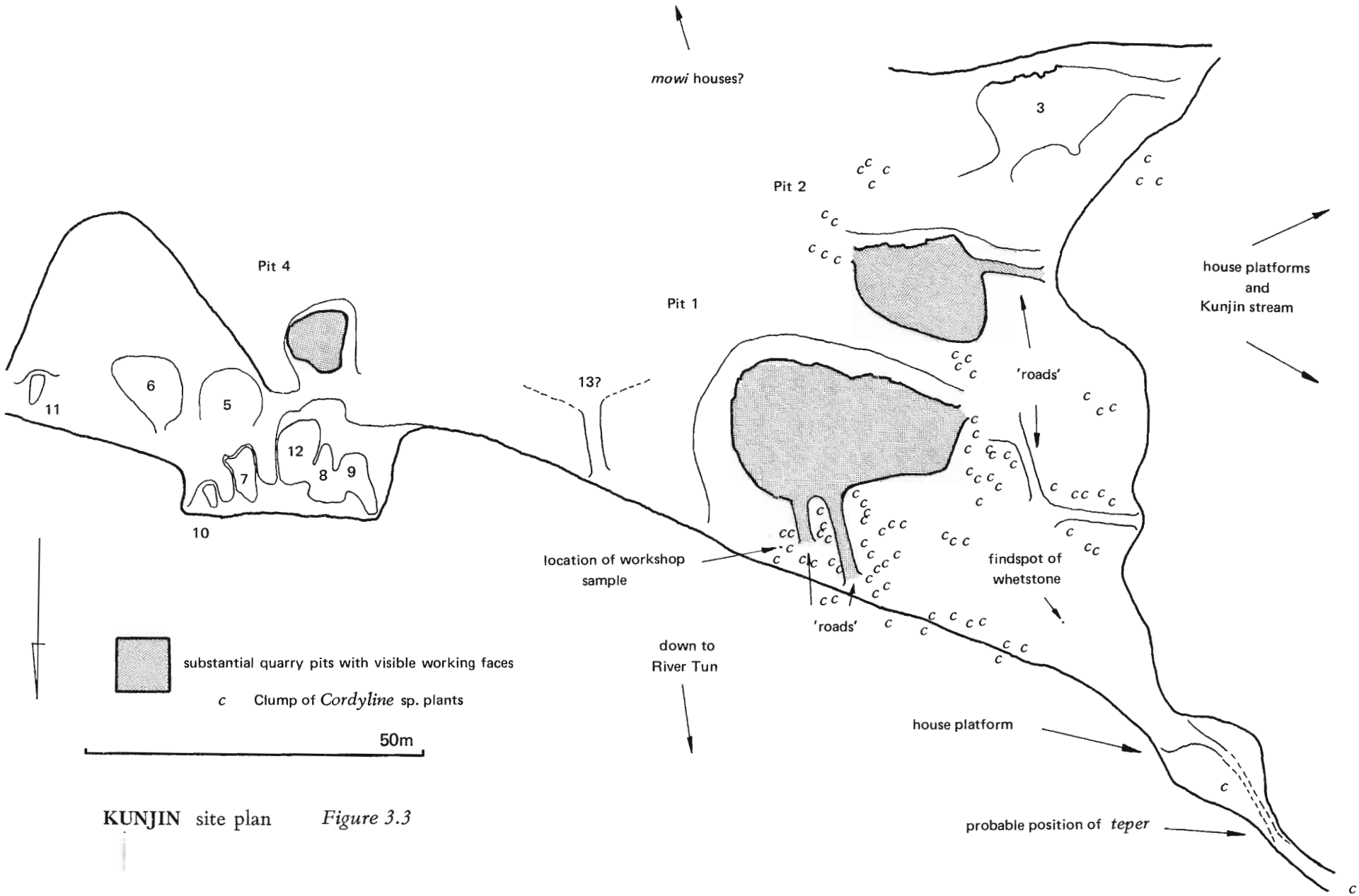
The evidence of topography and geological mapping in the Tun valley is thus capable of some kind of interpretation at the present time, even though the data are rather poor; there are also grounds for believing that the quarrymen's conception of the lie of the stone was a good operational model, but that it was not a perfect one. My stratigraphic mapping does not correspond with the linear projection used by the quarrymen, so that each quarry complex probably sampled a different stratum of a relatively thick formation of axe-bearing rock.

The yield of this formation may not have been high; the rock probably consisted of layers of axe-quality stone sandwiched between unusable lower grade layers, with many instances of good stone unpredictably lensing into poorer phases.

KUNJIN

In recent times, Kunjin (Fig. 3.3) undoubtedly had the largest output of the three major sites. Kunjin Pit 1 is the largest individual quarry and, according to informants, was also the one worked by the largest labour force, drawn from Kenjpi-emb, Akamb, Komnemb and Ekiemb clans (Table 2.1). It is also is the only pit at Kunjin known to have been worked in the memory of living men. Before the intertribal war which resulted in Mengka's loss of territory at Tun (Chapter 2), the Mengka clans Epni, Mombɨe and Mengka worked here in place of or in addition to the Tungei clans named above. At some time in the past the Mamelka were also able to quarry for stone at Kunjin; the Mamelka, however, do not claim to have had ownership rights, as do the Mengka.

Chappell (1966:103) visited Pit 1 and suggested it may have been the enlarged headwater basin of a small streamlet, but I saw no signs that this was so. Like the smaller Pit 2, 8 m to the south (see



KUNJIN site plan *Figure 3.3*

page 46), the bedrock has been physically hewn away to leave an open-cast working (Plate 3.4). Two parallel 'roads' - paths about 2 m wide - lead north from Pit 1 in the direction of the valley bottom (Plate 3.7; Fig. 3.4). Pit 1 has another exit on the western side which opens onto various dumps outside the quarried area and joins up with a road leading west. A single road leads from Pit 2, also westward in the direction of Kunjin creek; the creek flows northwards at the bottom of the slope on this side of the spur.

Under a deep leaf litter in the rainforest, a talus of discarded stone extends for several hundred metres below the sites; little spoil is seen around any of the quarries, because it has all been dumped on the steep hillsides which surround the site. Each of the roads leading from a quarry pit is depressed a metre or more below the present ground surface. This has probably resulted from spoil being dumped on either side, so as to raise the surrounding ground surface - it seems unlikely that the paths were worn down into the ground surface by the frequent passage of quarrymen.

In various places at Kunjin, as well as at Ngumbamung and Yesim, there are level areas where huts could have been erected. As described in Chapter 4, the quarrymen built temporary encampments at the sites and lived there at the time of a quarrying expedition. Although I did not attempt to excavate these sites, it is certain that they would yield useful information in the form of post holes, hearths with carbonised material, cooking stones and the like. Other archaeological materials to be found at the quarried areas, and in all suitably level places nearby, are chipped stone debitage and hammerstones. A rare surface find at the site was a piece of grindstone (Fig. 3.3); informants denied that axes were sharpened at the quarries and the fragment (see Fig. 5.6) was probably the stub of a whetstone - a portable sharpening stone carried about by a man to repair his stone axe at his place of work. It may have been dropped there at any time in the last 50 or more years and not necessarily by a quarryman.

As part of wider sampling strategy, I excavated a 60 x 70 cm cutting to a depth of 10 cm just east of the two roads which lead from Pit 1 (Fig. 3.3). This simply involved removing all the chipped stone for weighing, measurement and analysis - in this case, a total of 77 kg. The results of this exercise are reported in Chapter 5.

A notable feature of Pits 1 and 2, together with the roads which

lead from them and the house platforms near the sites, is that the area is planted with Cordyline fruticosa shrubs. The Tungei recognise at least eleven varieties and the one almost exclusively seen around the quarries is known as **guk koime** (Figs 3.3, 3.6 and 3.7). This shrub has a strong association with male rituals all over the highlands (e.g. R. Rappaport 1968:19; A.J. Strathern 1972:36) and it is not surprising to find it planted in a place of exclusively male activity. A thick grove of Cordyline surrounded a slight depression at the head of the two northern roads leading out of Pit 1; I was told that this was one of the places where the marsupial, **ka melka**, was cooked in an earth oven in a special quarrying ritual (see Chapter 4). Informants also said they planted Cordyline because they just liked to mark the place where they had quarried. The leaves of **guk koime** are also an essential part of male attire; informants said it was useful to have it growing around them.

The Cordyline plants are only found around the quarries that men said were used in the recent past. For some reason there were fewer growing at Yesim than at Kunjin and Ngumbamung, and around the pits of which informants had no knowledge there were no Cordyline plants at all.

Excavation at Kunjin

Pits 1 and 2 are the only quarries at Kunjin to have large exposures of bedrock in the form of a working face. In 1980 I made an excavation at the base of the working face in Pit 1, choosing the point at which there was the least amount of post-abandonment infill (Figs 3.4 and 3.5; Plate 3.4); as shown in Figures 3.4 and 3.5, I was also able to clarify the stratigraphic relationship between Pits 1 and 2.

Over the course of four weeks between 35 m^3 and 45 m^3, or about 100 tonnes, of rubble-like infill were removed. The fill consisted of blocky fragments of stone unsuitable for axe manufacture and it included sections of collapsed face of up to 3 tonnes in weight. A further 4 m depth of the working face was exposed, but no axe-quality stone was reached. There were no stratigraphic breaks in the fill and no dating materials were recovered. As I mentioned in Chapter 1, I was unable to continue the excavation in 1981 because of a crisis in

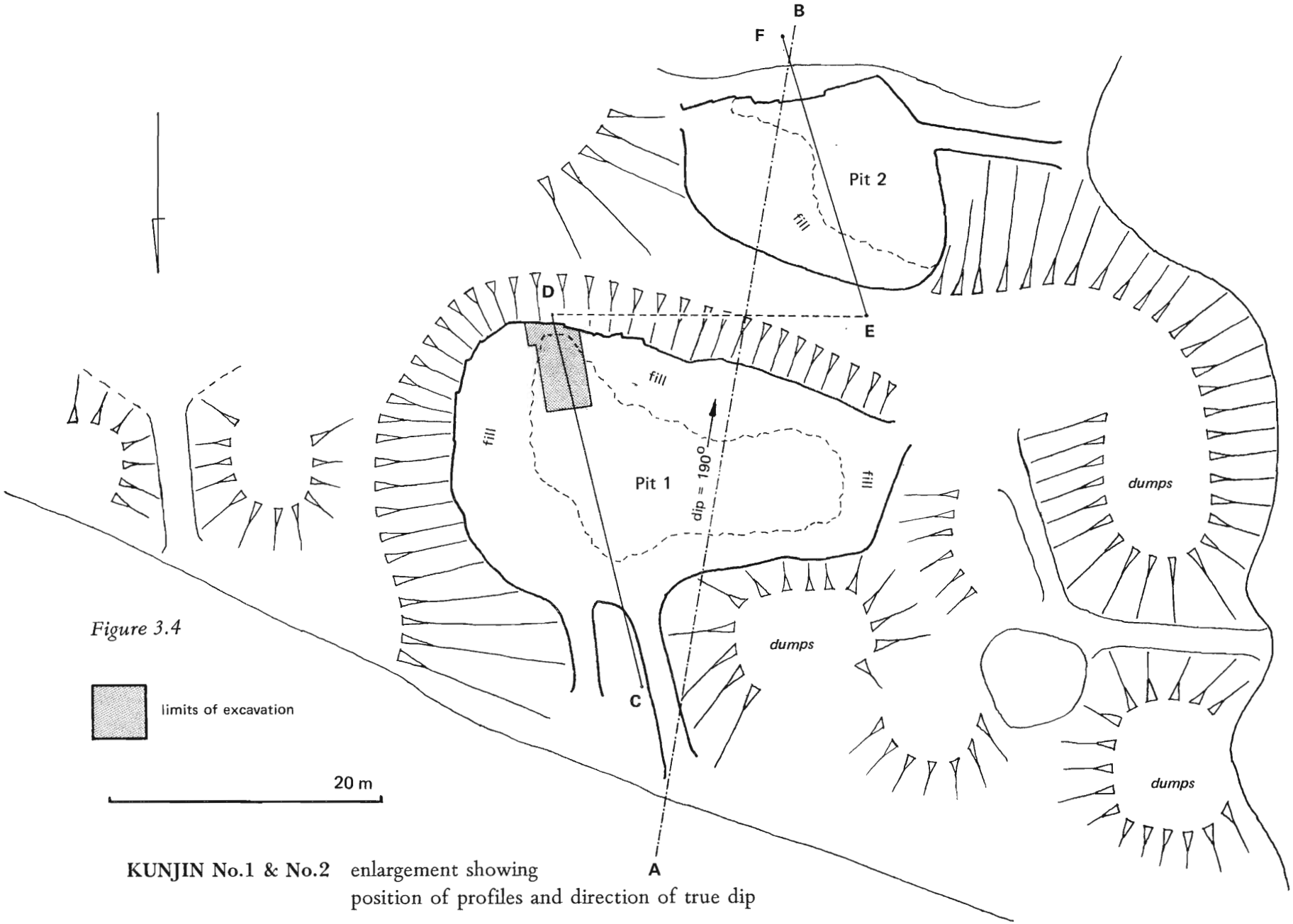
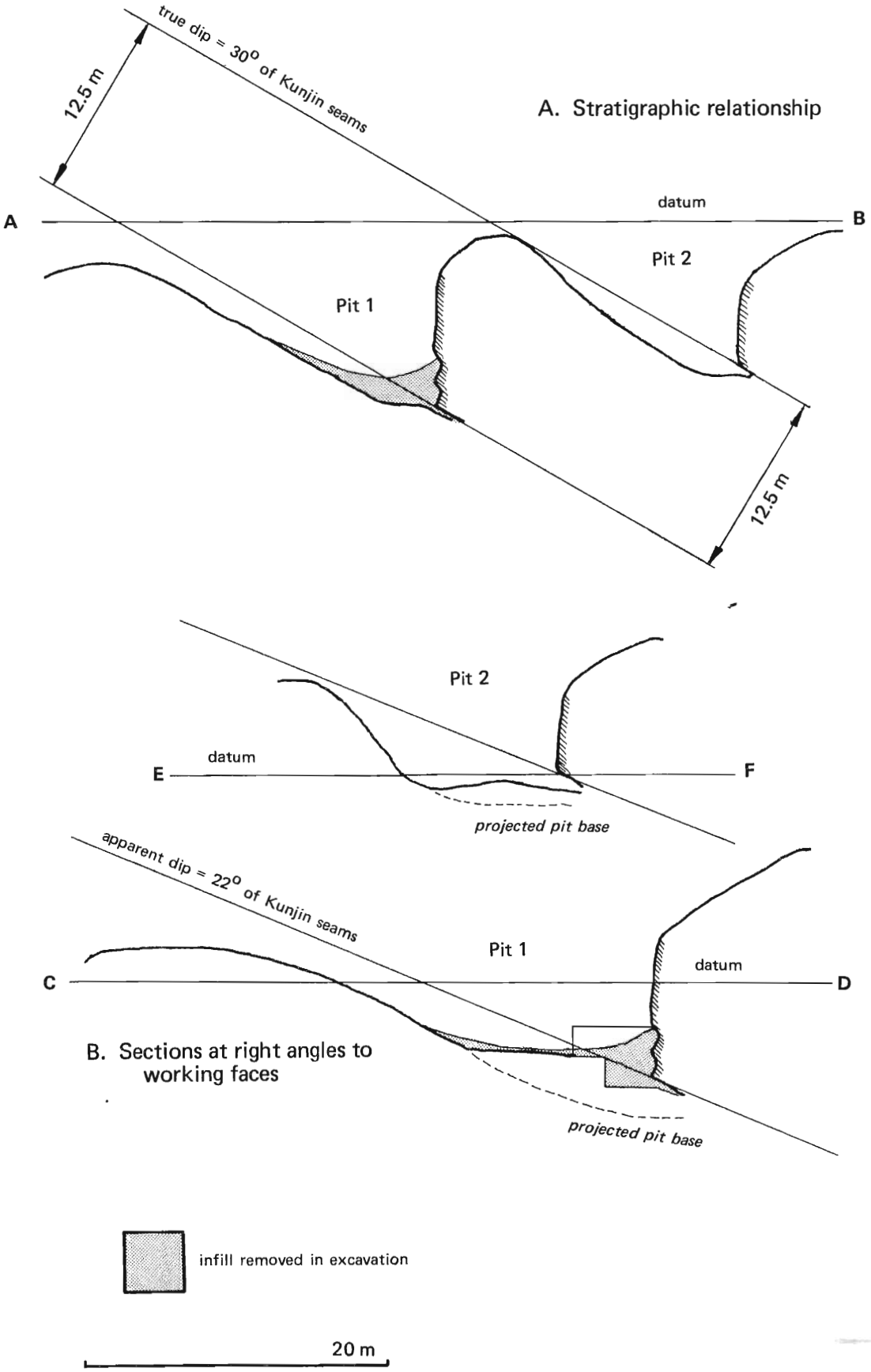


Figure 3.4

KUNJIN No.1 & No.2 enlargement showing position of profiles and direction of true dip



KUNJIN No.1 & No.2 profiles from north to south

Figure 3.5

the relations between the Tungei and their eastern neighbours the Sikeing.

The only finds made during the excavation were a number of hammerstones; but these did not occur in unusually high numbers and are common enough around the quarry complex as surface finds. Further analysis of the hammers may be found in Chapter 5 (Table 5.1).

I am satisfied that the great depth of rubble encountered in the excavation can be accounted for by natural processes acting on the 10 m-high face since the time of abandonment, 47 years before the excavation. In addition the quarrymen say they 'blocked the holes' when leaving the sites between mining trips; this probably involved bringing down rock pillars at the entrance to underground gallery systems and collapsing hanging parts of the face not previously removed. In order to cope with the rubble fill, and as seen in Plate 3.4, a timber shoring system was used, similar to that in Vial's photographs of mine-shafts at the Dom **gaima** quarry (see Chapter 9; Plates 9.3 and 9.4). This provoked the positive statement from informants that they never used such a technique traditionally.

The Amount of Axe Stone Removed

Chappell (1966:103) wrote that 1000 tons of material had been removed from Kunjin Pit 1. In order to arrive at a new estimate I guessed that the bottom of the pit is hidden beneath 4 m of rubble at the centre, by 6 m against the face, and by 1 m beneath the sloping northern side. If the volume of the pit is cut up vertically into parallel 2 m-wide slices, the total volume can be found by adding up the volumes of the slices.[3]

The figure I obtained was 4842 m^2. This can be multiplied by the

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[3] The slices were constructed on paper, following the plan of the pit as seen in Figure 3.4 and the measured profile of the pit as seen in Figure 3.5. The areas of each slice were measured on a Tektronix graphics tablet and scaled to square metres. The volume, V, of the pit was obtained from the following formula:

$$V = W.(A_1 + A_2 + .. + A_{N-1} + A_N)$$

where A is the area of a slice, N is the number of slices through the body, and W is the width of each slice.

specific gravity of the axe stone, which I separately determined to be approximately 2.91, to give an estimate for the total amount of rock removed of 14,090 tonnes. The higher figure of 5760 m^2, 16,762 tonnes, is obtained by assuming the pit is simply a regular six-sided space 36 m long x 10 m deep x 16 m wide.

Chappell's estimate therefore understates the amount of all rock removed by a factor of more than ten. Much of this rock was unsuitable for axe manufacture and a figure for the total tonnage of axe stone removed can be little more than an inspired guess. Informants distinguish between **mur ku**, 'pit stone', the stone that must be quarried out in order to reach the axe seam, and **tui**, 'axe' or 'axe stone', but it is difficult to state the relative proportions in which each occurred. Chappell (1966:103) suggested that 40% of the total would have been axe stone; I believe it would have been less, say around 10%. On this count, only about 1500 tonnes of axe stone can have been removed - a figure that is very close to Chappell's original estimate.

A typical 20 cm-long axe blade weighs around 800 g (Fig. 6.5) while the weight of chippings lost during its manufacture would certainly bring the amount of axe stone needed to make one axe up to 1-2 kg. Other forms of wastage are imponderable without replicating the process of quarrying itself: the proportion of stone which was wasted in hammering at the rock face and the proportion which had to be thrown away in the form of small and misshapen lumps. If a mere 1.5 kg were needed to make an axe, then 1,000,000 could have been made at Kunjin; if - as is more likely - 3 kg, 6 kg or even 9 kg were needed then 500,000, 250,000 or just 125,000 could have been made. These figures may be borne in mind in reading Chapter 4, when I attempt to reconstruct the output of the quarries from another angle.

Miscellaneous Details of Quarrying at Kunjin

The working face as a whole is crosscut by fracture planes, typically at 60° to one another, while the bedding planes dip into the face at 30° to the horizontal. The fracture planes provide the principal means of freeing blocks of stone without physically smashing them. This is not to imply that considerable force is unnecessary, and quarrymen say they needed large hammerstones and much effort to

break out the rock. After Chappell's description of the site, another visitor, in 1973, was O.A. Christensen (n.d.)). One of his slides (courtesy of the Department of Prehistory) is reproduced here as Plate 3.8. It shows Kenjpi-emb Pok and Gełu (Fig. 2.9) demonstrating how large hammers were held and smashed against the working face, in this case the face in Kunjin Pit 2. I found one hammer of similar size on the track below the quarries; it was made of axe stone and weighed more than 2 kg and may even have been the one used by Pok in Plate 3.8.

A distinguishing feature of axe stone, **tui**, is its clean, conchoidal fracture and absence of a preferred direction of cleavage. In contrast, the upper layers of rock, **mur ku**, have an irregular fracture. The physical extent of any particular piece of axe stone was limited by the fracture planes described above; these planes often provide the flat sides of the Kunjin-style axe, giving rise to the planilateral cross-section. For the quarrymen, **tui** is distinguished by the presence of 'ropes', **kan** - markings left by the sedimentary structures which have survived diagenesis and metamorphosis (cf. A.M. Strathern 1965:186). The 'ropes' only occur in the conchoidally fracturing rock suitable for making axes; they are not true laminations and the stone cannot be induced to part along them in the rare instances where they form linear patterns.

While on the subject of vernacular terminology, there are a number of verbs for digging in Ek Nii, such as **ak-**, as in **aka ak-**, 'to dig sweet potato', and **koi-**, as in **duł koi-**, 'to dig out a ditch'. However the all purpose modal auxiliary **to-**, to hit, is used in connection with quarrying and stone working: for example, **Kunjin tui to-**, 'Kunjin axe hit', to quarry at Kunjin.

The general term for stone, **ku**, can be used to refer to natural outcrops of rock in the landscape, **kombe ku**, as well as loose stones. Examples of the latter are **noł Tuman ku**, 'river Tuman stone'; **ku owi**, 'stone large', a boulder; **ku kembis**, 'stone small', a pebble; **ku ołpał**, 'stone gnat', sand.

In the quarry, broken **mur ku** is called **tui oi**, 'axe mud/ground', or overburden. (**Oi** is at the same time mineral soil, mud for face painting - and pigments in general - and the border mark between adjacent territories.) Removal of this overburden was a recognised task in quarrying and was accomplished by lines of men carrying

baskets, **grenj kon**, '**grenj** basket', from the pit (see Chapter 4). The 1980 excavation encountered **tui oi** exclusively.

Other Pits at Kunjin

Pit 3, to the south of Pit 2, is a much smaller pit. A small amount of rock is exposed, no more than a few metres in width, and is partially buried by land slippage. The pit is at most 5 m deep in the eastern part and the rim slopes downwards to the northwest, where the base of the pit is 1 m from the forest floor. South of the pit, the environment reverts abruptly to undisturbed rainforest (Fig. 3.4).

Pits 4-12 lie 50 m east of Pit 1 and form a linked complex of drives and shafts; they probably exploited the same band of axe-bearing rock. In contrast to what happened at Pit 1, the operation was never taken a step further so that the pits were joined together in an open-cast working. An 'upper deck' of pits, numbers 4, 5, and 6, penetrated the hillslope as true mineshafts. In the case of Pit 4 this is quite clear; it is 9 m across at the widest point and its present floor is 2 m below the baulk between it and pits 8, 9 and 12, while its sheer sides extend perhaps 8 m upwards to join the slope above it. Pits 5 and 6 are choked with fill and it does not look likely they were ever as deep as the adjacent Pit 4. They are surface features 1-3 m in depth. Pits 7-12 have never involved earth moving on any scale; they are drives which enter the slope more horizontally than vertically. Pits 8-10 are simple drives into the slope, beginning in the case of 8 and 9 with still open gallery entrances cut into the bedrock, approximately 1.5 m wide at the entrances. Pit 12 is filled with slumped material from above, but may have been similar to Pit 7, a deep shaftlike working with two open gallery entrances.

Pit 7 is an excellent example of underground mining technique and its state of preservation is all the more remarkable in that informants are not aware of its having been used within living memory. The present, and original, floor of Pit 7 is 1.5 m below the exterior ground surface; the south side rises sheer for about 8 m to join the baulk in front of Pits 4-6 (Fig. 3.3). The southern gallery is blocked by fill, but it is at least 6 m long, as I was able to show by pushing a wooden stick of this length past the blockage. The eastern gallery entrance is 1 m wide, free of fill, and runs in for 4 m as it

widens to 2 m, turning into the hillside in a narrow dogleg at that point. A second chamber, 4 m long, runs south from the dogleg. The gallery system is substantially clear of spoil, with an unsupported ceiling some 80-120 cm high (Plates 3.9 and 3.10).

The stone exploited here is not in a massive phase but appears to have been obtained in nodular form from a relatively friable bedrock, as at Gapinj Aka Nui (see page 55). In order to check its relationship with the seams in Pits 1 and 2, I plotted the level of the gallery entrances against a datum in Pit 1. The entrance to the southern gallery proved to lie some 6 m above the lowest level reached in the excavation in Pit 1. However, taking the figures for dip and strike at Pit 1 into account and projecting them in the appropriate direction, the rock exploited in Pit 7 can be shown to lie some 25 m stratigraphically below the Pit 1 seam.

Pit 11, 20 m further east, is a small drive with an entrance pit about 4 m in length. The drive continues for 3 m beneath the sloping ground surface. East of Pit 11 there are no surface indications of quarries for 35 m, when Ngumbamung is reached.

The mountainside is extremely steep at this point, rising from about 30° to a maximum of 45° near the crest of the ridge above Kunjin. Anthropogenic grasslands of **gumei** pitpit, Miscanthus floridulus, have replaced forest trees between the two sites and are kept open by the continuing instability of the soil and by dry-season firings (Plates 3.1 and 3.2). Any small pits in this area are very likely to have been obliterated by the land slips. At the summit of the ridge, the undisturbed rainforest begins again, containing many trees with trunks up to 1 m in diameter.

While forest regrowth has not taken place in these grasslands, with the exception of the shrubs now colonising the lowermost parts of the disturbed area, the actual quarries at Kunjin have become completely wooded. Trees of 20 m in height and 25 cm in diameter had grown within Pit 1 by 1980 and, in Pit 2, which Christensen cleared of vegetation in 1973, trees of 6 m in height and 10 cm in diameter had grown back by 1980.

The ground between Pits 1 and 4 appears to be covered by a landslide. If a pit or pits were located there, no trace is evident today. Visiting the site in 1980, Komnemb Warke suggested that it was the site of an accident when three men of Epni clan were killed in a

mining collapse; the incident is believed to have happened in the first few years of the century.[4]

NGUMBAMUNG

The site is owned and was worked by Tungei Eska and Kupaka clans; the most recently used pit was Pit 1 (Fig. 3.6). It is almost joined to Kunjin; only a narrow strip of broken ground separates the two sites. As may be seen from Plates 3.1 and 3.2, the several hectares of Miscanthus grassland above Kunjin and Ngumbamung is not interrupted at the nominal change from one site to the other.

Ngumbamung is the major quarry 'Umbamn' visited by Chappell (1966:103); it was also visited by Christensen (n.d.). The rim of the pit is equivalent in size to Kunjin Pit 1, but the bottom of it is a great deal smaller. The hourglass shape of the pit bottom strongly suggests that two shafts were in the process of being enlarged into a single open-cast working when the quarry was abandoned.

On the west side, the pit is extraordinarily deep, with the pit base over 20 m from the exterior ground surface. Two casuarina trees stand on the rim of the pit; both are mature and were presumably planted no later than the time of last use of the quarry. Three separate roads lead out of the double pit, terminating in the break-of-slope at the forest edge 25 m away on the down-slope side.

Pit 2 at Ngumbamung is broader at the base than either half of Pit 1, but it is not as deep. The bottom of the pit is approximately 8 m below the northern ground surface. As seen in Fig. 3.2, the area of **gumei** (Miscanthus) grassland above the sites extends as far east as Pit 1. Between Pits 1 and 2 however, a landslide descends into the space where a quarry pit might be expected to be. I think the slide may cover a shaft adjacent to Pit 2. Alternatively, Pit 2 may be the truncated remnant of a much larger open pit that has been mostly filled by the landslide. Pit 3 is another substantial shaft about 8 m deep; a short road joins the shaft base with the open slope to the north.

Seven minor pits are scattered through the Ngumbamung site.

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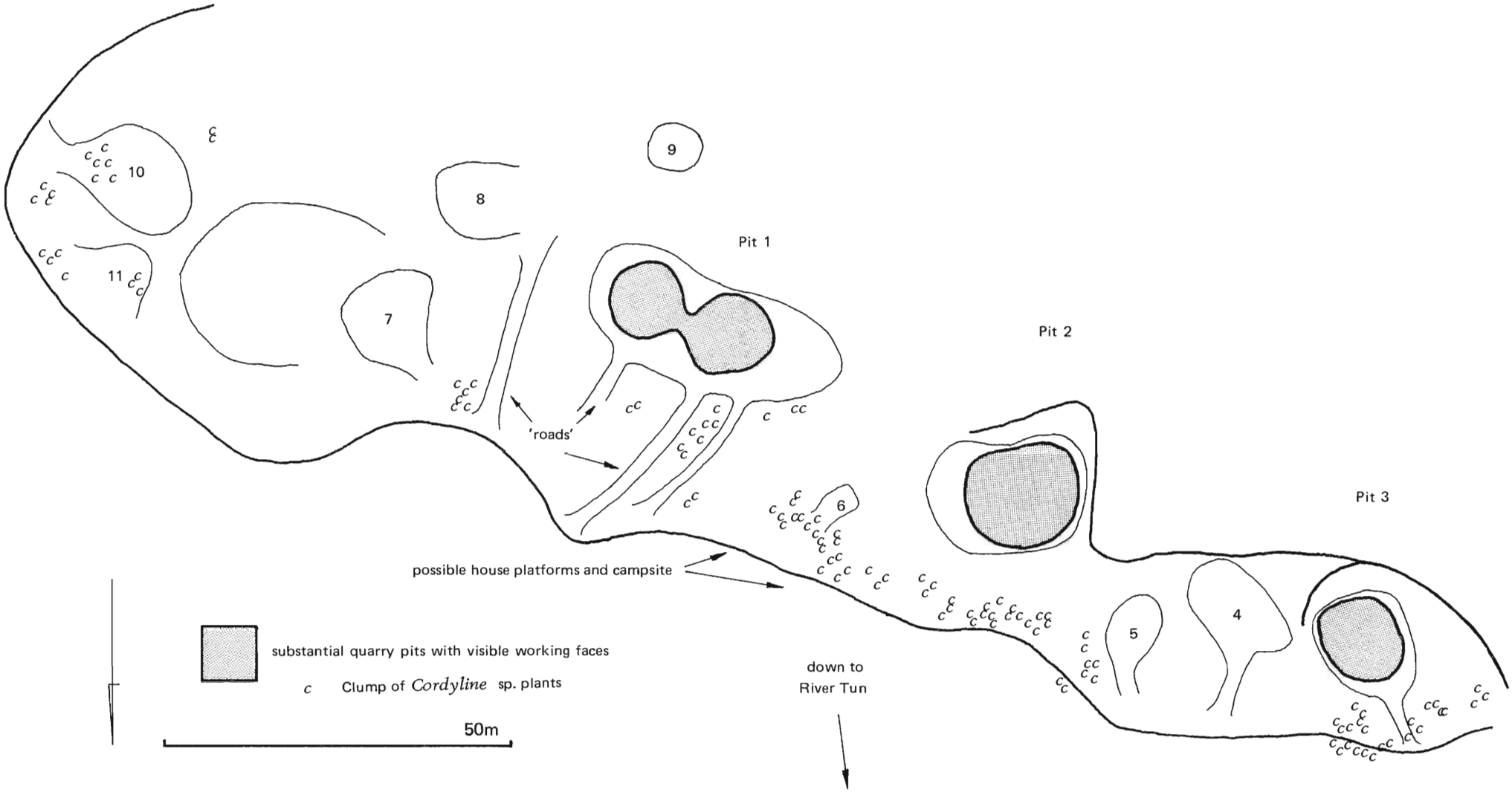
[4] Interview 5-80.



NGUMBAMUNG site plan *Figure 3.6*

Pits 4-11 are very similar to those mapped at Gapinj Aka Nui, the largest being numbers 4, 5 and 10, each about 4 m deep. It is notable that Pits 10 and 11 are sited well above Pits 7 and 8 and must have exploited different seams of axe rock. From the eastern end of Pit 1 the ground rises steadily, with 7 and 8 as much as 15 m above the Pit 1 base and Pits 10 and 11 some 8 m higher still.

Cordyline shrubs grow in great profusion along the length of Ngumbamung (Fig. 3.6). Following the remarks made by informants at Kunjin, they might be taken to indicate the places most recently used by quarrymen and, possibly, to mark out the areas where the quarrymen built their huts. Unfortunately no Eska or Kupaka informants were able to visit the site with me in either 1980 or 1981.

YESIM

The site of Tepi Yesim, or simply Yesim, is owned by Menjpi clan (Fig. 3.7) and Pit 1 was the site most recently worked by them; it was visited by Chappell who, as explained above, recorded it as **wui**, and in 1977 by P. Gorecki (pers. comm.). A decade before 1933, when the Mengka still held territory along the Tun valley, Menjpi worked the site in conjunction with the Mengka clan, Kenapuɨ.

Pit 1 is the longest of the big pits in any of the major sites, but it is at the same time the narrowest and shallowest; Pit 2 is another substantial quarry pit at the eastern end of the site. The working face at Pit 1, as at the other quarries, is on the south side and is preserved as a rock face some 5 m high. At the deepest point (Plate 3.5) the lowest part of the face is some 12-15 m below the rim of the pit, but to both east and west the pit is much more shallow; typically it is about 8 m below the ground surface to either side.

In the absence of radiometric or other 'hard' means of dating the sites, the development of open-cast quarrying in the Tun valley cannot easily be placed in chronological perspective. But on a visit here in 1981, Malimbe commented that in his earliest memory the base of Pit 1 was a couple of metres higher than it is at present.[5] This implies that in the short time he was working - probably about fifteen years -

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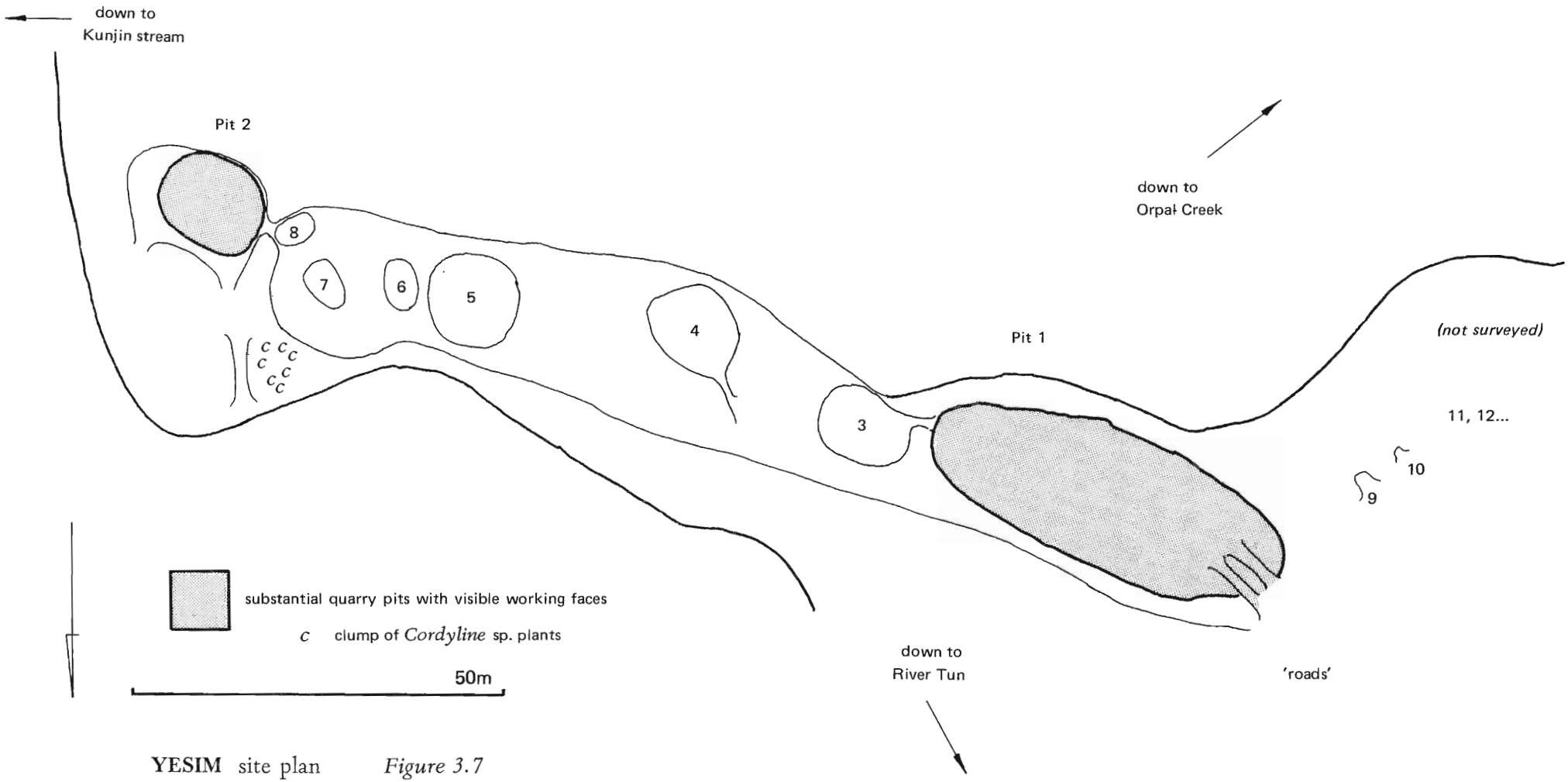
[5] Interview 50-81.



YESIM site plan *Figure 3.7*

the quarrymen were able to dig out a substantial amount of rock at a major pit. Malimbe's statement is not proof that quarrying is a recent phenomenon, but it is certainly a reminder that the sites were opened and exhausted on a human timescale.

The swathe of pits at Yesim runs east-west on the same alignment as Kunjin and Ngumbamung. It forms an artificially made trench through a narrow spur between the deep gulches formed by the creeks on either side, **noɨ** Kunjin and **noɨ** Orpaɨ (Fig. 3.2). The slope down to each of the creeks is extremely steep, as is the slope below the site on the northern side to the bottom of Tun valley. A narrow neck just above Pit 2 runs up from the spur to the mountain behind the site; it is here that the patch of grass visible from a distance or from the air is located (Plates 3.1 and 3.3). Behind Pit 1, a wooded slope descends to Orpaɨ (Fig. 3.7).

Pit 2 is large in area and tens of metres higher in altitude than Pit 1: further confirmation that the quarrymen were following a line, rather than following the outcrop in a stratigraphic fashion. The pit is not deeper than 5 m below the surrounding ground surface. Half-a-dozen insignificant pits, numbers 3-8, line the trench created by quarrying. Pit 6, for example, is merely a slight declivity. Pit 3, however, looks like the neck of a shaft and has an average depth of about 3 m. South-west of Pit 1's entrance, several tunnelled drives are present as well as other small workings; I did not survey these in detail. There are few house platforms at Yesim, but informants say the main encampment during mining was at the foot of Tepi Simemb, a creek bed descending to the valley floor from just below Pit 1.

GAPINJ AKA NUI

This minor site is on Menjpi land but, according to Waɨpi Pam Wu[6] and other informants, was last worked by the Waɨpi a decade or so before 1933. I do not know what agreement existed between the owners and the men who used the site, but no kind of payment was ever mentioned. (Note that the contrary was true at the Dom **gaima** quarry in Simbu Province - Chapter 9.)

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6 Interview 10-80.

Two Menjpi informants who visited the site in 1980, Kandel and Kale, dismissed the site as unimportant, with a yield of poor stone. In fact seven pits have been dug here (Fig. 3.8) but only one - Pit 5 - compares in size with the medium-sized pits at Kunjin, Ngumbamung or Yesim.

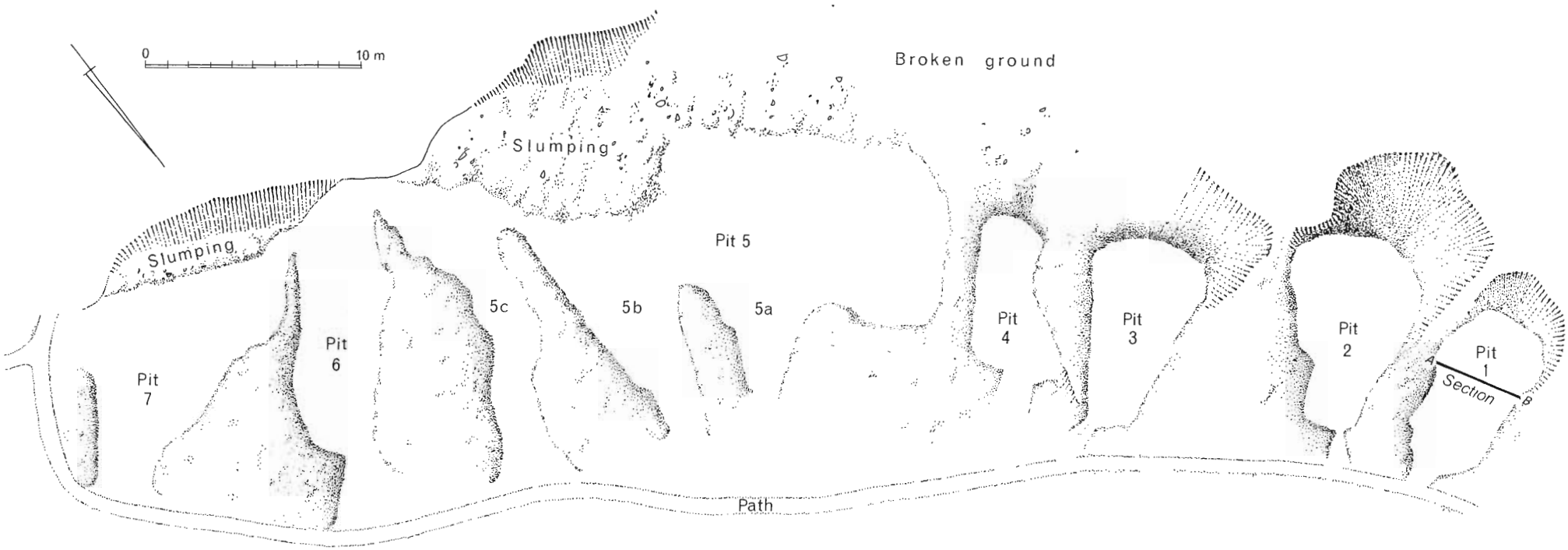
Excavations at Gapinj Aka Nui

In August 1980 I sectioned Pit 1 and it may be taken as a fairly typical example of a small pit at Gapinj Aka Nui. The pit (Fig. 3.9; Plates 3.11-3.13) is 4 m x 8 m at the rim and 4 m deep. It was filled to a depth of 3 m with spoil and slumped material. At this site, the bedrock is a friable mudstone and axe rock occurs not in a seam but in the form of nodules. The maximum nodule size seems to have been 20-25 cm in length and, unlike the massive rock from the major sites, there are no fracture planes to form naturally flat ('planilateral') sides. After reduction by flaking, it is probable that only small axes up to 15 cm in length could have been made here.

Unfortunately the products of Gapinj Aka Nui are not geochemically distinguishable from other Tuman axes using present methods and I am unable to give a description of the differences between them and axes made, say, at Kunjin. However, a very similar type of quarry to Gapinj Aka Nui was the site of Pukl, in the Jimi Valley. It was visited by Chappell (1966:101) and by P. Gorecki in 1983; only nodular axe stone was exploited there too (see Appendix F). Because Pukl axes have a very distinctive infrared spectrum, they can be identified in axe collections (Appendices G and H) and give some clue as to what kinds of axe blade could be made from nodular raw materials. The longest Pukl axe so far discovered is 20.5 cm in length; most are in the region of 10-15 cm in length.

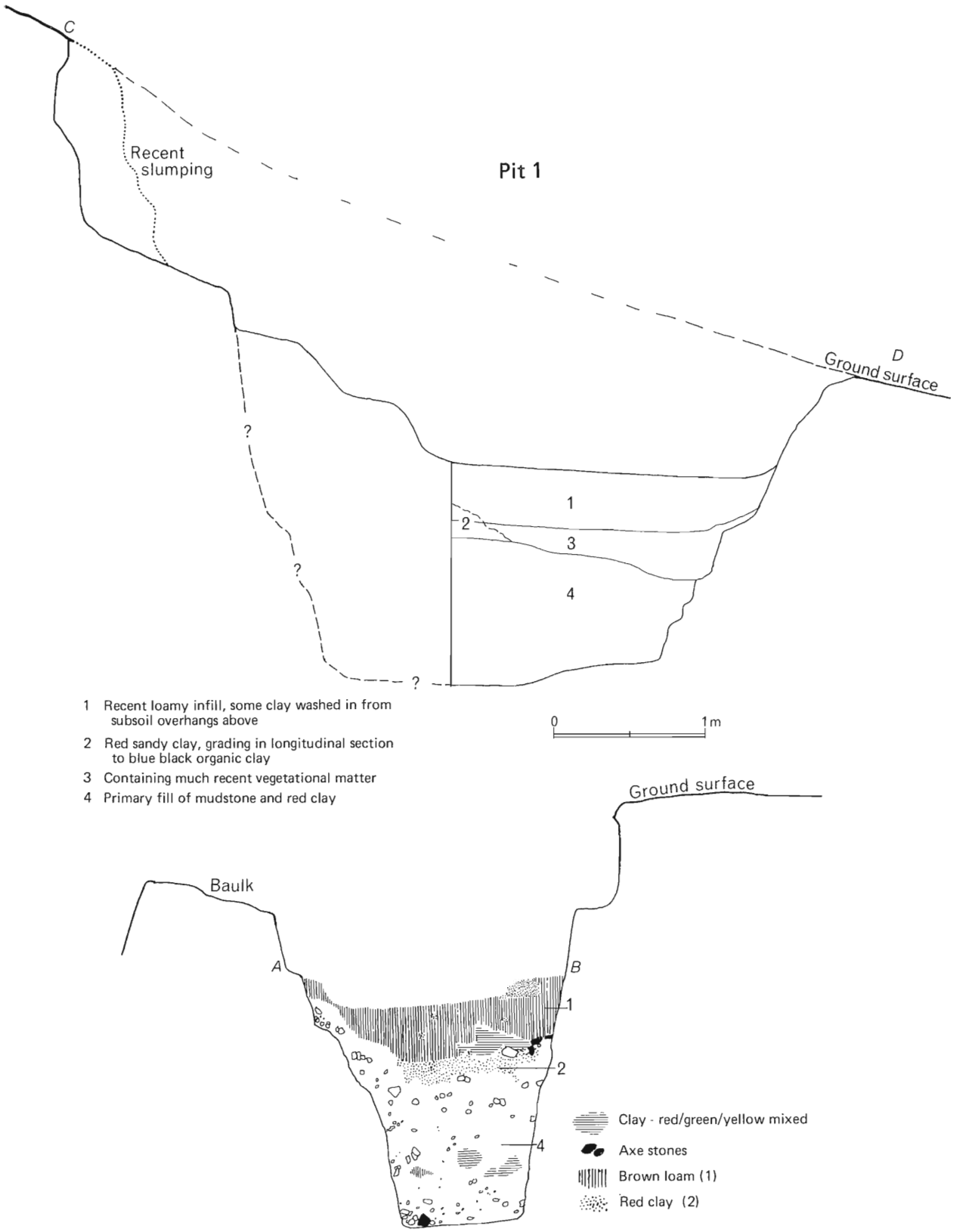
Labour Requirements at Gapinj Aka Nui

The time needed to dig out a small pit like the one I excavated must have been slight. Digging sticks and baskets would have sufficed and, bearing in mind its small size, the pit could probably have accommodated a workforce of half a dozen to a dozen men and boys. My



GAPINJ AKA NUI plan of workings

Figure 3.8



GAPINJ AKA NUI details of excavation

Figure 3.9

excavation of half of the fill of Pit 1 was equivalent to removing one quarter of the original contents of the pit. This is based on the fact that the long profile of the pit had an area of some 38 m^2, if a projection of the original ground surface is made (dashed line in Fig. 3.9), whereas the amount of fill removed had a profile area along the same axis of about 9 m^2, i.e. about 25% of the former figure. Four men took four days to bottom the pit with modern tools. In my opinion, the original quarrymen would have required no more than two or three weeks to dig out the whole pit.

Further calculations serve to determine how much labour the quarrying of the whole network of pits at Gapinj Aka Nui would have involved. The total plan area of the seven pits is 485 m^2, which is some 17.5 times the plan area of Pit 1 alone, at 28 m^2. A minimum value is thus 17.5 times the labour involved in quarrying Pit 1. However, Pit 5 is deeper and wider than Pit 1 and may have required a proportionately greater amount of labour. At a guess, a better estimate for the whole site is 20 times the labour involved in quarrying Pit 1.

I said that a workforce of less than a dozen members could have emptied Pit 1 in two or three weeks. Twenty times this force - over 240 men and boys - was actually deployed at the three sites of Kunjin, Ngumbamumg and Yesim in 1933 (Table 2.1). Were such a large number ever to have been concentrated at Gapinj Aka Nui, they could have accounted for all the visible quarry pits in two or three weeks. It is unlikely that so many men ever worked at this site at once; I do not know directly how many quarrymen the Wałpi could have mobilised when the site was last used in the 1920s, but it is likely to have been just over 40. The 1958 census return lists 66 adult men for Wałpi, compared with 65 for the clan-pair Kenjpi-Akamb, a unit of similar size to Wałpi (D.J. Hook, PR, Minj No.1 of 1958/59); in 1933 the Kenjip-emb mobilised 43 adult men, according to my count (Table 2.1).

The Wałpi workforce at Gapinj Aka Nui consisted of the three sub-clans Tumamb, Ngunjemb and Penjemb from what Pam Wu told me. Tumamb was probably quite large, containing two men's house groups, while Njunjemb had one. Penjemb had very few members and may even have been part of the Sikeing tribe at this time, according to Wałpi Pok. Two other Wałpi men, Asip and Opei Kang, confirmed that Tumamb

and Ngunjemb worked at Gapinj Aka Nui, adding that the remaining Waɨpi sub-clans, Pla and Ep-Ngipe (Fig. 2.5), quarried at Aɨame, an unknown site at or near Kunjin. They did not mention Penjemb.[7]

Because I do not know what proportion of the Waɨpi belonged to each sub-clan, an estimate of how many men worked at Gapinj Aka Nui cannot be precise. Waɨpi Pok also said that in the 1930s Pla and Ep-Ngipe comprised three and four men's houses respectively. Discounting Penjemb, and assuming that the Tumamb, Njunjemb, Pla and Ep-Ngipe men's houses were of the same size, Tumamb and Ngunjemb may have only made up 3/10ths of the total strength of the Waɨpi, namely 12 men. If their numbers were greater, a higher figure might have been 20 men. Split into two along sub-clan lines, there would have been two gangs of 6-10 men, plus any number of boys and adolescent youths. This is not too far from the estimate of gang size I proposed in the discussion of Pit 1.

Dating

Pam Wu said that when he was in his early teens, the men of his father's generation began working at Gapinj Aka Nui. This would have been before 1910 (see discussion on Pam Wu's age in Chapter 2). Asip also saw the men working the site sometime before the Mengka left the Tun valley around or just after 1920; after this time, the Waɨpi are known not to have quarried at all. Since Asip is a much younger man - he was just married in 1933 - I take this to have been very shortly before this event. In sum, there is evidence that the Waɨpi worked the site on a number of occasions over a fifteen year period from before 1910 to after 1920. Given the size of the quarried area at Gapinj Aka Nui, two gangs of the size mentioned above could have dug out all the pits in a reasonably small number of visits to the site. Since there are seven pits it is tempting to think of each gang digging one small pit at a time for three visits each and joining with its partner to dig out the larger pit on a fourth occasion.

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[7] Interviews 10-80, 11-81 and 55-81.

GAPINJ AND APIAMB

Both of these sites lie on Menjpi land, but little is known of them; use of the sites is only remembered anecdotally and their physical traces show that they were minor sites in comparison to Kunjin, Ngumbamung and Yesim. A line of seven pits is today concealed in thick rainforest at Gapinj; there are three pits at Apiamb. I did not survey at either site.

The Gapinj pits are rather larger than those at Gapinj Aka Nui, but only one merits comparison with medium-sized pits at the major sites, like Pit 2 at Yesim or Pit 4 at Kunjin. The remainder are features 2-4 m in depth in which it is certain that only nodular axe stone was obtained. A surface find of stone from Gapinj is illustrated in Figure 5.1.

At the western extremity of Gapinj there is a large washout which does not appear to be a natural creek bed and it may be the trace of the technique of damming and sluicing to remove overburden. As described elsewhere, the quarrymen would have diverted a stream above the site to flow over it. When the water had exposed the bedrock they would take out usable axe stone. Unfortunately no informants had seen the site in use during their lifetimes.

At Apiamb there are two medium-sized pits with a smaller depression just above them. As far as is known, Apiamb has not been used within living memory, but Komnemb Malimbe and Kombra both said that there was 'strong' stone to be found at Apiamb, unlike at Gapinj or Gapinj Aka Nui.[8] I take this to mean that axe stone was dug out of the bedrock rather than dug out of a softer matrix in the form of nodules. The assertion is backed up by the fact that a small patch of bedrock can be seen at the back of the larger of the two main pits at Apiamb, and by the solid slab of rock exposed in the bed of the creek **Orpał** only 20 m or so to the east of the site.

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8 Interview 25A-81.

MELA

Mela is the only known quarry situated on the north side of the Tun valley and also the only one not to lie on Tungei territory at the time of the Taylor-Leahy patrol in 1933. The site was owned and worked by Meka clan of the Sikeing, a tribe who were traditional enemies of the Tungei. I visited the site on one occasion only, in 1980; my Meka guides Ning and Onem were aged about 14 and 10 respectively in 1933 and were able to describe the main points of the quarrying operation.[9]

The four Meka sub-clans Menjpi-emb, Kisu-emb, Olt Kamen and Osi Kanem went to a place above the site where they each built a men's house. Food was brought to them and left at the place Kilbo, a ceremonial ground on the northern side of the ridge which conceals Mela from the rest of Sikeing territory. The men diverted a stream flowing from the top of this ridge to wash through the site and remove the overburden; they did not open shafts or pits like those seen at the major Tungei sites. At the site itself there were no discrete pits to be seen, but about one hectare of ground had evidently been disturbed and was crossed by washouts. Flakes and lumps of axe stone were strewn about the surface.

I have not seen axes that are certain to have come from this quarry, but informants identified several blackish Tuman axes as Mela. The shape was not noticeably different from that of other Tuman axes.

MIS

A very minor source of axes, according to informants, was the River Tun itself. **Tui** Mis was a black stone found in the riverbed in sufficient quantity to have made it an occasional source of axes. Presumably Mis had its origin at the main axe seams in tributaries of the River Tun, such as **noł** Kunjin and **noł** Orpał. Both of these creeks cut through exposures of hard stone in their upper reaches, the most notable instance of this being a 30 m-high waterfall, Kunjin **kułup**, in the Kunjin Creek between the quarry sites of Kunjin and Yesim. I have

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9 Interview 19-80.

never knowingly seen axes made from this material and informants never identified any Tuman axes that I showed them as Mis.

STRATIGRAPHY WITHIN THE SITES

One informant, Komnemb Warke,[10] said that small amounts of usable stone might be found in the **mur ku**, but the consensus of opinion was that the goal of quarrying was to exploit a seam at the base of the working face. Informants distinguish a minimum of eight, and often as many as a dozen or more varieties of axe stone in each quarry. These varieties refer to layers of axe stone occurring in an allegedly stratigraphic order at each site. Since a minimum thickness for one of these layers must have been 10 cm, if axes were to be obtained from it, I believe the minimum thickness of the whole seam to have been 1 m. A much more likely thickness for each of the layers is 20-25 cm, so that a seam 2.0-2.5 m thick is quite credible.

Table 3.1 shows the versions of this ordered list given by seven particularly experienced quarrymen; two of the men worked at Yesim and four at Kunjin; one - Komnemb Malimbe - worked at both sites. Three of these men - Warke, Geɬu and Malimbe - visited one or other of the sites with me on different occasions to make the descriptions.[11] I obtained no detailed information about the stratigraphy in Ngumbamung, but the men independently agreed that each variety was found in each of the three major sites, with minor exceptions. Toɬ, for example, said that the variety **goɬ onguɬ** was only represented in Ngumbamung.

As I have argued before, it is unlikely exactly the same layers of rock were exploited in each quarry. This means that the quarrymen must have been employing a typology of axe stone varieties as a guide to the local stratigraphy, rather than an actual stratigraphy. Indeed, each exposure seems to have been quite variable and capable of several different 'readings' by the experts. I found it interesting that no two informants gave the axe varieties in exactly the same order and that there was at least as much variation among the Kunjin quarrymen as between them and the Yesim quarrymen.

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[10] Interview 5-80.

[11] Interviews 13-80, 16-80, 17-80, and 8-81 among others.

	KANDEL	TOL	GELU	POK	GERI	WARKE	MALIMBE
stone only found above Kunjin Pit 1							*ongul aril*
							buneng guk
							wi pendi
				alame			*alame*
stratigraphic break							
types of stone found in the *mur ku* at Kunjin Pit 1			*kakelpe*			*kakelpe*	
			keneka			*keneka*	
			kelam				
			buneng guk				
stratigraphic break							
types of stone made into axes at both Kunjin and Yesim		*poinemb kopun-nge*					
		mur ku					
	win kambrem	*win kambrem*			*win kambrem*		
			pule mand				
	kopun kang			*kopun*		*poinemb kopun kang*	*poinemb kopun kang*
	poinemb		*poinemb kopun*	*poinemb*		*kelam*	
	kambrem			*pule mand*		*buneng guk*	
	mula pendi			*kambrem*	*mula pendi*	*kambrem*	*win kambrem*
				kaplsim			
	kang wem	*kang wem*	*kang wem*	*kang wem*	*kang wem*	*kang wem*	*kang wem*
			kur kaikile				
	wu wem	*wu wem*	*wu wem*	*wu wem*	*wu wem*	*wu wem*	*wu wem*
	pulemand			*kur*		*kur kaikile*	*pule mand*
	kaplsim	*kaplsim*	*kaplsim*		*kaplsim*	*kaplsim*	*kaplsim*
		pule mand	*kambrem*		*kur kaikile*	*mula pendi*	*kur*
	kur + kaikile				*pule mand*	*pule mand*	
		ginga kan pule	*ginga*	*ginga*	*ginga*	*ginga*	*ginga*
base of axe stone		*ginga kan kele*					
	tepi simb	*ku menjim*					
		ku denga					

VERNACULAR STRATIGRAPHY

Table 3.1 columns of stone names given by seven Kunjin and Yesim quarrymen

While the stratigraphies vary in details, they can be compared in general terms. **Buneng guk** was one of the topmost strata, where it was mentioned. Warke said it was so close to Kunjin, i.e. the axe seam as a whole, that it 'smelt' of it. **Poinemb** and **win kambrem** were also varieties always found at the top. Geri said that **win kambrem**, meaning 'flakes trodden on', was left as the roof stone when they began to dig into the face, and that it was smeared with pig grease when they did this.[12] Note that this is one of the few unambiguous references to making galleries into the seam. The testimony of others disagrees with this; they said that **win kambrem** was in fact used for making axes.

Kandeł and Malimbe said that **buneng guk** and **onguł arił** were found in Kunjin Pit 2, that is to say, stratigraphically above Pit 1. Lower down the lists, **kang wem** and **wu wem** are generally found together in the middle, **kaplsim** and **kur kaikiłe** are found further down, and **ginga** is consistently the lowermost variety named.

Etymologies for these names, where known, are descriptive or comparative, for example **goł onguł**, **goł** 'pitpit leaf'; **onguł arił**, 'leaf **arił**' (cf. **arił kułi**, 'dried leaf bustle'); **buneng guk**, 'dark red Cordyline leaf'. **Nonda kang wem**, 'mushroom boy **wem**', is a kind of mushroom that is not fully opened; **nonda wu wem**, 'mushroom man **wem**', is a fully opened mushroom; **kur** means 'unripe'.

All these types made good axes and informants willingly classified museum specimens by these names. Unfortunately they were too inconsistent in their identifications for the basis of the classifications to be clear. I found that only **ginga**, used for heavily striped axe blades, was at all distinctive. Informants were also inconsistent in attributing axe blades to the three main Tuman quarries. I found, for example, that only one axe blade in my possession was always identified with the same quarry - an axe borrowed from the National Museum of Papua New Guinea.[13] This blade was always attributed to Ngumbamung; it had very distinctive patterns of light and dark mot-

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[12] Interview 16-80.

[13] National Museum No. E8386, locality unknown. The axe was later hafted by Komnemb Duri (Frontispiece; Chapter 6) and is back in the National Museum.

tling just as described by Chappell (1966:105-6). Unfortunately it seems that, while Ngumbamung stone can show 'more primary textural variation in hand specimen' than any of the other types (Chappell 1966:106), this did not occur as commonly as Chappell supposed.

THE CONCEPT OF AN AXE FACTORY IN THE TUMAN AREA

In giving details of the individual quarry sites which lie in the Tun valley, I have diverted attention from the fact that the whole network of sites was, as far as complete outsiders were concerned, part of a single 'axe factory'. Although expeditions to obtain stone were only mounted every 4-7 years, the manufacture of axes was probably continuous in the sense that the axe makers of the Tuman area - the quarrymen and their immediate affinal relatives and trading partners - could be provided with enough axe stone to last them for several years.

Other people living in the Wahgi Valley had at least second-hand knowledge of the axe makers. The discovery myth told to Vicedom by Ko of the Hagen tribe Yamka (Vicedom and Tischner 1943-48, III, No.32) is one illustration of this and I give a fresh translation from the German in Appendix A. I heard this myth in several forms from the Tungei, but no variant that I heard was radically different. Equally, men who traded with the axe makers generally knew all the names of the quarry sites and who owned them, though they never had the opportunity to visit the quarries directly or pay for some kind of right to open a pit and work it independently. Such men learnt the names of some of the varieties of stone to be found at each quarry; thus, a Kurupka man at Kudjip knew of Kunjin **bonong go** (i.e. **buneng guk**) and an Andakelka man at Ketibam mentioned Yesim **kaplsim** and **kur kaplsim**; however neither could fit the names into a stratigraphic scheme.[14] Further afield informants knew of the existence of the Tuman factory only by its direction and, in some cases,[15] they did not distinguish between Tuman axe blades and those made in the Jimi Valley.

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[14] Interviews 16-81, 26-81.

[15] Interview 18-80.

THE TUMAN QUARRIES

Plate 3.1

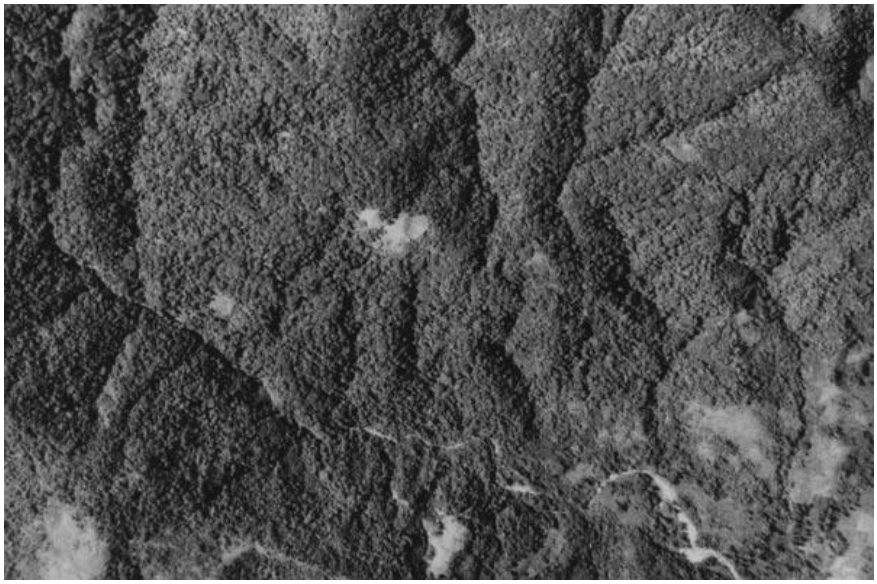
Tun valley from the air. The *Miscanthus* grassland at Ngumbamung and Kunjin is the light patch at centre (for location see Figure 3.1). Other light patches are gardened areas near settlements and, possibly, landslips in the rainforest.

Plate 3.2

Forest disturbance at Ngumbamung and Kunjin. Ngumbamung lies below the leftmost part of the grassland (concealed by a grove of trees). The string of pits at Kunjin runs from the centre of the grassland to the right-hand side.

Plate 3.3

Forest disturbance at Yesim. A much smaller area of grassland has formed above the string of pits, which are concealed by rainforest. Kunjin Creek descends from top left to bottom left.



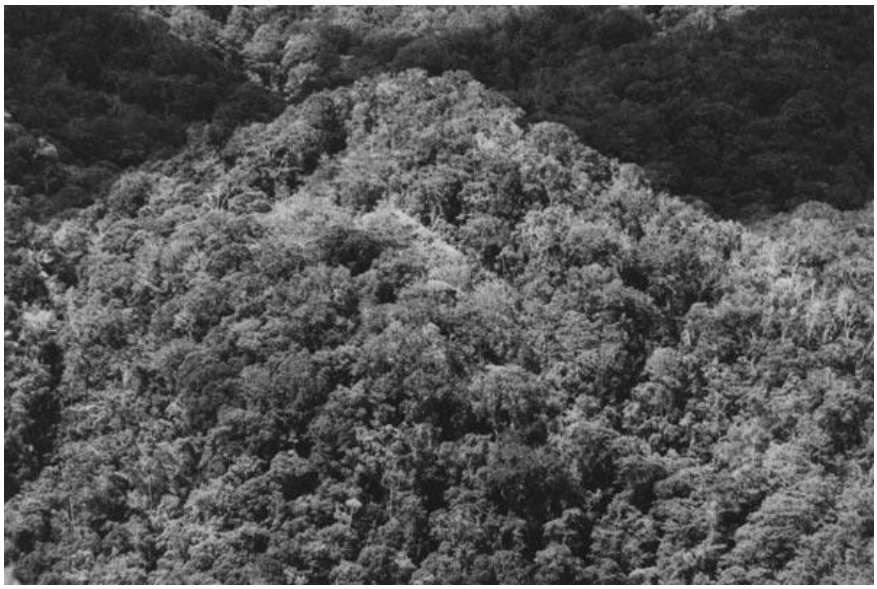


Plate 3.4

Kunjin Pit 1 cleared of vegetation. Note the wooden shoring for the 1980 excavation at the foot of the 10 m-high quarry face. Mounds to left and right are dumps of spoil left in the pit in 1933, together with the rubble from collapsed sections of the face.

Plate 3.5

Yesim Pit 1. The 10 m-high quarry face is completely covered by a mass of vegetation; a small section is exposed to view at bottom centre. Human figures can be made out at lower left, giving some idea of scale.

Plate 3.6

Malimbe and Ap at Yesim. The base of the quarry face is out of the picture to the right. The gully disappearing from view at top contains quarry pits to the east of Pit 1. They exploited stone at higher stratigraphic levels than Pit 1.

Plate 3.7

Access 'road' at Kunjin Pit 1. This path leads north from the base of Pit 1. Rightmost of three trees at centre is at C in Figure 3.4.

Plate 3.8

Kenjpi-emb Gełu and Pok demonstrating quarrying methods at Kunjin Pit 2. Gełu is pounding the rock face with a large stone hammer. Pok looks on to his left. Also present are Jimben, second from the right, younger brother of Pok, and two of Pok's sons. Photo: O.A. Christensen.

Plate 3.9

Kunjin Pit 7. The quarry pit takes the form of a drive into sloping ground. Two entrances at the base of the pit open into gallery systems 6-8 m in length.

Plate 3.10

Kunjin Pit 7. Rock-cut gallery at the base of the pit. The entrance to this tunnel is clear of debris; it lies at centre left in Plate 3.9. Robin Dennell at centre.

EXCAVATION AT GAPINJ AKA NUI

Plate 3.11

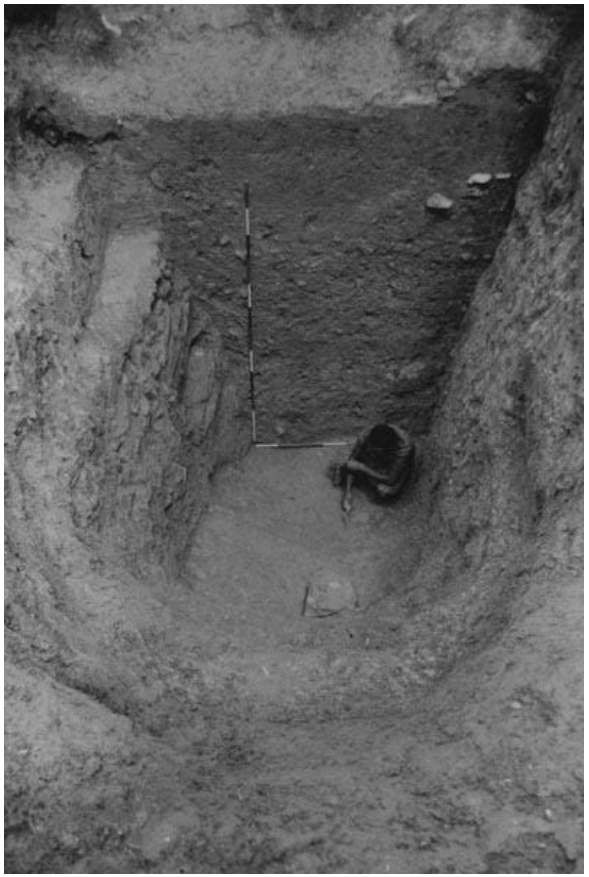
Pit 1 before excavation. Komnemb Kongua is holding a 2 m ranging pole.

Plate 3.12

Section through Pit 1. Menjpi Jack at bottom of Pit.

Plate 3.13

Pit 1 in course of excavation.



Chapter 4

THE ORGANISATION OF WORK AT THE TUMAN QUARRIES

Archaeological investigations at prehistoric quarries make it possible to understand many of the technological aspects of prehistoric mining and quarrying. In contrast, the organisation of the labour force, and the manner in which it employed the technology available to it, usually remain a complete mystery. In this chapter I describe Tuman quarrying operations in the form practised by the Tungei in 1933.

I have already given broad organisational details: quarrying was episodic, there was clan-based ownership of each site and the recently worked sites were the main pits at Kunjin, Ngumbamung and Yesim. I have also attempted a reconstruction of the adult and adolescent male population for the year 1933; this is reasonably complete for the clans which worked at Kunjin and Yesim, but rather schematic for the clan-pair Es-Kupaka, which worked at Ngumbamung. As will be seen, these are the parameters most central to a realistic model of how a large output was achieved and how formidable engineering problems were mastered by the quarrymen.

THE SIZE AND COORDINATION OF THE WORKFORCE

A key factor in reconstructing how the Tungei quarried is confidence in estimating the scale of operations. Informants always said every able-bodied male was conscripted for work at the sites, often adding that this was 'because the big-men said so'. The genealogies show that there were almost 200 adult men available, together with 40 or more adolescent youths (Figs 2.9-2.36; Table 2.1); if such a large workforce was really put to work for the weeks or months needed to make an impact on the solid rock at the major pits, then the manner in which this was done must be explained.

The Type of Leadership

Other tribally based activities, like pig festivals, mortuary ceremonies and war, require that all men attend 'without fail'. The incentives for joining in, and the sanctions against not participating, are different in each case; a variety of ethnographers have studied this under the heading of group decision-making processes. One aspect which has been given a full treatment is the role of big-men in initiating action. An extended review of the literature (e.g. Read 1959; Brown 1963; Salisbury 1964; A.J. Strathern 1966) would be out of place here, but it is worth making a (perhaps artificial) contrast between the 'despot' model in which a ruthless, bloodthirsty mafia consisting of a big-man and his henchmen terrorised their neighbourhood, and the 'consensus politics' model in which the leaders of a society maintained their position by swaying opinion with their skills as orators and by issuing 'orders' only when majority support for their course of action was certain. Two examples from societies close to the Tungei illustrate this dichotomy: Standish's (1978) historical discussion of despotism and political process in Central Chimbu, and Criper's (1967) study of how consensus is achieved in the staging of ceremonial exchanges in the Upper Chimbu Valley.

Among the Tungei, the general term for 'big-man' is **wu num** and for a 'leader', **tep wu**. A lineage head or a leader of lesser standing is generally called a **kengep wu**, 'a man who plans and offers council'. The essential quality which warrants the use of any of these terms is wisdom and skill in public speaking, not the possession of wealth or prowess on the battle-field. Different idioms describe a rich man - **kung mongei sałem**, 'pigs and wealth are there' - and a fight leader - **ope kunj tonem**, 'fight he incites'. This is not to say a leader should be poor, and he should certainly not be a 'rubbish man'. As far as warfare is concerned, a leader should direct the fight from the rear; he need not, and perhaps should not, get too involved himself. A list of key qualities I was given on one occasion ran as follows: **'ek nik, kengep tok, miting erik, peng denga pang, numan denga pang...'**, 'he talks, he councils, he holds meetings, he has a strong head, he has a strong mind...'.

For these reasons, I am inclined to think that decision-making among the Tungei in relation to stone axe quarrying followed the

model of 'consensus politics'. In any case, it is difficult to see how the Tungei leaders could have forced men to work against their wills. Perhaps more important to the present discussion are the factors which encouraged quarrying to proceed in an orderly fashion as well as the checks and balances preserving the workforce from fragmentation along socio-political lines. Naturally this assumes that individuals perceived the benefits of quarrying together and sought an active leadership to accomplish this.

Incentives, Sanctions and Risks

The ownership of the quarries was certainly felt to have been a great asset to the Tungei, notwithstanding the fact that quarrying was extremely hard and dangerous work. Older men would have indoctrinated their sons to the belief that quarrying was important to them and an effective means whereby the Tungei could maintain a form of economic supremacy over their neighbours. (This apparently did not extend to a military supremacy, as the battles chronicled in Appendix B make clear.)

Non-participation in group activities also invites a response in highlands societies: the absentees are 'rubbished'. Derision is heaped upon those who fail to kill pigs with everyone else, or who do not contribute to a brideprice payment. Those who - worse still - fail to answer a call to arms in times of danger face more severe penalties. In regard to quarrying, a man who did not help everyone else could not have expected a share in the output of axe stone and would have been considered an unreliable member of his clan. The converse of this situation - when a man attempted to dig up axe stone on his own - was equally discouraged, this time by quarrying lore of a more metaphysical nature. Malimbe told me an anecdote of one man who attempted to dig for axes on his own at the quarry Apiamb. In doing this he ignored the customary ritual safeguards of avoiding women and minding to eat 'pure' foods (see below). Because of this, men were afraid to go and help him at the quarry. He subsequently contracted leprosy (**kinj nołem**) and died, a fate that was thought to be perfectly just.[1]

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[1] Interview 25A-81.

The individual man who stayed behind while others camped at the quarry sites placed himself in physical danger. Without the support of his men's-house-group, he was easy prey for an enemy raiding party. The same argument applies to dissenting men's-house-groups, sub-clans or whole clans that might have come out in favour of absenteeism. The isolation of one body of men from the rest of the tribe would have been noted by its enemies, who would have wasted no time in attacking it.

Two considerations suggest that the actual quarrymen were safe, even though the recently worked sites were quite a distance from their everyday settlements and thus targets amenable to ambush. The first is that a temporary truce may have been observed in the Tuman area at the time of a quarrying expedition. Such may have been the case in other parts of Melanesia when important trade was a stake, though Oram, for example, says that warfare frequently interrupted the **hiri** in Papua (1982:9-10). I generally heard the idea of a truce among the more distant groups like the Kuma at Minj (J. Mangi and J. Muke pers. comm.), for whom there was no question of being able to rout the quarrymen and gain - or regain - possession of the quarries. Nearer to home, aggression may have been more earnest.

However, even the usually hostile neighbours of the Tungei may have found it more profitable to remain at peace with them, once a new quarrying expedition was a fait accompli. As those most closely connected by marriage, men from Mengka, Mamelka and Sikeing would have had first call in trading deals with the Tungei; this would have been a good second best to actually owning the quarries.

The second consideration stems from the fact that the group of quarrymen was enormous if the tribal leaders were able to mobilise every available man and youth. These men were not scattered about a large area; they were concentrated at the three major quarries and the encampments beside them. One instance of an attack at the quarries is, however, known to me. Menjpi Wiimbe (Fig. 2.30) was speared at Yesim itself by the Tungei's enemies, Sikeing. He survived and died sometime after 1933. The attack may have taken place around 1910.

Cult Beliefs Influencing the Manner of Quarrying

Informants link their ability to win stone from the sites with their observance of certain patterns of ritual behaviour. The quarrymen's 'cult' - like many other men's activities in the New Guinea highlands - revolved around their dealings with women and was strikingly similar in theme to the Melpa **amb kor**, or Female Spirit Cult (A.J. Strathern 1970). The Tungei myth of the origin of the axe stone (Appendix A) illustrates the belief that the best raw material was that least corrupted by the influence of women, and, by association with them, children and pigs.[2]

In the quarrymen's lore, a pair of spirit sisters, Kontim and Singam, owned or preserved the stone and controlled the power of men to gain access to it. Kontim and Singam - and the Tungei ancestors, Jimbe and Doimbe - were made the object of invocations of the ritual experts, **aning tonem wu**, 'talking-to-spirits men', and pigs were killed for them at the start and finish of an expedition. Ideally the female spirits should appear in dreams as nubile girls, **amb weniep**, indicating that the quarrymen were likely to succeed. The ideology surrounding the spirit sisters[3] was not nearly as well developed as in the Melpa **amb kor**, where the supposed appearance of the Female Spirit to clansmen, attractively decorated in the local style, is an essential precursor to the start of a cult performance.

Whatever the exact form of the Tungei beliefs, their consequence was that the quarrymen should go into seclusion at their encampments and that they should not try to see their wives, speak to them, or in any way compromise their state of masculine purity. Apart from the obvious dislocations to normal life, this had useful side-effects from the point of view of quarry output.

As discussed in Chapter 3, temporary men's houses were erected around the quarry sites. In general one house was built for each sub-clan, or two if the sub-clan was a big one. Most importantly,

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[2] Pigs are widely classed as 'female', they are fed and cared for by women; their production is controlled by women (Meggitt 1964:208; Clarke 1971:89).

[3] Interviews 6-80, 7-80, 1-81, 3-81, 20-81, 21-81, 32-81, 49-81.

access to the camps from the outside world was cut off by a screen fence, or **teper**. The **teper** was constructed from leaves of the wild karuka pandanus, **em kaman**, or something similar.

Female informants said that they brought sweet potato up to the **teper** every day, but were not allowed to give it to their husbands directly. Instead they left it out on specially constructed wooden platforms for the men to collect after they left. All the normal foods were eaten with the exception of pork; this was strictly forbidden. Many informants said that the people of the surrounding district would bring food to their female relatives among the Tungei, in the hope that they would be among the first to get an opportunity of trading with the quarrymen when they returned to their homesteads. Normally the quarrymen were glad to accept these gifts, but they had to be careful that 'poisoned' food did not reach them at the quarries. If an enemy sent 'bad' food up to the quarries, its contamination could have impaired the work or even caused the stone to collapse on top of the workmen.

Equally, special safeguards were sometimes necessary to reduce the danger of accidental or deliberate female pollution. In extreme cases, women were supposed to go to their gardens and stand facing the quarries - at a distance of several kilometres - in the ditches between the sweet potato beds; they should then have dug forwards with their sticks to remove the tubers without actually touching them, holding them by the runners. And if a man's own wife was ill, he might risk eating food brought by his wife's sister, but he would try not to eat very much.[4]

In some accounts people could communicate across the **teper** by shouting out for the person they wanted to speak with, but others say that no communication was possible.[5] Vicedom (Vicedom and Tischner 1943-48, II, 441) describes a similar scene outside the **tepr** [sic] which screened off part of a dance ground in the **amb kor**:

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[4] Interviews 6-81, 12-81.

[5] Interviews 1-81, 9-81, 20-81.

> Henceforth [the men and boys] live completely secluded and intercourse with the outside, insofar as it is necessary, is conducted only through the door of the secret ground. The man remains inside and the one wanting something of him must remain outside on the dancing ground, conversing with each other through the fence.

Note that it was not necessary for the **teper** to surround the quarry site; it was sufficient that it prevented outsiders from seeing the men's houses or the quarry pits. At Kunjin some of the houses were built at the side of Pit 1 and some below it alongside the Kunjin creek. In neither instance could they be seen from the bush track leading up to the site; the track was narrow and terminated on a ridge top about 4 m across (Fig. 3.3; Plate 4.1).

For the sake of ritual safety, circumlocutions were used by everyone concerned when it was necessary to refer to women or pigs. **Mapus** was a substitute for the usual word for a woman, **amb**; I was unable to elicit a meaning for this word, but Ramsey (1975:9) lists **amb mapis** as an alternative term for 'widow' in Middle Wahgi. It is perhaps an archaic word and fits well with the intention of the Nii usage. A phrase substituting for **kung**, 'pig', was **kom pare** or 'ears broad'.

In the same way, a woman would refer to her husband not as **wu**, 'man', but as **mara wał**, 'little **mara**-leaf'. **Ond mara** and its 'brother', **mond**, are male-associated species of tree and both Mara and Mond are used as boys's names (e.g. Fig. 2.33). **Mara** leaves are used in the forehead sprays, **mara jimba**, that men wear as a typical component of their 'second-best' attire (Strathern and Strathern 1971:Plates 23, 30).

As a supplement to the seclusion of the entire workforce, it was felt that one or two men should be chosen from each clan to live in an even stricter state of purity. This was known by the term **mowi pałem**, '**mowi** he-stays'.[6] The **mowi** men, usually one or two young and unmarried men, had in particular to observe the food taboos much more strictly than other men and they lived apart from them in small houses in the bush where they cooked and ate over

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[6] Interviews 14-81, 21-81, 27-81, 28-81, 29-81, 35-81, 49-81, 55-81.

their own fires, **dup ende nonmen**, 'fire one they-eat'.[7] This was a precaution against the possible spread of impurity and bodily corruption; these influences are believed to be contagious if 'infected' foods are cooked at the same fire as otherwise 'pure' foods. For the same reasons, men take special care whose fire they eat from in times of warfare (Reay 1959a:151). Against this, the **mowi** men probably had few physical tasks to do. If quarrying went well they might have joined in, but if it went badly their duty was to redouble their efforts to remain ritually untainted. Some of the ordinary quarrymen might have been suspected of carelessness in dealing with the outside world and the job of the **mowi** seems to have been to counteract this.

In 1933 the **mowi** were said to be Deing, Mambe and Yei of Kenjpi-emb clan (Figs 2.10, 2.11 and 2.13), Geri and Tuman of Komnemb clan (Figs 2.16 and 2.19), Onem of Menjpi clan (Fig. 2.30), Onem of Eska clan (Fig. 2.32) and Openj of Kupaka clan (Fig. 2.34). Of these, only Menjpi Onem and Kupaka Openj were still alive at the time of fieldwork.

A ritual was performed once the quarrymen began to mine the solid rock; the small animal **ka melka** was trapped, or shot with pronged **ope karpe** arrows, and cooked in an earth oven at the quarry site itself under the supervision of ritual experts, the **aning tonem wu**. The animal also features in the Tungei origin myth (Appendix A) and is by all accounts a tree-living creature between 25 cm and 40 cm in length. The Tungei classify it as a **ka**, that is to say, among the marsupials and 'furry mammals'. I have not seen **ka melka** but its description would fit one of the giant marsupial rats Mallomys rothchildi or Hyomys goliath, according to J. Muke and P. Dwyer (pers. comm.).[8]

In some accounts only the **mowi** men ate the meat, while in others all men should have eaten at least a small piece. In so

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[7] Interview 36-81.

[8] **Ka melka** is called (**kamb**) **bina** in the Banz dialect of Middle Wahgi, and (**kamb**) **ngunjin** in the Minj dialect of Middle Wahgi (Ramsey 1975:99). J. Muke described **kamb ngunjin** to P. Dwyer for me to arrive at this identification.

doing the quarrymen say they tried to emulate their ancestors, Jimbe and Doimbe, and in dedicating this offering to them, hoped to have their success in finding axes. The ritual was called **tui ka nonmen**, 'axe marsupial they-eat', and the **mowi** man was said to be **tui ka nop pałem**, 'axe marsupial having-eaten he-stays'.[9]

Completing the parallels with the sacred festivals of the highlands, the end of an expedition was marked with what can be termed a 'ritual fight'. Alerted to the fact that the men were ready to come out - the men called out to them when they finished quarrying at each of the three sites - the women armed themselves and brought up pigs to kill. On the day set for the coming out, they stormed the camps with loud cries of 'aa-oooo, aa-oooo', broke down the **teper** and smashed about them with sticks, beating the ground to drive away the female spirits. Ostensibly the women were glad to see their husbands again, but they lashed them too and burnt their houses down. Finally they gathered up the axe blanks into their string bags, **kon**, and returned to the settlements.[10]

Eye-witnesses have described very similar scenes at the conclusion of initiation ceremonies in other parts of the highlands (Reay 1959b; Read 1965:136-7; cf. Criper 1967:188). An overt purpose of the attack was to drive away the spirit-sisters, Kontim and Singam, whom the quarrymen had taken as 'second wives', **tun amb**; the women were said beat the ground to banish them underground until their help was needed on the next expedition. But like initiation, quarrying was a male activity from which women were excluded; according to Read, the attack of women upon men 'spoke of deep-seated divisions in Gahuku life' and was one of the few occasions 'when custom allowed the overt demonstration of opposed interests' (1965: 16). The violence ought to have been good-natured, but as Read describes, there was a fine line between sport and out-and-out assault.

Were it not for the quarrymen's beliefs about the corruptibility of the stone - and the danger to themselves if accidents

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[9] 3-81, 6-81, 14-81, 29-81, 36-81.

[10] Interviews 1-81, 3-81, 6-81, 29-81, 32-81, 55-81.

occurred - it is unlikely that they would have embarked on quarrying in quite the same way. They would certainly not have felt the need to isolate themselves at the sites, and the consequent difficulty of keeping a large labour force at work might even have prevented open-cast operations. This belief system definitely did discourage, in informants' eyes, casual digging by individuals or single men's-house-groups outside of expeditions mounted in the 'proper' fashion. In its positive reinforcement of a very suitable quarrying method, it may be seen as a case of a demonstrably functional ideology.

Opportunities for Holding Expeditions

The life histories of individual quarrymen show that the very oldest informants, born before 1900, recall five or even six visits to the quarries (Fig. 2.8), while the youngest eye-witnesses, born after 1920, recall only one or two, neither of which they participated in as adult clansmen. The consensus of accounts suggest an interval of 4-7 years between trips, although it seems reasonable to assume that the sites were actually visited irregularly. Periods when the quarries were in almost annual use may well have been followed by times when the sites were neglected for years on end and few axes were made. There is no proof of this, simply a few comments by men that this happened, and the knowledge that there were political upheavals in the Tuman area. Menjpi Kandet said that because of the fighting within the Tungei before about 1920, Pit 1 at Kunjin - which he referred to as Kunjin **mam**, Kunjin 'mother' - became overgrown and reverted to bush. Later the Tungei opened it up again. Similarly Komnemb Warke said that when he was young and newly married there were 'not many' stone axes.[11] Then the Tungei went and quarried many. Both statements are extremely vague; all that can be said is that the preferred interval between trips is likely to have been upset if serious fighting broke out in which the Tungei were involved. A period of stability may have been necessary before an expedition could be mounted, though this was obviously not as critical for quarrying as for holding a pig festival; as men-

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[11] Interviews 5-80, 55-81.

tioned in Chapter 2, no-one can remember the Tungei staging a pig festival before 1933 and this is attributed to continual fighting in the Tuman area.

TUMAN QUARRYING METHODS

Having at the outset a good idea of the size and motivation of the available workforce, and a basic knowledge of the geological nature of the sites, a reasonable reconstruction of the likely quarrying technique can be made from the descriptions given by informants.

The Composition of Labour Gangs

A number of men said that the men setting out to work at each site were split into labour gangs formed by whole clans working together. Thus some said that each of the four clans working at Kunjin started a separate drive into the 30 m-wide working face, leaving a baulk of untouched rock between them. Others said sub-clans could form a gang; for example Pok and Gełu said that within Kenjpi-emb clan, Menjpi Kanem and Andpang Kanem worked together, while Kełak Kanem had a hole to themselves. At Yesim, Malimbe said that Menjpi Pingka section worked the part of the pit to the west, while Kundika worked the part to the east. In fact the size of a gang probably depended on what it was doing at a particular time. Big gangs based on clans may have worked together when the need arose, but they may have split up into small gangs based on sub-clans when they were closer to the axe-bearing seam and when fewer men could profitably work in the confined spaces of the drives made into the working face.[12]

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[12] Interviews 4-80, 21-81, 48-81.

Site Preparation and Spoil Removal

The first task was to remove the rubble remaining from the previous expedition and that which had fallen into the pit in the meantime. It was clear from the depth of my 1980 excavation that natural infill could accumulate quite quickly: 4 m of fill was seen at the shallowest place in the partly filled pit and I saw no sign of the bottom of the pit. It may have been 1-2 m further down.

The rubble was called **tui oi**, and the process of removing it, **tui oi enmen**, 'axe ground they-do'. The task was accomplished in the following manner. Men formed themselves into basket chains, **grenj kan**, 'basket ropes', and passed from hand to hand a flat tray-like basket called **tui grenj**, 'axe basket', or **grenj kon**, 'basket carrier'. At Yesim, Malimbe said the Menjpi formed two **telap**, or lines of men, with Kundika section working at the easternmost end of Pit 1 and Pingka section to the west of them. They sang a work-song or shanty when they worked in gangs like this; the chorus, at least, consisted of the words **kirkilt-a weiwei-a.**[13]

Men say they simply used their hands to fill the baskets, though it would be no surprise if they had used small wooden scoops or shovels, as Vial describes at the Dom **gaima** site (1940:161). I asked Malimbe to show me what a **tui grenj** looked like and he made me two of them (Plate 4.2); one is illustrated in Figure 4.1. (The other is in the National Museum in Port Moresby.) He used a flexible withy of **ond meka**, coiled some three turns as the rim, and a strong vine, **kan kumnang**, for the woven surface of the basket. This compares with the use of the more all-purpose **kan minimb** used in binding the parts of an axe together (Chapter 6). **Kan kumnang** probably has less tensile strength than **kan minimb**, but it is more resistant to abrasion.

It is difficult to be certain on this point, but it seems that the full set of ritual restrictions came into effect only at the end of this preparatory stage. The time required to clear the **tui oi** must have varied, but it can seldom have been less than several

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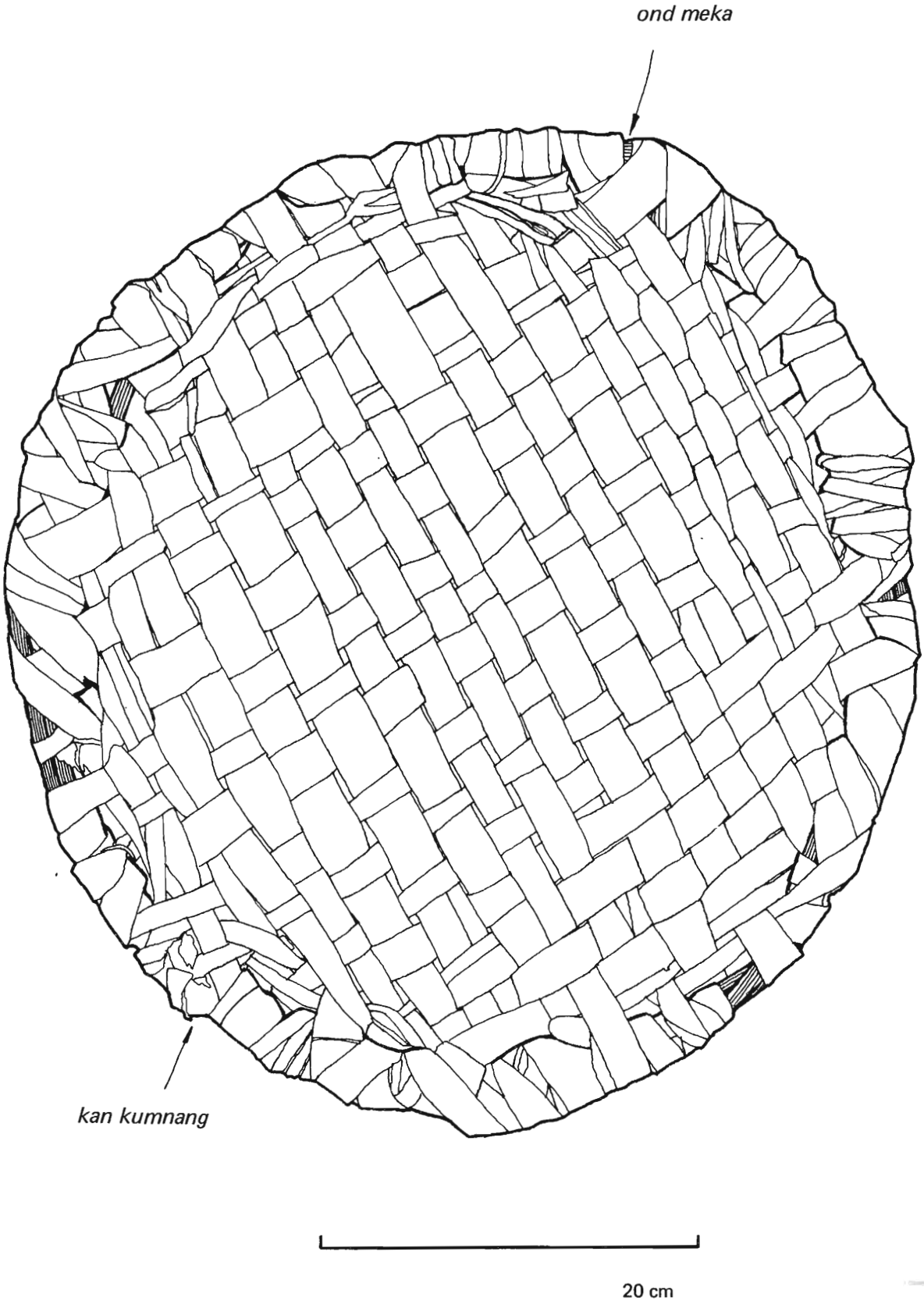
[13] Interview 50-81.



QUARRYMAN'S BASKET *tui grenj* or *grenj kon*

Figure 4.1

weeks' work and it may have taken a couple of months.[14]

It was probably at the end of this stage that the **melka** marsupial was sacrificed to the ancestors. It was also said that the ritual experts would later repeat the sacrifice if the stone was 'strong' and quarrying came to a standstill. The **melka** ritual was not associated with the removal of rubble, which - though tedious - was free of technical difficulties. The quarrymen were probably able to enter and leave the site during the preparatory stage, but they are said definitely to have been confined behind the **teper** once bedrock had been exposed. Also each clan's **mowi** man began his vigil at this time (or men, if a clan had more than one); it was proper to mark this by killing a pig, to 'bring Jimbe and Doimbe out of the hole'.

Mining the Axe Stone

When the rock was finally exposed, the quarrymen would wash it with water and begin the process of mining into the working face. Fire was never used as it would have been regarded as an unsuitable technique for the conditions; it was used in West Irian, as is well known (Harrer 1964), and also at Tsenga and the Dom **gaima** quarry (Chapters 8 and 9).

Large hammerstones were collected from the River Tun and experienced men examined the rockface for flaws and to find the lie of the bedding planes. They then hammered it until the cracks widened enough for them to be able to remove the stone in blocks. I have no knowledge of wedges or other implements that might have been used to lever out the material, but descriptions make it clear that the process of hammering the rock was the most time-consuming, arduous and potentially dangerous part of extracting the axe stone. The hammers or mauls, of up to 2 kg in weight, were held in both hands (Plate 3.8); they were not bound onto handles and swung like sledgehammers,[15] a technique known to have been used in dressing

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[14] Interviews 14-81, 21-81.

[15] Interview 29-81.

stones for the Egyptian pyramids (Engelbach 1923, cited by White 1974:65-6). I was not able to experiment with this, as Christensen was in 1973. The men who helped him were no longer inclined to physically demonstrate their methods, though Kenjpi-emb Geɬu did visit the same site with me in 1980 to describe the traditional methods.

In the 1980 excavation, several pieces of detached rockface were encountered, the largest being found to weigh 2.75-3.00 tonnes approximately (it was weighed in pieces). They were easily broken up with a seven-pound steel hammer because the rock was riddled with natural cracks and flaws. When swung hard, the hammer had the momentum to rip off a piece of stone already defined by the crosscutting fracture planes. Without doubt the steel hammer was easier to use than a stone one of the same weight, because its mass could be concentrated at a small impact point.

This account[16] of an incident which took place at Ngumbamung is filled with useful detail:

> Menjpi Toɬ [Fig. 2.30; Plate 4.4] gained a bit of a reputation for cracking hard rockfaces. When men could not get their stone out they would send for him, and he would come, 'like a boar', and give his services. Once Kupaka clan were held up by a difficult section of face at their quarry, Ngumbamung. Toɬ was at the place Kiam, but as soon as he heard, he hurried to Ngumbamung.
>
> The Kupaka men had built a wooden platform up the face in order to hammer at the uppermost part with stones brought up from the River Tun for this purpose. The litter of fruitlessly broken hammerstones lay deep at the foot of the face and buried the holes previously dug to obtain axe stone. Toɬ had this cleared away and the lower face washed with water to expose the natural flaws in the rock. Enjin Wu ['hair man'], one of the leading men of Kupaka clan, promised as a reward that he would kill one of his two biggest pigs, who were named Goi and Tei, if Toɬ could bring the face down. Then they brought him three large hammerstones which he struck against the face. Each of them shattered in turn, leaving no mark on the rock. He called for a fourth, again striking the face as hard as he could. The men watching from the side now called out that the rock had begun to leak water and urged him on with loud cries when they saw it cracking.

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[16] Interview 36-81.

> Enjin Wu was so excited he ran back and forth unable to conceal his excitement. Toɨ pulled out some small pieces of stone and saw that the bottom part of the face was broken. Above him there was still a strong part, so he hammered at it and broke it too. Then he scrambled out of the hole and the face fell down in heaps.
>
> When he emerged from the hole the Kupaka men raised a great shout and two of them, Tui Puɨi ['axes many'] and Kesap, linked arms and carried him around the mining area shoulder high. The looks of happiness on the faces of Kesap and Enjin Wu were unforgettable when he broke the rock. The Kupaka got out the axe stones and gave him a large pile. Then they came home to their settlements and Enjin Wu killed Goi, his pig, and gave Toɨ a side of pork, the head, and other men piled their pork high on this. They also gave him **tun mong** [cowries] which they had acquired from the Bamblinge at Banz. He was a young man and had never owned any before this.

What the men mentioned here[17] were attempting to do was to cut back the face by hammering at the top or middle from a scaffolding; this was all **mur ku**, useless rock. Toɨ hammered at the base of the face instead in an attempt to undercut it. He was successful and the face collapsed in a heap.

Cutting into the Axe Seam

At certain prehistoric sites elsewhere, stone axe quarrymen began their entry into a sloping hillside with shallow drives, but switched to the more efficient technique of shaft-and-gallery mining once the depth of overburden became too great. Using this method, little of the overburden was removed and shafts were let down onto the seams at suitable intervals (Bosch 1979; Sieveking 1979). Such a progression may well have occurred at the Dom **gaima** site, but it did not take place at the Tuman quarries. Conditions were not ideal for this because the seams do not lie at a more or less constant depth beneath the ground surface: they dip in the opposite direction to the rise in the terrain.

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[17] Enjin Wu (this was probably a nickname) does not appear in the somewhat abbreviated Kupaka genealogies; however Tui Puɨi and Kesap were of Numndi-emb subclan.

The question of whether galleries were used in the so-called 'room-and-pillar' technique, however, remains. This was a difficult concept to put across in New Guinea Pidgin to interpreters who had never seen stone axe quarrying and who did not have a clear idea of comparable modern methods. Nevertheless I learnt that the quarrymen went 'inside' the stone, leaving pillars of rock 'like house posts' to hold up the ceiling. One of the layers of axe stone, **win kambrem**, was named by Kenjpi-emb Geri as the layer that formed the ceiling; he said it was left intact and smeared with pig grease.[18] Both details indicate that galleries were in fact used. No gallery entrance was seen in the excavation at Kunjin Pit 1, as I did not get beneath the **mur ku**, but at Pit 7 I was able to explore an open example, as described in Chapter 3 (Plates 3.9 and 3.10).

Two indirect clues supplement these answers. Firstly, the quarrymen said they prevented thefts of stone by 'covering up' the holes at the end of a mining trip. If the rock was quarried in a continuous process, they would have had to laboriously hammer away a sufficient amount of face rock (**mur ku**, 'pit stone', or **kombe ku**, 'outcrop stone') to cover the base of the pit effectively or they would have to have dumped spoil there. But if galleries were used, the last action of the quarrymen need only have been to stove in the rock pillars at the entrances to the galleries, thus bringing down the roof and blocking access to the seam with much less effort. The second clue is that the spirit sisters, Kontim and Singam, were said to have had the power to help the men see clearly in the darkness of the 'holes'. If the 'holes' were simply pits, this makes little sense; only if they were galleries or tunnels can the men have had difficulty in seeing what they were doing.[19]

A limit to the length of galleries is set by the distance men find it practicable to haul out the rock they have removed. At Rijckholt, in Holland, the neolithic axe miners put in a new shaft after excavating an average of 25 m^2 of 60 cm high galleries (Bosch 1979:102). Little of the floor area was directly under the shafts,

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[18] Interview 16-80.

[19] Interviews 14-81, 28-81, 32-81.

which were only 1.0-1.5 m in diameter, or 5-7% of the total exploited area. In contrast, the shaft base in 'Greenwell's Pit' at Grime's Graves, England, covered about 16 m^2, or 20% of the exploited area of about 64 m^2. Four galleries totalled 48 m in length; they were on average 1.33 m in width (Sieveking 1979:29, 32, 35).

A gallery-making operation would probably have taken place in three stages. As already described, the first task was to clear the debris and dead ground covering the exposure of axe stone. In the second stage, the quarrymen would have ignored the face above them, unless it was unsafe to proceed. They would have cut their way into the base of the face at the level of the axe seam, following this as it dipped downwards. If all went well, this would yield a considerable quantity of axe stone; if there were holdups due to the intractability of the solid rock, more of the face might have to be brought down to clear the blockage. I imagine this is what happened when Toɨ helped out Kupaka clan in the story narrated on page 76. The eventual outcome of this stage of the work would be a network of galleries.

If this did occur at Kunjin Pit 1, the galleries would probably have been shorter than the neolithic examples at Grime's Graves; these were between 8 m and 24 m in length. At Kunjin Pit 7 one of the two visible tunnels was 8 m long and the other at least 6 m long, but the rock into which they were cut was much softer than at Pit 1. Galleries of 2-4 m in length may be more conceivable at Pit 1. To judge by the practice at both Rijckholt and Grime's Graves, such galleries may have interconnected so as to provide a means of escape if one passage became accidentally blocked.

When the quarrymen were satisfied they had removed as much stone as they were able to, given the difficulty of hauling the spoil out of deep tunnels and the possibility of coming against places of impassable solidity in the rock, they would proceed to the third stage. This was as has already been described - they would bring down the face by undercutting the pillars supporting the roof of the gallery system.

In order to extract more stone, the quarrymen would have to begin again at stage one. Theoretically, this point would only have been reached when a quarrying expedition was completed and the ideal

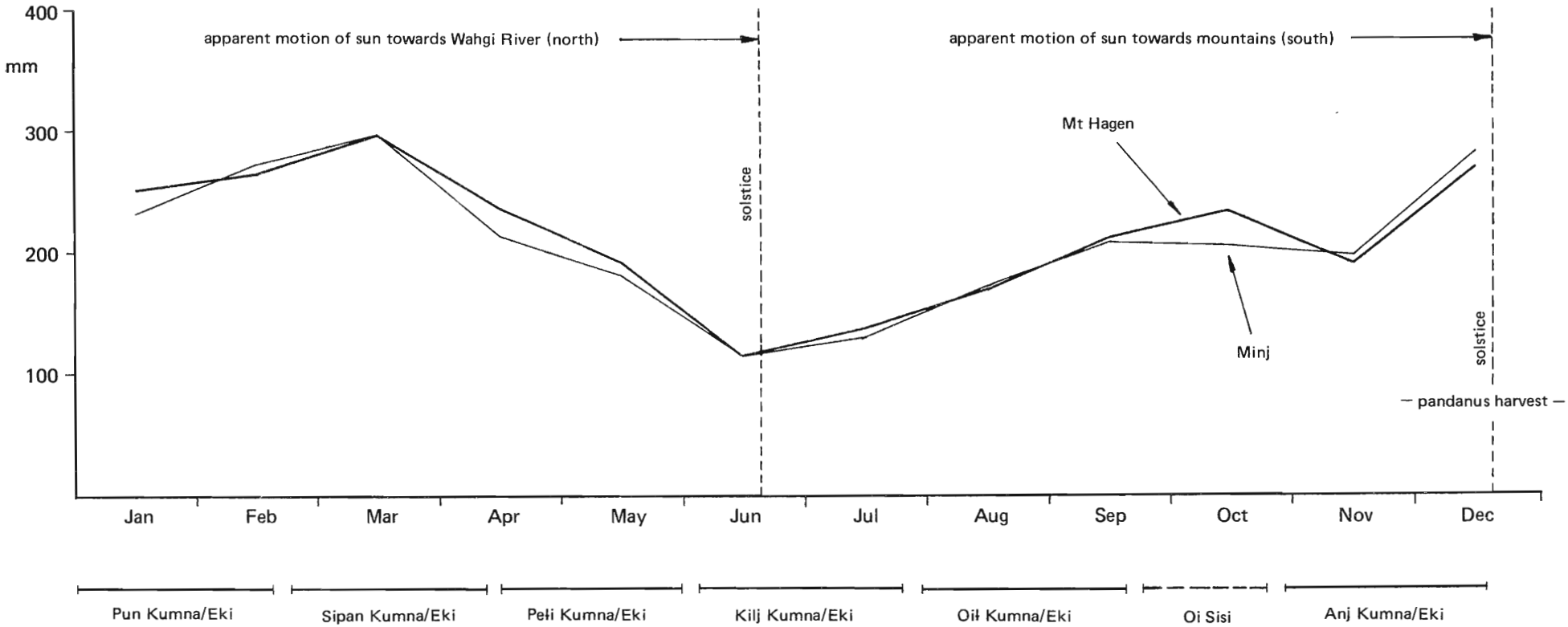
scheme would have been to clean up the rubble once (**tui oi enmen**), cut the axe stone and exhaust one set of galleries (**tui tonmen**), and knock down the face when the expedition was over.

There are a number of reasons why I think this method was used. Firstly, the quarrymen would have wanted to extract only the useful stone whenever possible; I think that this would have inevitably led to the creation of tunnels under the **mur ku**. As the time grew closer to the end of an expedition, the men would have increasingly devoted their efforts to removing axe stone, at the expense of removing the worthless rock above it. The penalty of having to clear up the rubble - an essentially non-productive task - was thus deferred until the subsequent quarrying expedition. If the current expedition members could be guaranteed a place on the next trip, no advantage accrued; but obviously no such guarantee could be made because of the danger of military defeat and of the sites falling into enemy hands. It might well be said that the price of opening a quarry was the ability of a group of men to make the high 'investment' needed to 'pay off' the penalty of removing the back-fill.

An exact parallel for this is found in the European flint mines, where the workmen made their 'investment' by digging a deep shaft through dead ground. The investment did not always show a return, as is illustrated by one pit at Grime's Graves which was found to have no galleries (Mercer 1981). The miners seem to have missed striking a seam altogether.

Methods of Coping with Flooding

Apart from the general satisfaction of the quarrymen with the amount of raw material yielded by the site, there are indications that a limit was set to the depth which could be reached when digging into the sloping seams. Rainfall in the area averages over 2.50 m per year, as monitored by weather stations situated on the floor of the Wahgi and nearby valleys (Fig. 4.2). However, the quarries are located on the margins of the Kubor Range and mountains rise to over 3800 m altitude within a few kilometres of the sites. Afternoon storms are typically heavier and more frequent than in the open valley and it is certain that the actual rainfall is much higher than the 2.50 m recorded lower down.



SEASONALITY IN THE WAHGI VALLEY average rainfall 1956–70 and vernacular calendar (approx.)

Figure 4.2

Source: McAlpine et al. 1975

Informants speak of underground 'lakes' at each of the main sites. These were named as Kunjin Golsir, Ngumbamung Kam Kuldung, and at Yesim, Tepi Simemb, which is also the name of a stream which has its head just below the Yesim site, at the place Tepi. When the water table rose in the quarry pits, work would have become increasingly hard. In fact the baling of water from the bottom of the pits was a daily job, as several accounts indicate.[20]

A bamboo of especially large diameter, **mengał kundup**, was used. Tubes of it were fitted with shoulder straps so that one man could carry one on each arm and empty the water away outside the quarry pit. **Mengał kundup** may have been 30 cm in diameter; it was specifically imported from the Bamblinge tribe at Eldimb, near Banz. A short bamboo baler of local origin was used to fill these water carriers.

THE TUMAN QUARRYING CYCLE

The account that I have given of quarrying at the Tuman quarries raises questions that I have only briefly considered or cannot answer directly myself. In particular, I have ignored what preceded a quarrying expedition. The process of arranging for a mass of men to coordinate their labour for months on end is likely to have been more important than the technical orientation of my analysis so far suggests.

Quarrying expeditions really began long before men entered the quarry enclosures. Extra gardens must have been planted six to nine months in advance and men must have settled their domestic affairs in such a way that they could afford to be absent for so many weeks and months. Thus it may be useful to talk of a cycle of quarrying to emphasise the fact that much work had to be done outside the quarries. It is also clear that the quarry owners did not 'spend' their stocks of axe stone immediately on returning from an expedition. They may have had debts to repay and part of their production would certainly have been traded or given away quite quickly. Nevertheless, they seem to have found that it took several years to

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[20] Interviews 32-81, 36-81, 48-81.

exhaust their total production. As one man said, axe production was like owning a trade store (a small retail business) - when you ran out of stock, it was time to get more goods in.

Referring to the next step, the organisation of a new expedition, Menjpi Aip said '**Mongka tui tamen pamen nik**', 'the (Tungei) Mongka axe let's-hit let's-go they-said'. When I questioned him further, he added that it was more involved than such a bald statement might imply. He called the rather secretive negotiations which preceded positive action **ol silmen**, 'plan they-did'.[21] A similar process takes places in many other social contexts today in the form of canvassing an idea in private before risking its public announcement; it is designed to avoid the embarrassment of no-one following the proposed course of action. For example, men urge their fellows to hold a pig kill or gift-giving ceremony on a certain day, but they cannot compel them to cooperate. Everyone knows that much prestige is to be gained by synchronising their actions, but the causes of delay are numerous - and potentially disastrous - when there is no central direction (e.g. Criper 1967:203-8). The exhortation **tui tamen pamen**!, 'let's go and cut axes!', should be seen as the culmination of a long-drawn-out process of tribe-wide negotiations.

DURATION OF EXPEDITIONS

No formal account of time is or was taken by the Tungei; no reliable recording was used, but without actually being able to observe a mining expedition experimentally, estimates of the length of time required to complete all the tasks described above need not be entirely speculative. A Wahgi calendar exists and may be related both to the seasons and to the length of the quarrying trips - at least in an approximate fashion. The calendar (Fig. 4.2) consists of six double 'moons', **kalemb** or **oi**, together with a 'leap moon', **oi**

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[21] Interview 25-81. Cf. A.M. Strathern (1972:89) on the meaning of the Melpa term **ol ik** in marriage negotiations.

sisi.[22] This is used if the wet season comes unexpectedly early; it is fitted in before the usual wet season moons. As can be seen in Figure 4.2, there seems to be a period of early rain in October; this could be the empirical basis for **oi sisi.** The identical Middle Wahgi version is given by Ramsey (1975:432-3). In both areas the New Guinea Pidgin calendar is used today.

In addition to the moons, which were not necessarily thought of as fixed, i.e. 28 days, in length, the passage of the sun is observed from solstice to solstice. It is said to travel down to the Wahgi for the southern winter (dry season) and up into the mountains for the southern summer (wet season). Knowledgeable men are said to mark the sun's apparent motion by watching the position inside their houses of the sun's rays at dawn.

I was frequently told that each of the main tasks described above would have taken a 'month' to complete: clearing the ground, removing the **tui oi**, cutting into the seam. Ideally, it was said, the whole process should have been finished inside one dry season; in the Western Highlands these are the months from May to October. At the same time men affirm that they were indeed at the quarries in April 1933 - when the patrol plane flew overhead - but had completed a full expedition by the time the foot patrol arrived, namely by May of that year.[23]

There is no way of knowing whether 1933 was a dry year which permitted an expedition to go ahead in the wet season; or whether the tribe-wide consensus needed to launch an expedition had acquired a momentum of its own, overriding considerations about the time of year. Because it was presented to me in this way, I propose to continue the discussion as if the ideal case of quarrying through the dry season was actually realised.

In a single month, or two months even, I believe it must have been impossible to build the camps, excavate down to the axe seams and then hammer out the axe stone. I do not think it was possible for the quarrymen to remain at work for the period of one year; a

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[22] Interviews 19-80, 3-81, 6-81, 7-81, 32-81.

[23] Interviews 7-81, 21-81, 29-81, 32-81, 35-81.

limit must have been set by the capacity of their tribal society to sustain itself without agricultural inputs from men. Quarrying, however, can be sub-divided into several stages of activity, as I have already shown. At the core was the period the **mowi** men spent in seclusion - but even this was stated to be quite long, that is, more than a week or ten days. It ran concurrently with the extraction of the axe stone; a 'month' is the length of time quoted by informants.

The Komnemb men Kuma, Kombra and Malimbe helped me relate the timing of an expedition to the Wahgi calendar, and I have based Figure 4.2 on their account. As can be seen, they suggested a typical start in June with the finish in September. Menjpi Aip suggested one to two months to prepare the pit and a month to get the axe stone. A fourth month might be necessary to finish off, he said. Given the range of uncertainties, the estimate I favour for the length of a complete expedition is between three and five months.

THE NUMBER OF AXES PRODUCED

The primary product of the quarries was raw material in the form of axe blanks. Some knapping, but no grinding and sharpening of axe blades, took place at the quarry sites. That the quarrymen flaked some of the axe stone at the sites is certain, because a thick carpet of debitage lies around the quarried areas (Chapter 6). Informants expressly say that the sharpening of axes was done elsewhere; it was not a job that was carried out in groups or in a formal way. (This contrasts with the probable situation on the Ganz River, described in Chapter 8.)

No direct measurements of production can be made - no quotas were matched nor, for example, did individual men give names to their axe blades in a way that could help inventory their output - but it is possible to argue for low and high estimates, given further details of camp organisation.

As it happens, the quarrymen had a positive ethic that the raw material should be shared equally among all. Gang leaders, big-men or rich men were not in a position to monopolise the output. No individuals 'sponsored' quarry trips and all men were equally placed

to receive axe blanks. To ensure a fair distribution, a man was nominated in each gang - clan or sub-clan - to deal out the pieces of stone as often as a heap was won from the face. Men say the services of the **tui mok tołem wu**, the 'axe share-out do man', may have been needed once a day or once every couple of days, when each new batch of stone was successfully removed.

The motives for acting like this were not arbitrary. The Tungei views of the seat of human reason and 'social consciousness', **numan**, and of 'protest anger' or resentment, **popuł**, are identical with the concepts **noman** and **popokl** discussed by A.J. Strathern (1968) and A.M. Strathern (1968). In normal circumstances, a sense of grievance causes a person's **numan**, or sense of reason, to become 'spoiled' or 'choked' by a form of frustrated anger or **popuł**. In times of hoped-for ritual purity, such as during warfare or an expedition to the axe quarries, **popuł** might be extremely dangerous. It cannot only visit sickness on the wronged person, it can lead to general calamity. Among the North Wahgi Komblo, O'Hanlon (1983) has described the negative effects of disloyalty or undisclosed anger on whole clans; should these trangressions go undiscovered, the very survival of the group as a viable community can be placed in jeopardy (1983:326).

In warfare men explicitly recognise dangers of this nature by performing a ritual called **towa tui tonmen**, 'banana axe they-hit'. As described to me, men of a sub-clan congregate in a men's house and take turns to confess some wrong-doing or slight they may have inflicted on each other; each man slices a banana leaf with an axe as he does so. By confessing possible causes of grievance between their closest kinsmen, they hope to neutralise the effects of **popuł** before taking to the battlefield. Feeling untainted, they are confident that the enemy's arrows will be unable to cause them harm; in the opposite case - of festering, unconfessed grievance - the projectiles will unavoidably swerve in flight to cause injury and death.

When quarrying, dangers of the same order confronted the workmen; injury and death stalked them underground, flying rockchips threatened to blind or lacerate the unfortunate. Some men said that the **towa tui** ritual, mentioned above, was done before quarrying, but I believe it more likely that whatever ritual was done took a

different form; one term I heard was **ek nik kałmen**, 'talk they-said they-made-an-?offering'. It took place in the context of a pig kill before an expedition started. Koip Kui, where I made a collection of chipped stone (Chapter 5), was said to be a place, a **kung koiłmen kone** ('pig they-killed place'), where such a pig kill was made. The important thing was that men should not cheat or steal while quarrying and - above all - should have received equal amounts of stone.[24] Vicedom (Vicedom and Tischner 1943-48, II, 442) noted that theft must not occur during a performance of the Female Spirit Cult at Mt Hagen; the supernatural forces being invoked would descend on a thief and kill him.

On the question of the number of axe blanks each man would receive, the ethic of honesty and openness led men to construct wooden crates at the sites where they stored their personal share of the axe stone. These were called **tui palteng**.[25] Menjpi Kandeł indicated the size by having sticks laid out on the ground in a square; the area enclosed was 1.5 x 1.25 m (Plate 4.3). Malimbe said they were rather smaller, approximately 80 x 70 cm and 50 cm deep.

The fact that these were built by each man to contain his entire share of stone sets a credible minimum on the amount he could expect to take home. I suggest that ten would be the lowest number of blanks, but this is a very small figure; many informants said they could have expected one piece of stone for each day they spent cutting into the seam of axe stone. Even so, with 200 men at work, a figure of around 2000 blanks would have been the least that one expedition could have produced.

A higher estimate would seem more reasonable; informants answered the question of how many axes they made on an expedition by clasping both fists together a number of times; in the Tuman number-

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[24] Interviews 35-81, 50-81.

[25] Cf. 'pig stalls', **kung palteng**, the stalls in which pigs are kept at the end of a women's house.

ing system, each fist-clasping indicates a quantity of ten.[26] Equally, when the women entered the site enclosures, they filled their string bags with stone to take back home: **amb tui palteng kongend simbi onmen**, 'women axe stalls take-out they-will-get they-come'. I asked if a man's wife could have filled her string bag with her husband's share and carried it all away at once; I was told there was more than she could have carried. This is consistent with the probable size of the crates. All things considered, an upper limit may have been 50 axe blanks, and the most likely estimate 20-30 blanks.

LESSONS FROM THE TUMAN SYSTEM OF QUARRYING

It is likely, on the grounds that the number of skilled knappers and haft makers was limited (Chapters 5 and 6), that few men possessed all the skills needed for quarry work. At least it seems probable that some men were more skilled than the majority of their kinsmen; if so, these were the men who took turns to hammer at the rock face. The bulk of the labour force must have consisted of unskilled or inexperienced men but, in the Tuman system, their efforts were effectively harnessed when the basket chains were formed to remove the rubble. This merits direct comparison with the Dom system of sinking elaborately timbered shafts to reach the axe stone (Chapter 9). The design of the Dom shafts, and the very slow rate of progress achieved in their construction, ruled out the use of a large pool of unskilled labour.

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[26] The Tuman numbering system has a base of ten and is counted off in a special way. When counting from one to four - **endeim, tał, tałediłe, kapl-kapłe** - the four fingers of the open right hand are folded down with the left hand and thumb, starting from the little finger and working towards the forefinger. Five - **pemb**, 'fist' - is indicated by a closed right fist; six - **angeł oreng pemb**, 'finger at fist' - by the tip of the left thumb inserted into the top of the right fist, between thumb and first finger; seven - **angeł oreng tuke**, 'finger at [not known]' - by inserting the left thumb and forefinger together into the right fist; eight - **engke pemb tał mon**, 'ten without two thumbs' - by clasping two fists with thumbs concealed; nine - **engke pemb oreng mon**, 'ten without one thumb' - by clasping a fist with raised thumb with a fist with concealed thumb; ten - **engke** - is shown with two clasped fists with thumbs showing.

In this and other respects the organisation of the labour force at the Tuman quarries was highly idiosyncratic, but it is obvious that the overall system was an extremely effective means of extracting axe stone. The key factors that determined this system were primarily ideological ones, though the geology of the axe stone played an important part as well. If the ethic of all clans participating at once were to have been absent, the Tuman achievement would have been much less - this is a case of the sum of the parts being greater than the whole. If the belief in the corruptibility of the stone were to have weakened, the consistent effort which the men put into quarrying while on an expedition would have diminished. Men would have come and gone as they pleased, causing confusion and chaos. If the ethic of sharing the stone out equally were to have been absent, the whole point of many men working together would have been lost.

The Tuman example shows - if demonstration were needed - that non-ranked, non-hierarchical societies can organise themselves for large-scale productive ventures when a range of conditions are met. It is worth noting that this 'method' of organising labour is characterised by being very cheap, but also very volatile - liable to disappear or be unusable if the conditions change or are not present at the start. An example of the latter might be a different ideology concerning the influence of women; in this case the removal of one of the ideological keystones of the Tuman system might have brought the expedition system to a standstill. Some modification to the balance, discussed above, between the number of skilled and unskilled quarrymen needed could also have had this effect. By comparison, the bureaucratic structures needed by hierarchical or industrialised societies to achieve the same results are very costly, but they are less dependent on serendipitous circumstances and have the capacity to reorganise themselves to fit different conditions. The question of how the Tuman system evolved into its recent form is, of course, rather less easy to get to grips with.

Plate 4.1

Malimbe indicating the position of the teper at Kunjin. Note that he is standing on a narrow ridge: the teper need only have been a token screen here. The tall plants are the Cordyline species known as guk koime and are planted in profusion around the sites.

Plate 4.2

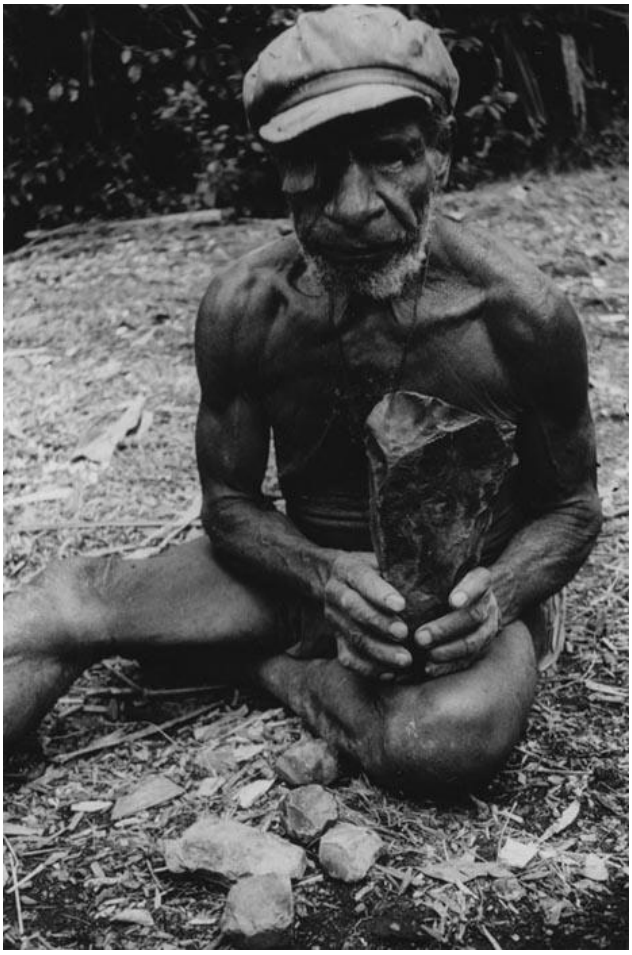
Malimbe making a grenj kon - a quarryman's spoil-removing basket.

Plate 4.3

Interview at Kupang. Menjpi Kandeɨ (second from left) is explaining the use and size of the 'axe stalls', tui palteng, in which men stored their stone at the quarry. Sticks are laid out on the ground at right to show how large the stalls or boxes were.

Plate 4.4

Menjpi Toɨ with a selection of axe making materials. He is holding a roughout made by his father. Four hammerstones and another roughout, made by himself, are on the ground before him.



Chapter 5

TUMAN KNAPPING PATTERNS

By the end of a quarrying expedition the manufacture of Tuman axes had barely begun. A certain amount of knapping, the first essential step in the process of axe making, had taken place at the quarry and in the workmen's camps; this activity continued at the homesteads of the quarrymen and their immediate exchange partners. Outside the quarries, work was carried out on a much more individual basis, without the formality of the expeditions. In this chapter I describe the knapping of Tuman stone into roughouts and carry out a debitage analysis, the goal of which is to determine how the tasks involved in knapping axe roughouts were distributed across the landscape of the quarries and their neighbourhood. I was not able to investigate the actual reduction methods and technology of knapping because I could not obtain fresh axe stone for experiments. My account mainly concerns the locational aspects of knapping and less the technical means of lithic reduction employed in axe making.[1]

RAW MATERIALS AND QUADRANGULAR FLAKING

The Tuman quarries yielded several different grades of raw material which contrast in their physical properties. From an economic point of view, the most important raw material occurred in the form of tabular flakes and pieces of stone at the major quarries

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[1] Informants who were experienced knappers were also unwilling to demonstrate their methods; knapping, they said, was dangerous for those long out of practice, because of the risk of being blinded by flying fragments of stone. This danger is well known to experimental archaeologists; the Tuman axe makers were genuinely worried by it.

Kunjin, Yesim and Ngumbamung (e.g. Fig. 5.1a). These blocks of raw material typically had flat surfaces at right angles to one another. Tuman axes made from prime raw materials were not initially knapped bifacially and later finished by grinding to achieve a planilateral shape - it is certain that the planilateral style of the Tuman axe is principally a result of the tabular 'habit' of the raw material.

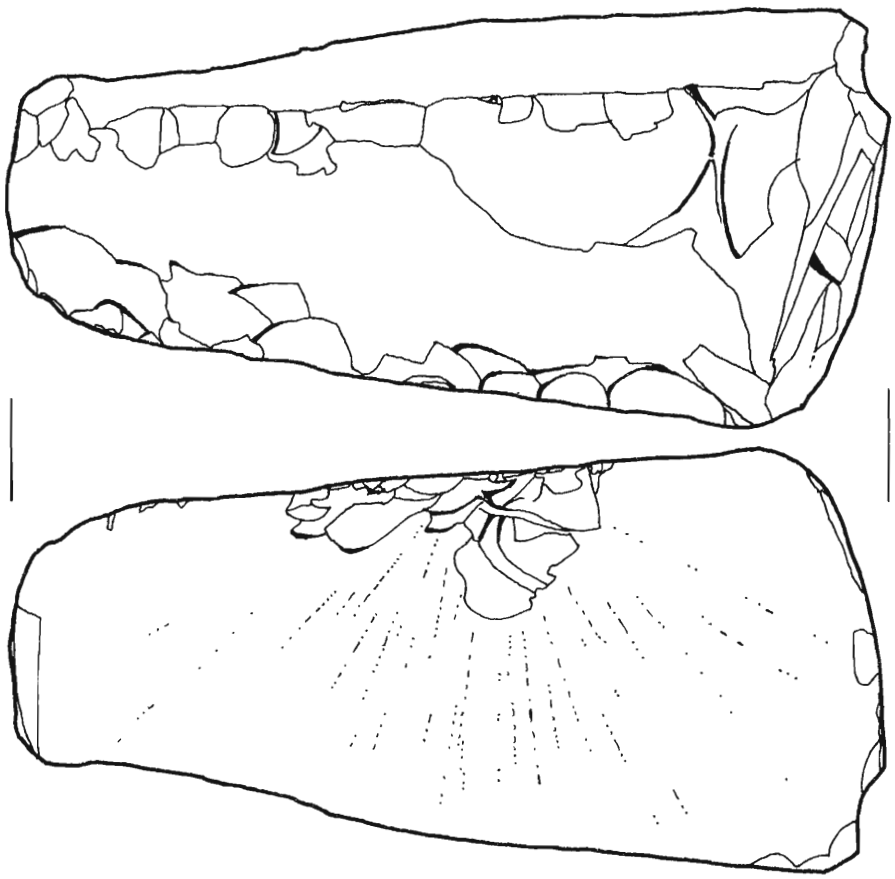
However, many axes less than 15 cm in length were made from bifacial - as opposed to quadrangular - roughouts, including many work axes. A large proportion of the smaller axe roughouts in collections from the Wahgi Valley are bifacial. They were made from what might be called secondary materials: stone that was left over at the major sites when the prime materials had been used up, and nodules in the deposits of softer rocks at the minor sites of the Tun valley.

Figure 5.1b shows a surface find from the Gapinj site; it is a nodule 20.5 cm long and carries a few flake scars on one surface only. Close examination shows that it is covered with a coarse, brown skin or cortex up to 1 mm thick. The cortex is relatively smooth and does not offer the kind of purchase needed for quadrangular flaking. To make a planilateral axe, the knapper would have had to flake the stone into a lens-shaped roughout and then 'artificially' trim the edges square, as suggested in the literature (e.g. S. Bulmer 1964:248; Chappell 1966:103; Lampert 1972:3).

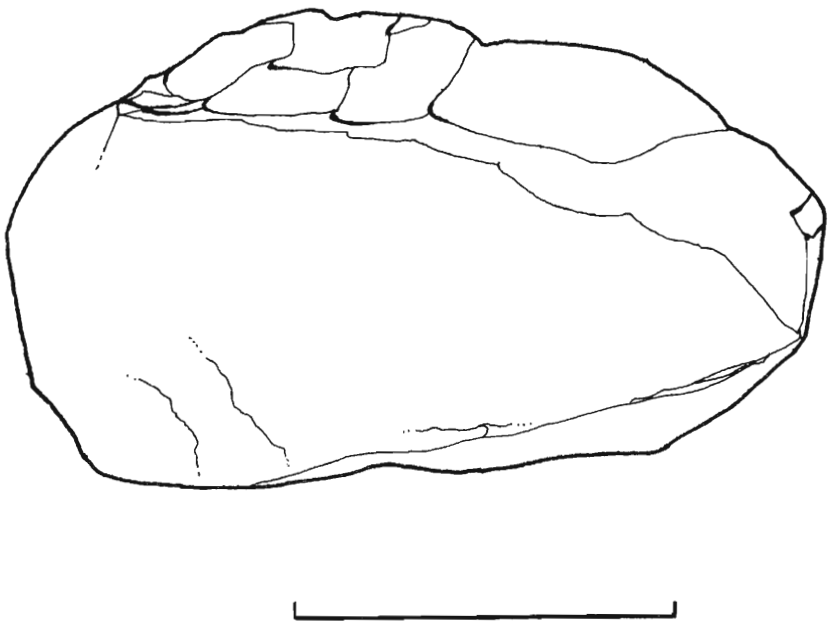
The difference between work axes and larger blades intended for 'ceremonial' purposes, that is to say for use in the formal exchanges of the wealth economy, is purely one of size. The relatively small scraps of stone that were made into work axes could not have formed the basis of a wealth economy. The larger axes made from tabular stone played this role.

Whether the other quarries of the region, such as those in the Jimi Valley (Chapter 8), also produced planilateral axes by means of quadrangular flaking is uncertain. The Jimi Valley style is for axes to be thinner, and examples of roughouts collected by P. Gorecki (e.g. Fig. 8.1) indicate that the rock probably had a single dominant cleavage which yielded thinner, flatter tabular axe blanks. These would then have been trimmed with hammerstones on the top and bottom surfaces only (cf. Plate 8.5). The sides could be ignored because they were much thinner than on Tuman axes.

(a) Tabular flake from Kunjin quarry, partially trimmed



(b) Nodule from Gapinj quarry



10 cm

TUMAN AXE MAKING two kinds of raw material

Figure 5.1

It is noteworthy that a number of early sources (e.g. R. Hill, PR, Minj No.3 of 1956/57) refer indiscriminately to the sites as 'slate' quarries, leaving no doubt as to the physical properties attributed by observers to the rock types.

The existence of secondary materials leads on to the hypothesis that sites which yielded mainly nodules had a low output of large axes and a large output of small work axes. In the Tun valley, the sites of Gapinj Aka Nui, Gapinj, Apiamb and Mela fall into this category. P. Gorecki's report on the Pukl site (Appendix F) shows that nodules were the dominant raw material form there also. The large-bladed 'ceremonial axe' (see Chapter 8; Vial 1940; Højlund 1981:38) could not, according to the hypothesis, have been manufactured at these sites on a regular basis.

Examples of Tuman Roughouts

Pok's axe (Fig. 5.2a) is the finest example I have seen of quadrangular flaking.[2] The stone is particularly fine-grained with a very good conchoidal fracture. Skimming flakes have been removed from both faces and the two sides have been worked against striking platforms of around 70° and around 125°. These angles (see Fig. 5.3) are remarkable in themselves. A 70° angle is about that preferred by blade makers on their prismatic cores, but it is so rare as to be unheard of that satisfactory flaking can continue beyond a platform angle of 100°. Enough of the natural surface of the sides remains to show that the roughout was originally a tabular piece of stone and that Pok simply maintained that shape as he reduced the piece to the final shape. He did not actually create the bi-directional platforms at each edge, but he had the skill to keep them there.

Figure 5.3 shows a giant roughout believed to have been made by

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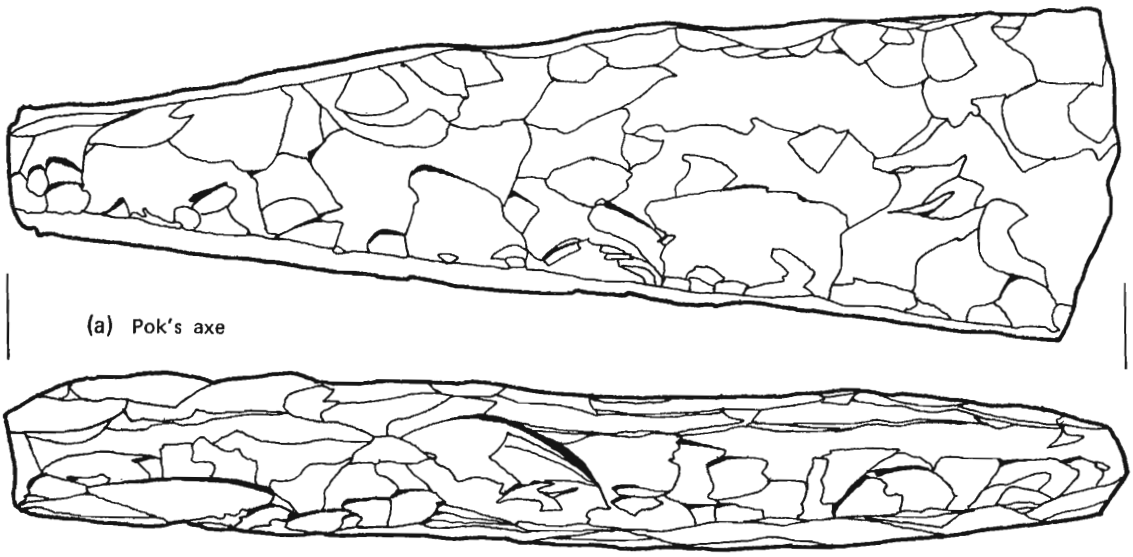
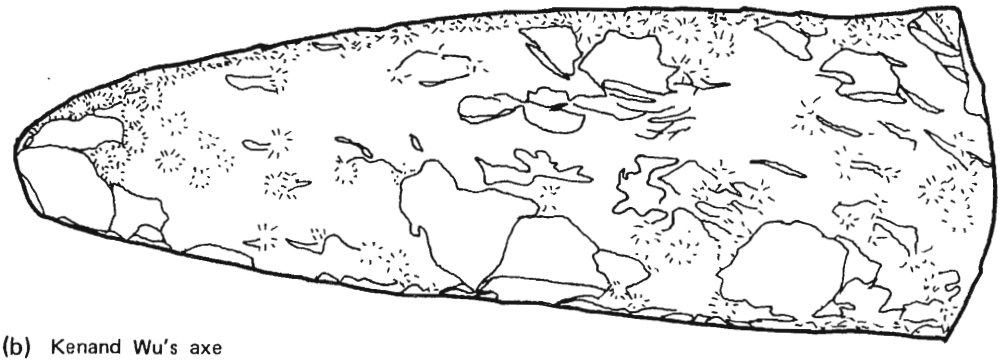
2 The axes and roughouts discussed in this chapter are a selection of those offered to me for sale. In most cases the sellers made these artefacts themselves. Kenjpi-emb Pok made his roughout from the stone known as **kaplsim** found at the Kunjin site. I do not know which stone the others were made from.

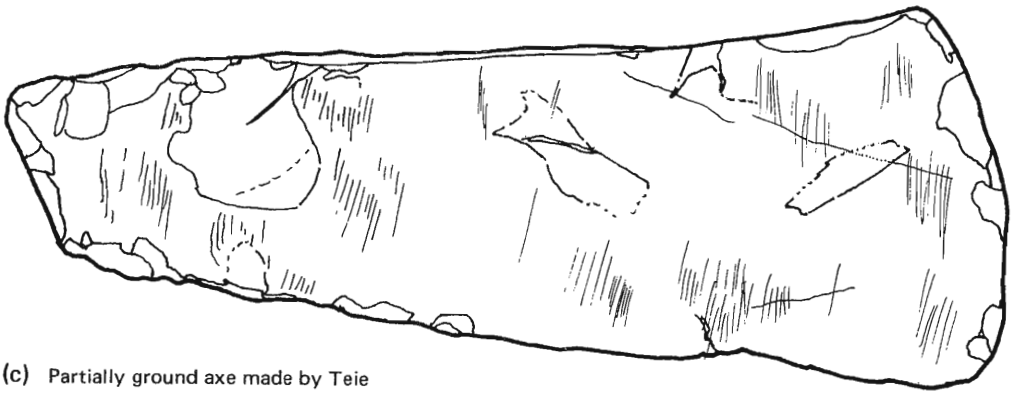


(a) Pok's axe

10 cm



(b) Kenand Wu's axe



(c) Partially ground axe made by Teie

TUMAN AXE MAKING alternative reduction methods: flaking, pecking, & grinding

Figure 5.2

TUMAN AXE MAKING giant roughout made by Teie

Figure 5.3

Komnemb Teie.[3] In this case one of the flat sides has been flaked (not shown) and one has not. The latter is exposed as the natural rock jointing, and the platform angles against each of the two main flaked surfaces which meet it are about 70° and 120°. Teie apparently did not find it difficult to remove flakes from the 120° platform and the flake scars are the same sizes on both surfaces. Some of the scars end in hinge fractures and here he has even used the prominence left by the hinges to strike flakes from the middle of the flaked area. The large size of Teie's roughout makes this technique quite plain, but it is also visible on Pok's roughout.

Teie's roughout, measuring 33.5 cm in length, is one of the very largest that can have ever been made.[4] It is important to note that a very real limit is set on the size of axes made by percussion flaking. They must be small enough for the knapper to hold firmly and - importantly - to protect against breakage. An unsupported roughout has a tendency to snap in mid-section under its own weight when struck with a hammerstone. More precisely, this occurs when low amplitude shockwaves ripple through the roughout causing it to come apart at a place of weakness. I have seen it suggested (Coope 1979:98-9) that similarly broken roughouts at a European axe factory must have deliberately smashed; the clean break is deceptive and in fact quite mechanical in origin. A technical solution, enabling even larger axes to be made, is to adopt the sawing technique, as was done at the Dom **gaima** quarry, but it was never used by the Tuman axe makers.

Other roughouts show the use of pecking, the technique in which a hammerstone is used to chip away at prominences by pounding or crushing (cf. Best 1974:43-4). It is not possible to use this method with flint or chert axes because pressure cones form to a

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[3] Teie (Fig. 2.17) died in the mid-1970s. The roughout was found in the topsoil at the settlement Tama by Teie's great-nephew, Wandaki.

[4] Hughes' axe No.7 from Kere in Simbu Province is 33.3 cm long and weighs 2.275 kg (Hughes 1977a:Table 10); it must have been been made from a roughout surpassing Teie's in length. This is the largest finished Tuman blade I have seen.

depth of one to two centimetres within the material, making subsequent flaking impossible and increasing the likelihood of breakage. Equally, the rock types which are most suitable for pecking cannot always be flaked, so that on occasions pecking and flaking have erroneously been seen as exclusive alternatives (Coope 1979).

Figure 5.2b shows that this is not true of Tuman stone. The roughout illustrated was initially flaked but reduction has been completed by pecking. Pressure cones apparently did not penetrate far below the surface - perhaps around 1 mm - and a high degree of evenness was achieved. This contrasts with steps and hinge fractures of up to 5 mm depth on Pok's and Teie's axes, all of which would have presented problems at the grinding stage.

Pecking can be seen as either an alternative to flaking or a supplement to it. Indeed flaking, pecking and even grinding (Fig. 5.2c) could be seen as interchangeable methods with the stoneworker choosing one of them to handle a particular problem at a particular time. Skilled knappers would have found it quicker to reduce a piece of stone to the required shape by flaking, but there was nothing to prevent those with little skill from achieving the same results. At the same time, flaked roughouts were probably given a final dressing by pecking in order to remove stepped fracture scars and other prominences; this would have been less trouble than grinding them off. In fact a small amount of pecking has already been done on both Teie's and Pok's axes. Best (1974:44) calls this finishing process 'bruising' and remarks that Maori stoneworkers saved themselves much work in grinding their axes by using it.

THE KNAPPER IN TUMAN SOCIETY

The term for a knapper is **tui win kałem wu**, 'axe flake break man', after **tui win**, 'axe flake', a struck flake, and **tui win kał-**,

'axe flake break', knapping.[5] Two men of Mamelka Gultemb clan gave me an illustration of how it was possible to hire the services of a specialist knapper:

> Gultemb had no stoneworker of their own and they had no access to the quarries in the years before 1933. They were nevertheless able to procure large pieces of axe stone in its raw state. One of the clansmen was the brother-in-law of a Menjpi man, a gifted knapper. The Gultemb paid this man to come to them and assist them. If he had to cut up a large piece of stone, he would half bury it in the ground before striking it in two and going on to help them knap the pieces into axe roughouts. The Gultemb felt that the stone was too valuable to risk attempting to split it up themselves.

The informants gave as examples of payments to the knapper the special bananas, **toue embin** and **toue kumbeł**, pandanus fruit, taro, sweet potatoes and other vegetables like **sem weika**, Hibiscus manihot L. (see Powell n.d., Appendix 1).[6]

Most men in the quarrying clans would have had some experience in knapping (e.g. Plate 4.4), but the **tui win kałem wu** sought out in instances such as the above would have possessed a much greater degree of expertise. These men were often haft makers as well, on whom I have rather more information (Chapter 6), and their numbers were equally restricted. Like the haft makers, they may be deemed to have been 'specialists' in the sense that they developed certain skills to a higher level of proficiency than other men. Their pattern of work was not, however, comparable with that of men in craft guilds in a medieval society nor with the rigid separation of duties that apply in a caste society.

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[5] The verb **kał-** is used in a variety of other contexts. An example is in the expression **goltem kał-**, 'Miscanthus beat', to prepare Miscanthus cane for house screens by cracking it open and flattening it. Ramsey (1975:98) lists 'to break open an egg', 'to break a glass container' and 'to fracture the skull' as similar usages for the Middle Wahgi verb, **kal-**.

[6] Interview 19-81.

Further knapping terminology

Some comments may be also made at this point about knapping terminology. The language family to which Ek Nii belongs is action oriented, which means that, while there are only about a hundred basic verbs, there are many thousands of 'specifier combinations' in which a modifier and a basic verb are combined to create new, action-oriented meanings. In contrast the range of nouns is more limited. This is reflected in the terminology used for axe making. The English words 'axe stone', 'axe', 'adze', 'hatchet', 'blade', 'blank', 'preform', and 'roughout' are all glossed as **tui**, 'axe', depending on context. Finer distinctions can be made with adjectives or by saying what has been done to the axe.

Terms decribing knapping follow a descriptive pattern in Ek Nii, as in **tui win kałpen kone**, 'axe flake they-break place', a flaking floor or, equally, the point of percussion on a flake. A phrase used specifically to describe a workshop site at Yesim was **tui tołmen mołem kone**, 'axe they-hit (it)-stay(s) place'. A roughout is distinguished from a finished axe blade by calling it **tui enj pei** or **tui enjim pei**, 'axe rubbish/faeces all'. A man might say **enj pei pałem**, 'rubbish all it-lies', or **tukem mondnenjeng**, 'sharpen they-did-not' (see Chapter 6).

Win is really a term for debitage as a whole; the term also covers flake scars, **tui win**, and hammerstones, **ku win**. The latter can also be referred to by another term, **tui pup**. **Tui to-**, 'axe hit', is most generally used in connection with quarrying (Chapter 4). Thus a man might summarise the process of axe making by saying **tui tołmen, win kałmen**, 'axes we-hit, flakes we-struck-off': the knappers quarried the stone and flaked it into axes.

Another word for 'fragment' or 'shard' is **kerał** and flakes are sometimes called **tui kerał**. (This compares with **ond kerał**, 'wood fragment' - wood for kindling.) **Kerał** are still used today in the form of spoke-shaves made from freshly broken bottle glass. Men select suitable glass shards and use them to scrape down their new spears, bows and axe handles (Plate 6.15). It is not difficult to see how axe flakes were formerly used for the same tasks; no attempt is made to modify the glass shards today, nor apparently in the past when axe flakes were used.

WORKSHOP DEBITAGE FROM THE TUMAN FACTORY AREA

What archaeological remains can be found of the processes described above? Pecking might be detected only through its effects on hammerstones, but flaking debris can readily be found all over Tungei territory and elsewhere. I am able to describe here the analysis of over 100 kg of debitage from six workshop areas at different distances from the Kunjin quarry. The purpose of the analysis is to discover what kinds of knapping were carried out at the quarries, and what kinds were carried out elsewhere. I attempt to do this in two stages. In the first stage, I use various taxonomic methods to set up a series of putatively different 'flake classes' and, in the second, I show how flaking debris collected at places of varying distance from the quarries can be characterised by graphing the proportions of each class represented.

I sampled a transect running the length of the Tun valley, starting from the site of Kunjin (Fig. 5.4). Many tonnes of waste, consisting of tens of millions of flakes, lie thickly on the present ground surface at Kunjin and more could be found sealed under dumps of quarry fill. I opened a 60 x 70 cm cutting in an area thickly covered in flakes (see Fig. 3.4 for location) and, after clearing the surface of loose debris and vegetation, removed 77 kg of debitage from the first 10 cm depth of fill. Debitage indistinguishable from that which I had collected continued to an unknown depth.

On the valley floor most of the old workshop sites where knapping was carried out have been dug over to make gardens and the debitage has been scattered about. Nevertheless they remain detectable as concentrations of flakes among the sweet potato beds. At three sites I walked along the ditches between the beds and collected all visible pieces of axe stone from the bare earth of the ditches and the parts of the beds that I could reach from them. The sites were Tun Wareng, at the foot of the Kunjin Creek, Koip Kui, at the foot of Orpał (the creek which runs up to the Yesim site), and Temek, at the exit of the Tun valley. The three collection sites yielded 2.5 kg, 9.5 kg, and 7 kg of material respectively.

At Kełmbei, Komnemb Sike showed me a partially intact chipping floor behind his house. We excavated this and passed the spoil

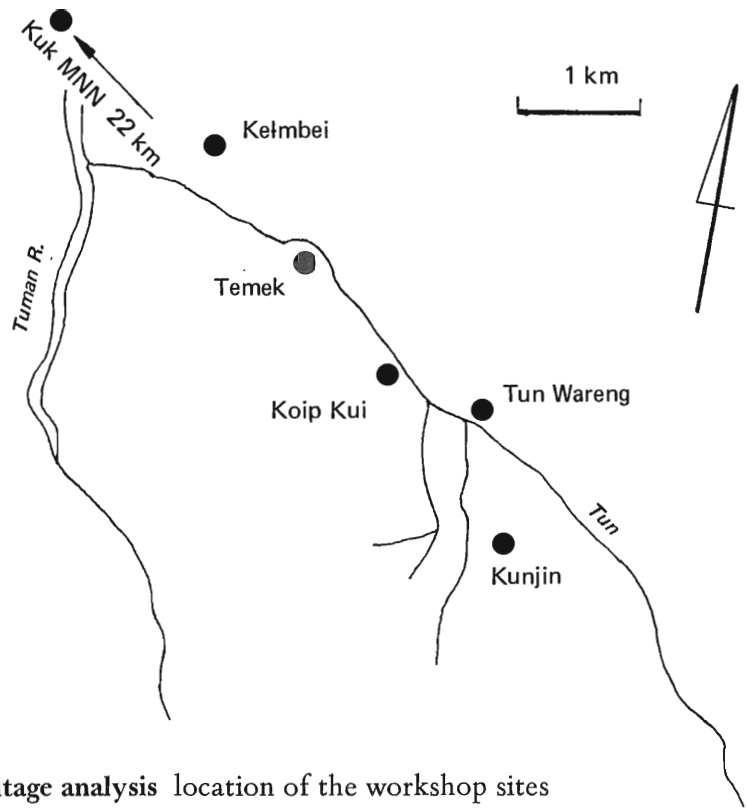

Figure 5.4

Tuman debitage analysis location of the workshop sites

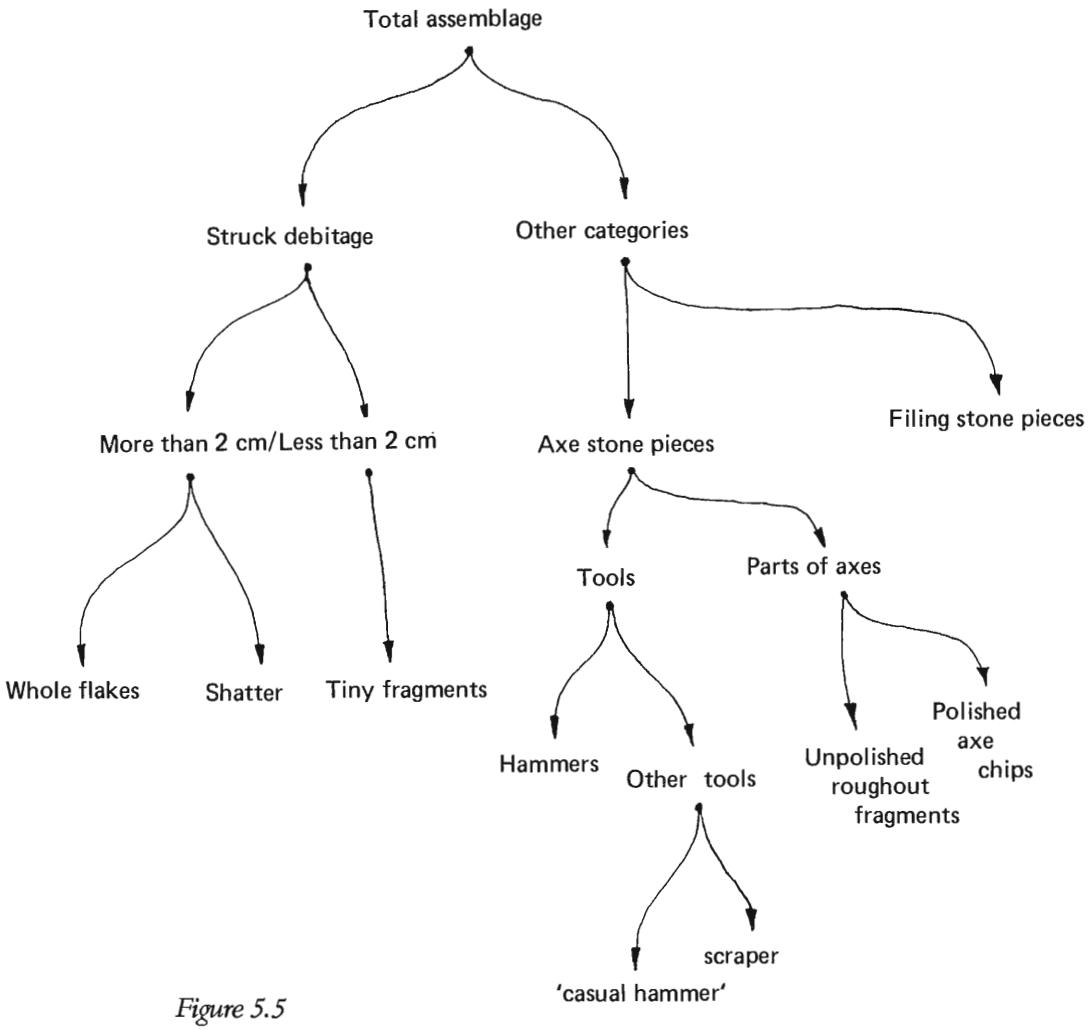

Figure 5.5

Tuman debitage analysis breakdown of the assemblages

through a 1/4" sieve, yielding some 10 kg of debitage. Debitage from a sixth site, Kuk MNN, was kindly provided by P. Gorecki. Kuk lies about 22 km from the Tuman quarries in the direction in which the Tun transect is oriented (for location see Figs 5.4 and 10.2). MNN contains 1.3 kg of Tuman debitage together with 20 polished axe fragments. Two of the fragments were not from the Tuman quarries: one was definitely from the Dom **gaima** quarry and the other may have been from the Tsenga **gaima** quarry (these quarries are discussed in Chapters 8, 9 and 10).

METHOD OF ANALYSIS AND MEASUREMENT

Each assemblage was sorted according to the scheme in Figure 5.5. The simplest task was to distinguish between struck debitage and miscellaneous categories like hammers and grinding stone fragments. The struck debitage was then divided into three parts: material with a maximum dimension of less than 2 cm, whole flakes larger than 2 cm, and non-flake debitage larger than 2 cm. The items in each part were counted and weighed separately.

Whole flakes are defined here as being flakes over 2 cm in size, measuring along any axis, that are substantially complete. Flakes with minor retouch, edge damage or use wear are permitted within this category; flakes that have snapped during manufacture are not. Non-flake debitage over 2 cm in size consists of broken flakes, block-fractured material and shatter. Shatter is produced at the same time as flakes are; 50 macroscopic pieces may accompany the production of a single flake, as I discovered in earlier experiments (Burton 1980). I found that knapping one bifacial flint axe produced 0.12 kg of block fractures, 1.75 kg of shatter and 5.28 kg of flakes, while a second produced 1.06 kg of shatter and 2.47 kg of flakes (Burton 1980:Table 1). The 'less than 2 cm' category is a mixture of tiny flakes and pieces of shatter.

At Kunjin, Kełmbei and MNN each piece of non-flake debitage was

weighed, otherwise an overall weight was obtained.[7] Table 5.1 summarises the finds from each site; some of those from Kełmbei are illustrated in Figure 5.6.

I recorded the shapes of the whole flakes on plain paper, tracing the outlines in pencil at exact size and marking the positions of the point of percussion and the axis of percussion as shown in Figure 5.7. I used an automatic recording system, a program called WKSHOP, running on a Tektronix 4051 minicomputer and 4956 graphics tablet (a coordinate digitiser), to take measurements from the flake outlines. Figure 5.7 illustrates this process.[8] The coordinates of points on the tablet (i.e. on the flake outlines) were returned under program control, converted into linear and angular measurements and stored on the computer's tape cartridge. The contents of the cartridge were periodically transferred to a bigger computer for statistical analysis.

A feature built into WKSHOP was a preset sampling level. If a less-than-100% sample was desired, a given fraction of the flakes could be omitted at random. I recorded all flakes in five of the assemblages, but set a sample level of 50% for the large Kunjin assemblage: 612 out a total of 1246 flakes were included and the remainder excluded from analysis. Note that the number does not amount to half the total because individual flakes had an independent 50% chance of being selected or omitted. Thus the 50% sampling level did not amount to a selection of exactly half the total number of flakes.

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[7] The preliminary sorting was carried out in the field and I was able to use the electric balance at the Kuk Agricultural Research Station laboratory to weigh debitage quickly and accurately. I transported only one of the five Tun assemblages to Canberra to help with the analysis: the Kełmbei assemblage. The other five were processed in the field and sent to the National Museum directly.

[8] Courtesy of the Department of Biogeography and Geomorphology, RSPacS.

	Kunjin	Tun Wareng	Koip Kui	Temek	Kełmbei	Kuk MNN
FLAKES >2 cm	(n=1246)	(n=100)	(n=538)	(n=170)	(n=406)	(n=110)
Mean weight	23.93 g	19.42 g	13.30 g	22.57 g	10.92 g	5.78 g
Std. dev.	42.04 g	23.62 g	17.48 g	30.41 g	21.53 g	7.83 g
Minimum	0.36 g	1.79 g	0.71 g	0.82 g	0.58 g	0.50 g
Maximum	349.54 g	109.05 g	146.62 g	193.48 g	340.41 g	58.30 g
Total	*29.280 kg	1.942 kg	7.156 kg	3.837 kg	4.431 kg	0.635 kg

* estimate only: twice the weight of a 50% sample

NON-FLAKE DEBITAGE >2 cm						
	(n=1528)	(n=38)	(n=160)	(n=39)	(n=522)	(n=178)
Total	48.200 kg	0.582 kg	2.102 kg	0.885 kg	5.431 kg	0.572 kg

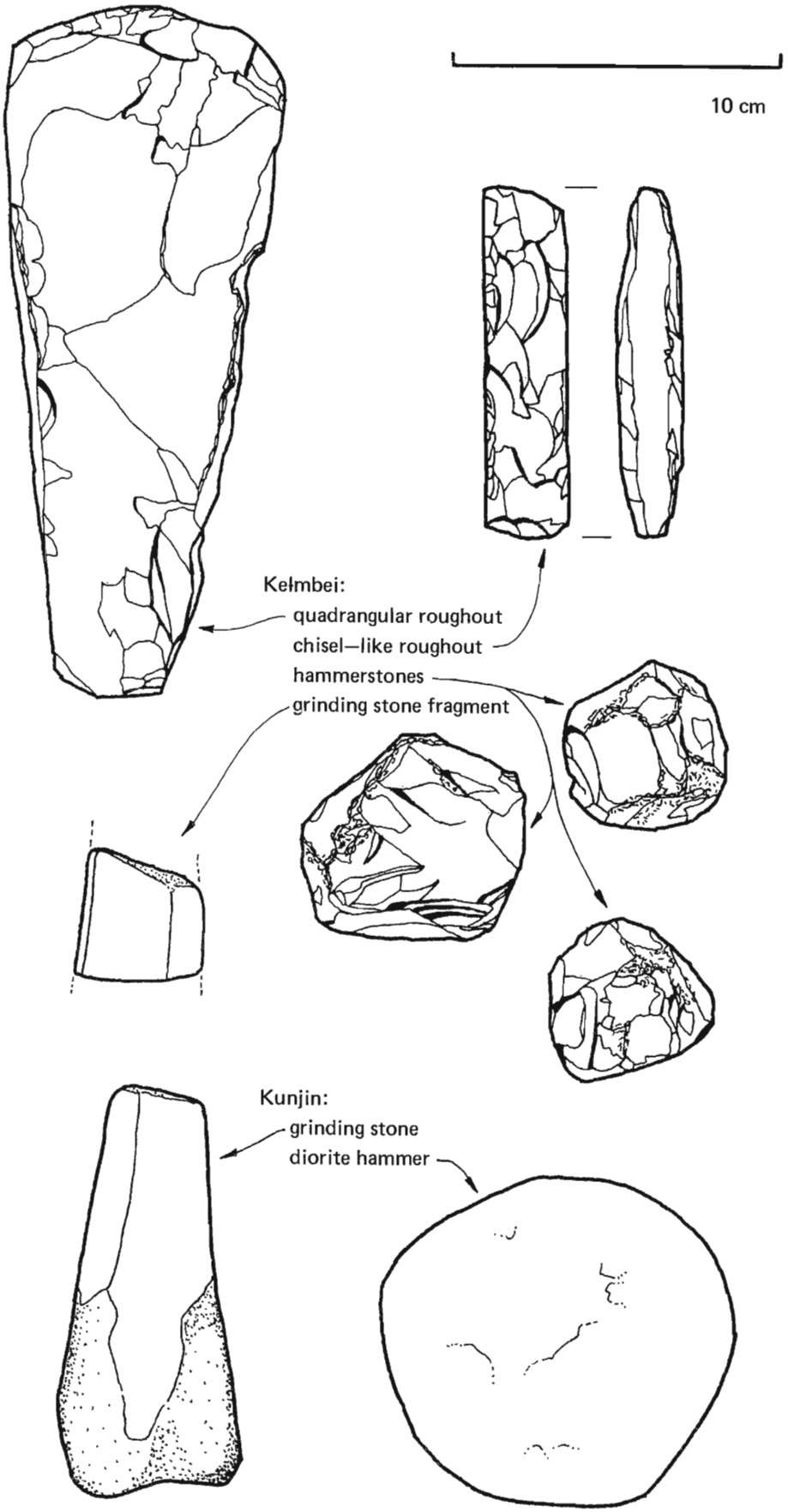
DEBITAGE <2 cm						
					(n=196)	(n=161)
	(not recorded for these sites)					
					0.101 kg	0.064 kg
Total of major debitage classes	77.480 kg	1.524 kg	9.258 kg	4.722 kg	9.963 kg	1.271 kg

HAMMERS						
From 1981 workshop collection:	(n=3)	none	none	(n=4)	(n=25)	none
Mean weight	386.70 g			297.25 g	170.12 g	
Std. dev.	180.10 g			159.47 g	82.07 g	
From 1980 excavation:						
1) Axe rock	(n=34)					
Mean weight	531.79 g					
Std. dev.	383.40 g					
2) Diorite	(n=8)					
Mean weight	1428.13 g					
Std. dev.	448.60 g					

OTHER ITEMS						
axe fragments			1324 g	1394 g	1249 g	
polished axe chips						121 g
grindstone fragment					88.32 g	
?scraper				103 g		
'casual hammers'				384 g		

WORKSHOP ANALYSIS composition of the six assemblages

Table 5.1



TUMAN AXE MAKING workshop materials from Kełmbei site and Kunjin quarry

Figure 5.6

MEASUREMENT OF THE FLAKES

Different authors tend to orientate a given set of measurements of length and width along a different axis (Burton 1980:Appendix). The advantage of a graphics based approach, implemented here with the WKSHOP program, is that several measures of length and width may be taken simultaneously.

For the purposes of this analysis only one is particularly useful - length along the medial axis (Wilmsen 1968) - but two other kinds were recorded (Fig. 5.7). The medial (or centroidal) axis is the one which divides a flake into two equal halves; measuring along it attempts to give the fairest indication of length for a wide variety of flake shapes. I prefer it to the percussion axis for measuring flakes that are not a product of prismatic core technology. (For the latter, the length and width of a box aligned with the percussion axis is simple and effective.)

WKSHOP automatically divided the outline of each flake into four quadrants, as illustrated in Figure 5.7, and returned the area of each in square centimetres. The weight of each flake, previously noted on the recording sheets, was entered at the terminal keyboard and added to the other measurements.

Three main coefficients of shape and size were calculated by transforming the measured attributes; they were 'thickness', 'bladedness' and 'expansion'. Each of them are dimensionless quantities, meaning that they are independent of the absolute magnitudes of the measures of mass, area and length used to calculate them.

Thickness is defined as the cube root of mass[9] divided by the square root of area; the larger the value, the thicker the flake is. In theory, thick flakes are produced when the knapper is removing lumps at the start of work on a core piece or roughout, while thin flakes are produced in the final stages of shaping a biface.

Bladedness is defined as length along the medial axis divided by the square root of area; elongated flakes have higher values on

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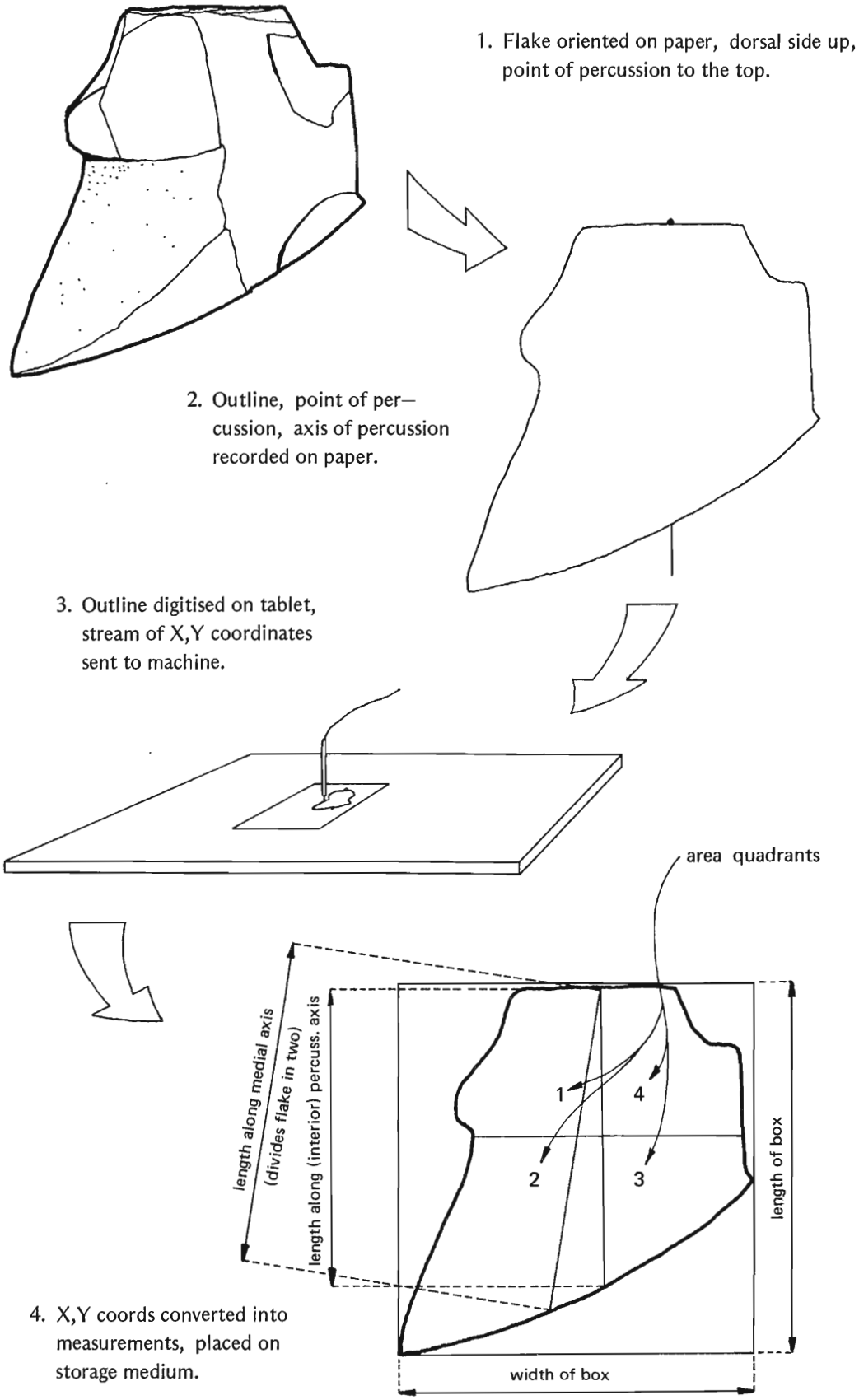
[9] Mass - a cubic measure - is a highly skewed measure of populations that might be expected to be more normally distributed on some linear measure like length. Taking the cube root converts it into a linear measure.



FLAKE ANALYSIS operation of the automated recording system WKSHOP

Figure 5.7

this coefficient than short, squat ones. Tuman axe manufacture might involve longer flakes towards the final stages of knapping when long, shallow flake scars are required than at the start, when shorter and, as noted, thicker flakes are produced.

The coefficient of expansion is defined as the area of the distal quadrants divided by the area of the proximal quadrants, multiplied by a correction factor. The distal quadrants are those marked 2 and 3 in Figure 5.7, and the proximal quadrants are those marked 1 and 4. The correction factor is the length along the (interior) percussion axis divided by the medial length; it is applied to normalise the value of this coefficient on particularly skewed flakes, that is, flakes where these two length measures are very different. Flakes with a high expansion value are narrow near the bulb of percussion and become wider towards the distal end. It is a possibility that expanding flakes are more commonly produced towards the end of work on Tuman axes than at the beginning (but I stress that I have neither seen Tuman axes being made, nor made them experimentally myself).

PRELIMINARY CLASSIFICATION OF THE FLAKES

I followed two paths towards a classification of the assemblages. Firstly I roughly sorted the Kełmbei assemblage according to my own perception of what was the most important variation among the flakes. Note that at this point I was not seeking to produce a finished classification, but merely a starting point for further taxonomic work.

I divided the flakes into a group of thick ones and a group of thin ones, corresponding in a gross sense to the flakes produced first and those produced when knapping is nearly complete and thin, skimming flakes are needed to correct the shape of an axe roughout. I further divided these two categories into large, medium and small flakes, to make a total of six flake classes. I will refer to this as my 'intuitive' classification of the assemblage, abbreviating this to '6I' (six class intuitive sorting) in discussions which now follow.

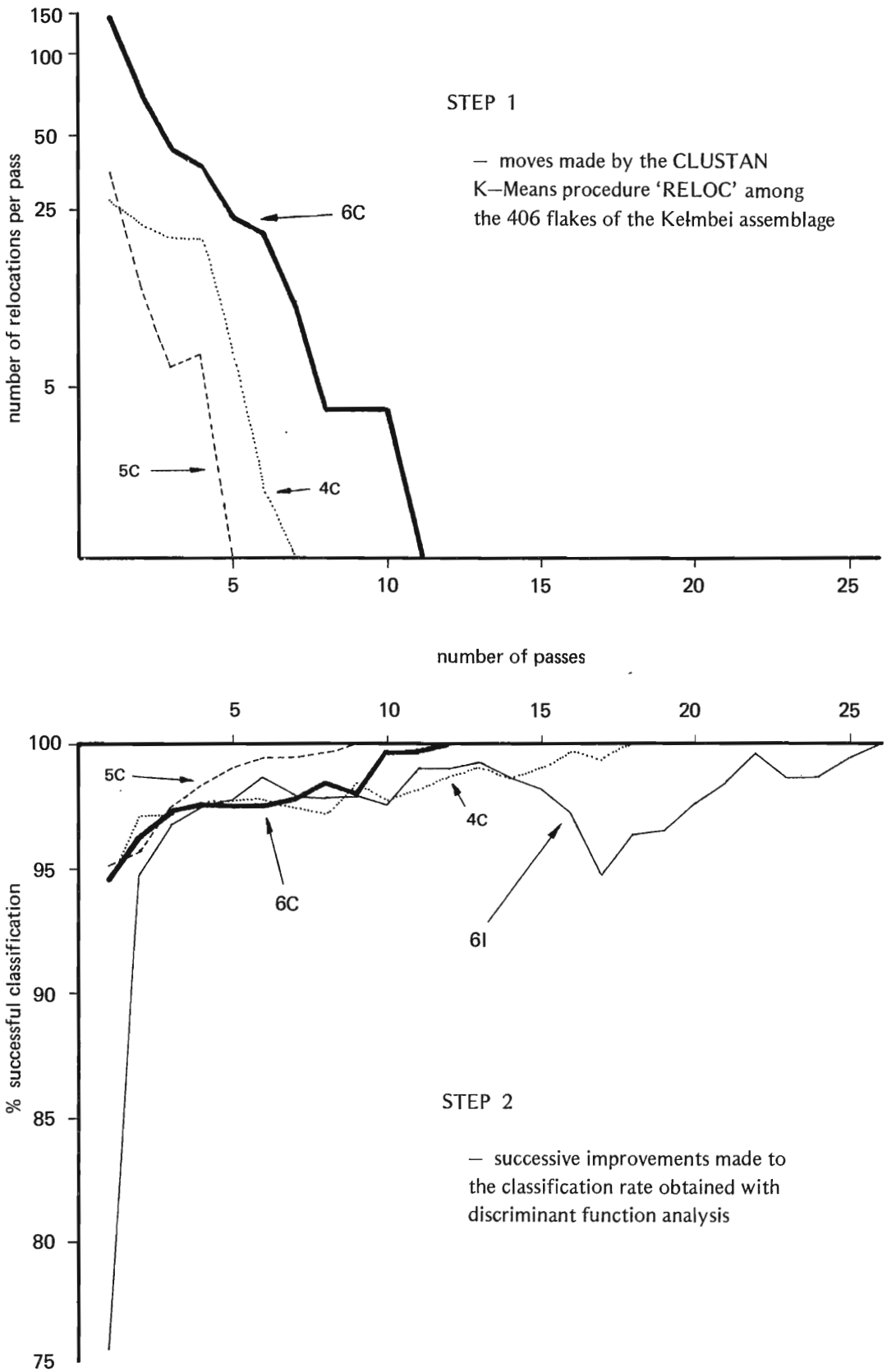
The objective of this was to pick out flakes with thick, fat platforms and large bulbs of percussion; their function in a reduc-

tion sequence is to remove mass at an early stage of knapping (cf. Newcomer 1971). Thin flakes, on the other hand, are produced at a later stage of knapping, when the knapper wants to leave shallow flake scars that will prepare the axe for grinding on a stone file. The secondary division of the thick and thin flakes into size classes was made with the aim of separating flakes of widely differing function in the reduction sequence, as judged by size alone.

The second path towards a classification was to look for clusters in the Keɨmbei assemblage using the well-known CLUSTAN program (Wishart 1975). To be comparable with my hand sorting, six groups of flakes - clusters - were requested. I selected five variables to give what I considered likely to provide a meaningful classification of the 406 flakes. They were the cube root of mass and logarithm of medial length, which gave a better spread of values than simple length, and the above-mentioned coefficients of thickness, bladedness and expansion. This classification is referred to as '6C' (six way CLUSTAN sorting) in the discussion.

Starting with a previously defined set of clusters, CLUSTAN proceeds by making a series of 're-assignment passes' when the 'K-Means' procedure RELOC(ate) is selected. During each pass, each cluster member - in this case, each flake - is checked to see whether it is 'closer' to the middle of another cluster than to the one it currently belongs to. If so, its membership is tranferred to the other cluster. This is called a re-assignment or relocation. (When a move is made, the program has to find a new centre for both the old cluster and the new cluster before it can return to membership ckecking.) During one re-assignment pass the program begins at the top of the list of items (flakes) and works its way to the bottom, making relocations as necessary. When a complete pass has been made without a single relocation, a 'stable' classification is deemed to have been made.

The choice of the initial configuration can be important; I used my intuitive (6I) sorting to 'seed' the program. CLUSTAN made some 366 changes over 10 re-assignment passes before finding six stable clusters; the process is summarised in Figure 5.8 ('Step 1'). Also shown are the effects of merging the two 'closest' clusters after reaching a stable position with six clusters, then continuing



FLAKE ANALYSIS numerical taxonomy of the Kełmbei assemblage

Figure 5.8

with five (the '5C' classification), and a repeat of this with four clusters (the '4C' classification). However, I did not find these classifications illuminating and mention them only briefly below.

Another important choice was that of the 'distance coefficient' used (the measure of 'closeness' referred to above). It was 'error sum of squares', effectively a summation of the ruler distances between each cluster member and the centre of the cluster.

CLUSTERS TO FLAKE CLASSES: A TAXONOMIC REFINEMENT

The two classifications just described (6I and 6C) were taken to a second stage of analysis. Doran and Hodson (1975:183-4) describe how the Mahalanobis distance measure coupled with K-Means relocation could provide an optimal, if computationally time-consuming, means of classification. It is not a standard method, but there is merit in taking up the idea here. Having been used to find stable classes in one assemblage, discriminant analysis (the practical implementation of the Mahalanobis distance measure) has a useful spinoff in that the contents of further assemblages can readily be distributed among the classes already defined. This use is of special interest, because there are five other assemblages waiting to be classified.

I used the widely available SPSS DISCRIMINANT procedure (Klecka 1975) to determine which flakes were 'closer' to clusters other than the ones they were in, and moved the misfits to the suggested new clusters. As before, this constituted one 'pass' through the data. The success of a classification (the result of a given pass) was recorded as the percentage of individuals successfully 'reclassified'. Reclassification is the equivalent operation in DISCRIMINANT to the membership checking performed automatically by RELOC. A 'perfect' (re-)classification, according to this criterion, had 100% of its cases correctly classified and no misfits.

From this point on, I will call the clusters of flakes 'flake classes'; this is an arbitrary choice, but I intend it to mean that the taxonomic groups will be interpreted archaeologically once they are formed, and that they will no longer be taxonomic abstractions. Note that after each pass of DISCRIMINANT, and after the completion

of each batch of relocations, the flake classes came to resemble less and less what was originally seen in 6I or 6C, thus it is more appropriate to think of 6I and 6C as classification models rather than actual classifications. It is especially important to stress that the flake classes of 6I ultimately bore little resemblance to my intuitive groupings. Both 6I and 6C were shuffled by relocations and the final difference was that only 6C had been through the intermediate step of a cluster analysis.

On the first pass through the 'K-Means Mahalanobis' algorithm the 6C model scored a rate of 95% success, while the 6I model scored a rate of only 75% (Fig. 5.8, 'Step 2'). On the second and subsequent passes 6I jumped to a 95% success rate, then both models slowly improved towards 100% success. This was reached in 12 passes by 6C, while the success of the 6I model declined between pass 13 and pass 17, only reaching 100% on pass 26 (Fig. 5.8, 'Step 2').

It is evident that both classifications satisfied some criterion of mathematical perfection as each was able to come up with a (different) set of discriminant function weights to achieve a 100% success (Figs 5.9 and 5.10). There could in fact be very many 'perfect' classifications. It might be thought desirable to examine many of them but this would be impractical and there is a strong likelihood that major differences would be found only if completely random or quite artificial choices of starting position were made (e.g. five groups containing only one flake, and a sixth containing all the remainder). This was avoided by guiding the process with 'intuitively reasonable' starting positions, namely the groups or clusters of flakes initially defined.

Discriminant analysis is an effective way to classify 'unknown' individuals. In the present instance there are 1530 flakes in the remaining sites in the Tun valley and Kuk MNN, all of which may be thought of as 'unknown'. The advantage of this over other means of classification is that flake class membership at these sites will be defined exactly as at Keɨmbei: flakes in each class should look the same whether they are from the quarry, Kunjin, or from MNN over twenty kilometres away. In practice the properties of each flake class exhibit individual variations around a grand mean. Statistics for each site are listed in Tables 5.2 and 5.3, and a selection of the flakes from Keɨmbei are illustrated in Figure 5.11 with their flake class memberships under the two classification models.

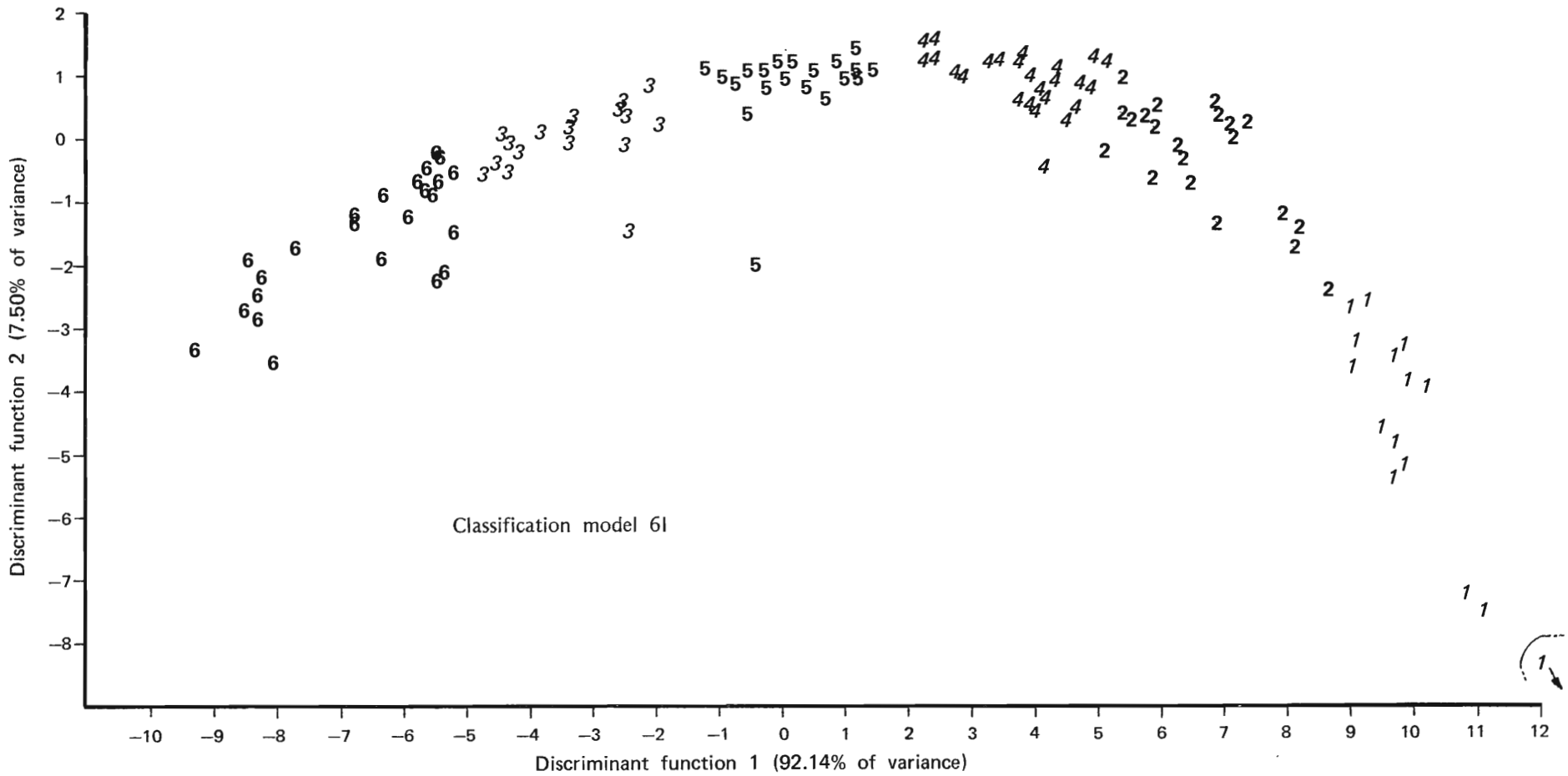
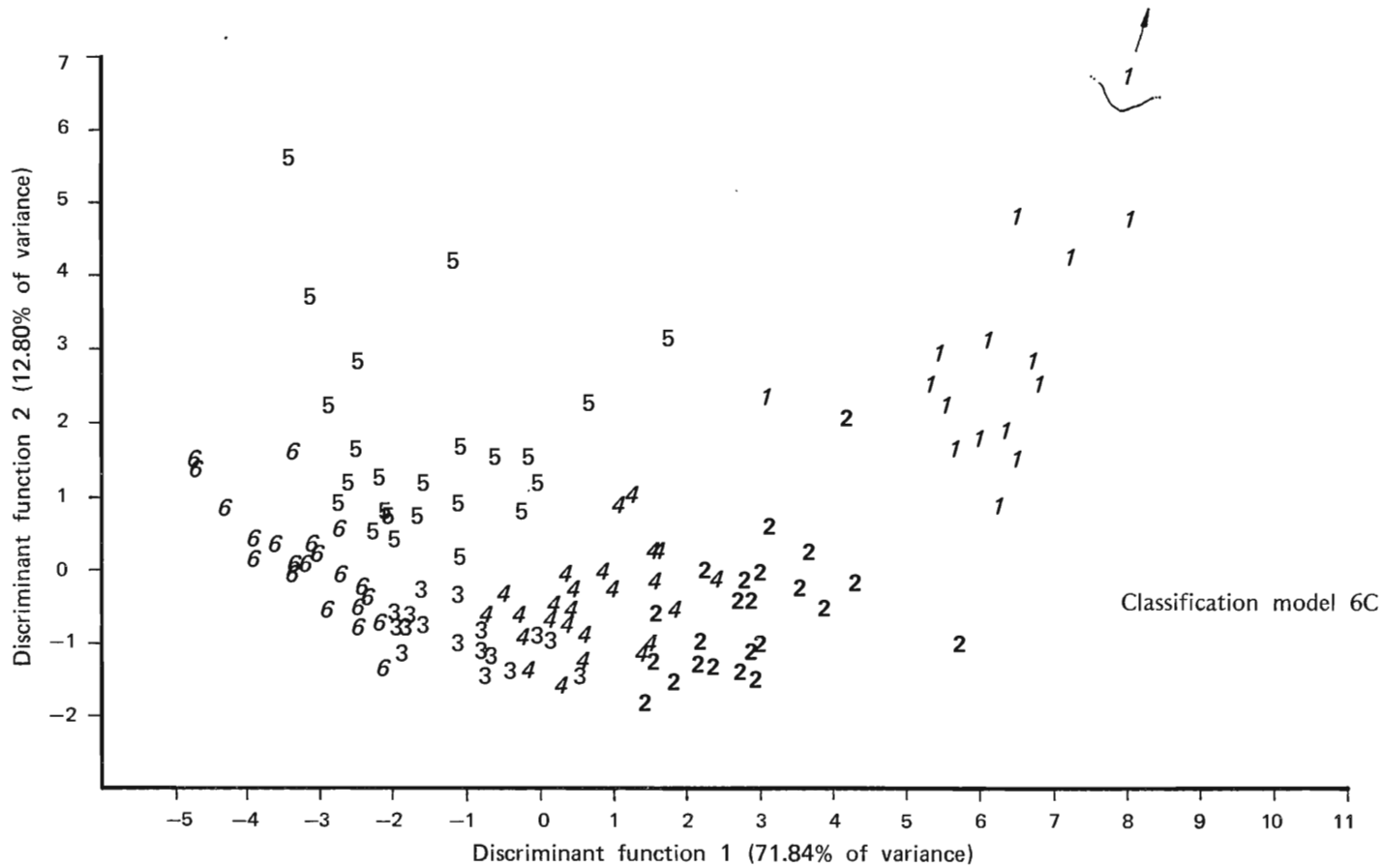
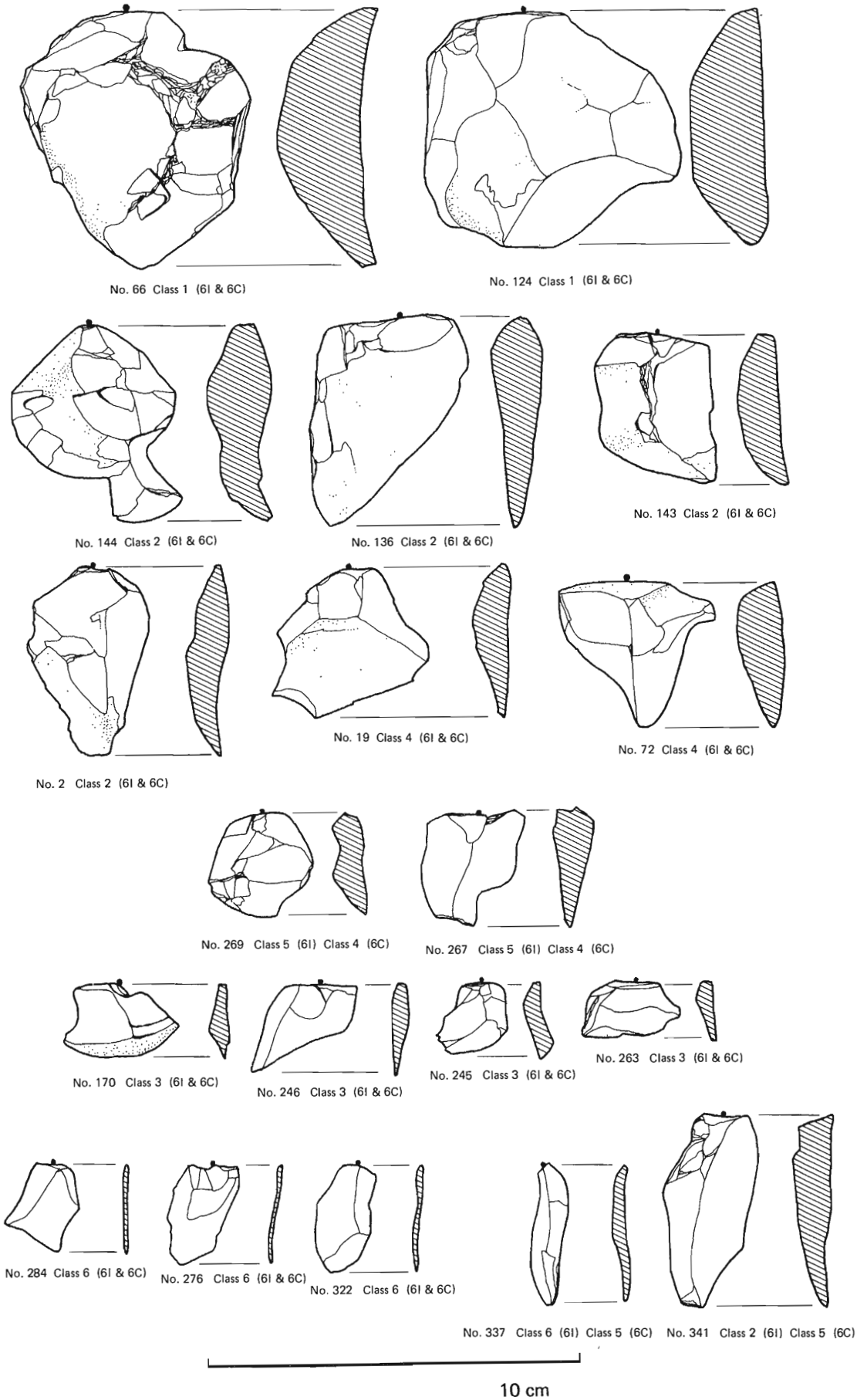


Figure 5.9 **FLAKE ANALYSIS** members of flake classes plotted on first two discriminant functions



FLAKE ANALYSIS members of flake classes plotted on first two discriminant functions

Figure 5.10



FLAKE CLASSES a selection of flakes from the Kełmbei floor

Figure 5.11

Assemblage	Total Weight (g)	Mean Weight (g)	Mean Length (cm)	Mean values of coeffs. Thick-ness	Bladed-ness	Exp-ansion	N
Flake Class 1 (massive flakes):							
Kunjin	9365.8	102.9	5.7	0.80	1.00	1.08	91
Tun Wareng	1017.2	67.8	5.7	0.78	1.08	1.02	15
Koip Kui	2085.8	71.9	5.5	0.79	1.05	1.02	29
Temek	2106.0	78.0	5.4	0.82	1.04	1.63	27
Kełmbei	1321.1	82.6	6.1	0.84	1.23	1.03	16
Kuk MNN	58.3	58.3	4.9	0.81	1.02	1.25	1
	15954.2	89.1	5.6	0.80	1.04	1.15	179
Flake Class 2 (mass reduction flakes of medium to large size):							
Kunjin	3416.0	21.8	3.5	0.83	1.03	1.13	157
Tun Wareng	466.7	23.3	3.3	0.79	0.93	1.14	20
Koip Kui	1781.5	26.2	4.0	0.76	1.02	1.12	68
Temek	823.2	28.4	4.0	0.79	1.04	1.10	29
Kełmbei	1755.5	19.3	3.6	0.84	1.15	1.15	91
Kuk MNN	184.6	18.5	3.0	0.81	0.96	1.05	10
	8427.3	22.5	3.6	0.81	1.05	1.13	375
Flake Class 3 (small, relatively thick flakes):							
Kunjin	444.1	3.2	1.6	0.82	0.90	1.09	137
Tun Wareng	79.9	3.6	1.6	0.86	0.94	1.06	22
Koip Kui	174.7	3.6	1.8	0.75	0.91	1.20	48
Temek	64.2	3.8	1.6	0.77	0.83	1.39	17
Kełmbei	191.0	2.8	1.7	0.80	0.96	1.22	68
Kuk MNN	59.0	2.9	1.5	0.78	0.86	1.22	20
	1012.9	3.2	1.6	0.80	0.91	1.16	312
Flake Class 4 (large thinning flakes):							
Kunjin	1228.4	9.1	2.9	0.74	1.05	0.95	135
Tun Wareng	329.4	8.9	3.0	0.74	1.10	0.96	37
Koip Kui	2805.1	10.2	3.2	0.70	1.06	1.04	276
Temek	744.7	11.1	3.4	0.70	1.11	0.94	67
Kełmbei	869.3	8.0	3.0	0.76	1.16	0.98	109
Kuk MNN	236.7	7.9	2.7	0.70	1.02	1.12	30
	6213.6	9.5	3.1	0.72	1.08	1.00	654
Flake Class 5 (bladelike flakes):							
Kunjin	74.9	3.4	2.9	0.79	1.55	0.94	22
Tun Wareng	42.2	10.5	4.4	0.81	1.71	0.96	4
Koip Kui	28.1	2.8	2.9	0.71	1.52	1.11	10
Temek	10.6	5.3	2.9	0.81	1.37	0.89	2
Kełmbei	150.5	3.3	2.9	0.76	1.58	0.92	46
Kuk MNN	25.7	4.3	3.4	0.73	1.57	0.82	6
	332.0	3.7	3.0	0.76	1.57	0.94	90
Flake Class 6 (tiny, very thin chips):							
Kunjin	115.7	1.7	1.5	0.72	0.95	0.86	70
Tun Wareng	6.2	3.1	2.0	0.70	0.94	0.87	2
Koip Kui	280.6	2.6	2.0	0.67	1.02	0.93	107
Temek	88.7	3.2	2.1	0.66	1.04	0.90	28
Kełmbei	144.6	1.9	1.9	0.68	1.07	0.91	76
Kuk MNN	71.1	1.7	1.6	0.69	0.96	0.97	43
	706.9	2.2	1.8	0.68	1.01	0.91	326
Grand totals and means:							
	32647.0	16.9	3.0	0.75	1.05	1.05	1936

'6C' CLASSIFICATION properties of the flake classes

Table 5.2

Assemblage	Total Weight (g)	Mean Weight (g)	Mean Length (cm)	Mean values of coeffs. Thick-ness	Bladed-ness	Exp-ansion	N
Flake Class 1 (massive flakes):							
Kunjin	9154.6	106.4	5.8	0.80	1.00	1.08	86
Tun Wareng	974.3	69.6	5.8	0.79	1.10	1.01	14
Koip Kui	1880.7	78.4	5.6	0.79	1.05	1.02	24
Temek	1984.2	86.3	5.9	0.83	1.12	1.11	23
Kełmbei	1274.1	84.9	6.2	0.84	1.22	1.04	15
Kuk MNN	58.3	58.3	4.9	0.81	1.02	1.25	1
	15326.2	94.0	5.8	0.81	1.06	1.06	163
Flake Class 2 (mass reduction flakes of medium to large size):							
Kunjin	3000.9	28.3	4.1	0.79	1.06	1.11	106
Tun Wareng	520.3	28.9	4.3	0.76	1.07	1.05	18
Koip Kui	2591.1	25.9	4.2	0.73	1.04	1.07	100
Temek	1116.0	28.6	4.3	0.75	1.05	1.00	39
Kełmbei	1498.9	25.0	4.0	0.82	1.14	1.08	60
Kuk MNN	121.0	24.2	3.2	0.81	0.93	0.88	5
	8848.1	27.0	4.1	0.77	1.07	1.07	328
Flake Class 3 (small, relatively thick flakes):							
Kunjin	298.9	3.2	1.8	0.81	0.99	1.00	93
Tun Wareng	55.2	3.1	1.7	0.85	1.02	0.99	18
Koip Kui	262.3	2.8	2.0	0.69	1.01	1.05	94
Temek	82.6	3.2	2.0	0.73	0.99	0.94	26
Kełmbei	252.3	2.5	2.1	0.75	1.15	1.04	99
Kuk MNN	69.4	2.7	1.9	0.72	1.03	1.00	26
	1020.7	2.9	1.9	0.75	1.05	1.02	356
Flake Class 4 (large thinning flakes):							
Kunjin	1206.6	12.3	3.1	0.79	1.04	1.04	98
Tun Wareng	229.2	11.5	2.9	0.76	0.99	1.07	20
Koip Kui	1513.1	11.3	3.4	0.70	1.07	1.07	134
Temek	413.4	11.2	3.6	0.70	1.14	1.01	37
Kełmbei	805.3	11.2	3.4	0.80	1.22	1.07	72
Kuk MNN	222.9	11.7	3.1	0.74	1.03	1.10	19
	4390.4	11.6	3.3	0.75	1.09	1.06	380
Flake Class 5 (medium sized flakes):							
Kunjin	856.1	6.4	2.4	0.79	1.01	1.00	134
Tun Wareng	160.5	5.5	2.5	0.78	1.09	1.02	29
Koip Kui	851.4	5.8	2.6	0.70	1.03	1.02	147
Temek	190.6	6.4	2.6	0.72	1.04	1.00	30
Kełmbei	509.3	5.5	2.6	0.77	1.13	1.02	92
Kuk MNN	114.1	5.2	2.5	0.71	1.04	1.20	22
	2682.1	5.9	2.5	0.75	1.05	1.02	454
Flake Class 6 (tiny, thin chips):							
Kunjin	128.0	1.3	1.3	0.76	0.93	0.99	95
Tun Wareng	2.0	2.0	1.0	0.83	0.66	0.68	1
Koip Kui	57.3	1.5	1.6	0.69	1.02	0.98	39
Temek	50.5	3.4	1.4	0.67	0.86	2.21	15
Kełmbei	92.0	1.4	1.7	0.72	1.12	0.99	68
Kuk MNN	49.6	1.3	1.4	0.71	0.93	1.02	37
	379.5	1.5	1.5	0.73	0.99	1.06	255
Grand totals and means:							
	32647.0	16.9	3.0	0.75	1.05	1.05	1936

'6I' CLASSIFICATION properties of the flake classes

Table 5.3

A comparison of the two classifications is also given in Table 5.4; the table entries show how the members of each class in one classification model are distributed among the classes of the other model. The two classifications are certainly correlated, but the relationship is far from a one-to-one mapping.

THE FLAKE CLASSES EXAMINED

Commonsense suggests that raw materials are more likely to be 'cheaper' - in some undefined sense - and more plentiful closer to their sources. Texts on location analysis reinforce this view with the more formal evidence that human artefacts typically show an exponential falloff in abundance with increasing distance from their sources (e.g. Hodder and Orton 1976:Chapter 5). The effect is clearly noted here in the decaying importance of the two heaviest flake classes with distance (Fig. 5.12); these are the massive flakes of typically 50 g and above (Flake Class 1 in both 6I and 6C) and the medium-large sized flakes (Flake Class 2 in both 6I and 6C). Obviously there are some fluctuations in the graphs, but the general trend is for fewer big flakes further from the quarry site. How can this be interpreted from the point of view of the knapper?

The members of Flake Class 1 are by far the biggest flakes in both classifications. Only one flake in 6C Class 1 is not also in 6I Class 1 (Table 5.4). The flakes average about 90 g over all assemblages, compared with the overall mean of 16.9 g. They can only be interpreted as being the byproducts of dressing large blocks of raw material; and from the graphs this activity was of diminishing importance with distance from the quarries. Thus at Kunjin and Tun Wareng, a garden collection area at the foot of the Kunjin Creek, the stoneworkers roughly shaped large blocks of axe stone; at the unambiguously domestic sites, Keɨmbei and MNN, this activity was not important (there is a single Class 1 flake at MNN).

This interpretation hides the fact that a component of the Class 1 waste consists of broken hammers - it is unfortunately not always possible to be certain which was the hammer and which the piece hammered. What can be said is that such debitage pieces were more often produced closer to the quarries and, moreover, that those produced actually at the quarries were the biggest of all. The

		FLAKE CLASSES OF 6C MODEL							Class members shared
		(1)	(2)	(3)	(4)	(5)	(6)	Totals	
FLAKE CLASSES OF 6I MODEL	(1)	15	0	0	0	0	0	15	100%
	(2)	1	52	0	7	0	0	60	87%
	(3)	0	0	40	4	25	30	99	40%
	(4)	0	36	0	32	4	0	72	44%
	(5)	0	3	13	66	6	4	92	7%
	(6)	0	0	15	0	11	42	68	62%
Totals		16	91	68	109	46	76	406	
Class members shared		94%	57%	59%	29%	13%	55%		

TUMAN FLAKE ANALYSIS comparison of 6I and 6C classifications

Table 5.4

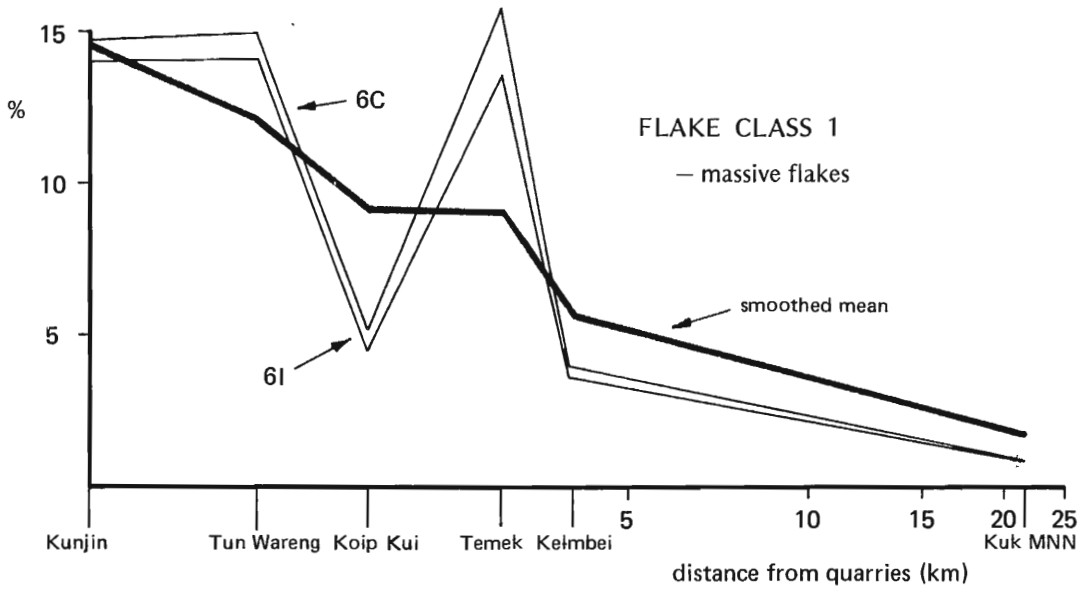


Figure 5.12

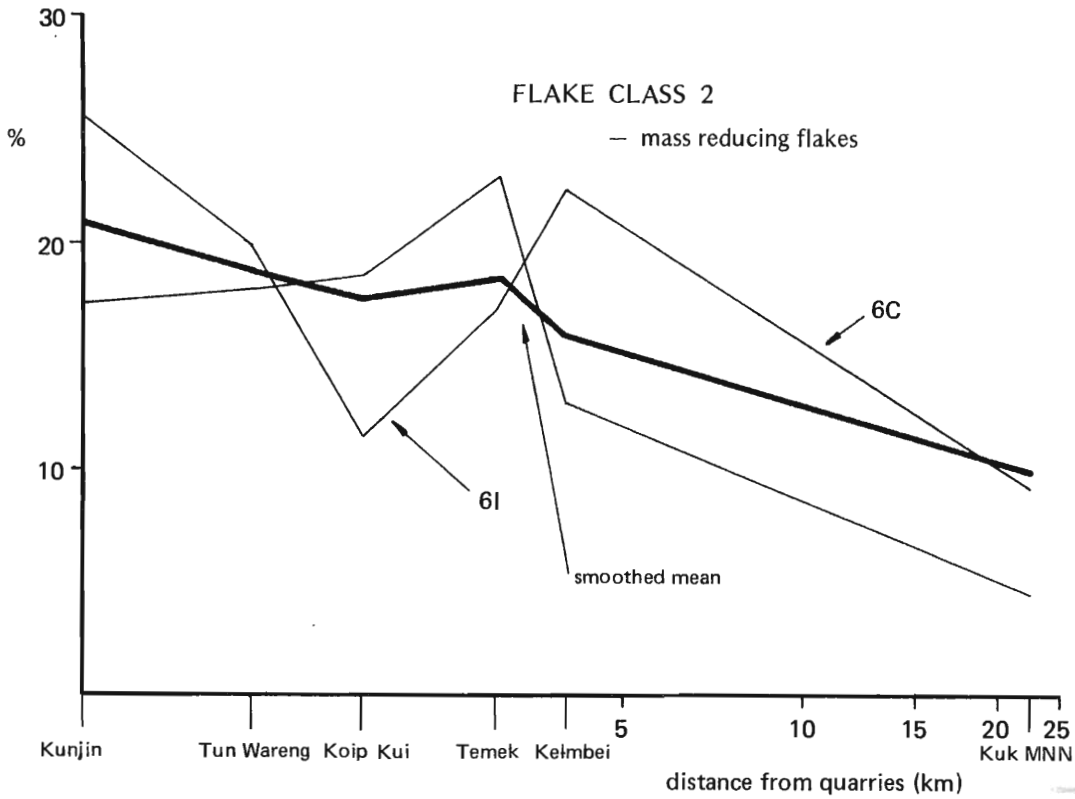


Figure 5.13

FLAKE ANALYSIS percentage importance of flake classes along transect

Class 1 flakes from Kunjin were much heavier than elsewhere; at no other site was their mean weight over 100 g (Tables 5.2 and 5.3).

The Temek and Koip Kui assemblages do not fit into this scheme. Temek was several kilometres from the nearest quarry but contains proportionately many Class 1 flakes, while Koip Kui, which was much closer (just below Yesim), contains very few. The two sites also show differences in some of the other flake classes, as will be seen below.

The next largest category, Flake Class 2, comprises medium-large flakes in both classifications, though there are marked differences between them. From Table 5.4 it can be seen that Class 2 in 6C is a superset of Class 2 in 6I: the 6C class also contains flakes which belong to Class 4 in 6I. The flakes of 6I Class 2 are heavier (mean of 27.0 g) and longer (mean of 4.1 cm) than their 6C counterparts (22.5 g and 3.6 cm), but they are not so thick. I interpret them as generalised flakes with a mass-reducing function. Again the falloff with distance may be seen as reflecting the diminishing importance of this activity away from the quarry sites (Fig. 5.13).

A point to note is that these mass-reducing flakes do not dwindle into insignificance anywhere. Even at MNN they have some role to play in stoneworking, unlike Class 1 flakes, which are essentially absent there.

Flake Class 6 lies at the other end of the spectrum and both classifications contain a core of similar flakes (see Fig. 5.11). In 6I the mean weight is 1.5 g, in 6C it is 2.2 g - these are the tiny trimming flakes and platform preparation chips most closely associated with 'tidy' knapping, and especially with the final stages of tool manufacture. The classifications differ in the number of flakes which each places in Class 3 instead of Class 6 (Table 5.4). Class 3 (see page 107) comprises chips and small flakes which are relatively thicker than typical Class 6 members. There is variation among the assemblages, but an overall trend of increase with distance stands out (Fig. 5.15).

One factor may distort this. The very low numbers of Class 6 chips (1-2 only) found at Tun Wareng leads to the suspicion that they may have escaped detection because of their small size. At Keɨmbei, where the assemblage was discovered in the form of an

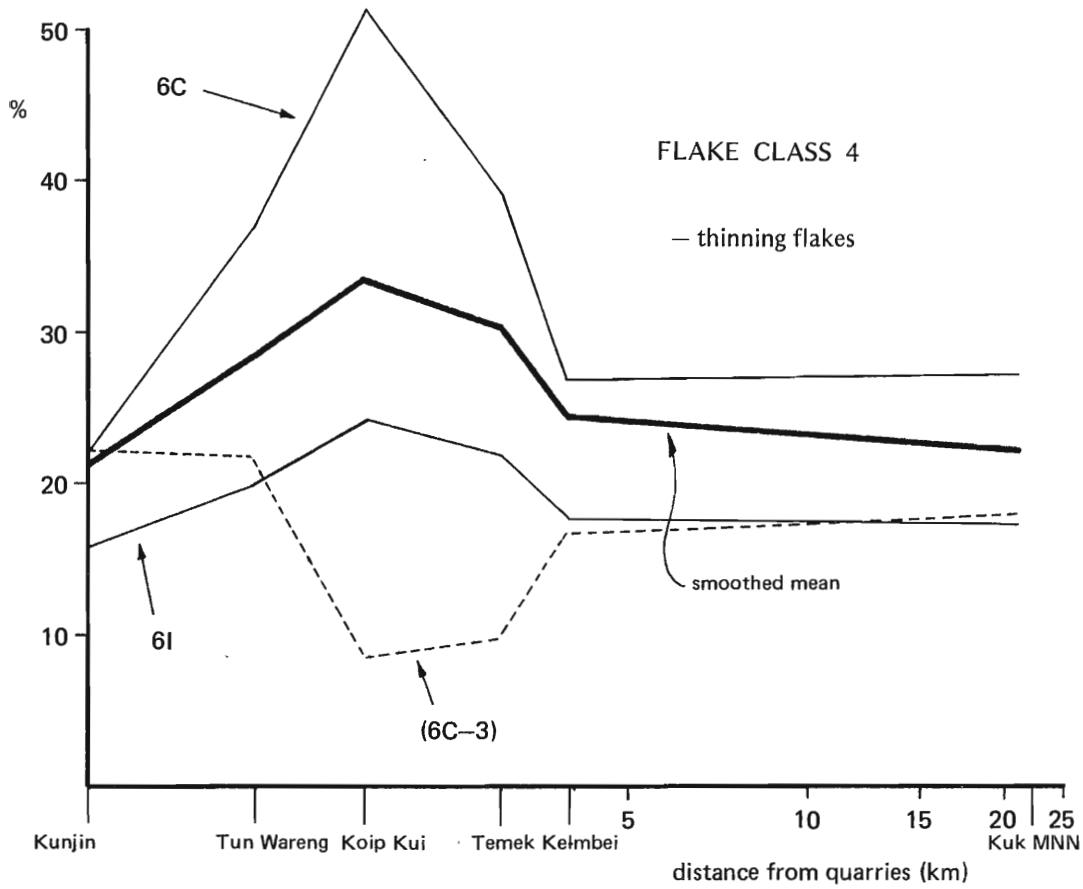


Figure 5.14

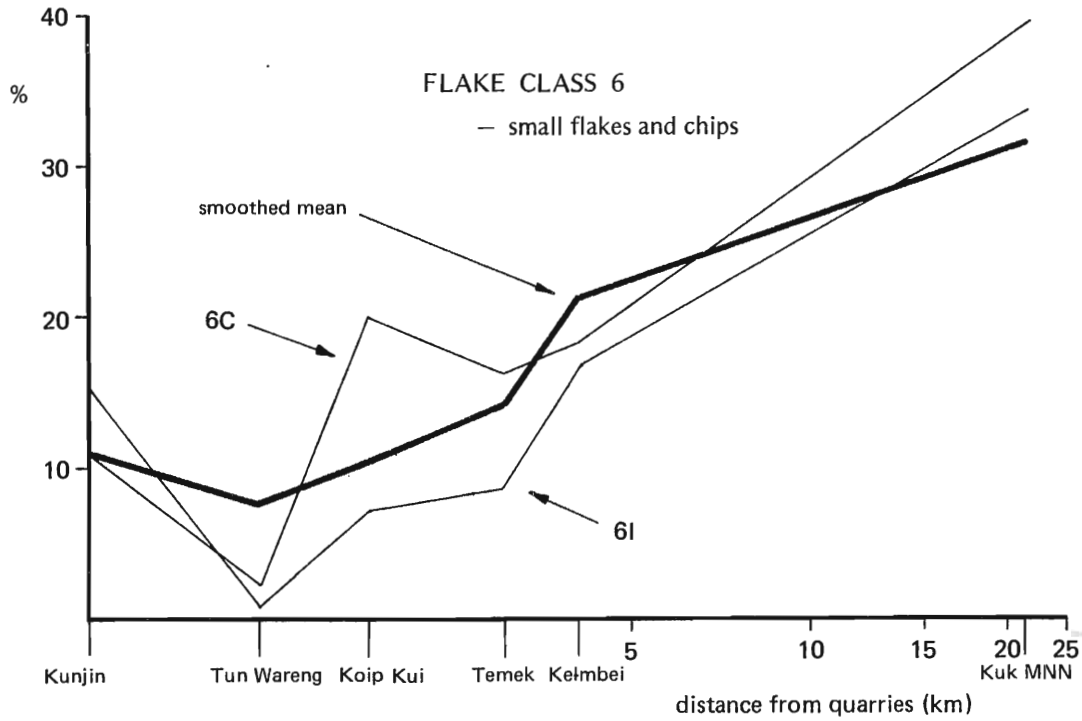


Figure 5.15

FLAKE ANALYSIS percentage importance of flake classes along transect

actual flaking floor, I used a sieve when collecting the flakes and many Class 6 flakes were found. But at MNN, the method of collection cannot account for the great number of Class 6 flakes; the site must have seen knapping of a qualitatively different nature that in the Tun valley. Either the MNN stoneworkers were reworking old axes or they made new axes from very small pieces of material by Tun valley standards.

What of the intermediate flake classes? The two versions of Flake Class 4 are poorly correlated (Table 5.4), largely because many of the flakes which would, in 6C, be placed with the Class 2 mass-reducing flakes are present in 6I Class 4. Equally, a great number of Class 4 flakes in 6C are put into Class 5 in 6I, a class of relatively smaller flakes.

Despite these differences, the proportions of Class 4 flakes parallel each other in the assemblages (Fig. 5.14) and a core of similar flakes resides in both classifications. Mean weights are 11.6 g in 6I and 9.5 g in 6C. The flakes are about the same size as the mass-reducing flakes discussed above (about 3 cm long compared to about 3.5 cm), but they are not so thick (cf. Fig. 5.11). I interpret them to be the thinning flakes that must be present in an axe making assemblage. They do not show a purely distance-based trend (Fig. 5.14).

The Class 4 flakes account for about 25% of the flakes in each of the assemblages, according to an average of the two classes. But at two sites, Koip Kui and Temek, there are more than this. At Koip Kui over 50% of the flakes were in 6C Class 4, where the average value of the thickness coefficient was the smallest (thinnest) among the six sets of Class 4 flakes (Table 5.2). One of the other intermediate flake classes, Flake Class 3 in the 6C classification, shows a complementary effect (Fig. 5.14, dashed line). The class consists of flakes of around 3 g that are relatively thick; this may give some clue to what was happening at these two sites.

Perhaps the explanation lies in the habits of the quarrymen returning from trips to the mining encampments. If they brought large pieces of stone down from the quarries, they may not have wanted to carry them far. They could have stored them at the nearest settlements for a short time. Under this hypothesis they would have returned repeatedly to thin the blocks of stone at the

Tun valley flaking floors before carrying them home. If this was the best stone, thinning flakes might well take the place of thicker - if smaller - chips of generalised function. In 6C the latter were marked out as being very squat: they had low coefficients of bladedness. I do not understand why such flakes should have dropped in numbers at Koip Kui and Temek while thinning flakes increased there.

Flake Class 3 and Flake Class 5 consisted in 6I of small and medium sized flakes. Figure 5.16 shows that, although there are quite sharp differences among the assemblages, there is no clear trend with distance from the quarries. I interpret this to mean that the activity which produced these flakes was present everywhere. It was probably the general trimming that features in most kinds of flaking.

The two versions of Class 5 are the classes with least in common, according to Table 5.4. Only 13% of Class 5 flakes in 6C are members of Class 5 in 6I, while a mere 6.5% of the latter class are members of the former class. There is a simple explanation for this. Class 5 in 6C averaged over 1.5 on the bladedness coefficient (a very high value) and thus formed a superficially familiar category of flakes, namely 'blades'. On inspection, however, the class was not homogeneous (cf. Fig. 5.11, Nos 337 and 341). The Keimbei 'blades' of this class are of quite different sizes and the dorsal scar patterns do not suggest they had been produced in a systematic way. Their varying percentage contributions to the six assemblages should therefore be seen as fortuitous. The properties of this class as a taxonomic cluster were preserved to some extent in the 5C model and this is graphed with 6C in Figure 5.17.

THE HAMMERS

Hammers for knapping were made from axe stone. Cuboid lumps of a suitable size were chosen and an important point was that they should have what was described by Malimbe[10] as **gupe**, or 'teeth'. That is to say a smooth lump was of no use; a piece of stone with

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[10] Interview 51-81.

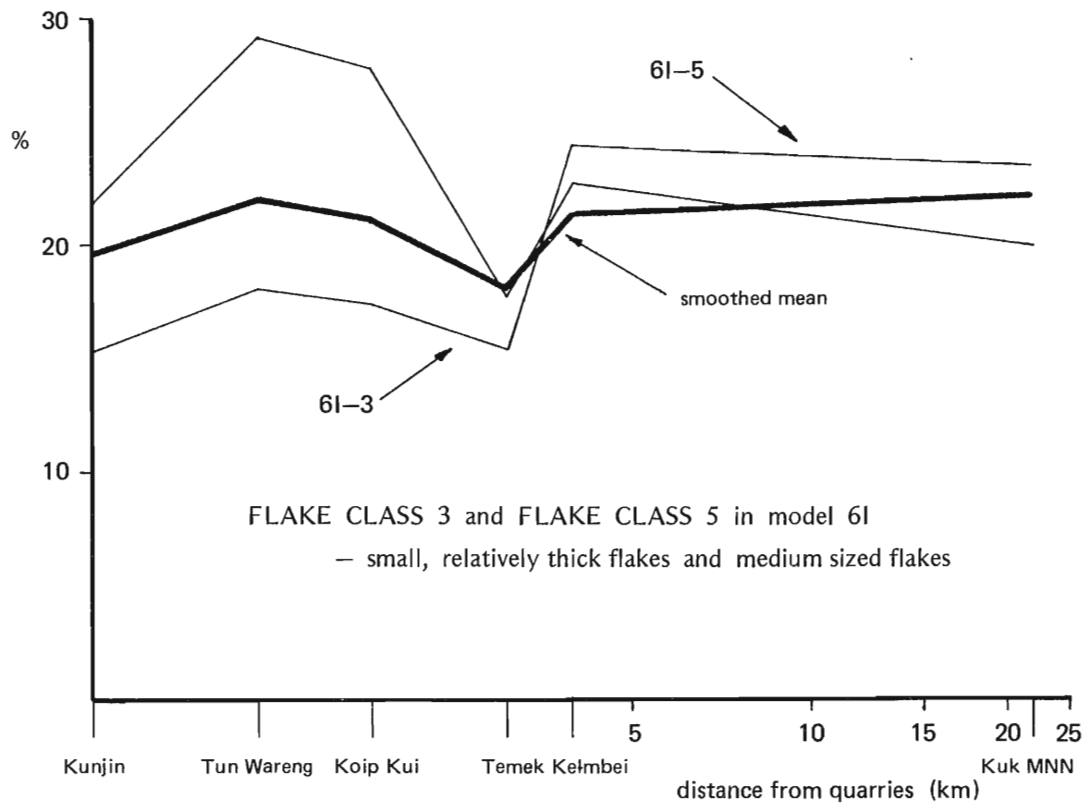

Figure 5.16

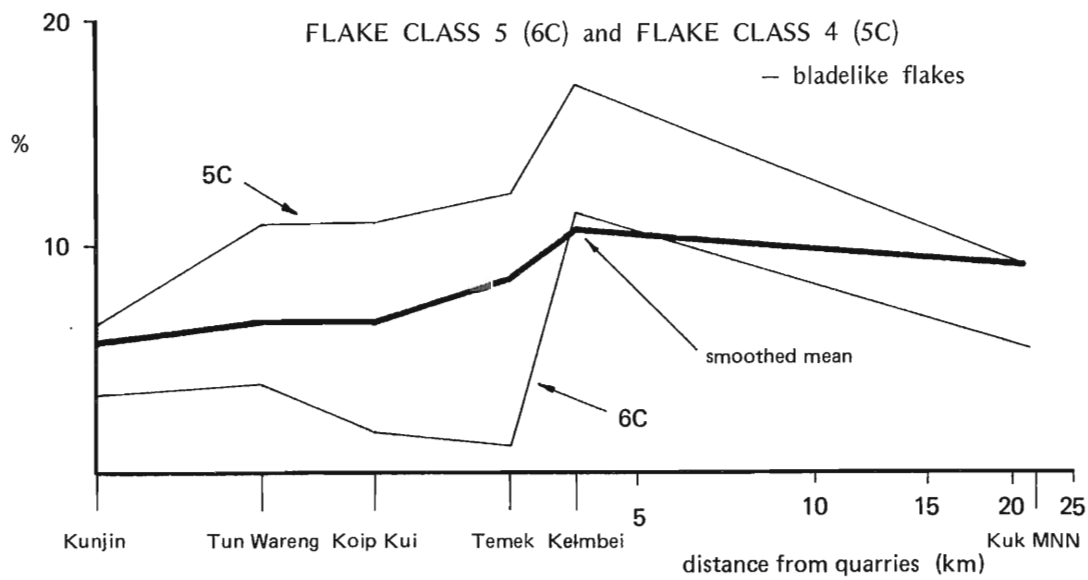

Figure 5.17

FLAKE ANALYSIS percentage importance of flake classes along transect

the right projections had to be found (the projections were called **gupe**). I did not inquire whether good hammers were curated, but it seems likely that a knapper would pick up and discard hammers at a rate in direct proportion to the supply of stone at his disposal: at Tun a man might not curate hammers, but he might well do if he lived at Kuk.

It is no surprise to find that the mean size of hammerstones decreased with distance from the quarries (Table 5.1). On the Kunjin flaking floor they averaged 387 g and were heavier than Temek hammers, at around 297 g. Lightest of all were the Keɨmbei hammers, at around 170 g. This corroborates the finding of the previous section that the heaviest work was carried out at or near the quarry sites.

There were two further sets of hammers from my 1980 excavation in Kunjin Pit 1. Eight large (average 1428 g) hammers were made of diorite (A. Watchman, pers. comm.) and were used for working at the quarry face. Old men said they used to collect large hammers from the bed of the Tun River and carry them up to the quarry. There is no reason to doubt that this was the source and, indeed, the Tun streambed contains a varied source of materials.

A further 34 hammers made from axe rock were also found in the excavation, with a mean weight of 532 g. These hammerstones may have been used for both quarryface work and stone flaking of a heavy-duty nature: they averaged more than three times the weight of the Keɨmbei knapping hammers.

THE NON-FLAKE DEBITAGE

Few lithic specialists trouble with this fraction of their assemblages, but in axe making and quarry analysis the non-flake debitage is very important and often forms the bulk of all wastes. I have examined three of the assemblages along the transect from this point of view: Kunjin, Keɨmbei and Kuk MNN.

In Figure 5.18 the numbers of pieces in each of fourteen

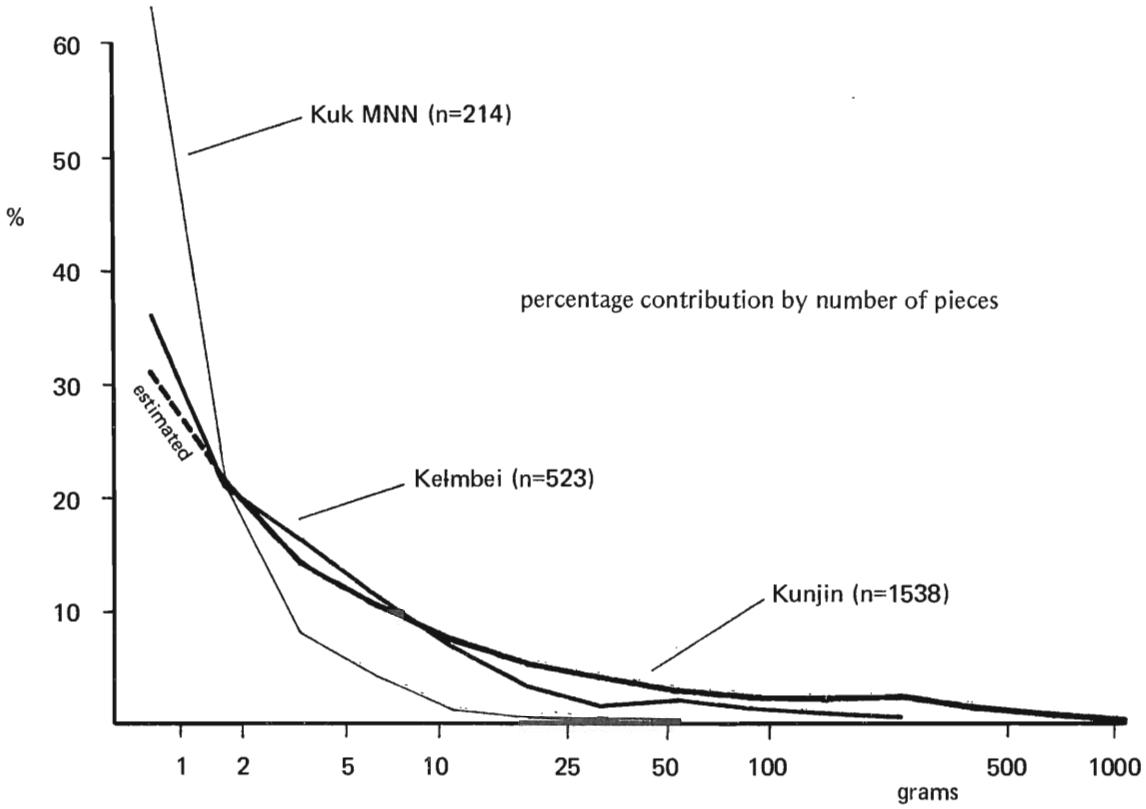

Figure 5.18

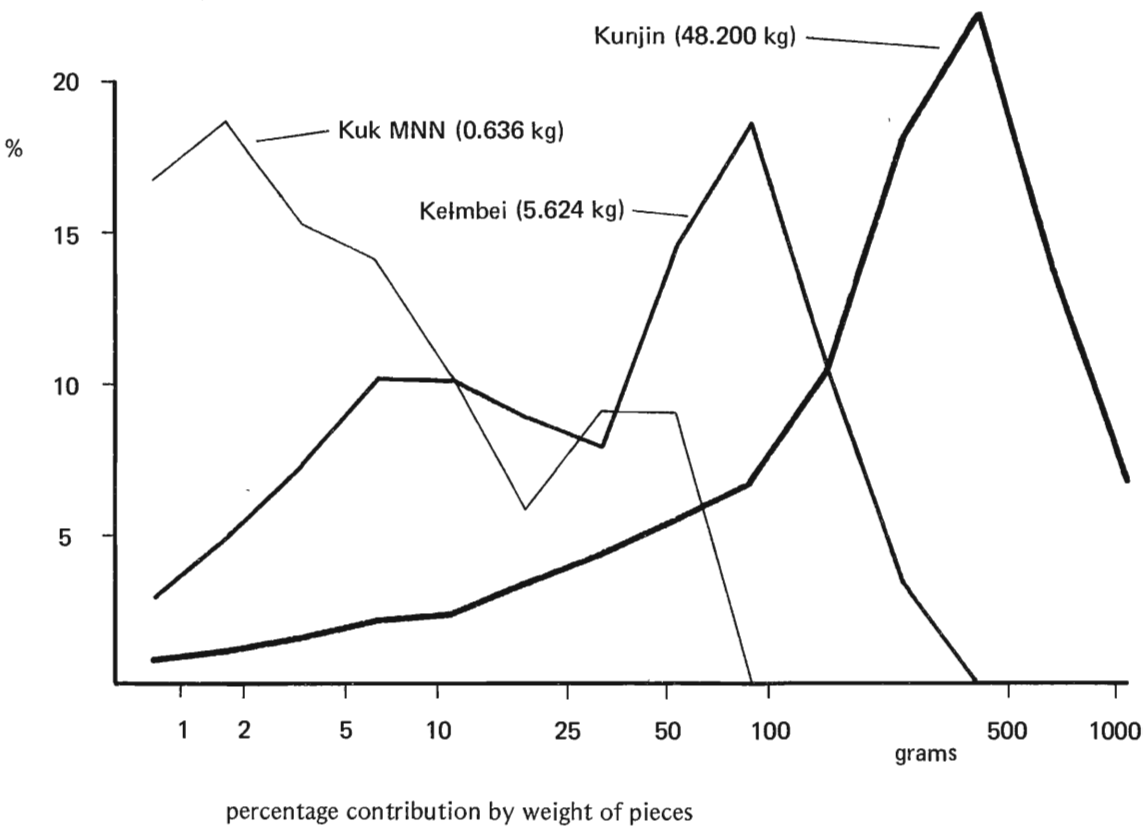

Figure 5.19

NON–FLAKE DEBITAGE percentage importance of (fourteen) weight classes

logarithmically defined weight classes are graphed as percentages.[11] This includes, except in the case of Kunjin, the 'less than 2 cm' debitage pieces; they were collectively added to the smallest weight class. I did not formally record this fraction for Kunjin, but I can say that it was relatively unimportant. The Kunjin and Keɨmbei sites show a similar falloff in the sizes of debitage pieces, while Kuk MNN is noticeably dominated by pieces in the 1-2 g size range.

Major differences between the assemblages are more apparent in Figure 5.19, where the weight classes are graphed by their percentage contribution to the overall weight of each assemblage. It can be seen that the bulk composition of Kunjin is dominated by lumps of rock in the 300-600 g range approximately. Only a few per cent of the total assemblage is accounted for by fragments of up to 10 g, which is the range of the struck flakes typically produced by a knapper in making an axe.

The Kuk assemblage is completely opposite in nature and the bulk of the assemblage consists of debitage pieces of less than 10 g. Clearly the stoneworkers were engaged in a different task here than at Kunjin. It is sufficient to note that the Kunjin assemblage represents a huge amount of debitage compared to any of the other sites and that most of this is taken up with trimming large blocks of stone. The Kuk graph hints that the distribution of weight classes could be bimodal and this is indeed the case at Keɨmbei. Here the prime mode is of debitage pieces of around 100 g, but there is a secondary mode at around 10 g. The trimming of block fractures from quite large pieces of stone was still important at Keɨmbei. It was only occasionally so at Kuk.

I suggest that non-flake debitage accumulates in two ways in these workshops. At the quarry, and at settlements nearby, lumps of axe stone broke up along pre-existing lines of weakness in the rock when struck with stone hammers. Large pieces also broke from the roughouts early in their preparation. This block fracturing is an unavoidable part of knapping but can only occur when the raw

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[11] Weight class membership obtained by rounding up or down $2 \times \log_e(\text{weight in grams} + 1)$ to nearest whole number, for each piece of debitage.

material retains lines of weakness; at a distance from the quarry, the material should have already broken along such flaws and the remaining stone should have been free of cracks. If the stone was traded in its raw state, exchange partners would not be expected to take away pieces with obvious cracks or suspicious veins.

The second way in which non-flake debitage accumulates is through the breakage of conchoidal flakes during normal flaking and the formation of shatter. Big pieces of shatter may be expected to fall into approximately the same size range as the flakes they accompany. I interpret the 10 g mode in the Kełmbei graph to have arisen in the same manner.

CONCLUSION

The several kinds of debitage discussed in this analysis have shown varying effects with respect to location. Considering the flakes, no assemblage consists entirely of one or two flake classes and only at Kuk MNN is a class almost totally absent. This suggests that there were no single purpose sites, rather a range of sites where various steps in the manufacture of axes had different probabilities of being carried out. The complementary evidence of the non-flake debitage is less ambiguous; it highlights the differences between debitage left at the quarry, in the Tun valley and 20 km distant at Kuk.

The two sources of information tell us different things. The flakes show what the knappers were doing with the pieces of stone they actually made into axes, whereas the non-flake debitage has more to say about the range of materials they were able to choose from. The pieces they left behind reflect the knapping environments more than do the flakes, which show more of the intentions of the knappers.

The model which I suggest best fits the observations is that the process of axe making took place in three overlapping stages. These should not be viewed as discrete compartments, but as abstractions to help in making sense of the axe making process.

Primary reduction took place in and around the quarry and consisted of dressing large blocks of stone into what should strictly be termed 'blanks' (cf. Burton 1977). A 'blank' can be

thought of as a piece of stone suitable in shape for axe making, but that has by no means been reduced to its final proportions. A piece of stone from the quarry face cannot automatically be thought of as a 'blank' unless it already has the right shape or has been dressed to it. Many block-fractured pieces entered the archaeological record at this stage.

Secondary reduction consisted of true stone knapping and its intention was to reduce blanks to roughouts (or, in the specialist literature, 'preforms') ready for sharpening. It took place at the quarries and at flaking areas around the homesteads and indeed accounts for most of the debitage collected outside the quarry. But from the apparently copious amounts of thinning flakes in the part of Tun valley below the quarries, secondary reduction was an activity that men preferred to carry out before taking home their shares of the stone. The non-flake debitage shows that shatter was produced in the appropriate size range for thinning and general reduction (about 10 g) and that block fractures were still being removed from the stone, though neither in such copious quantities nor in the same large size range as at the quarries.

Tertiary reduction may then be put forward as an additional kind of reduction which took place at some distance from the quarries and the major knapping areas. The stoneworkers at Kuk MNN were not a part of the 'Tuman factory area'; they lived more than 20 km away and were totally dependent for their supplies of stone on third parties between them and the quarrymen. Hence the breakdown of flake classes there illustrates stoneworking under different conditions. From the graphs this evidently involved the tidying and trimming of axe roughouts; primary flaking was definitely not carried out there. It is also likely on the grounds of distance that the Kuk stoneworkers had to work with smaller and second-choice materials; this may be expected to have contributed to the much greater numbers of small flakes.

Chapter 6

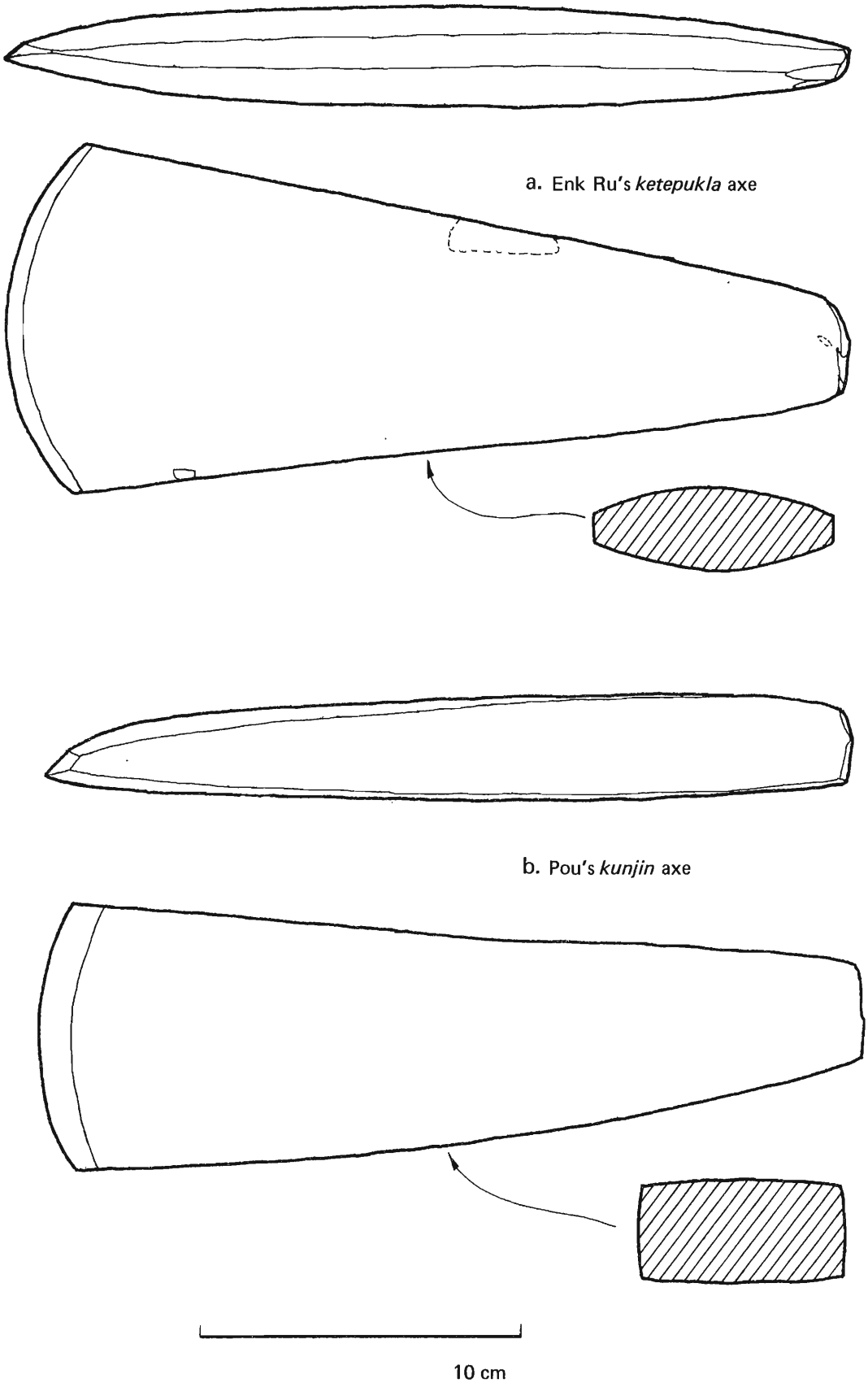
AXE BLADES AND HAFT MAKING

The work of sharpening axe blades on a grindstone and the skill of haft making offer a marked contrast to the rather exclusive labour of quarrying and stone knapping in the vicinity of the quarries. These tasks provided all men in the Tuman area with the opportunity to participate in axe making if they could trade with the quarry owners and obtain axe stone or - as seems more likely - fully flaked roughouts.

The sharpening of axe blades was open to all, and the kind of work most suited to unskilled hands, but the hafting of axes to a standard high enough to be of value in the Wahgi Valley wealth economy was skilled work restricted to the few good haft makers in every clan. In this chapter I follow the stages of axe making from the acquisition of a roughout to the last touches to its hafting as an axe ready for use or for exchange. The method is at the same time ethnographic and experimental - I watched and took advice from axe makers and made an axe myself.

AXE STYLES

The two main styles of axe circulating in the Middle and Upper Wahgi wealth economy were the Tuman and Hagen styles. Hagen axes are so named, despite their origin in the quarries of the Jimi Valley (Chapter 8), because of their widespread circulation in the Central Melpa Mt Hagen area. The differences between the two styles of axe blade are clearly seen in fine examples of the types (Figure 6.1). The Hagen axe, whose paradigm may be taken as the **ketepukla** (Ganz River) axe given to me by Enk Ru of Palg (Fig. 6.1a), has divergent sides and a wide cutting edge. It has smoothly convex upper and lower surfaces and the flat sides are relatively narrow. The National Museum houses a collection of about



TWO FOREMOST AXE STYLES a. the Hagen style b. the Tuman style

Figure 6.1

100 similar blades from Simbai in Madang Province; all are variants of the paradigmatic shape of Enk Ru's axe.

The Tuman style is exemplified by the axe I borrowed from Komnemb Pou (Fig. 6.1b) and intended to have hafted (unfortunately Pou fell ill before this could be organised). The sides of the axe diverge slightly, but in a different manner to the Hagen style axe; one side has a convex curve to it and the other a concave curve, a feature almost never seen in the Hagen style but which is not uncommon in Tuman axes. The axe is much thicker in section and the flatness of the sides is much more pronounced; it is a quadrangular axe in the true sense of the word.

Both axes have a cutting edge markedly asymmetrical in profile; this is an attribute which is sometimes seen as the distinguishing feature of the adze (e.g. Celoria and Wilcock 1975:12; Manby 1979: 65-6). Most archaeologists working in Papua New Guinea have found that there are few legitimate distinctions between axe blades and adze blades (S. Bulmer 1964:247; Lampert 1972:2) and a series of interviews I conducted at Tun have a bearing on this interpretation.

Few stone axes could be obtained at Tun at the time of fieldwork because the axe makers had long since either sold, lost or broken most of the axes that they had in their possession 30-40 years ago. But in 1981 I was able to borrow and take to Tun an assorted collection of axe blades from the National Museum. It comprised 30 unprovenanced Tuman axes, a black Jimi axe, a white Jimi axe and a mottled axe reminiscent of the **sambe** axes in the Enga Cultural Centre at Wabag.[1]

Reactions to these unhafted blades were very interesting (Plates 6.1 and 6.2). Shape, in a general sense, was of little concern to the elderly men whom I asked to describe them; instead they commented on the huge size of the largest axes and certain secondary features like unusual markings and what they termed the

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[1] The axe blades were selected, with kind permission of the curators, from the several drawers of uncatalogued axes in the Museum. Many had white printed stick-on labels with numbers ranging from 1 to 62 and could have been collected by one person. The likelihood is - judging from the large size of the axes - that this collector bought most of them in the Wahgi or Simbu area in the 1950s.

'incorrect' sharpening of the cutting edges. A facet on the cutting edge is usually termed a 'bevel' or a 'chin' (Lampert 1972; Hughes 1977a:Fig. 28); unlike Enk Ru's and Pou's axes, most of the axes in the collection had more or less symmetrical cutting edges and were not bevelled at all. It was the absence of this characteristic that the axe makers remarked upon; in their view, correctly sharpened blades should have had pronounced facets.

Various authors have attempted to account for the feature, many assuming that a true axe should have a symmetrical cutting edge. Only a few (e.g. Steensberg 1980:44; pers. comm.) have shown that a bevel is a functional part of the cutting edge. Men at Tun pointed out to me that a stone axe cannot be sharpened on both sides like a steel one and that the correct way to make a new blade was to grind one side almost flat while making a marked facet on the other side. The vernacular term for the facetted part is the **kopsi**, or 'cut',[2] while the other side of the cutting edge is called the **pouen** (no particular meaning).

Furthermore, right-handers hafted such blades so that the unfacetted sides were to their left when the axes were held in an upright position (Plate 6.1; cf. Steensberg 1980:51). When felling trees or making fencing posts, right-handers would normally cut from the right. In this case the unfacetted sides could make contact at a low angle without being deflected. Mounted the opposite way, with the facets inwards, the axe would bounce off or, having made a cut, fail to bite deeply.

Because **kopsi** were absent on most of the National Museum axes, informants said that the last owners had not sharpened them correctly. It is possible that the largest examples were never intended for use and were consequently left unsharpened, but this was not what the informants had in mind. In their opinion, all Tuman axes should have been finished correctly with a **kopsi**.

There is, however, some sense in the 'incorrect' shape; discussing the day-to-day maintenance of stone axe blades, Sillitoe (1982:34) states that the main consideration on the part of stone

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[2] **Kopsi** is a participle of the verb **kopes-**, to slice or butcher, thus meaning 'cut' in the passive sense of 'something cut'.

axe owners - as opposed to quarrymen and axe makers - was conservation. This was achieved by grinding off as little as possible when repairing nicked and chipped axes - at the expense of stylistic perfection and, perhaps, optimal function. The **kopsi** are clear to see on Enk Ru and Pou's axes, because neither was ever used and resharpened.

Some Tuman axes do not look at all like the paradigm that I have just described. One of these was collected at Gembogl in the Chimbu Valley by J. Hope (Fig. 6.2). It is made from Tuman stone, but is very long and narrow in comparison to other Tuman blades, and also oval in section - an unheard-of attribute to be given to an axe at the factory itself. However, a tell-tale mark shows that the owner refashioned it from a larger axe by 'sawing' it with another stone, a method of adze manufacture used with some stone types in New Zealand (Best 1974:58-71). This technique was confined to Simbu Province in the recent past and was the main method used to fabricate axes in the Dom **gaima** factory area (see Chapter 9). It is remotely possible that the Gembogl axe was one of a pair cut from the same stone, though all that is certain is that a large axe was reshaped by sawing.

VERNACULAR TERMINOLOGY

People of the Melpa, Ek Nii and Middle Wahgi language areas used special terms to describe the various parts of an axe blade. I collected Nii terms but the cognate forms can be recognised in the other languages and apply regardless of the source of the axe.

A loose axe blade, or an axe blade as opposed to a hafted axe, is known as a **tui mong**, or 'axe piece'.[3] As can be seen in Figure 6.3 many of the parts of a **tui mong** were given anatomical names. Each flat side was called **kon**, 'cheek, temple', the butt or poll (Crosby 1973:Fig. 3) was called **sip**, 'elbow', and the cutting

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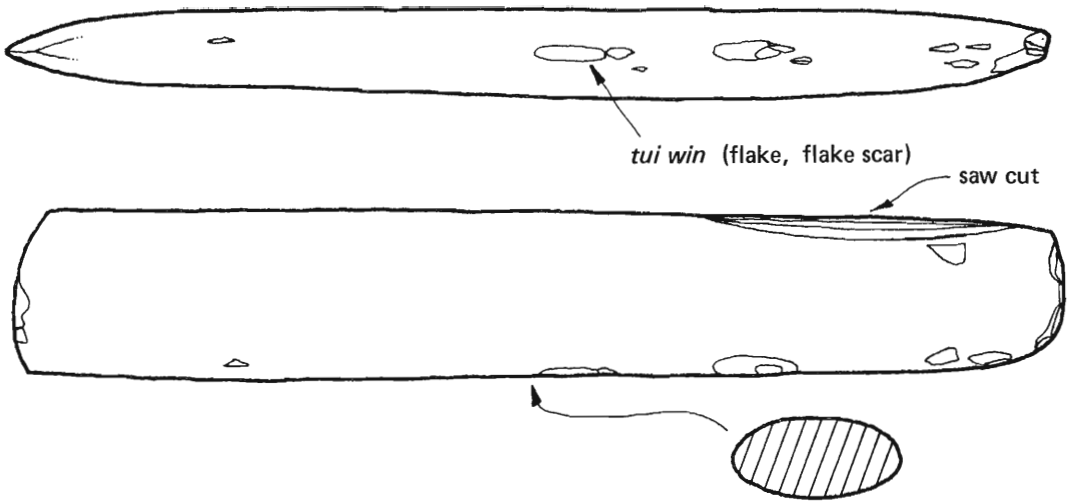
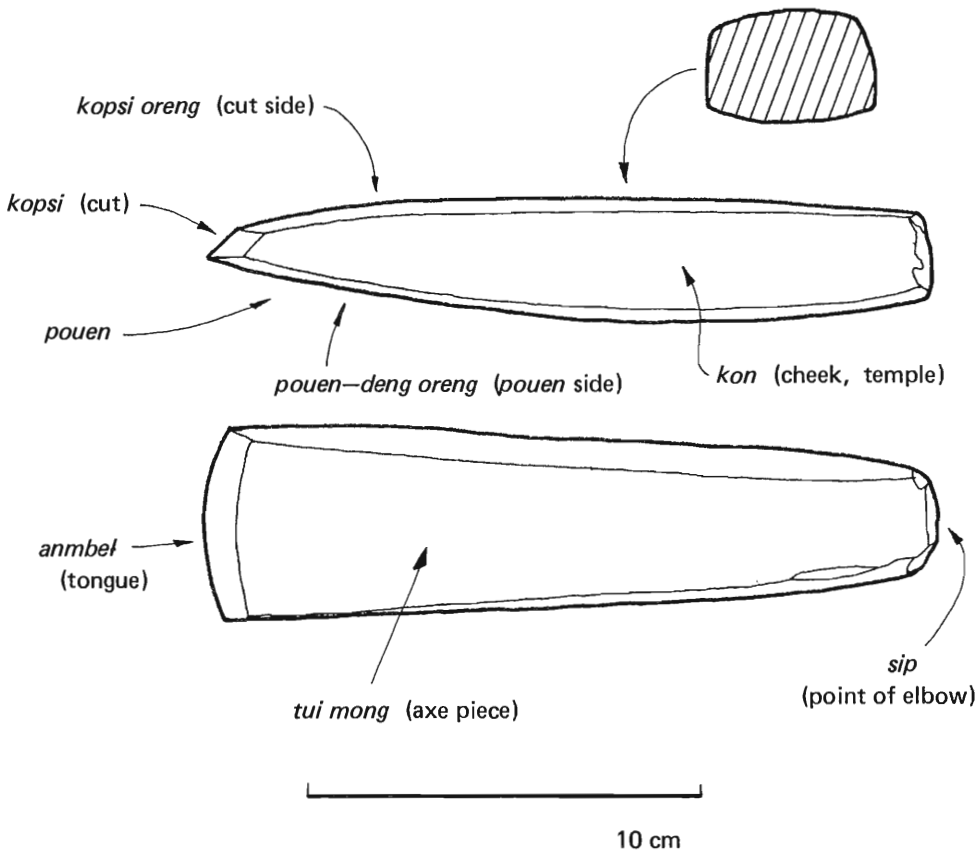
[3] **Mong** also means 'lump', 'projection', 'attachment' or 'fruit', as in **gupe mong**, 'teeth', **ku mong**, 'money pieces' (coins), **angeł mong**, 'fingers' and **ond kueng mong**, '*Castanopsis acuminatissima* fruit'.



AXE FROM GEMBOGL, SIMBU a Tuman axe with evidence of sawing (J. Hope)

Figure 6.2



TUMAN AXE HAFTED BY DURI Ek Nii terminology

Figure 6.3

edge was called **anmbeł**, 'tongue'. The upper and lower surfaces (if the blade was laid flat with the **kopsi** surface upppermost) were called the **kopsi oreng**, the '**kopsi**' side, and **pouen oreng**, the '**pouen**' side (or **pouen-deng oreng**, the '**pouen**-wards' side).

Axes were sharpened on a **ku tukem**, 'stone sharp', or **kum**, 'grindstone'. The action of sharpening is either **tukem mond-**, 'sharp put', or **tukem e-**, 'sharp do', and several terms describe the condition of an axe when sharp. An axe is 'very sharp' if **tukem gelke mołem** ('sharp ?**gelke** is') and 'very sharp indeed' if **tukem jiki mołem**, ('sharp angry is').

GRINDSTONES: THE TOOLS BEYOND THE QUARRY

The main task for the majority of those involved in the manufacture of stone axes in the Papua New Guinea highlands was the sharpening of axes on semi-portable grindstones. As a consequence, the demand for grindstones and whetstones must have been extremely heavy.[4] Grindstones are available in various grades throughout the region and are distinguished by name. Men still obtain them from the traditional sources today and use them for whetting steel axes and bushknives. A serviceable variety is found in the Enga Creek on the border between the land of Tungei Kenjpi-emb clan and Wałpi (see Figure 2.2), but the best grindstones known to the Tungei were **kum opamil** and **kum konmil** and these outcrop further down the valley in the Middle Wahgi language area. They had to be acquired through trade. These are the Middle Wahgi names; the Nii names are **opemi** and **kunmi**.

Kum opamil is found in the headwaters of the Kanye River on Kisu or Deimanka ground together with another stone called **kum munumb**. The two stones are coarse-grained and suitable for fast, rough grinding. **Kum konmil**, together with another grindstone called **kum kaken**, outcrops near Sigmil (near Kup on the Western Highlands-

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[4] The term 'grindstone' has two separate meanings in archaeology and in Australia archaeologists mainly use the word to mean 'seed grinding stone'. I do not wish to impart this meaning here and in this text 'grindstone' should be taken to mean a large sharpening stone. Note that a 'whetstone' is a hand-held sharpening stone.

Simbu border). Both stones are extremely fine-grained and particularly suited to putting a good edge on a blade - they are honing stones rather than grindstones.

I was shown examples of both **opamil** and **konmil** but was not able to visit the outcrops myself. I was also shown a stone called **kum kanjpe**; I am not sure whether this is a North Wahgi stone or, as some informants said, another variety outcropping near Kup.

On the River Ga and on the River Kanye at the place Pilsange (Plate 2.4), I was shown stone outcrops with obvious signs of use as tool-sharpening emplacements.[5] I collected suitable samples at each site with which to experiment. Both were said by local informants to be contemporary spade-sharpening sites, rather than axe-sharpening sites, and not traditional grindstone sources. A report describing the fabric and mineral composition of the rock types, as well as the two archaeological examples in Figure 5.6, was kindly prepared by A. Watchman. His conclusion was that both the Ga and Kanye stones were similar in composition and that the archaeological whetstone from Kunjin is likely to have come from the same geological formation. The Keɨmbei whetstone proved to be rather more fine-grained. Watchman's report is reproduced as Appendix D.

Grindstones suitable for axe making were traded in the form of portable slabs. They were brought to the many places where sharpening took place; it was not the rule for axes to be taken to fixed emplacements of sandstone. Today men carefully curate their grindstones, typically keeping them concealed by the side of a stream running near their houses. Many say their stones are decades old and even that they inherited them from their fathers. With the light use that they receive nowadays, good grindstones might well last a lifetime.

An important point concerns the pattern of wear on grindstones. Some men turn a stone from time to time to work on a different facet. In this way an elongated stone is given a prismatic cross-section, and this seems to be one of the favoured shapes. I do not know if this shape is purely the result of use, or whether new

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[5] The approximate locations were about 200 m downstream of a Bailey road bridge crossing the Ga at BP 563519 and about 1 km south of Kudjip Hospital on the Kanye at BP 321515 respectively.

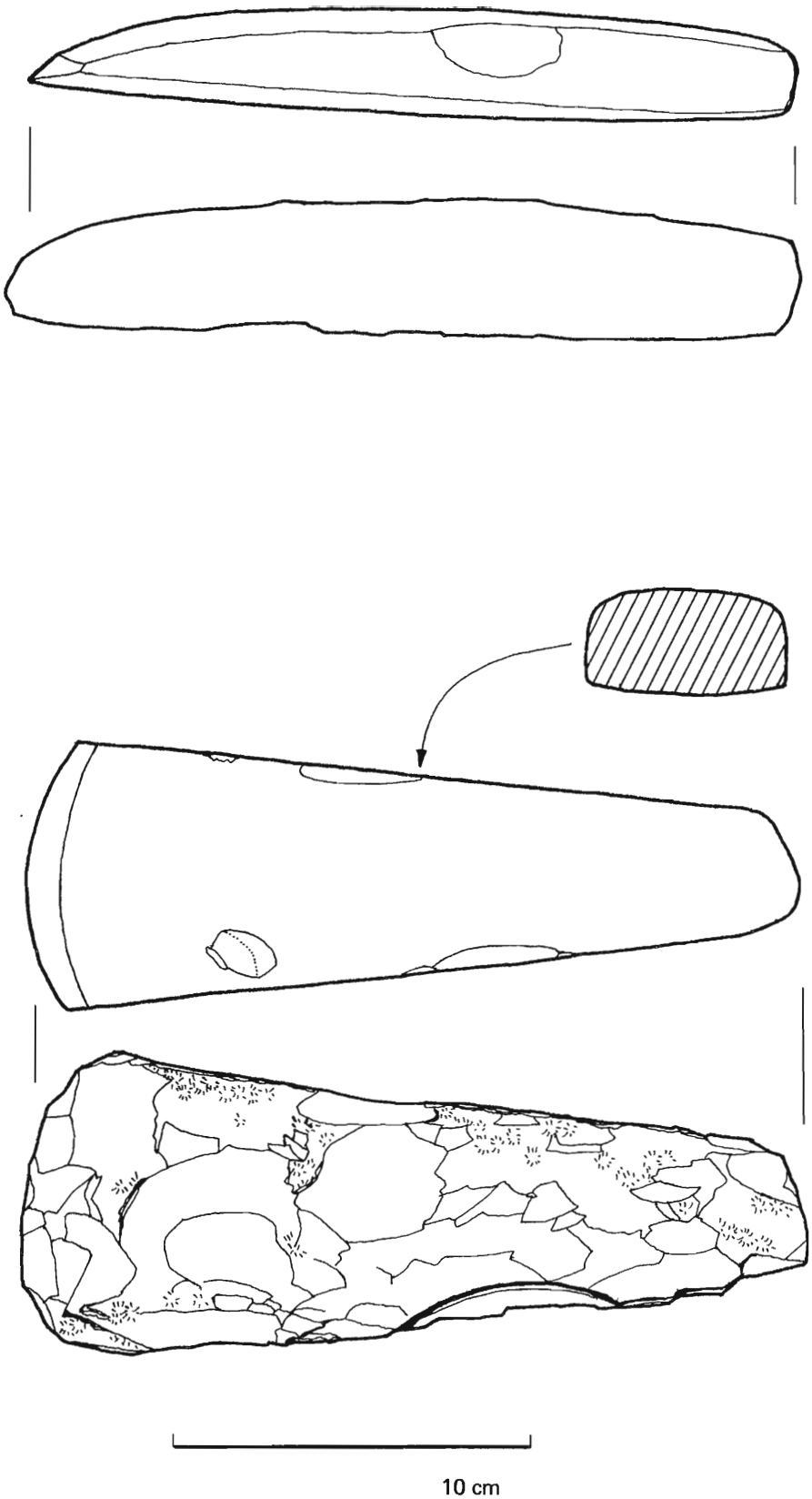
stones are hammer-dressed to give them a predetermined shape. Grindstones do not develop the deep grooves described by Dickson (1980) in connection with the making of Aboriginal stone hatchets, though some take on a dished form. They can be as large as 60-70 cm in length and 10-15 kg in weight and the prismatic shape can be preserved in small stubs like those illustrated in Figure 5.6. Small stones like these were 'pocket' whetstones and could be carried around in a man's string bag; they would have been used to repair nicks in the cutting edge of a man's stone axe and to keep it sharp throughout the day.

Descriptions of axe making are rare and few photographs survive. In Plates 6.3-6.6 two men are seen using whetstones to give an edge to the axe blades of particularly fine stone axes. Plates 6.3 and 6.4 show a man demonstrating his technique with the blade of an axe from one of the Jimi Valley sources (note the flared shape), while Plates 6.5 and 6.6 show the same thing with a Tuman blade. Interestingly the Tuman axe owner has removed the blade from its haft to show how sharpening was done. This seems to have been standard practice; if a man wanted to repair a few nicks, he might not bother, but if more serious sharpening was necessary, he would take it out of the haft first.

Gilliard (1953:486) commissioned a man at Kup to make an axe for him and knew of both the Jimi and Tuman sources (1953:480). The colour plates which accompany Gilliard's article show the axe maker demonstrating the sharpening of a Tuman roughout of about 25 cm in length on one of three dished grindstones. The working environment is very similar to that described by Mick Leahy and Jim Taylor on the Ganz River (see Chapter 8), with the axe maker apparently working in a small shelter with a set of semi-portable grinding slabs.

SHARPENING AN AXE UNDER EXPERIMENTAL CONDITIONS

From time to time I was offered roughouts at Tun (I was unable to obtain fresh axe stone) and I bought one from Menjpi Aip with the objective of completing its manufacture under experimental conditions. It was of average size and appearance and therefore in some sense a 'typical' Tuman quarry product (Fig. 6.4). It was from the Yesim quarry and was knapped in the 1930s.



TUMAN AXE MAKING Aip's roughout compared with finished axe blade

Figure 6.4

I first weighed the roughout on the electric balance in the laboratory at Kuk Agricultural Research Station. I was subsequently able to keep track of the weight loss of the axe as time went by (cf. Dickson 1980:159). I used two grindstones: one from the River Kanye and one from the River Ga (see page 117). The River Ga stone was used for the greater part of the experiment, in addition to which Komnemb Siki worked for several hours using his own **kum kanjpe**, a traditional sharpening stones mentioned on page 117.

The experiment was undertaken at my house at Tun and the work was carried out mainly by myself. Three other people put work into it from time to time and I was careful to keep a note of the length of time they worked for. I was able to reweigh the axe at approximately fortnightly intervals until sharpening was completed.

Sharpening an axe is straightforward. Water is splashed onto the grindstone and the roughout is rubbed backwards and forwards over it with the application of downward pressure. After about half a minute the abrasive quality of the grindstone appears to diminish. At this point the axe is washed clean of the rock waste that has accumulated and, after a brief inspection with perhaps some adjustment to the angle at which the blade meets the grindstone, the process is repeated. The task is complete when the axe blade is tolerably free of visible flake scars and has an even and sharp cutting edge. Little skill is involved in the initial stages and individuals are likely only to vary in how hard they press the axe onto the grindstone and how well they can maintain their enthusiasm for this immensely repetitive task.

In early interviews men said that sharpening an axe took 'a very long time', months perhaps - but it was impossible to say exactly how long. Unfortunately published eye-witness accounts do not speak with one voice in their assessments of the time needed. Vial, who visited the Ganz River factory in 1938 (1940:160), stated that:

> It takes from half an hour to all day to chip out a good ceremonial blank, depending on a man's luck and skill; the polishing takes about three days; the carving of the wooden handle a day; and the weaving of the cane binding and other decoration two days. So a first class ceremonial axe can be made in a week.

On the other hand Gilliard (1953:480) says that it takes 'almost three months of constant toil to make a good stone ax, and another week to complete a woven stock and handle for it'. The circumstances of Vial and Gilliard's visits were, of course, rather different. Vial was able to see one of the most 'professional' groups of stone axe makers in action at their factory (see Chapter 8). It is quite possible that a specialist axe maker on the Ganz River could achieve in days what a part-time axe maker took weeks or months to accomplish.

Actually, I think that Gilliard's estimate is a good example of reporting the elapsed time as if it were the actual time spent at the grindstone. A partially worked roughout, shown in close-up (1953:486), was shown as the the work of an axe maker who, 'commissioned by the author, ground steadily for three months to make the blade below'. The amount of grinding that had actually been done on the axe can be clearly seen in the photograph, however, and could not have amounted to more than a few hours at the outside.

When I began my experiment, it was obvious from the comments I received that the axe makers who spent all day at their grindstones were in the minority. The activity is of the kind that can best be carried out intermittently, rather than one which people set out to do all day, like bulding a house. Some informants said as much - that they worked on their axes when they felt like it and this is in fact why a single axe might take several months to finish. Though I took about six weeks to complete the experiment, the exact time logged at the grindstone was 36 hours and 55 minutes (Table 6.1).

As a postscript, this length of time is of a completely different order of magnitude to the 2-3 hours needed by Dickson (1980: 159-60) to grind an Australian hatchet head. The difference between the two artefact types is, however, very great. Tuman axes are made from roughouts which have pronounced flake scars over their surfaces and they must be ground all over, except for the small area of the butt. The hatchets are often made from pebbles that are already of a suitable shape and the task of sharpening is much less formidable.

END OF DAY	ON THIS DAY	RUNNING TOTAL	WEIGHT
Start weight:			1010.44 g
1	4 hr 30 min	4 hr 30 min	
2	2 hr 45 min	7 hr 15 min	956.48 g
	Subtotal:	7 hr 15 min	
	Weight Loss:	53.96 g at 7.44 g/hr	
3	2 hr 30 min	9 hr 45 min	
16	1 hr	10 hr 45 min	
17	1 hr	11 hr 45 min	
20	2 hr 25 min	14 hr 10 min	
21	30 min	14 hr 40 min	
22	1 hr	15 hr 40 min	900.65 g
	Subtotal:	8 hr 25 min	
	Weight Loss:	55.83 g at 6.63 g/hr	
25	2 hr 15 min	17 hr 55 min	
27	1 hr 30 min	19 hr 25 min	
28	1 hr	20 hr 25 min	
30	4 hr	24 hr 25 min	
31	4 hr 45 min	29 hr 10 min	
34	2 hr	31 hr 10 min	
35	2 hr 15 min	33 hr 25 min	793.48 g
	Subtotal:	17 hr 45 min	
	Weight Loss:	107.17 g at 6.04 g/hr	
38	1 hr 15 min	34 hr 40 min	
44	2 hr	36 hr 40 min	
47	15 min	36 hr 55 min	771.30 g
	Subtotal:	2 hr 30 min	
	Weight Loss:	22.18 g at 6.34 g/hr	
	Grand total:	36 hr 55 min	
	Total weight loss:	239.14 g at 6.48 g/hr	

Weight loss as a percentage of start weight: 23.67%
Weight loss as a percentage of final weight: 31.00%

SHARPENING EXPERIMENT time spent at grindstone and weight of material removed

Table 6.1

Labour Investment in Axes of Other Sizes

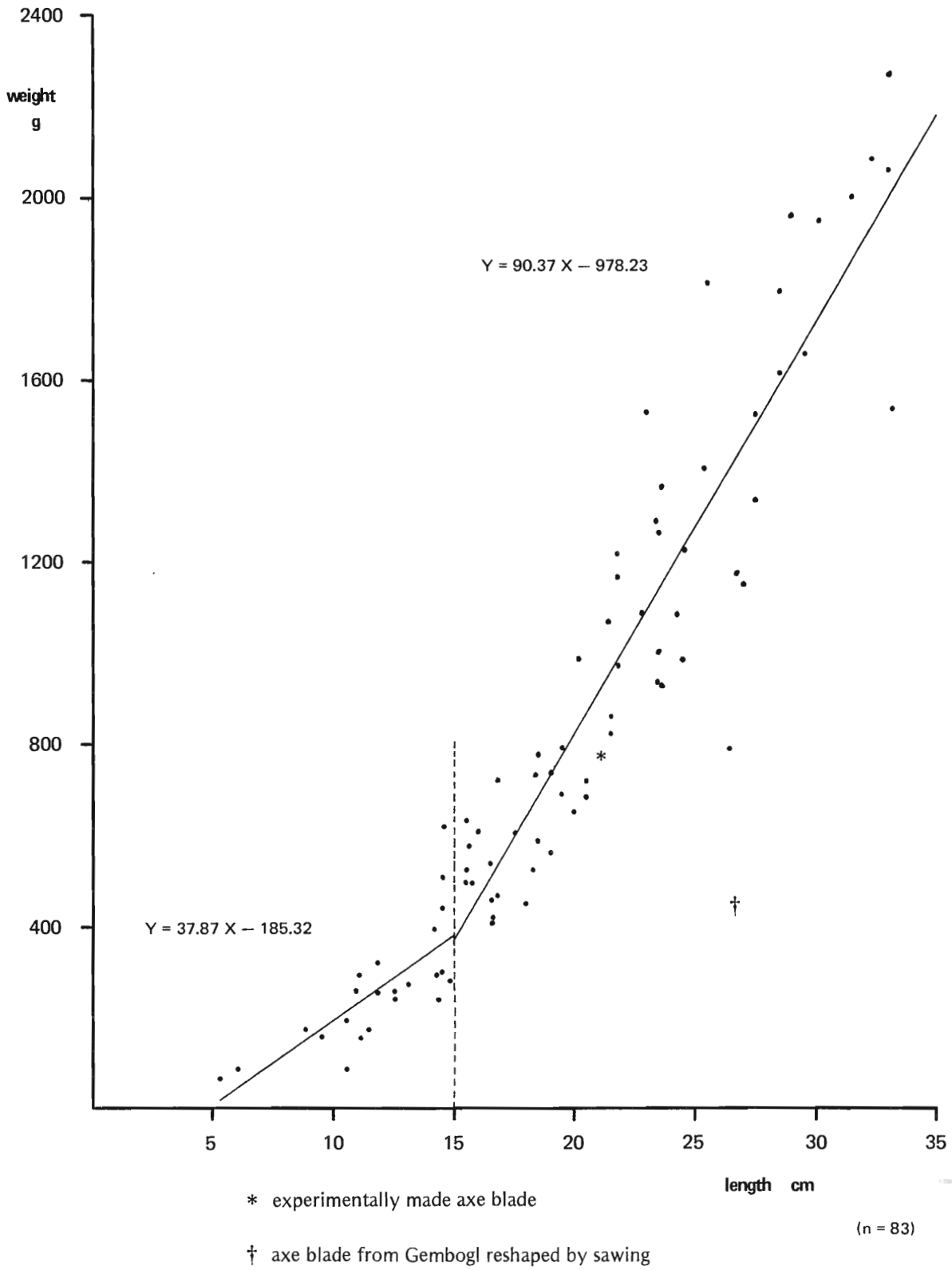
How can my result be generalised? Tuman axes comply to one basic design and it seems reasonable, as a first approximation, to assume that shape did not affect the total time spent sharpening an axe. It is true that some axes are thick and narrow and some are wide and flat and that the extremes of variation may have caused some differences, but such cases are rare and I will choose to ignore them.

Size can be summarised by a single measured attribute, namely length. Figure 6.5 shows the results of a regression of weight on length for 83 Tuman blades in collections. The axe blades were all those I could find in 1981 and 1982 which were longer than about 15 cm, and a selection of those shorter than this. For the regression I have also split the sample into those over 15 cm in length and those shorter than this, because an overall regression line would intersect the X-axis at around 10 cm and there are a good number of axes smaller than this. (The aberrant Gembogl axe discussed on page 115 falls well off the regression line and was not included in the regression calculations.)

The graph of the regression line shows that length is a good predictor of weight for Tuman blades, so that axes of any given length lie within a narrow band of possible weights. From Table 6.1 it can be seen that the experimental axe was 23.67% lighter than the roughout from which it was made and that the mean rate of weight loss was 6.5 g an hour. These figures may be used to show how long it would have taken to sharpen any of the 83 museum axes plotted in Figure 6.5.

Firstly, it may be noted that the experimental axe does not lie on the regression line, but just below it; this indicates that it is marginally thinner that the 'average' Tuman blade. Generalisations for the whole set of museum axes should be based on the regression line. Secondly, the figure of 23.67% weight loss can be applied only to roughouts, not to finished blades; the equivalent figure to be used in further calculations must be the percentage by which the weight of roughouts <u>exceeds</u> that of finished blades: for my experiment this was 31.00%. It is impossible to be certain if this was typical and further experiments carried out by different people would undoubtedly give different answers.

Figure 6.5



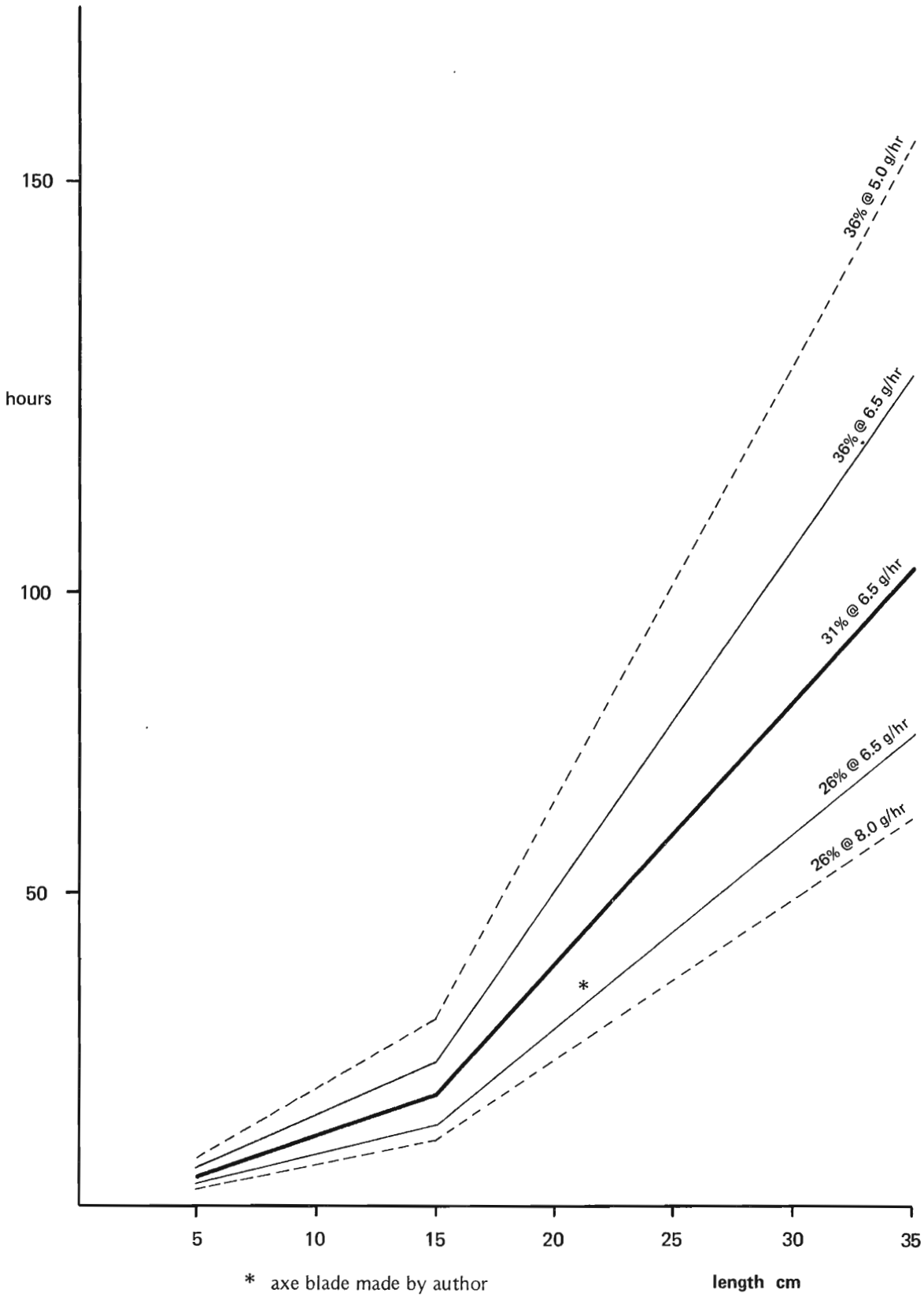
Tuman axes from modern collections relationship of weight to length

In Figure 6.6 I have attempted to allow for some of these unknowns in presenting a model predicting the time needed to sharpen an axe from the length of a finished axe blade. For any given length, the predicted weight of a Tuman blade is given by the regression equations derived from Figure 6.5. (If the time spent sharpening an axe of known weight is required, this step may be omitted.) This in turn leads to the knowledge that the roughout was 31% heavier and the weight loss in grams may be found. At 6.5 g an hour the time taken to sharpen an axe of a certain length is given by the heavy line in Figure 6.6. (Note that the experimental blade lies off the line, which, as already discussed, is based on the whole sample of 83 axes.)

With other assumptions, different conclusions can be reached. If 5% less weight loss was the case, sharpening times would have been shorter; if 5% more weight loss, they would have been longer. The same relation holds if a rate of 8 g an hour or 5 g an hour were to be assumed. Some of these worse or better case models are also shown in Figure 6.6.

As a general result, it is safe to say that the giant 35 cm blades - very few of which are known from collections - would have taken a great deal longer to make than the typical 15 cm work axe. My central model suggests that they would have taken around 104 hours, while my worst case model suggests 157 hours, or roughly half as long again. The best case model suggests about 71 hours. I feel that the worst case model is too pessimistic because there are factors which the method does not consider. The extra weight of the larger roughouts may be useful in helping to increase the contact pressure between axe and grindstone, for example, thereby speeding up the process of weight loss. Note that weight loss proceeded at a higher rate in the early stages of my experiment (Table 6.1), when only the rims of flake scars were in contact with the grindstone; it was much easier to maintain a high contact contact pressure than at the end of the experiment, when the axe blade was quite smooth.

A last point is that I choose to assume here that the amount of material to be removed has a constant relationship with size. An equally justifiable but more complex series of calculations could be done on the assumption that a fixed depth of flake scars had to be removed on all axes, regardless of size. This would assume that the



Axe making experiment hours of grinding related to length of blade

Figure 6.6

time spent sharpening an axe was related to surface area, not weight.

Stylistic Control and the Axe Maker

How much control do axe makers have over the style of their axes? This question is of vital concern to archaeology and it seems most appropriate to introduce it in a section about the sharpening of axe blades. Having been the only active axe maker myself in the Tuman area during the time of my fieldwork, it may seem amazing to try to draw any conclusions about traditional axe making in the area 40 or 50 years beforehand. Yet I can attest to the fact that community pressure plays a role in ensuring that the individual does not deviate from established practice, with the result that I consciously conformed to the recognised Tuman style.

At the same time, my choices were limited by the form imposed upon me by the knapper many years previously. If I had radically changed the shape of the blade, this would have entailed a good deal of extra work. Cosmetic changes might have been achieved more easily, such as a symmetrical cutting edge instead of a facetted one. As I have already mentioned, many axes in museum collections do have much more symmetrical cutting edges than the Tungei see as 'correct'; they have, of course, been subject to repeated resharpening. But the question of why Tuman axes are never lenticular needs further thought.

Flat sides arise in two ways. Some Tuman axes retain the parallel fracture planes of the rock as naturally flat surfaces; no grinding has been done at all on the sides. The remainder have had their flat sides finished by grinding. In this case, it is surprising how quickly an even, flat facet can be obtained; I do not think that it is so easy to create rounded sides through grinding.

Either way - and excepting the category of small work axes I mentioned above - the prerequisite is a raw material that can be split to a tabular shape. Of the many forms of naturally occurring fine-grained stone, relatively few could satisfy this condition and at the Tuman quarries only those rocks from the deep mines were suitable.

THE HAFTING OF AXE BLADES AND THE CONCEPT OF SPECIALISM

The next step in axe making - the fitting of an axe blade into a wooden handle - was the most difficult part of the manufacturing process and the skills involved were mastered by the fewest number of men. Informants agree that most men could make their own axe blades and put hafts on their own work axes, but that the hafting of the bigger, more valuable axes was the province of specialist haft makers. Such men were known as **tui else kapłe kułem wu**, 'axe helve crosspiece bind men'.[6]

The fact that there were specialist axe makers in the Wahgi Valley does not imply that there existed a guild of craftsmen set apart from the mainstream of the society. The men were specialists by virtue of the fact that they were good with their hands and because other men could not do the same tasks as well. The haft makers were paid in kind for their services; payments could range from small gifts of food up to legs of pork (**kung kełip**).

The haft makers were often knappers as well - the **tui win kałem wu** discussed in Chapter 5; their counterparts today are basket makers and those who know how to weave **mum tuland**, the intricate cane belts that men wear with traditional dress. Other men have to pay in cash or in kind to have such a belt made. The work may take several weeks to complete, but - like the sharpening of an axe - it is the sort of work that can be done intermittently during the day, rather than continuously until it is finished. Perhaps haft makers were sometimes busy enough to work full-time, but they may be considered to have been specialists by virtue of their skills rather than their mode of work.

To find out which men were recognised as having been haft makers, I made enquiries with informants from various different sub-clans. Among the Komnemb sub-clans, according to Malimbe,[7]

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[6] Interviews 19-81, 51-81, 52-81, 55-81. The verb **kuł-** is also found in the expression **ope elke kuł-**, 'bow string bind'. The common action is thus one of fitting cane-like strings as tightly as possible.

[7] Interview 52-81.

there were only two very good haft makers, Kiagin (Fig. 2.17) and Kumbuł (Fig. 2.19). Both were also accomplished stoneworkers. Others mentioned as quite capable haft makers were Geri (Fig. 2.16) and Kilep (Fig. 2.17). In Menjpi clan, Kandeł said that he and Ju of the Kundika section were haft makers, he himself having been taught by Ju (Fig. 2.28). However, he said that Keng Wu, also of Kundika (Fig. 2.28), was the most renowned at both knapping and haft making. Kelti and Kal were the haft makers of the Menjpi Pingka section (Fig. 2.31).

I have estimated Komnemb and Menjpi numbers in 1933 at 46 and 37 men respectively; the fact that there were so few really good haft makers suggests that there was a ratio of between ten and fifteen 'ordinary' men to one haft maker; each sub-clan probably had one specialist whose services could be called upon. Over the Tuman area as a whole, further inquiries revealed that haft makers were thinly scattered among other groups in a similar way. North of the Wahgi, Bamne of Komblo tribe, Keganem clan[8], gave the names of three Komblo haft makers - Pundang, Anamb and Kauwi. Just as among the Tungei, the owners of axe blades would bring them gifts when they wanted to have their axes hafted. While there was no set payment, the owner of an axe had to see to it that the haft maker was well looked after while he was working and well supplied with choice foods.

Hagen-style axes originating in the Jimi Valley were mounted in a way that was recognised to be different from the Tuman style. In other areas, other hafting styles prevailed. The differences may be identified in museum collections and published illustrations, and in photographs taken by Mick Leahy in 1933 (Plates 6.7-6.9). Plates 6.6 and 6.8 show classically hafted Tuman axes, while Plate 6.9, previously published by Leahy and Crain (1937:192), shows a typical Hagen-style axe. The man seen in Plates 6.5 and 6.6 could be from the Middle Wahgi area or from Hagen, but the others are definitely Hageners. The head gear in Plates 6.4 and 6.8 is typical of Mt Hagen, in addition to which the man in Plate 6.8 is shown in

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[8] Interviewed with M. and L. O'Hanlon at Koskal, Ka River, 31 June 1981.

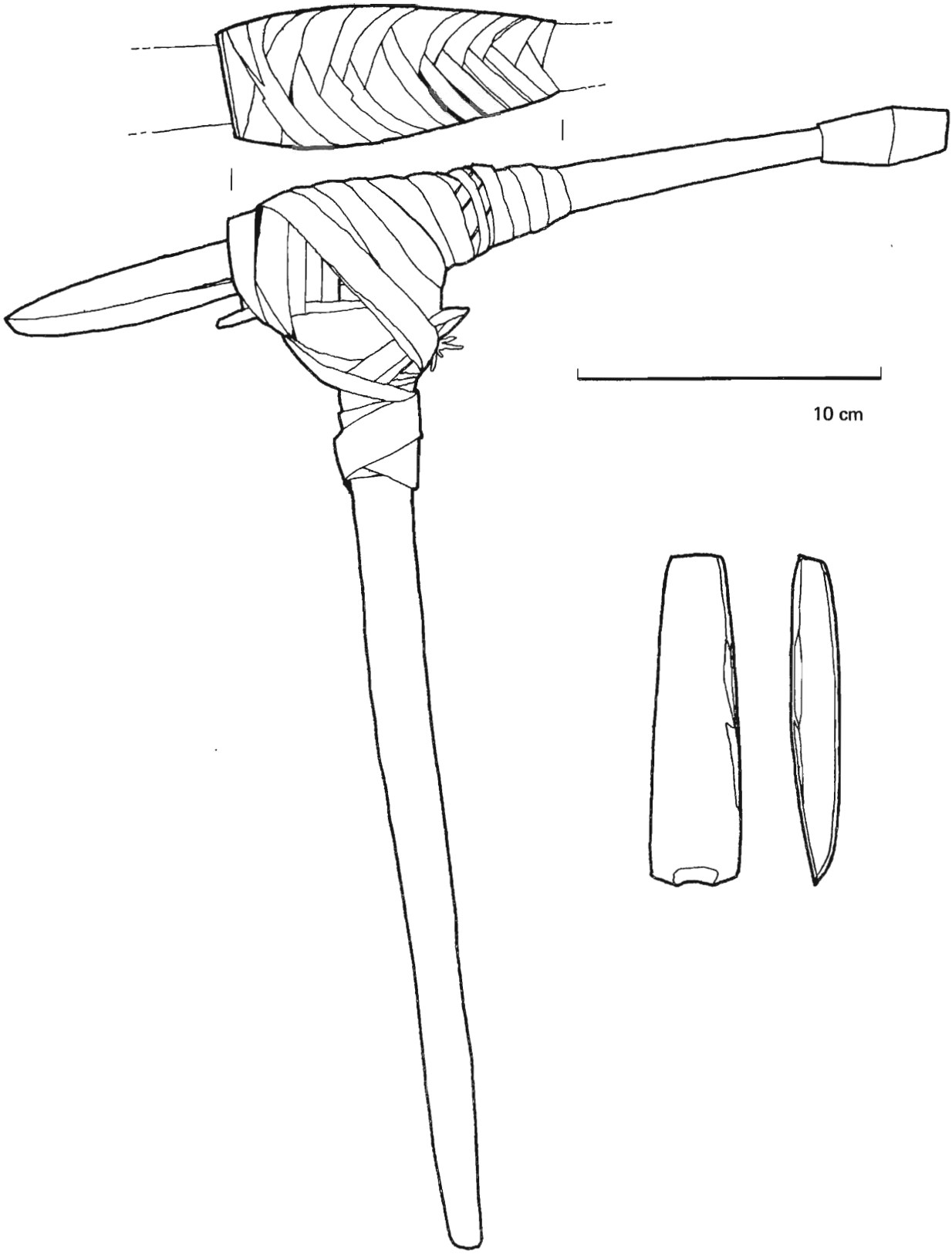
another photograph to be wearing the **omak** bib of a participant in the Hagen **moka** exchange system.

Little is known of regional style variations in either Hagen or Tuman axe mountings or, for that matter, the hafting style of axes from minor sources. Plate 6.7, for example, shows a man carrying an axe of unknown origin hafted in a fashion unlike that of either Tuman or Hagen axes. This picture was probably not taken in the Wahgi Valley; it may show Baiyer Valley men, though the grounds for suggesting this are not firm.

AN EXPERIMENT CONTINUED: HAFT MAKING

I asked Komnemb Duri, a man who was recommended as being one of the few who had the appropriate knowledge, to fit a haft to any of the axe blades I had in my possession and at the same time to teach me how to make a haft for my own axe blade, sharpened as already described on page 118, Duri was only in his early teens in 1933 and was personally involved neither in the last quarrying expedition nor in traditional axe making, having learnt to make axe hafts after 1933 from the Komnemb haft maker Kumbuł. He probably continued to make and repair axe hafts into the 1950s and is today an active basket maker and particularly skilled in traditional weaving methods. Older axe makers that I contacted complained of poor eyesight and arthritic fingers. The steps of haft making followed by Duri were close to those followed traditionally and are shown in the sequence of photographs of Plates 6.10-6.18. Duri picked out an axe blade from Kunjin that formerly belonged to Komnemb Mure; I copied him and hafted Aips's Yesim axe.

Duri first requested that I find him a small stone blade so that he could make a **tui ongka**, or adze, for woodworking. I did this and he mounted it on a miniature haft as shown in Figure 6.7. This figure also shows a chip taken out of the adze blade towards the end of the work and not removed by resharpening. I did not watch him make the adze, but the construction of the haft was quite similar to that of the full-size example described below, except for the fact that the blade was mounted with its cutting edge at right-angles to the axis of the haft instead of parallel to it. The adze blade was also shaped (by its last user) in a similar way to a Tuman



TUMAN AXE MAKING woodworking adze (*tui ongka*) made by Duri

Figure 6.7

axe with its chisel-like facet or **kopsi** at the cutting edge. The blade was mounted so that the **kopsi** side was the closer of the two sides to the user (Fig. 6.7). Duri also used his own woodworking adze - a sharpened car spring or similar piece of steel hafted in an identical manner to the stone adze. He used the two tools interchangeably and though there was a difference in performance between them, it was not so great as to make the use of the stone adze an effort tolerated only in the interests of authenticity.

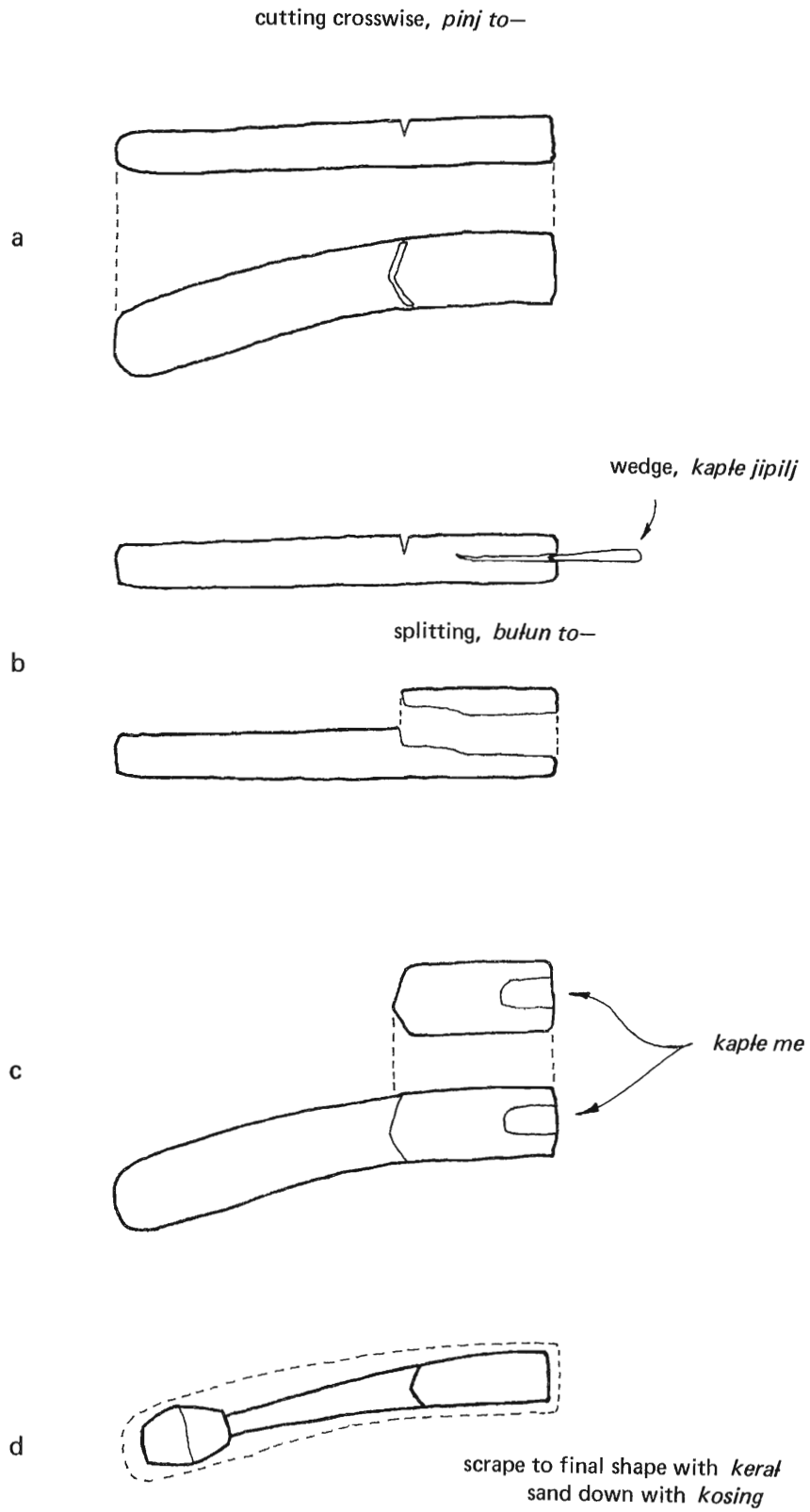
The Crosspiece and Socket

Tuman (and Hagen-style) axe hafts are made in two parts: an **else**, or helve, and a **kapłe**, or crosspiece, bound onto it in a 'T' shape. A socket to hold the axe blade was cut into one end of the crosspiece.

Duri's first task was to select wood for the crosspiece and to cut it to the correct shape. He used unseasoned wood of the tree known as **ond mormor**. This is a medium-sized hardwood of relatively high density and resilience. As soon as he had made a rough billet of about the correct proportions, he made a deep cut across the wood about 15 cm from the end in which he wanted to make the socket (Fig. 6.8a). This kind of cutting was called **pinj to-**, 'to cut crosswise'.

Upturning the billet, he started a split along the grain across the end of the crosspiece with an axe and forced a pair of wooden wedges into the opening (Fig. 6.8b). The wedges, **kapłe jipilj**, were made of a wood called **ond bur** and the action of splitting was referred to as **bułun to-**, 'to split'. Tapping the wedges with the back of a steel axe (Plate 6.10) was sufficient to open the split until it reached the previously made cut. A piece of wood about 15 cm long was removed from the side of the crosspiece (Fig. 6.8c). This was the **kapłe me**, or what might be termed the 'socket piece'.

When I copied this process, I found that the reason Duri made the cut on the side first was to 'bias' the subsequent splitting of the socket. Without the cut, the crosspiece would have split in two longitudinally. With the cut present, the split was short and swung into the bottom of the cut automatically. The **kapłe me** could then be removed quite cleanly. (Incidentally, this term also refers to



TUMAN AXE MAKING preparation of the crosspiece *tui kapłe* and the socket *kapłe me*

Figure 6.8

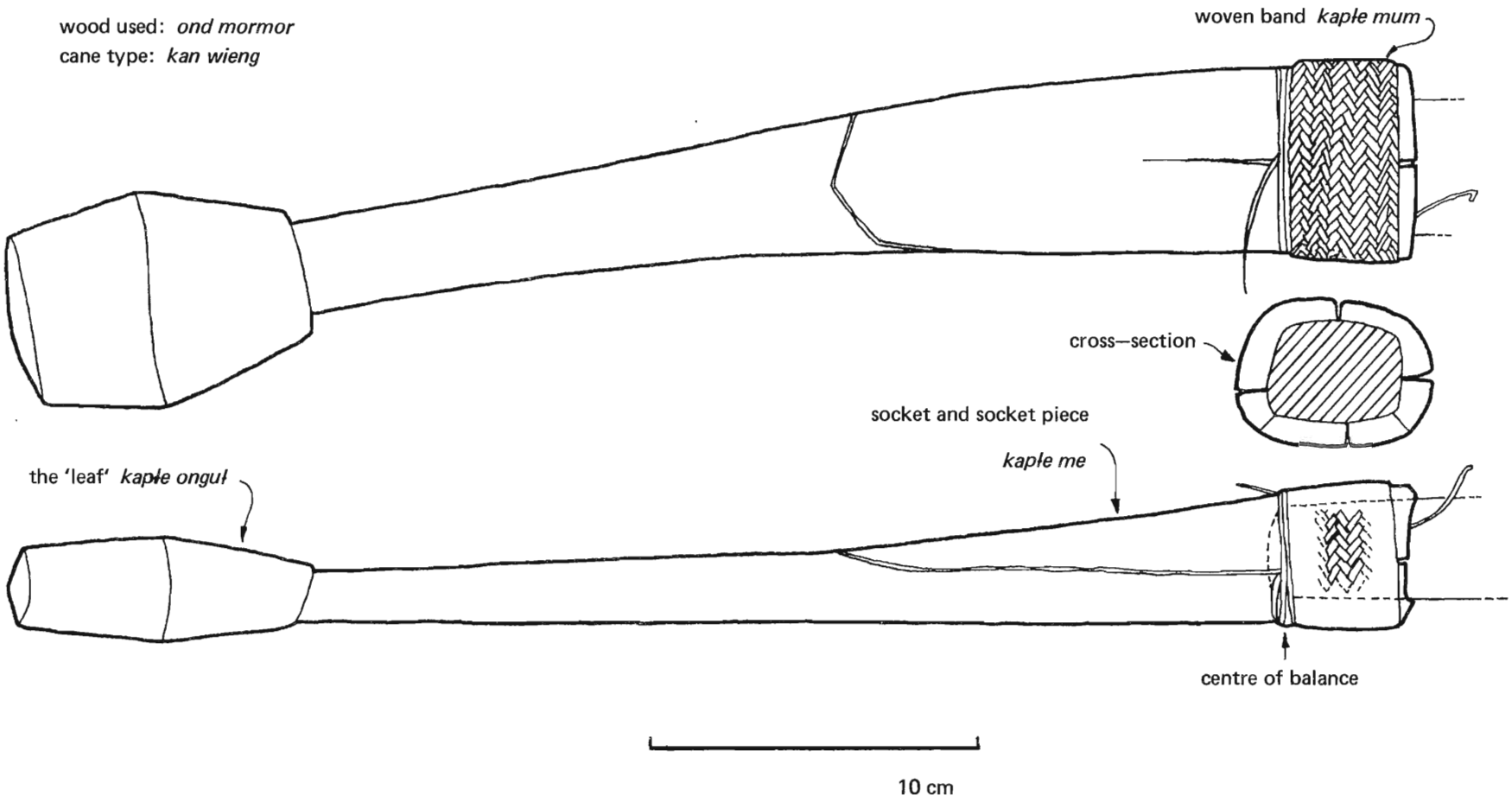
the 'socket' in the sense of the empty space of the hole.) The **kapłe me** was formed by splitting one piece of wood into two rather than by shaping two pieces and fitting them together because the two split halves locked perfectly when placed together once more. Separately made components would have to have had a more complicated tongue-and-groove join to achieve the same degree of snugness.

Duri used the small adze to cut a 1 cm-deep trough in the opposing split surfaces of both the **kapłe** and **kapłe me**. He shaped these troughs to receive the butt of Mure's axe blade when they were pressed together again (Plates 6.11, 6.13 and 6.14). When this was completed to his satisfaction, he finished shaping the rest of the crosspiece until it reached the traditional **kapłe** shape (Figs 6.8d, 6.9). As well as using the adzes, he used bottle glass shards to plane the surfaces smooth. Broken beer bottles seemed to work best; other types of glass were not so hard and did not break with such a sharp edge (Plate 6.15).

Even when well scraped down, the wood was still perceptibly rough to the touch and to the eye. Duri rubbed it with handfuls of **kosing** stems until it was completely smooth. **Kosing** is a low, stick-like plant which grows along the banks of streams. The stems seem to incorporate microscopic nodules of a hard substance and the plant was an effective 'sandpaper'.

The unusual tail of the socket piece is sometimes referred to as the 'counterbalance'; its vernacular name is **kapłe onguł**, or 'kapłe leaf'. Whether it does function as a counterbalance is open to question, but the particular form that Duri chose was a traditional one. The axe seen in Plate 6.8 has an almost identically shaped **kapłe onguł**. A slightly different shape is seen in Plate 6.6, and I have seen other examples. Duri himself hafted a second axe with a different style of **kapłe**; it is the leftmost axe in the Frontispiece.

With the **kapłe** finished, except for cosmetic touches, Duri wove a tight cane band, the **kapłe mum**, around the mouth of the socket (Plate 6.12). He measured up the diameter of the socket with the axe blade in place, removed this and wove the band to a fractionally smaller diameter. With the axe blade in its socket again, the band was now tight enough to clamp it in place. The only way to remove the blade henceforth was to slide the band back first. The weaving



TUMAN AXE MAKING Duri's crosspiece, *tui kapłe*

Figure 6.9

cane used for the **kapłe mum** was **kan wieng**, a material of exceptional tensile strength and little tendency to stretch under load. I did not attempt to make one since a lot of practice is clearly necessary before consistent, accurate results are achieved. Duri wove a second band onto the axe I was making.

Once the axe blade was forced into the socket with the band in place it was held fast; the only way to remove it was to carefully rock the blade loose and slide the band back. As mentioned above, this was often done when repairing and resharpening the axe blade. Men do say an axe blade could fall out of its haft, but it is clear that the more the axe was used, the more tightly the blade would have been rammed into its socket. The finished **kapłe** is shown in Figure 6.9 and is depicted with the blade in place.

On a point of design, this type of socket provides a good deal of protection against shock damage to the blade and may be classed as a 'soft' socket. A different variety has been described from the Southern Highlands by Sillitoe (1982). The Wola used a split socket held together by a **kwiy dob** (Tuman equivalent: **kapłe mum**) and cane windings. The canework, however, was put on in a different manner and the final shape of the haft was also different.

Another, though brief, description is that of Vial (1940:160), who saw axes being made on the Ganz River in June 1938. He wrote:

> Handles for ceremonial blades are made from two pieces of wood of different kinds, one of which is later broken and the blade wedged between the broken pieces and packed with sugar cane. The three pieces are held together by cane lashings.

Vial is certainly referring to the two parts of the **kapłe** when he says that one of the pieces was 'broken' to receive the axe blade. Duri did not pack the **kapłe me** with sugarcane, but this is very likely to have been used in certain circumstances. Duri did use it later on when binding the **else** and **kapłe** together (see page 132).

Axe blades must be more likely to break in 'hard' sockets, as seen in the club-like axes of the Balim Valley Dani (e.g. Mitton 1983:73), than in ones of **kapłe**-like design. The axe blade does not rest against a physical stop inside the haft and cannot cause this to split in the course of everyday use. Large shearing or wrenching forces are more likely to break either the woven band or the socket than the stone blade.

The Helve

The helve, the 'T'-shaped part of the handle, is called the **else**. It was made from a separate piece of wood bound onto the crosspiece. Duri made this from the tree known as **ond kueng**, a large forest tree of the family Fagaceae.[9] The parts suited to helve making are straight branches of 5-7 cm thickness at the join with the bole of the tree. Part of the bole must be cut out with the branch, since it is the angled join that is of most concern here.

I did not get the chance to see Duri making the **else** for Mure's axe, but went instead with Malimbe to cut wood for the haft I was making for Aip's axe. The main difficulty proved to be finding the right kind of branch in a stand of **kueng** trees. Finally we found half-a-dozen likely examples and cut them all out with a steel axe.

At this stage it was important not to remove the bark from the metre-long stems, because the next operation was to straighten them over a hot fire (Fig. 6.10). The bark prevented them from charring but allowed a controlled amount of heat to reach the wood and steam it into a flexible condition. The objective was to make a series of right-angled 'T' shapes. After a few minutes in the flames, each stem was quickly cut with an axe on the obtusely angled side and firmly pulled into the 'T' shape. Several of the stems broke during this operation, which is why so many were needed in the first place.

As each stem was pulled straight, two things happened. The cut that had been made on the obtuse angle closed up and the grain of the wood on the acutely angled side was wrenched open. This was stuffed with chewed sugarcane wadding (**omb ngenj**) to prevent it from closing again; this was a shim to wedge the handle permanently into the 90° position.

The stems which survived this process were ready to be shaped into **else**. I was advised to select the one with the best combination of strength, flexibility and straightness. To my eyes they all seemed to be equally weak, but appearances proved deceptive. The

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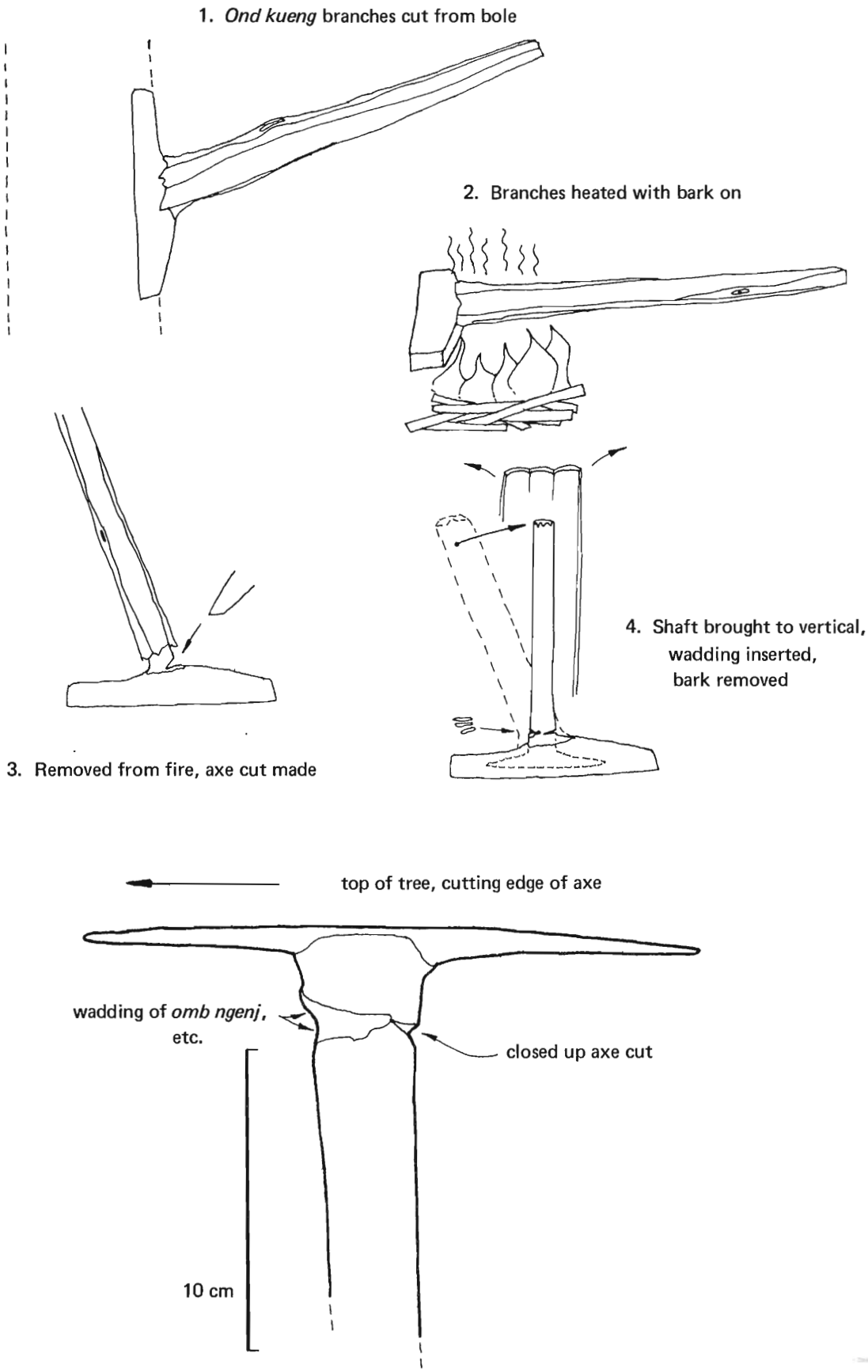
[9] Powell (n.d.:11) identifies this under the Melpa name **kuang** as Castanopsis acuminatissima (Bl) Rehd.



TUMAN AXE MAKING preparation of the handle *tui else*

Figure 6.10

advantage of the design was that, like the **kapłe**, the **else** was able to provide a flexible link between the hand of the user and the axe blade.

Axe blades hafted in the contemporary Hagen style, it should be noted, are hafted with the obtuse angle between blade and handle preserved. This is seen in axes made for the tourist industry and, in stylised form, on the Papua New Guinea two Kina banknote. Plates 8.5-8.7 show the manufacture of axes on the Ganz River in August 1957 and the obtuse angle is untouched. Whether or not Hageners traditionally did not cut the **else** and deform it is difficult to say. On the one hand Plate 6.9 shows a Hagener carrying an axe with an almost right-angled join between **kapłe** and **else**. In Tischner's illustrations of Vicedom's ethnographic collection (1939: 35-46), on the other hand, where the Hagen and Tuman styles of hafting can be readily identified - Hagen-style axes (Nos 33, 34, 35, 39, 40, 41, 42, 43, 44, 45, 46) generally have the swept-back handles reminiscent of the 1950s Ganz style of hafting. A Tuman axe (No. 36) has a distinctively right-angled join between helve and crosspiece.

Fixing the Parts Together

The last step in haft making was to fix the crosspiece onto the helve. This was also the step in which the artistry of the weaver could be given free expression. The binding actually consisted of two overlays of canework (Fig. 6.11a; Fig. 6.11b). Only the first one was absolutely necessary; the top layer lent extra strength to the whole, but it was essentially decorative. Another point is that the binding did not serve, in this style of hafting, to fix the axe blade in place. As discussed on page 128, the **kapłe mum** did this job. The only assistance provided by the binding was to keep the split parts of the **kapłe me** firmly together.

The basic binding was made from **kan minimb**; branches were cut from the tree called **ond minimb** and the bark was stripped off.[10]

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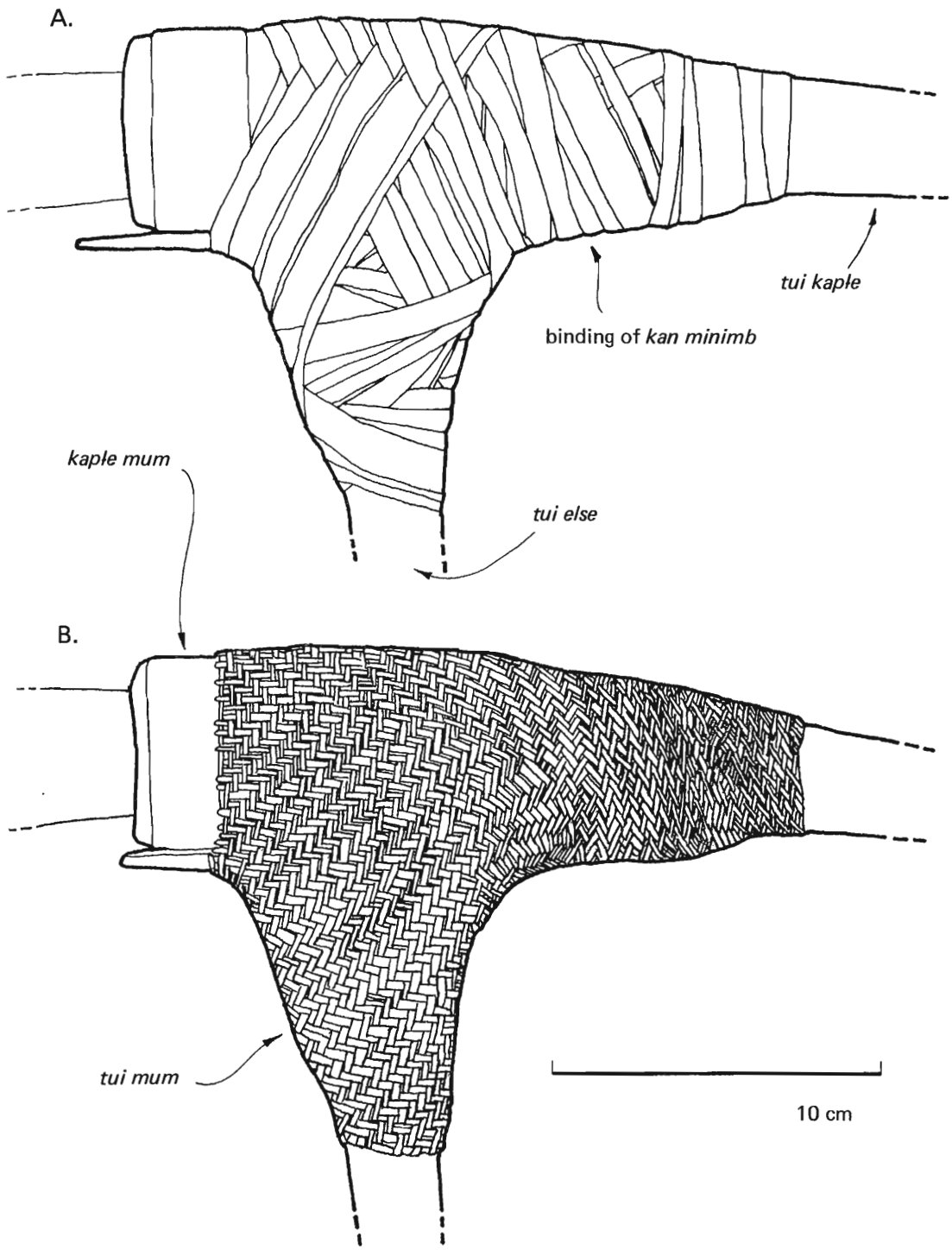
[10] **Minimb** is a Ficus. It has large 'elephant's ear' leaves (used in earth ovens) and is commonly found both in the bush and garden areas. Powell (n.d.:Appendix 1) lists **miniba** in her Melpa checklist and identifies it as 'Moraceae, Ficus dammaropsis Diels'.



TUMAN AXE MAKING binding of *else* and *kapłe* together

Figure 6.11

Underneath lay a sticky, buff-coloured inner bark which was peeled off in 2-3 m long strips; no further preparation was necessary. The lengths of **kan minimb** were used while still relatively damp. Because it dried out quickly if left indoors and became too brittle to be used, it was kept outside at night to preserve its supple properties for as long as possible.

The first job was to loosely tie the two parts of the haft together; Plate 6.17 shows Duri in the process of doing this. He first wrapped several turns of **kan minimb** around the crosspiece to hold the **kapłe me** together. Then he positioned the **kapłe** and **else** on one another and tied them in place with scraps of cane. Had he begun to apply the binding immediately, no direct pressure would have been brought to bear on the two sides of the join; there were slight recesses there. These he padded out with wads of **omb ngenj**, or chewed sugarcane (see page 129; cf. Vial 1940:160). Once satisfied with the positions of **kapłe** and **else**, Duri bound the **kan minimb** around the join in tight figures-of-eight.

I found this one of the hardest tasks in making the haft; in fact I was initially unable to get the ribbons of **kan** to lie evenly under tension, yet evenly covering the whole of the 'T'-shaped junction. Duri was able to achieve the same result with less **kan** and his binding (Plate 6.17, Fig. 6.11a) was much smoother than mine. It is worth noting that such a binding is all that is needed to make a functional axe. The hafting of even the fine, 'ceremonial'-type axe in Plates 6.5 and 6.6 has the appearance of being a plain **minimb** binding.

Axes in everyday use would certainly have never had more sophisticated bindings and most men would have been able to haft work axes like this. The specialist haft makers would undoubtedly have been able to make the most durable work axe hafts but in the context of the household economy - as opposed to the ceremonial economy - the efforts of ordinary men are likely to have been very important.

Duri's next step was to prepare the special weaving cane **kan wieng**, obtained from a commonly occurring vine. **Kan wieng** was procured in 4-6 m lengths and an even 0.5 cm in diameter (cf. Steensberg 1980:Fig. 3) Holding them between his fingers, Duri split them by pulling them across a knife blade. From each length of vine

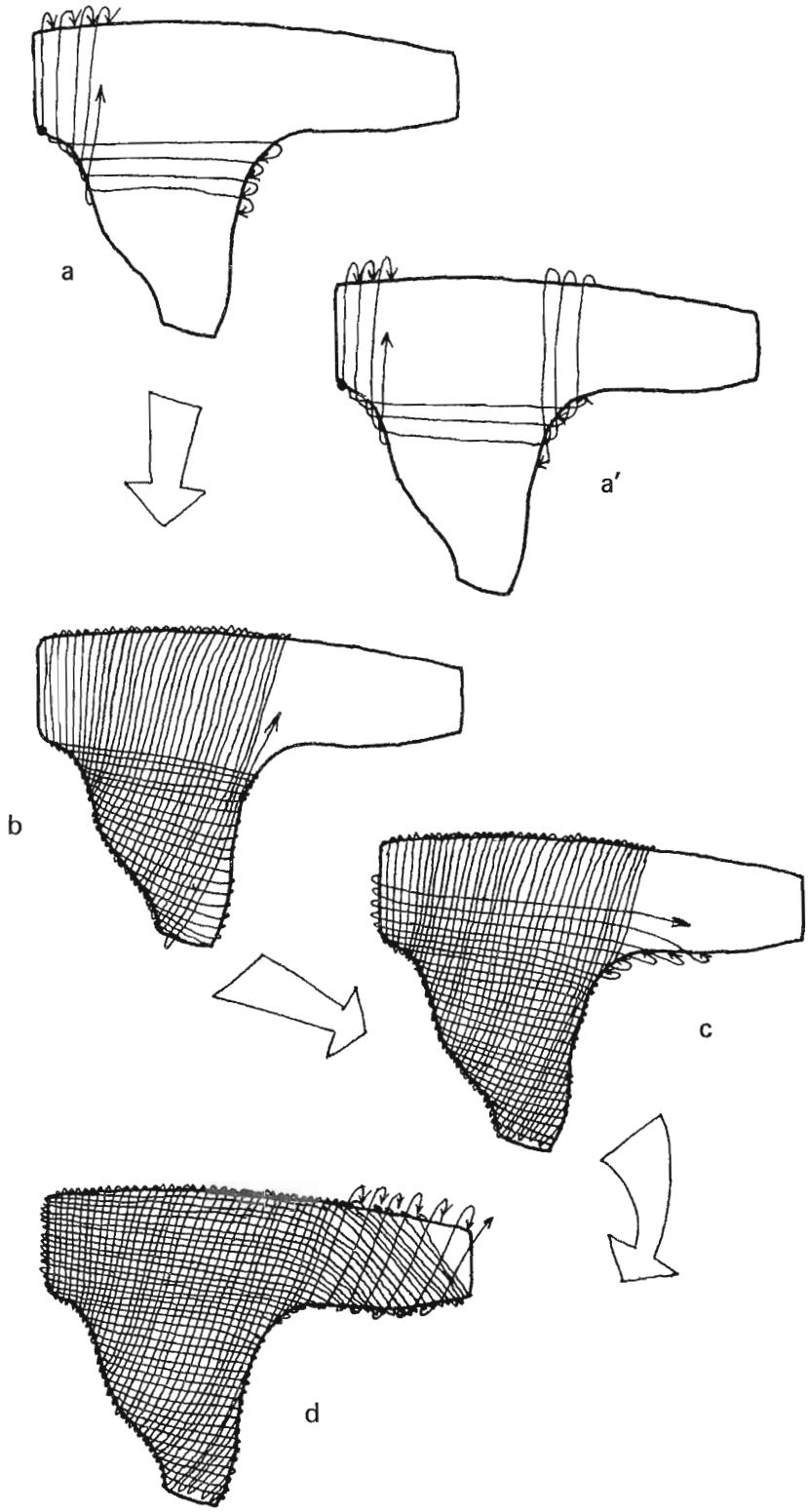
he was able to make two or three lengths of weaving cane about 2 mm in width and approximately 1 mm in thickness. Like the **kan minimb** used in the basic binding, **kan wieng** tends to get dry after storage indoors and must be used while still green. Over the course of a few days, it became noticeably paler and finally dried to a shiny white colour. **Kan wieng** is not difficult to obtain and the technique for preparing it is widely known.

Not so well known was the method of weaving **kan wieng** to make the **tui mum**, the 'axe weaving' or fancy outer canework (Fig. 6.11b). The main difficulty lay in covering the whole area of the inner binding without leaving gaps. Duri had difficulty with this to start with, and no one else had done the job - or had seen it done - for over thirty years. He started it off incorrectly and had to undo several hours' work. Finally he settled on the method shown in Figure 6.12 and successfully filled in the whole area.

Figure 6.12a shows one way of starting the weaving off: there are undoubtedly many others. From a knot just under the socket, cane is wound around the top and sides of the binding alternately. Where the strands cross, they are woven in and out of each other; Plate 6.18 shows this process a little more advanced. Several methods may be used; Duri wove over two rows and under two rows repeatedly. Eventually a stage is reached where the available space is used up and it is no longer possible to continue as before with 'wrap-around' weaving. By this I mean a form of weaving where the cane is wound over the whole binding, usually in a figure-of-eight configuration; in this mode the weaving supplies its own tension.

Subsequently a 'fill-in' method must be adopted: new lengths of cane are not wrapped round the whole binding but simply woven backwards and forwards into the spaces still left. Figure 6.12b shows how this started when the wrap-around weaving reached the bottom of the binding. When the lower part of the 'T' was complete, the remaining space was filled in horizontally (Fig. 6.12c) and finally with a criss-cross pattern to the back end of the crosspiece (Fig. 6.12d).

Duri used a steel bodkin to open the weave when threading new lengths of cane through it, as seen in Plate 6.18. This was probably the least traditional of his tools - it was a sharpened bicycle spoke or something similar - and possibly the least replaceable. He



TUMAN AXE MAKING steps in weaving the *tui mum*

Figure 6.12

would formerly have used a thin bamboo or bone needle and this would undoubtedly have demanded a lot more skill and patience. I used a thin probe on a pocket knife to do the same job; as a beginner, I would have found the traditional tool too difficult to use. Plates 6.19 and 6.20 show the axes when we had finished them.

Duri later hafted a second axe and a visitor of his from another tribe (name unknown) made the **tui mum** with a different pattern, weaving over three rows and under three rows. His starting position was also different to the one Duri used; he began with a double wrap-around technique (Fig. 6.12a') which enabled him to cover the main part of the 'T' from both sides at once. A clear ethnographic example of the use of this method is illustrated by Crosby (1973:Plate A19E).

No doubt there were further ways of accomplishing the same thing. The main aim was undoubtedly to add to the tension of the inner binding and build in more strength by pulling the **else** and **kapłe** tightly together. This is easy to achieve by making the 'wrap-around' windings quite slack. As more cane is threaded in and out of them, they are gradually put under more and more tension until it is almost impossible to open the canework with the bodkin to insert the last few lengths of cane. The **tui mum** is therefore not entirely stylistic. It tightens the existing binding and provides a protective casing for it.

The Cost of Hafting an Axe

As with the sharpening of roughouts into axe blades, it is of no small interest to assess how much time was spent making hafts. The time spent by Duri was difficult to measure exactly because he already had some of the materials and he prepared others at times when I was not present. The time he spent making the haft exclusively was as follows: 12 hours for the **kapłe**, 2 hours 30 minutes for the **kapłe mum**, 1 hour 30 minutes for the inner binding of **kan minimb**, 16 hours for the **tui mum**. The total time without considering preparation of materials was thus 32 hours, as shown in Table 6.2a.

Surprisingly, I did not take a great deal longer to copy what he had done. I was able to account for my time more precisely and

A.

DAY	DESCRIPTION	TIME SPENT ON THIS DAY	TIME SPENT RUNNING TOTAL
1	Shaping of **kapłe** including fitting of axe blade	8 hr	8 hr
3	Finishing and smoothing of **kapłe**	4 hr	12 hr
7	Weaving of **kapłe mum**	2 hr 30 min	14 hr 30 min
8	Binding of **else** and **kapłe**	1 hr 30 min	16 hr
9	Weaving of **tui mum** (incorect start made, undid work)	4 hr	20 hr
10	Weaving of **tui mum** (figure-of-eight work around 'T')	6 hr	26 hr
11	Weaving of **tui mum** (closing up the sides)	4 hr	30 hr
13	Weaving of **tui mum** (closing up the sides)	3 hr	33 hr
14	Weaving of **tui mum** (last rows of cane filled in)	3 hr	36 hr

B.

DAY	DESCRIPTION	TIME SPENT ON THIS DAY	TIME SPENT RUNNING TOTAL
1	Preliminary shaping of **kapłe**	1 hr 30 min	1 hr 30 min
3	Shaping of **kapłe** and splitting **kapłe me**	1 hr	2 hr 30 min
4	Thinning of **kapłe**	1 hr 15 min	3 hr 45 min
5	Shaping of **kapłe ongul**	1 hr 15 min	5 hr
6	Cutting out socket	1 hr 30 min	6 hr 30 min
8	Fitting axe blade into socket	3 hr	9 hr 30 min
	Smoothing with glass scraper	45 min	10 hr 15 min
	Weaving of **kapłe mum** (Duri)	3 hr	13 hr 15 min
10	Smoothing with glass scraper	2 hr 30 min	15 hr 45 min
	Preparation of **kan minimb**	15 min	16 hr
12	Preparation of **else** (with Duri)	2 hr	18 hr
14	Preparation of **kan minimb** (with Malimbe)	1 hr	19 hr
	Binding of **else** and **kapłe**	2 hr	21 hr
	Preparation of **kan wieng**	1 hr	22 hr
	Weaving of **tui mum**	12 hr	34 hr
15	Weaving of **tui mum**	7 hr 45 min	41 hr 45 min
19-22	Completion of **tui mum**	4 hr	44 hr 45 min

HAFTING EXPERIMENT breakdown of tasks and time spent:

A. Duri's axe B. axe made by author

Table 6.2

an analysis is to be found in Table 6.2b. The totals for the same categories as above (excluding the preparation of materials) was as follows: 12 hours 45 minutes for the **kapłe**, 2 hours for the inner binding, and 23 hours 30 minutes for the **tui mum**. I did not, as I have said, make the **kapłe mum**; Duri spent 3 hours making a second one for me.

Included in this time was a good deal of 'work' that was not strictly necessary, such as 3 hours 15 minutes spent shaving the wood down with a glass scraper. On the other hand, work like this was undemanding and could be done at any spare moment. I spent 50% more time on weaving the **mum** than Duri - but then again his friend worked exceedingly quickly on the third axe and finished the same job in 25% less than Duri's time.

The preparation time should not be overlooked. This amounted to about 5 hours during the making of my axe, including a trip into the bush to look for **ond kueng** trees with suitably shaped branches and cutting and stripping binding materials. The total time spent hafting my axe blade was thus over 40 hours - longer in fact than it took to sharpen the blade.

CONCLUSION

This chapter has shown how rough pieces of stone could be turned into highly valued artefacts and useful tools in the hands of the axe sharpeners and haft makers of the Tuman axe factory area. On the question of whether more axes were sharpened and hafted by men in the quarrying clans or by men who were able to obtain roughouts from them through trade, Table 7.1 shows that roughouts exceeded finished axes by a factor of about 2 : 1 in brideprice payments made up to the Pacific War (see Chapter 7). Naturally these formed only one kind - a very formal kind - of known exchange payments; roughouts probably outnumbered hafted axes by a much greater factor in casual trade. Thus at least two thirds of Tuman axes were sharpened and hafted outside the quarrying clans, and there is every likelihood that the actual figure was a great deal higher.

A point I made at the beginning was that the work was divided into two quite different steps that contrast in almost every way.

The first step - sharpening axes on grindstones - was tedious, repetitive and demanded little manual dexterity most of the time. Any man who possessed the raw materials would have sharpened his own axe blades. Perhaps only in the final stages of sharpening a blade was the task intrinsically difficult.

Haft making has been cast here as a total opposite, with only a small band of specialist craftsmen able to achieve superior results. The haft makers had mastery over some quite difficult techniques but their rewards were nonetheless not materially great. They worked independently of each other - they did not all live in one village or community - and in the kind of society that encourages fellow clansmen to help each other to achieve jointly held goals. They did not live in a society where skills could be marketed for substantial personal gain.

Plate 6.1

Malimbe illustrating the handedness of axe blades with the National Museum collection of Tuman axe blades. Komnemb Sike at left.

Plate 6.2

Use of the National Museum collection in interviews. J. Mangi and J. Muke are questioning Tangilka elders at Minj. Note the size of the crowd attracted when the set of axes, some of which were extremely large and thus seldom seen even traditionally, was unwrapped.

Plate 6.3

Close-up of a Hagener demonstrating the use of a grindstone to hone the blade of a Jimi Valley stone axe. From the M.J. Leahy collection.

Plate 6.4

Hagener demonstrating the use of a grindstone to hone the blade of a Jimi Valley stone axe. Note the small size and portability of the grindstone. From the M.J. Leahy collection.

Plate 6.5

Man demonstrating the sharpening of a Tuman axe blade on a portable grindstone. Note the haft lying to his right. From the M.J. Leahy collection.

Plate 6.6

Sharpening completed, the man has refitted the haft and axe blade. Note the style of the haft. From the M.J. Leahy collection.

Plate 6.7

Man with stone axe of unknown design; location unknown. From the M.J. Leahy collection.

Plate 6.8

Hagener with Tuman axe (compare the design with Plates 6.5 and 6.6) From the M.J.Leahy collection.

Plate 6.9

Hagener with Jimi Valley - probably Tsenga gaima - axe. From the M.J. Leahy collection.

KOMNEMB DURI'S DEMONSTRATION OF HAFTING AN AXE IN THE TUMAN STYLE

Plate 6.10

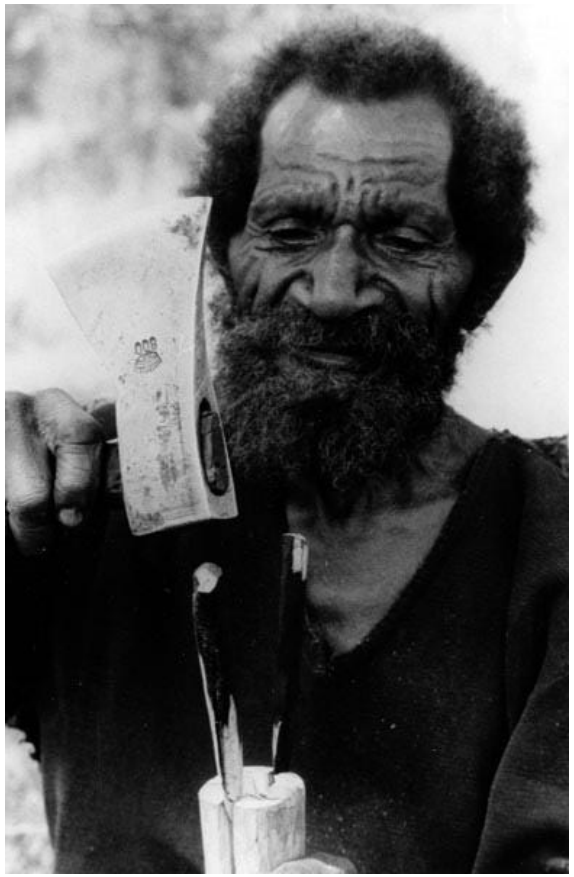
Duri using a pair of **jipilj** to split the **kapłe**.

Plate 6.11

Cutting the socket, **kapłe me**, with a stone adze, **tui ongka**.

Plate 6.12

Making the woven band, **kapłe mum**.



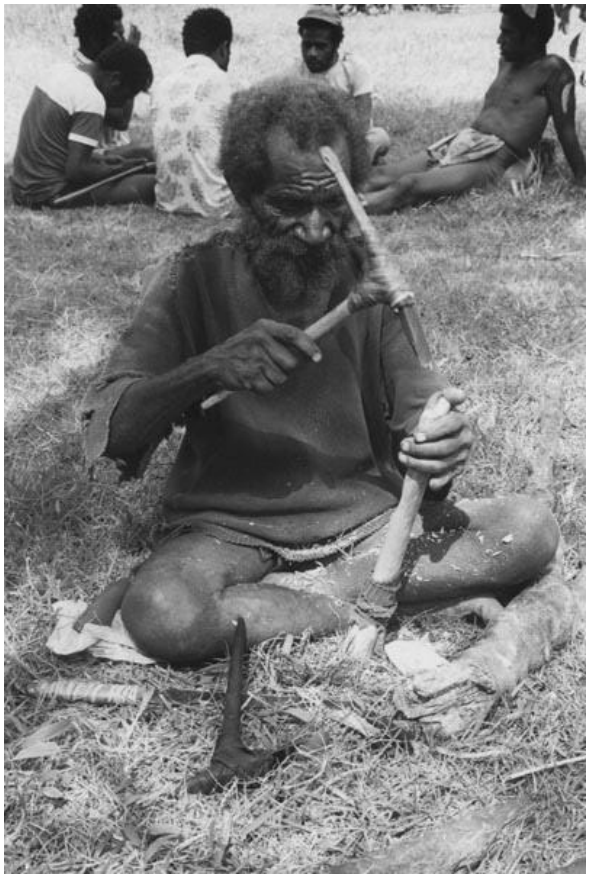


Plate 6.13

Using the adze blade like a chisel to shape the loose socket piece, **kapɨe me.**

Plate 6.14

Fitting the axe blade against the **kapɨe me.** The blade was made by Komnemb Mure during the 1930s.

Plate 6.15

Smoothing down the **kapɨe** with a glass scraper. Formerly a stone flake would have been used.

Plate 6.16

Tying the **kapłe** to the else. Duri is loosely fixing the two parts together at this stage. He wedged some chewed sugar-cane against the side of the joint (beneath his little finger in the photograph), then applied the **kan minimb.**

Plate 6.17

Binding the haft with **kan minimb.** This is the secure binding which holds the hafting together.

Plate 6.18

Weaving the **tui mum.** Duri has finished the first step and is beginning to close up the sides of the weave.

Plate 6.19

Duri's axe completed.

Plate 6.20

My axe completed.

Chapter 7

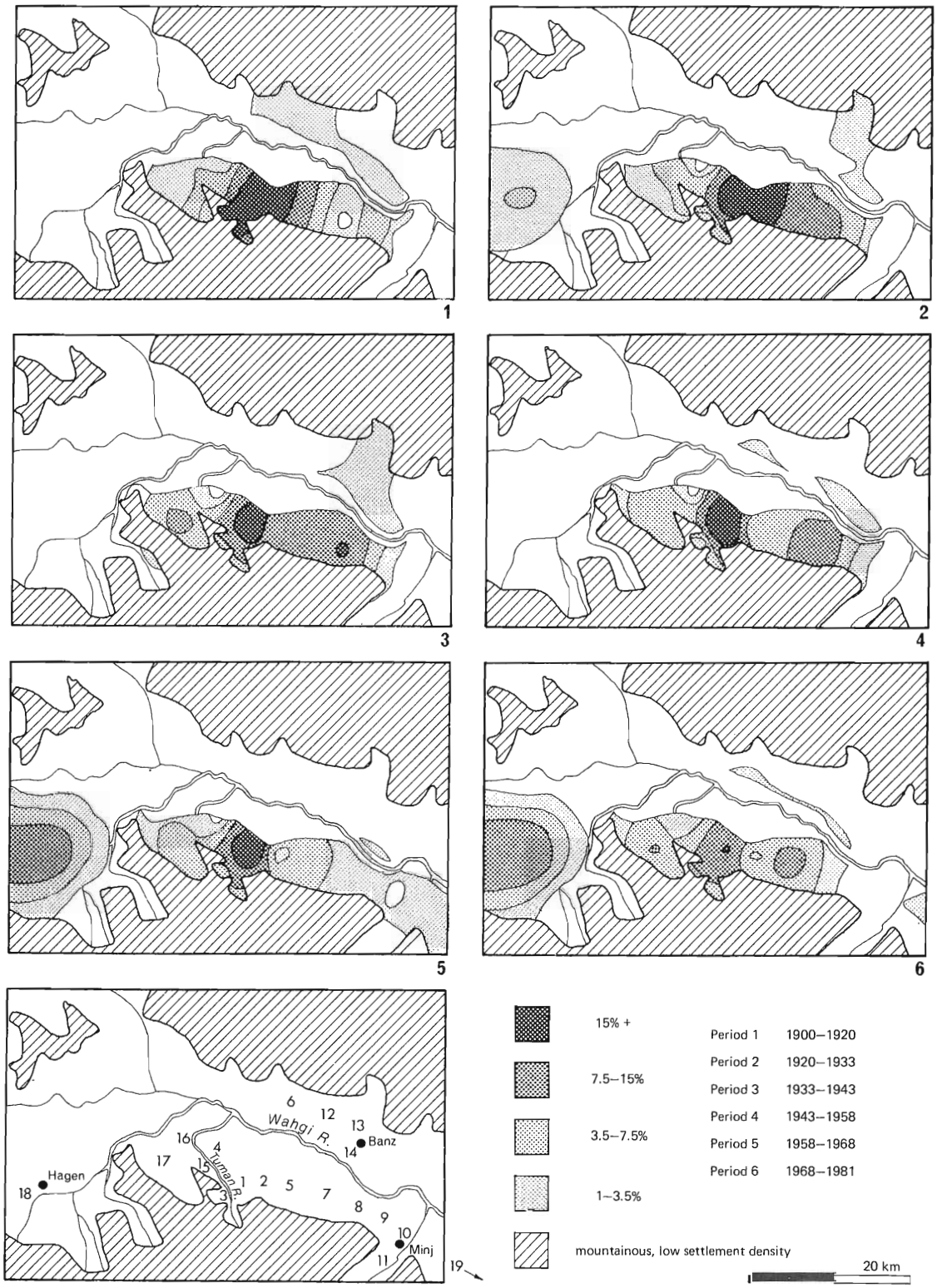
AXES AND BRIDEPRICES: WIFE-TAKING PATTERNS OF THE TUNGEI

In this chapter I test a hypothesis about patterns of marriage and axe making. It is based on the assumption that among the tribes of the Tuman River area (and in the New Guinea highlands generally) the primary pathways of trade and exchange were traditionally those established between clanspeople by marriage, and that during the axe making period the stone axe trade was intimately linked with wife-taking patterns by virtue of the important role of axes in brideprices. According to the hypothesis, Tungei wife-taking patterns in the earlier part of the century (Fig. 7.1) document the first trade-leg of stone axes in their tortuous journeys from the quarry to their final resting places about the highlands, perhaps broken and thrown away in the corners of gardens - and occasionally sold to anthropologists or dug up by archaeologists in excavations. I also test the claim that distortions to the patterns of Tungei marriage after European contact reflect economic changes resulting from the loss of the axe trade.

THE WEALTH ECONOMY AND THE EXCHANGE OF AXES

New Guinea highlands societies are well known for sophisticated systems of exchange; transactions are commonly between individuals, but also between entire clans or tribes. In their economic life the tribes of the Tuman area are no exception; they exchange a variety of wealth items among themselves and with people from other parts of the Wahgi Valley. To all intents and purposes the Tungei did not engage in long distance trade; they confined their exchange activities to the immediate vicinity of their own territory. The web of regional trade described by Hughes (1977a) is that within which the Tungei operated.

The physical components of the wealth economy were pigs, marine



Key to groups: 1. Tungei 2. Wałpi 3. Mengka 4. Mamelka 5. Sikeing 6. Kelaka 7. Kuma (Kudjip) 8. Kisu and Deimanka 9. Berepka 10. Minj township 11. Minj River 12. Komblo 13. Bamblinge 14. Andpang 15. Andakelka 16. Onembe 17. Kuli 18. Hagen 19. Simbu

TUNGEI MARRIAGE PATTERNS origin groups of wives over six periods

Figure 7.1

(data in Table 7.2)

shells, bird of paradise plumes, stone axes, salt packages and forest products like marsupial skins. The opportunities for transacting them were provided (as they are today, in addition to the recent development of a local market economy) by festivals organised at the clan or tribal level, war reparations payments, brideprice-giving ceremonies and on a miscellany of more informal gift-giving and debt-repaying occasions. As mentioned in Chapter 2, the main festivals of the Tungei are the pig festival, **kung ngi** ('pig house'), held by all Tungei clans simultaneously, and a produce-giving ceremony, **opał**.

Kung ngi cannot have been important to the stone axe trade. None was held by the Tungei in the early part of the century and the first one in living memory was held after the first Europeans arrived. In the same way, **opał** has never been a notable forum for the distribution of durable wealth and it was not traditionally a direct means of obtaining axes for the exchange partners of the Tungei.

The big festivals illustrate a central principle of trade in the highlands. On ceremonial occasions hosts and guests are brought together through the shared interests of kinship. There may be a high degree of intermarriage between hosts and guests, in which case the strength of affinal ties will be obvious. On the other hand they may be enjoying a relatively recent peace or political alliance; in this case the expectation is that future marriages will consolidate the relationship between the groups. Either way, ceremonial gift-giving is most intense between those groups that are most closely intermarried, and least carried out between groups that have few marriage ties. This can be illustrated statistically for a variety of nearby societies.

Meggitt, for example, presents data which show that partners in the Enga **te** are overwhelmingly drawn from clans related by marriage to each other (1974:Table 5). Only 16% of the **te** partners of his sample of informants were not related to them. Meggitt (1974:81) adds that

> ...not only do the various obligations that exist between un-related Te partners (for instance, those of hospitality and of military and economic aid) resemble those between relatives; they also operate to convert the former partners into affines.

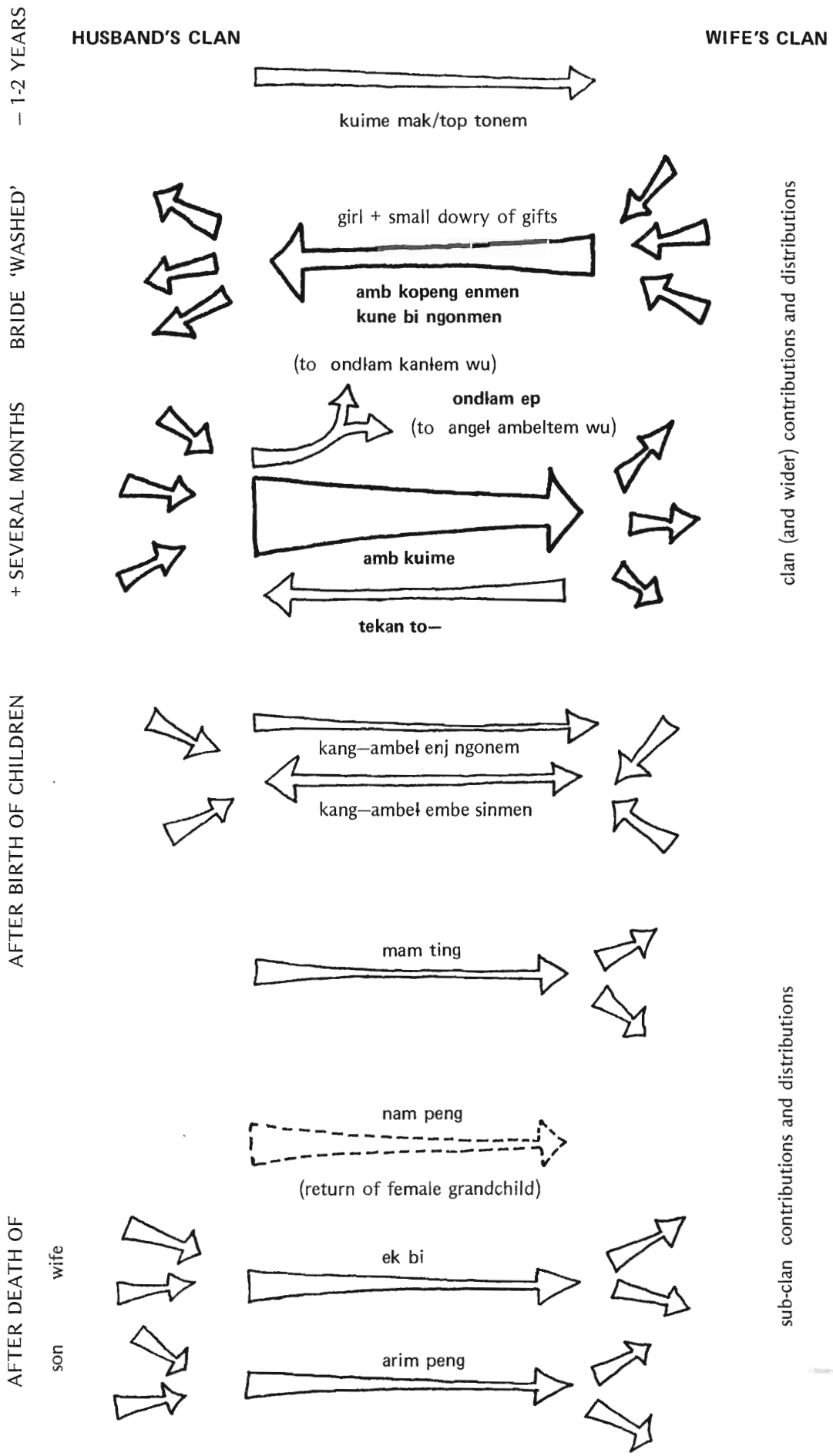
Among the Northern Melpa, affines tend to receive the largest gifts of pigs and shells in **moka**, although cases do arise where men deliberately choose not to follow their marriage ties in making **moka** (A.J. Strathern 1971:Chapter 7). Wola men in the Southern Highlands make the greatest number of exchanges with those who are most closely related to themselves, and with decaying frequency with those who are not so closely related or not related at all (Sillitoe 1979:Fig. 45). Instances from other ethnographies could be cited to support this tendency (e.g. Reay 1959a; Salisbury 1962; Brookfield and Brown 1963; Read 1965; Criper 1967).

The Traditional Importance of Axes in Brideprices

Tungei brideprices form a complex system of payments and counter-payments between the two sets of kin joined by a marriage. They typically take place over number of years and can even be extended to last over a number of generations. Though a full discussion would be out of place here, Figure 7.2 is a diagrammatic summary of the order of events. For the sake of completeness, further details are given in Appendix E. The main payment, the **amb kuime**, is generally handed over some months after a new bride has settled in and traditionally consisted mainly of stone axes. A sample of these payments is set out in Table 7.1.

In the 14 brideprices given before the Pacific War an average of 5.4 finished axes (**tui else kapłe**) were given, together with 8.1 roughouts (**tui enjim pei**). I did not spend a great deal of time collecting brideprice data, because, as the table shows, men tended to answer in large round numbers of axes. At other times they did not mention giving roughouts, or they did not specify in what state of completion the axes were in, so that the items included are variable. In the eight brideprices where hafted axes were mentioned, an average of 10.6 was given; in the nine brideprices where roughouts were mentioned, an average of 14.2 was given.

The importance of axes was a regional phenomenon; in North Melpa, the Kawelka big-man Ongka (Ongka 1979:26) asserted:



TUNGEI MARRIAGE PAYMENTS transactions between two clans

Figure 7.2

BRIDEGROOM	GROUP RECEIVING PAYMENT	MARRIAGE PERIOD	AXES WITH HANDLES	ROUGHOUTS	COOKED PIGS	PEARL-SHELLS	NASSA HEAD-BANDS	COWRIE ROPES	BALER HEAD-PIECES
					kung kui	**mong kina**	**geram**	**mong tun**	**mei duma**
Pam Wu	Sikeing	1	10			1			
Kandeł	Akamb	2		20	2				
Kandeł	Ekiemb	2		20	3				
Kandeł	*Sikeing	2	-	-	-	-	-	-	-
Malimbe	Miamka	2	20	20		+		+	+
Aip	Kenjpi-emb	2	10	20	5	3	-	-	-
Warke	Andakelka	2			2-3			1	
Numndi	Komnemb	2		10	4				
Gełu	Epni	2		3	4	1			
Pok	Kurupka	2	10	10		2	1	5	
Gełu	Mengka	3	10	10	4-5		1		1
Toł	Sikeing	3	10	15					
Warke	*Onembe	3	-	-	-	-	-	-	-
Aus	Miamka	3	10	10	10	5		5	
Aus	Deimanka	3	5		5	3			

+ indicates presence of item
- indicates absence of item
* indicates refugee, no brideprice

STATISTICAL SUMMARY

	AVERAGE NO. OF AXES	AVERAGE NO. OF ROUGHOUTS	SAMPLE SIZE
Payments up to 1933	5.0 ± 7.1	10.3 ± 9.1	10
Payments up to 1943	5.7 ± 6.2	8.5 ± 8.6	15
All payments with axes	6.5 ± 6.3	9.8 ± 8.5	13

SAMPLE OF TUNGEI BRIDEPRICES *Table 7.1*

> ...pigs might be given too, but the axes were the essential thing; if axes were not given they would refuse the marriage, saying 'He's a rubbish, useless man, what shall we do? Don't let's give him the girl.'

Vicedom discusses a number of brideprices given at Ogelbeng before the Pacific War. Pearlshells were rather numerous, 1-8 being given, as opposed to 0-3 stone axes, but although it is not possible to tell how long after 1933 the payments were made, the shell component was probably inflated by the newly introduced pearlshells of the Europeans (Vicedom and Tischner 1943-48:II, 206-7, Plate 2).

From work in the Banz area Heaney provides data on 11 marriages up to 1934 (1982:Table 24.1). The brideprices consisted of an average of 3.2 stone axes, 1.3 pearlshells, 2.6 pigs, 0.4 baler shells, 0.1 Nassa shell headbands, 0.1 salt packs, and 4.1 bird of paradise plumes.[1] Presumably the pigs included in this list were given in the form of cooked pork as well as live animals. The axes and pearlshells were the main wealth objects in this list; axes outnumber pearlshells by about 2.5 : 1.

In Sinasina, Hide (1981:Table A3.1) provides data on 8 brideprices given before 1933 and a further 23 given in the period 1933-38. An average of 1.2 ± 1.7 stone axes were given in the earlier period, and 1.7 ± 1.4 in the second. This compares with 0.5 ± 0.5 and 0.9 ± 1.1 pearlshells given in the same periods, among other things (Hide 1981:Table A3.2). In Central Chimbu, Vial (1940: 162) witnessed brideprice ceremonies where 20-60 axes were given. Bergmann (1971:174) says payments included '30-40 stone axes, beginning with the very big axes only used for the purpose of bride price, down to the small working axes'; axes far outnumbered pearlshells, Nassa shell headbands and pigs (2-3 per payment each), plumes (2-4 per payment) and miscellaneous other items. Hide (1981: 129, Note 12) comments on the high numbers of axes seen by Vial and Bergmann, speculating that this could have been due to the favourable location of the Central Chimbu groups at the junction of the main part of the Wahgi Valley (Middle Wahgi), the Chimbu Valley

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[1] The values given by Heaney were mean values in separate columns for the years 1925-29 and 1930-34 respectively. I have combined them to give a joint mean for the period 1925-34.

and the Lower Wahgi areas of Dom and Gumine with their sources of axes and salt.

None of the data on pre-1933 brideprices, including my own, are completely satisfactory, but the general pattern is clear. Stone axes were regionally almost always a major part of brideprices and locally they were given in very large numbers indeed. After 1933, when pearlshells were flown in by Europeans and large numbers became available, axes were quickly displaced from brideprices. Further data collected by Hide (1981:Table 4.3), Heaney (1982:Table 24.1) and others show that after the Pacific War stone axes all but disappeared from brideprices.

There is no intrinsic reason why axes should have dominated brideprices; it is highly likely that they did so because of an adequate supply and a high - if not insatiable - demand. Other studies show that no other high value wealth item had the same regularity of supply that may have ensured a stable exchange system. Pearlshells are a case in point. Before 1933 their supply was uncertain east of the Tuman River and tied up with the **moka** system to the west of it.

Payments Made to the Tungei by Outsiders

Having collected little field data from the groups receiving Tungei axes, I can only provide anecdotal evidence for the kinds of payments made by outside groups to the Tungei. Although producers in some parts of Melanesia received wealth objects ultimately originating with themselves, the Tungei say they preferred incoming payments to include pearlshells (**mong kine**), cowrie ropes (**tun mong**), Nassa shell mats (**geram**) and other valuable things like pigs.

Peke of Andakelka Maui clan, for example, married a girl from Tungei Ekiemb clan before 1933; he paid in **kine** and pigs. Ołmeni of Andakelka Pingka married a girl from Tungei Komnemb clan; he paid in **tun mong** cowrie ropes and provided cooked pigs for the wedding feast. Kuli, another Andakelka man, said they would give brideprices in **kine**, **tam** and **duma** (baler shells), **ep mur** salt packs and **kopeng seka** tree-oil. On the other hand, the Andakelka wanted axes if they were the ones giving away the bride: two of the largest axes should be the minimum centrepiece payment, **amb peng**, the

'woman's head'. If they presented the Tungei with a brideprice containing the above-mentioned valuables, they did not want the same things to form the return payment. Axes and Raggiana plumes (**kei parke**) should have been returned.[2]

Kondika informants at Minj confirmed the typical asymmetry of transactions with the Tungei. Tungei women rarely married so far from home but the following items were paid for them: cowrie ropes, Raggiana plumes, marsupial furs (**kamb sine**), and salt from Gumine: **ap kuse**. Return payments given by the Tungei should have been axes and salt packs from the Sirunki source: **ap mur**.[3]

PATTERNS OF TUNGEI MARRIAGE

If the generalisation that trade follows the lines of kinship is taken as an assumption, an analysis of the marriages contracted by the Tungei between about 1900 and the present day can be used to provide a reasonable picture of the traditional 'market' area of the Tungei (Table 7.2; Fig. 7.1) and, for the sake of the present analysis, this length of time can be divided into six roughly equal periods: Period 1 1900-20, Period 2 1920-33, Period 3 1933-43, Period 4 1943-58, Period 5 1958-68, and Period 6 1968-81. I recorded some marriages contracted in the 1800s; I placed them in Period 0, but I do not use them for statistical purposes.

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[2] Interviews 13-81, 16-81. The decorative style of the Tungei does not call for the use of tree-oil and it only has a high value to the west of the Tuman River. I cannot explain why Kuli suggested it was used in exchanges with the Tungei.

[3] Interview 18-81. Note the slightly different Nii terms for these things: **ka sine**, **ep kuse** and **ep mur**.

Periods:	0	1	2	3	4	5	6	
EK NII SPEAKING GROUPS								TOTAL
South Wall Wahgi								
Mamelka	0	7	5	9	7	10	16	54
Mengka	20	29	2	8	2	9	17	87
Sikeing	5	11	12	10	6	9	21	74
Waɨpi	11	26	17	11	5	4	7	81
MIDDLE WAHGI SPEAKING GROUPS								
South Wall Wahgi								
Berepka	0	0	0	1	1	1	0	3
Kisu + Deimanka	6	10	5	7	5	3	1	37
Kuma (at Kudjip)	0	1	8	18	15	2	6	50
Kuma (at Minj)	0	0	0	0	1	2	2	5
Kuma (head of Minj)	0	0	0	0	0	1	0	1
MELPA SPEAKING GROUPS								
South Wall Wahgi								
Andakelka	0	7	5	9	7	10	16	54
Kuli	0	3	2	11	7	8	17	48
Mt Hagen area	1	0	3	0	0	16	30	50
Onembe	4	5	5	3	5	3	4	29
NORTH WALL WAHGI GROUPS								
Andpang	3	3	0	2	2	1	2	13
Bamblinge	0	0	2	3	0	1	1	7
Kelaka	0	3	0	1	1	0	2	7
Komblo	0	1	0	0	0	0	1	2
GROUPS FROM NEW AREAS								
Baiyer Valley	0	0	0	0	0	0	1	1
Hanuabada	0	0	0	0	0	0	1	1
Ialibu	0	0	0	0	0	0	1	1
Jimi Valley	0	0	0	0	0	2	4	6
Madang	0	0	0	0	0	0	1	1
Nondugl	0	0	0	0	0	0	3	3
Simbu (inc. Dom)	0	0	0	0	0	2	24	26
Tari	0	0	0	0	0	0	1	1
TUNGEI	4	29	22	32	43	40	34	204
DON'T KNOW	1	1	1	4	6	19	16	48
TOTALS	57	131	84	120	107	134	220	853

Origin groups of wives received by the Tungei absolute numbers for each period

Table 7.2

The Data

Two versions of the Aviamp village census book were available, as described in Chapter 2; they were compiled in 1958 and 1968 respectively. They readily enabled the marriages of the younger generation of men to be classed into Periods 5 and 6. In some cases the actual year of marriage was recorded by the patrol officer; more usually the name of a new wife was entered below that of her Tungei husband at the end of a census interval of two or three years. The names of children were entered in the same way. The statistics that I gave in Chapter 2 for the median ages of men and women at the births of their first children (25 years and 20 years approximately), together with the spacing of further children (approximately 4 years), enabled the age estimates of the older generation of men and women to be corrected.

There was no difficulty in establishing whether men of the older generation were married before or after 1933, the date of the first patrol, so the age correction procedure was directed towards classing the marriages of men that took place over the 25 years between 1933 and 1958 into Periods 3 and 4. These were divided at the nominal date of 1943, the mid-point of the Pacific War, when Mt Hagen was bombed.

Before 1933, three periods could be distinguished. The living men who married before white men arrived almost all did so after the major war between the Tungei and the Mengka, just after 1920. The fathers of all the men married by the time of the Pacific War must have been married early than 1920, so that Periods 1 and 2 are set at 1900-?20 and ?1920-33, respectively. As I mentioned on page 142, wives of some of the sub-clan ancestors also appear in the genealogies; marriages to these women were classed into Period 0 (before 1900).

Some 28 clans and tribes were listed by informants as the natal groups of their wives and those of their kinsmen, over Periods 1-3 (Table 7.2). Some changes are seen in the social orientation of the Tungei over time, notably that the majority of marriages with Mengka clans are confined to Period 1, before the onset of hostilities with Tungei. But no new source groups were added to the roll until after the Pacific War. After Period 3, and particularly in Periods 5 and

6, the social horizons of the Tungei widened and marriages were made with women from far-away groups.

The Distance-Decay Maps

An important story is told by the geographic spread of wife-taking patterns, shown in Figure 7.1. The shading in the maps for each period is based on output from the computer program SYMAP, which I have used to plot percentage information onto a base map of the central part of the Wahgi Valley for a total of 796 marriages over the six periods (data in Table 7.2). Note that the shading in a given region was obtained by interpolation from a set of data points representing the natal groups of men's wives. The percentages of women originating from each group were supplied as values for these points.[4]

I estimate that around 90% of the actual number of marriages contracted by the Tungei clans Menjpi, Kenjpi-emb, Akamb, Komnemb and Ekiemb during this century have been included; the reliability is somewhat less for Eska and Kupaka clans, but in both cases the marriages which I failed to pick up are likely to have been those which did not last long or which did not result in the birth of children.

The maps illustrate the diminishing strength of affinal ties with distance from Tungei territory with some precision. Women traditionally - that is in Periods 1-3 - had about a 1 in 3 chance of marrying within a 2.5 km radius of their homes. More than 2 in 3 married within a 5 km radius, while almost all the remainder were married within 15 km of their homes.

Two other effects are remarkable. Firstly, very few wives were drawn from the North Wahgi groups directly adjacent to the territory

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[4] The choice of which groups to represent at one point is arbitrary, but generally reflects the need to have regularly spaced data points. Thus four clans - Kurupka, Miamka, Ngeneka and Owilka - are summed at Kudjip; Kisu and Deimanka are summed at Kurumul; and all Hagen tribes are summed in the vicinity of Kagamuga. I have also assigned values of 0.0% to dummy sample locations at parts of the map beyond the positions of the listed groups.

of the Tungei, beyond the Wahgi River. This is surprising in the case of Kelaka, who are Ek Nii speakers and traditional friends. Nevertheless, the statistics do show that the empty wasteland of the Wahgi swamp once presented a highly effective barrier to everyday social traffic - at least of the kind which led to exchanges of women - and that modern access by road has not changed things.[5] As among the Mae Enga, the pattern of marriages made by the Tungei is demonstrably subject to 'topographical constraint' (Meggitt 1974: 80).

The second effect is that along the South Wahgi a bias is seen in the relative proportions of women drawn from east and west. In Periods 1-3, 137 wives were from the east while 113 were from the west. This imbalance is not statistically significant, but if the immediate neighbours of the Tungei are excluded - Mengka, Mamelka, Sikeing, Waɨpi and Andakelka - 50 of the remaining women were from the east and only 32 from the west. This reflects a value of $chi^2_{[1]} = 2.304$, which is significant at the 5% level.

The western attenuation was not therefore immediate, but began some 5 km from the borders of the Tungei. It is especially noticeable that the large Eastern Melpa tribe, Kuli, two groups west of the Tungei, was the source of fewer brides (16) than the equivalently distanced groups to the east, the Kuma clans Kurupka, Miamka, Owilka and Ngeneka (27) at one remove from the Tungei and, at two removes, Kisu and Deimanka (22). The most likely explanation for this effect is that the Tungei were (as they still are) culturally orientated towards the Middle Wahgi peoples to their east and that they differentiated themselves from the Hageners to their west. This would have the consequence that they would have participated more in Wahgi festivals than in Hagen ones, established exchange relationships more often with Wahgi men, danced more often with Wahgi women and married more of them.

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[5] A road bridge now crosses the Wahgi just north of Kindeng, i.e. immediately to the north of Mamelka territory. However, the modern land tenure system is now complicated by the establishment of a resettlement scheme for non-Wahgis in newly drained areas of the swamp. To all intents and purposes, North Wall Wahgi groups like Komblo and Kelaka are as far removed socially as they are distant by (roundabout) road travel.

As motor transport came to be regularly used by the Tungei, a quite different pattern became established. Marriages with Hagen women became common in Period 5, and by Period 6 were second in number only to marriages contracted within the tribe. Also important in Period 6, but not shown on the maps, is the number of marriages contracted with women originating in Simbu Province. They were the third most important source after the Hagen area.[6] In this last period, intra-tribal marriages dwindle to an unprecedentedly low level.

CHANGES OVER TIME

In common with the experience of other groups in and around the highlands, the Tungei have widened their social horizons since 1933 and many young men temporarily leave Aviamp to seek work in Port Moresby, Lae and other distant places. The townships of Mt Hagen, Minj, Kundiawa and Goroka can easily be visited by road and social contacts between all these outside areas and Aviamp have increased enormously. A number of young men now find brides as far away as Hanuabada and Madang, but for the most part the 'new' brides have come from closer to hand: from Togoba, the Baiyer Valley, from Mt Hagen itself, from Central Chimbu and - intriguingly - from the other axe making villages at Tsenga and in the Dom-speaking area of Simbu Province, all formerly places known to the Tungei from hearsay, but not visited by them before 1933.

A.J. Strathern (1972:Table 11) shows that the wives of Kawelka men came, in the post-war period, from tribes further afield than traditionally. However, this was not marked by the time of fieldwork in the 1960s. Changes in Tungei wife-taking have been rather greater. One measure which is particularly interesting is the proportion of wives obtained from inside the tribe as opposed to those from outside groups: 'tribe exogamy'. The data, covering the

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[6] I am not certain if all the Simbu women were actually living in Simbu when married to Tungei men in the 1970s. A number of them may have been living on the 'Wahgi Blocks' around Kindeng. Nevertheless at this stage their allegiance must still have been to land-holding groups still resident in Simbu itself.

six time periods already distinguished (Table 7.3), are graphed in Figure 7.3 together with comparable information for the Kawelka.[7]

Women from the Kawelka clans Mandembo, Membo and Kundmbo constituted 16% of all Kawelka wives of the senior generation: 84% were drawn from outside tribes. In the junior generation the percentages were 14% from inside and 86% from outside. This represents a modest rise in tribe exogamy, but the chi-square value from a 2 x 2 test of homogeneity is not significant.

Among the Tungei, outside wives comprised 78%, 73% and 72% of the totals in Periods 1-3, but this dropped to 58% in Period 4 (1943-58). In Period 5 (1958-68) the percentage climbed again to 66% and in Period 6 (1968-81) to 83%. Outside groups were an important, and constant, source of wives in traditional times; wives from new areas contribute to present-day tribe exogamy, helping to explain the higher modern value. All the same, between the 1940s and the 1960s there was a temporary drop in the level of tribe exogamy of about 15%. The problem is to determine:

1. Whether the observed variations in the level of marriage with other tribes are statistically significant.

2. Whether the variations, if established to be significant, can be related to:

    a. A rapid growth in population since the arrival of Europeans (resulting from the cessation of warfare and the introduction of basic medical services, roads and agricultural extension programs) which has caused clan segmentation to occur.

    b. The operation of Tungei marriage rules at a hitherto unsuspected level of complexity, resulting in natural oscillations in the number of brides available within the tribe.

    c. Shifting patterns of alliance in the Tuman area, altering the socio-political orientation of the Tungei during the century.

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[7] A.J. Strathern (1972:102-3) deals with affiliation choices classed as 'pre-1944' and '1944-1964'. These are presumably the 'senior' and 'junior' generations of Kawelka men distinguished in Strathern's data (1972:Table 11). 'Pre-1944' can therefore be equated with my Periods 2 and 3, and '1944-1964' with my Periods 4 and 5.

d. Socio-economic changes resulting from the loss of the axe trade around the time of the Pacific War and the impoverishment of the Tungei relative to their status in former times.

These points will be examined in turn.

Chi-Square Tests of Significance

Firstly, how should 'tribe exogamy' be defined? Marriages contracted by men of the Tungei clans with women from elsewhere are all 'outside' marriages - exogamous to the tribe - but today they can be classed into two categories: local marriages with women of traditionally affinal groups, and those with groups from new areas. The total rate of tribe exogamy in the post-war periods is therefore not strictly comparable with that for Periods 1-3, when only local marriages were made. This is indicated in Figure 7.3, where the two rates are separately graphed. If only local marriages are considered, the proportion of outside marriages to those within the Tungei was the same in Period 5 as in Period 4 (both 57%). In Period 6 the percentage finally rose, to 75%, which is about the average of what it had been in Periods 1-3.

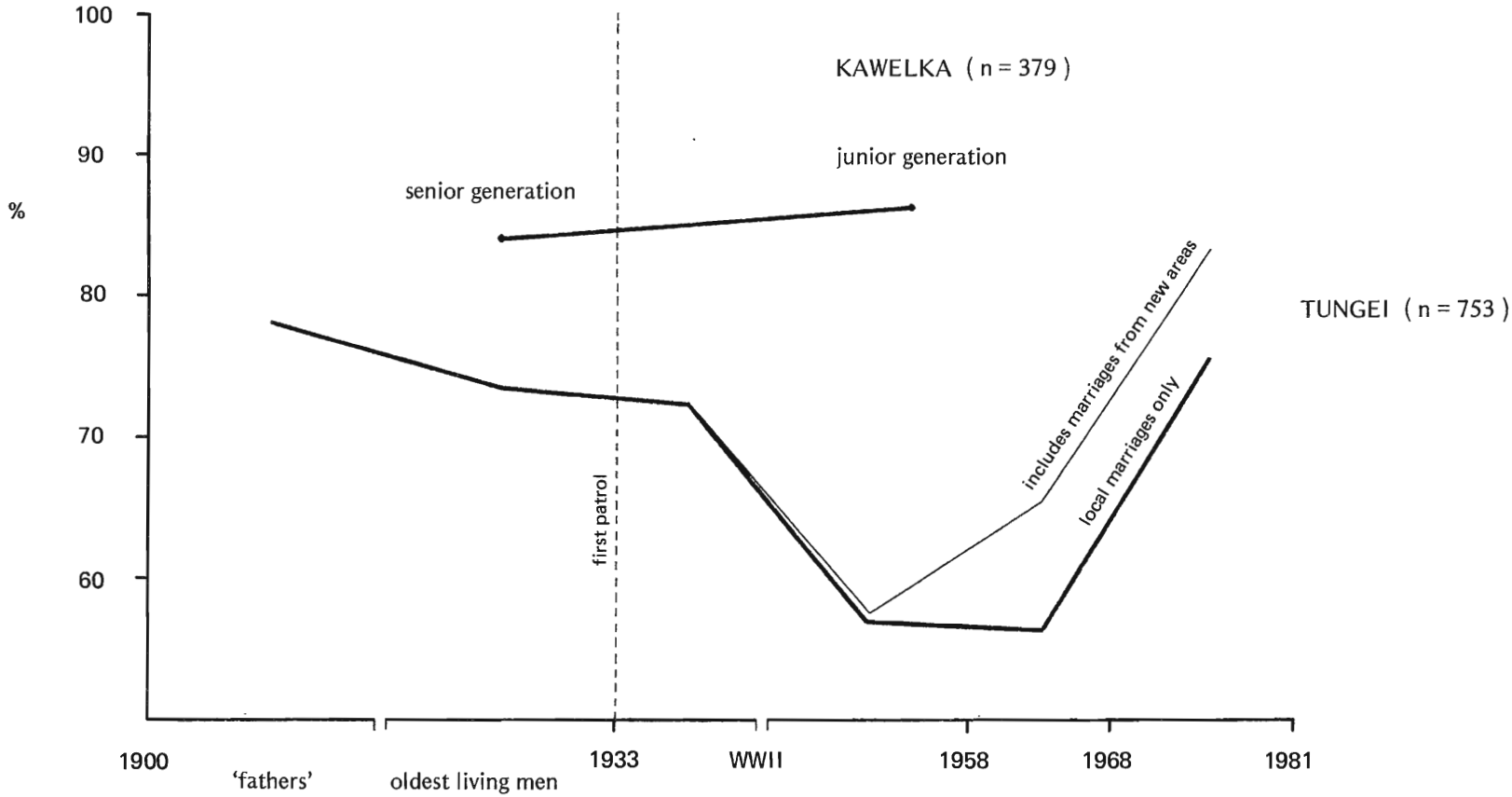
It is appropriate to use chi-square tests to examine the null hypothesis that chance factors are the only agents of change in the rate of tribe exogamy. Extracting the figures from Table 7.3, the total change from Period 3 (in: 32, out: 84) to Period 4 (in: 43, out: 57 + 2) results in a value of $\text{chi}^2_{[1]} = 5.106$. This is significant at the 5% level: $p(H_0) < 0.025$. The test is not unfavourable to the null hypothesis, because it includes the two non-local marriages made in Period 4 and slightly minimises the magnitude of the fall in tribe exogamy.

Two tests can be made of the longer term change between Periods 2 and 3, on the one hand, and Periods 4 and 5, on the other. Firstly local marriages may be considered in isolation. Over the two periods in question there is a drop of about 15% (from 72-73% to 57%) in the numbers of wives obtained from outside groups; this is the test least favourable to the null hypothesis (Periods 2 and 3, in: 22 + 32, out: 61 + 84; Periods 4 and 5, in: 43 + 40, out: 57 + 52). This gives a test value of $\text{chi}^2_{[1]} = 11.119$, which is significant at the 0.01% level: $p(H_0) < 0.001$.

NUMBERS OF WOMEN FROM INSIDE & OUTSIDE TUNGEI, BY CLAN

Table 7.3

	Ekiemb	Kenjpi-Akamb	Komnemb	Es-Kupaka	Menjpi	
PERIOD 1						
wives from Tungei	4	11	2	2	10	29
from local groups	17	35	35	5	10	102
totals	21	46	37	7	20	131
out-marriage %						77.9%
PERIOD 2						
wives from Tungei	1	6	2	2	11	22
from local groups	14	17	14	6	10	61
totals	15	23	16	8	21	83
out-marriage %						73.5%
PERIOD 3						
wives from Tungei	4	8	8	3	9	32
from local groups	13	26	26	7	12	84
totals	17	34	34	10	21	116
out-marriage %						72.3%
PERIOD 4						
wives from Tungei	2	11	9	7	14	43
from local groups	4	15	15	11	12	57
local totals	6	26	24	18	26	100
local out-marriage %						57.0%
wives from new groups	0	0	1	0	1	2
grand totals	6	26	25	18	27	102
overall out-marriage %						57.8%
PERIOD 5						
wives from Tungei	3	11	3	10	13	40
from local groups	3	15	18	5	11	52
local totals	6	26	21	15	24	92
local out-marriage %						56.5%
wives from new groups	1	7	10	1	5	24
grand totals	7	33	31	16	29	116
overall out-marriage %						65.5%
PERIOD 6						
wives from Tungei	0	10	4	10	10	34
from local groups	9	26	35	12	22	104
local totals	9	36	39	22	32	138
local out-marriage %						75.4%
wives from new groups	2	15	25	6	19	67
grand totals	11	51	64	28	51	205
overall out-marriage %						83.4%



Tungei wife-taking over six periods percentage of marriages from outside the tribe (compared with Kawelka)

Figure 7.3

When the non-local marriages of Period 5 are included - the wives obtained from new areas - (Periods 2 and 3, in: 22 + 32, out: 61 + 84; Periods 4 and 5, in: 43 + 40, out: 57 + 2 + 52 + 24) the drop in tribe exogamy is reduced. Its test value of $chi^2_{[1]} = 5.642$ is significant at the 5% level: $p(H_0) < 0.025$. On several counts, then, the change in marriage patterns is statistically significant.

Processes of Segmentation

Sustained population growth is a clear determinant of change in the Middle Wahgi. According to Reay (1959a:29-30), clans pass through several phases of segmentation, marked by an increase in size from 100-300 persons (Phase A), to 200-900 (Phase B) and to 700-1700 (Phase C):

> ...in accounting for the development of phratries (the descent groups of widest span) there is always a tradition that there was originally a single clan that underwent progressive segmentation through phases A and B until, at C, the main segments of the clan began to intermarry. Separate clanship was established as the groups became exogamous.

Perhaps clan fission of this kind was a factor, after the Pacific War, adding to the permissible sources of brides within the tribe. Equally, restrictions may have been placed on internal marriages, after about 1960, once these new sources had been 'exhausted'. The effect of Tungei marriage rules may have been to require young men to look outside the tribe again for wives during the 1960s and 1970s, when the trend of the 1950s was reversed and tribe exogamy became more important again.

The paradigm for Tungei segmentation is given by Komnemb clan. The suffixes **-kanem**, 'kind', **-emb**, 'stem, root or shoot', and **-ka** (no literal meaning) are used at progressively more inclusive

levels.[8] Naming conventions are similar to those discussed by A.J. Strathern (1971:26-7, 31) and new names are often formed in pairs. Examples are Kundi/Ping-ka ('red and black **ka**'), Komn/Eki-emb ('first and last shoot') and Osi/Olt Kanem ('short and long kind'). An exception to named pairs is the use of names like Einaɨ Kanem, 'obsure kind', Wunouen-emb, 'tiny root', and Kelemb, 'small root', to denote sub-branches of main lineages.

An example of intra-clan segmentation was given as follows. A big-man of Andakelka Tungpi clan was distributing pork to members of Tungei Komnemb clan. Two parts of the clan were descended from the two wives of the founder, who were by birth from Mengka Epni and Kenapuɨ clans. In his speech to the recipients the big-man called on each to receive a side of pork. He addressed them by the name of the natal clan of each ancestress, calling out 'Epni Kanem' ('Epni kind') and 'Kenapul Kanem' ('Kenapuɨ kind') to name the two sections.

In the case of some clans steadily growing in numbers, low level segmentation has occurred fairly recently. Malimbe told me that the smallest sub-divisions of Komnemb clan, the **arim kumna/eki** ('first father/last father') lineages of both Kenapul Kanem and Epni Kanem had been named in his adult lifetime, perhaps in the 1930s. On the other hand, Ekiemb clan has declined in numbers - its sub-clan genealogies show many more men living in 1933 than now - and both Menjpi and Kupaka have a number of relict sub-clans with few or no members today. Menjpi Toɨ named three Menjpi Pingka sub-clans, Kuse-emb, Kiltei-emb and Kei-eimbaɨ-emb ('Lesser bird of paradise root'), which all became defunct by the 1930s.

But even by 1981 no great structural changes affecting clan exogamy had occurred, despite a rate of population growth which must

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[8] These are the typical Tungei suffixes. Regionally, the suffix **-emb** becomes **-mbo** in Melpa areas (e.g. A.J. Strathern 1972:42-3); it is not used in the Middle Wahgi. In the latter area **-kup** and **-kanem** are the sub-clan markers. At the highest level, the suffix **-pi** is sometimes seen, as a alternative to **-ka**, for example Kendipi or Kenjpi, a Melpa tribe in the Dei Council, Tungpi, Niɨpi, etc.; **-pi** may be archaic; in the formation Kenjpi-emb, 'shoot of the Kenjpi tribe', it is so firmly attached that another suffix has been added onto the whole word rather than the presumed stem.

have caused an increase in numbers of between 50% and 100% since these last sub-clan divisions were made.[9] Most of this increase may be accounted for by the unusually large family sizes seen since 1950; a small increase in the number of families has resulted in a huge increase in clan populations. While major changes can be expected eventually, fission should not occur until the present generation of young clansmen are mature, family men (**wu gał**), or even elders (**wu mam**). The lineages which do become sub-clans will take the family heads of the 1930s as their apical ancestors.

Tungei Marriage Rules

Tungei marriage rules have a direct bearing on how many marriages can be made within the tribe. They can readily be understood by reference to what is permissable in Hagen and in the Wahgi. The Stratherns (1969; A.J. Strathern 1972; A.M. Strathern 1972) have discussed Hagen practices in some depth, while Reay (1959a) and Brown (1969) provide details for the Middle Wahgi and Central Chimbu respectively. Another related but less widely known people are the Narak-speaking Manga of the Upper Jimi Valley described by Cook (1969). In none of these societies may two people of the same clan (or 'great clan' in some cases) nor two people already recognisably related by marriage marry one another.

All the societies stress the need to maintain friendly relations between clans and their neighbours by exchanging clan sisters with each other. The main difference between the Kuma and Hageners lies in the expression of sister exchange. In Hagen a rough balance is kept in the numbers of women flowing between pairs of clans; in the Wahgi, men can exchange their family sisters. Among the Manga just to the north it appears that sister exchange is especially highly developed, with 20-30% of all marriages being arranged this way (Cook 1969:103-4). The Hagen rule which precludes this (the **rapa** rule) is given by A.M. Strathern (1972:80) as follows:

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[9] The population size of the Tungei increased from 910 in the 1958 census book to 1125 in the 1968 book, equivalent to a rate of growth of 1.02% a year or 66% over 50 years. This is one of the lower figures for population growth that can be extracted from official statistics.

> Once, depending on context, a clan's or sub-clan's lower level units (sub-sub-clans, lineages) have each made a marriage with those of another sub-clan, no further unions can be contracted between the two groups.

It is easy to see that this would normally prevent a man from marrying his brother-in-law's sister (ZHZ), so that sister exchange, **amb rop**, would be ruled out (Strathern and Strathern 1969:156). The Tungei also follow a **rapa** rule but still exchange sisters. The apparent contradiction is resolved by making the exchanges simultaneous. Thus the **rapa** rule can be conceived of as taking effect only after an exchange marriage dyad has been set up, as if it were a singleton marriage link. Cook (1969:100) states that among the Manga 'Marriage prohibitions largely depend on previous marriages. These marriages establish kinship ties which ideally last for a specifed two generations, after which the descendants are again regarded as non-kinsmen'. This is, in other words, a form of **rapa** rule. Whether this prescribes simultaneous (and proscribes delayed) sister exchange is not stated.

The 'lower level units' referred to by the Stratherns are unfortunately not easily pinned down. The general Hagen term, **manga rapa**, for men's house has the Tungei counterpart, **ngi rapa**, 'house **rapa**',[10] or **ngi pese**, 'house **pese**'. A small clan might only make up one **ngi pese**, while the several sub-clans might themselves consist of a number of **ngi pese**.

Tungei Minimal Lineages: an Exercise in Tracing Marriage Links

One way of identifying the **ngi pese** is to discover the minimal lineages of a clan which have historically made just one marriage each with the minimal lineages of other clans. An attempt to do this is presented in Table 7.4, where I have listed all the 168

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[10] This specifically refers to the Hagen-style round men's house, which is only built by the Tungei for **kung ngi**, the pig festival, when the magical properties of the round house for attracting wealth are required. In the Blowers-Ramsey orthography, **ngi tape** would be the strict spelling of the term (see Notes on Orthography). For consistency with the existing literature I am continuing with the spelling **ngi rapa**.

Natal lineage of women

Lineage of men		Komnemb															Kenjpi-emb										Akamb		Ekiemb				Kupaka			Eska		Menjpi											
		KUI KOM	MEI WU	KAIMA 2 & 3	DAL	PEKAM	MINDING	REI	TUMI	WANDAKE (1)	NOMUNI	TANG WU	GERI	GUS (1)	GUS (2)	MANGE	KREL	KILTEI	KENG WU	(PAPENGA)	OMBUNG	WU KUNDI	MAPSE	MAMBE	MAMBE AMB	TEPIP	KEPIP	MENDI	(TUMBANG)	WENI WU	YEN WU	JIPENEMB	NUI	WEMBE	EINGAL	OSI	KELEMB	PINGKA	NUMNDI	ONEMBE	ESKA	MENE (KELTI)	MENE	GARU (1)	GARU (2)	KORE	KANLE	WU KELIP	ENDU NI	WUKA	DUA	WURI	JU	KUNDI PARKE	KUNE WU
Komnemb	KUI KOM																																				1	1				1												
	MEI WU																																					1						1										
	KAIMA 2 & 3																																									1					1							
	DAL																																											1	1								
	PEKAM																																							1														
	MINDING																																																					
	REI																																																					
	TUMI																																							1														
	WANDAKE (1)																																																					
	NOMUNI																																															1		1				
	TANG WU																																																			1		
	GERI																																																			2		
	GUS (1)																																									1		1				1						
	GUS (2)																						1																											1				
	MANGE																																											1										
	KREL																																																					
Kenjpi-emb	KILTEI																																																		1	1	
	KENG WU																																							1										1				
	(PAPENGA)																																																					
	OMBUNG																																									1									1			
	WU KUNDI																																						1	1		1					1						1	
	MAPSE			1								1																																								1		
	MAMBE																																2						1		1		1				1						3	1
	MAMBE AMB			1																																															1				
	TEPIP																																									1		1	1						1			
	KEPIP																																													1								1	
	MENDI																																									1									1			
	(TUMBANG)																																									1												
Akamb	WENI WU																																														1			1	1		
	YEN WU																								1								1										1		1		1						1	
	JIPENEMB																																														1			1			
Ekiemb	NUI																							2			1		1										1		2						2			1				
	WEMBE																																																					
	EINGAL																																			1																		
	OSI																																														1						1	
Kupaka	KELEMB																																																					
	PINGKA																																																					
	NUMNDI		1	1									1					1													1	1							1	1	2													1	1
	ONEMBE													1									1													1							1											1	
Eska	ESKA			1	1				1	1				2	1							1	1													1			1															1	
	MENE (KELTI)			2	1										1					1						1			1												1													
Menjpi	MENE	1			1									1						1					1	1					1																								
	GARU (1)																					1																																	
	GARU (2)											1														1	1		1																										
	KORE	1			1				1																	1													1																
	KANLE								1		1																1																												
	WU KELIP	1	1						1		1							1				1			1	1						1																							
	ENDU NI																									1																												
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	JU																					1													1																			
	KUNDI PARKE		1		1												1	1						1			1																												
	KUNE WU	1														1																	1																						

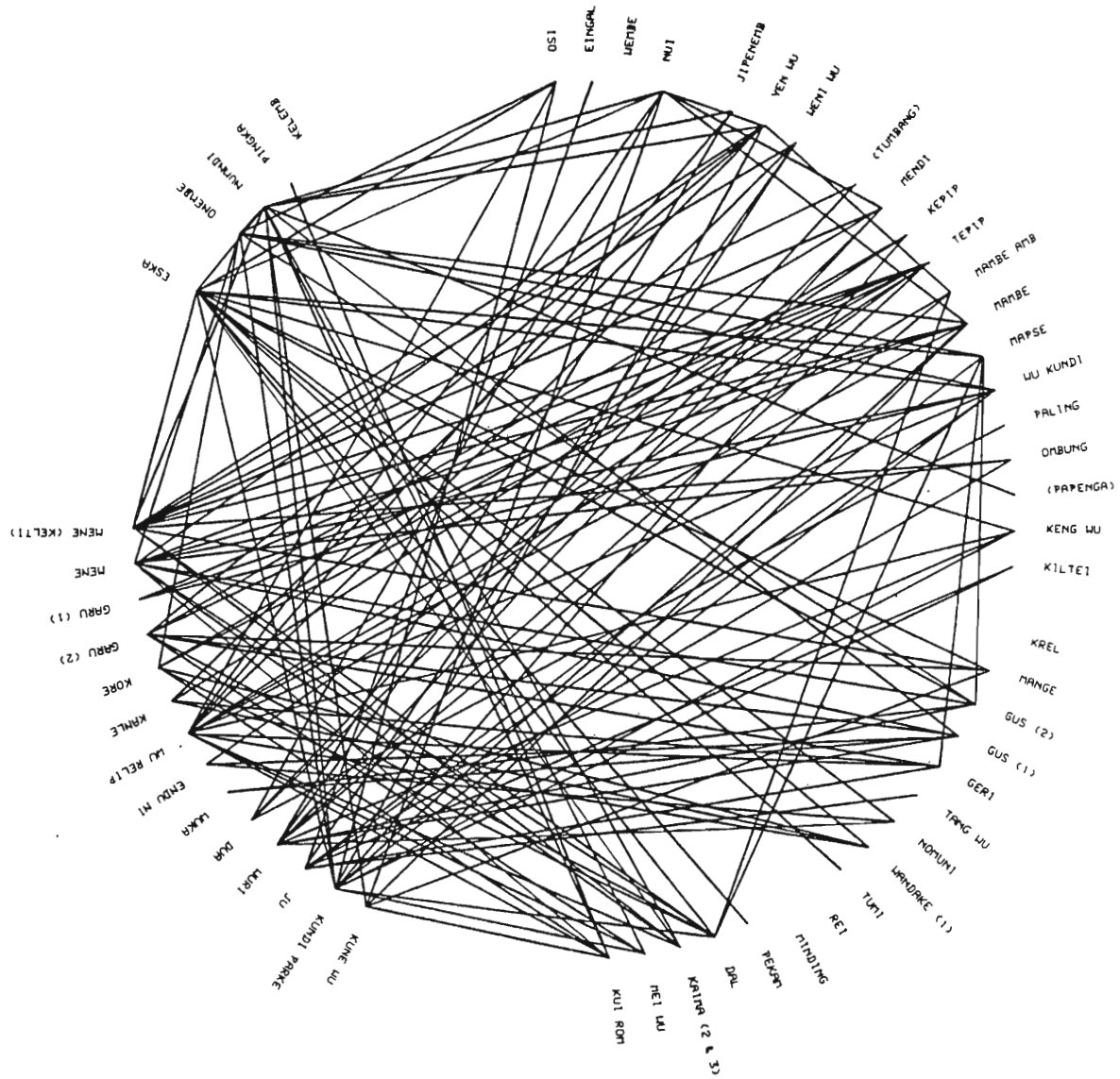
Recorded marriages between Tungei lineages sample of 168 over all periods

Table 7.4

marriages that I recorded between lineages of Tungei clans, in which the natal sub-clan of the wife was ascertained. The starting point of each lineage was chosen by dividing the sub-clans of Figures 2.9-2.36 into roughly equal-sized parts headed by a male member. Each lineage is intended to be as large as possible, but not so large that more than one marriage link exists with a lineage of another clan. A link could be either a single marriage or an **amb rop** dyad.

Named sub-clans often made more than one marriage with each other, but as Table 7.4 shows, in most cases where there have been several marriages, they have been distributed quite evenly among the different lineages that can be distinguished within them. A case in point is Kenjpi-emb Kełak Kanem (Fig. 2.11) and Menjpi Kundika (Fig. 2.28) with nine marriages over the past 80 years. Kełak Kanem is said to comprise two lower level lineages, loosely known as Mambe **kupam** and Wu Kundi **kupam** ('grandfather'), after the two sons of the founder, Wan Eki. However, these are insufficient to reduce Kełak Kanem to its lowest genealogical denominators. Mapse, the sister of Mambe and Wu Kundi, returned with her children from another clan to found a line of non-agnatic sub-clan members, and this has also happened more recently within Mambe **kupam**. Four lineages, then, might be thought of as the **rapa** within Kełak Kanem for the purposes of reckoning genealogical closeness between prospective marriage partners. They are labelled 'Wu Kundi', 'Mapse', 'Mambe', and 'Mambe Amb' in Table 7.4.

In total I have distinguished 55 lineages along the same lines. The names I have given them are those of the apical heads of the lineages; most are to be found in Figures 2.9-2.36. In all, 754 permissable links can be reckoned between the lineages, but far fewer are known to have been taken up, because there have not been enough women in each lineage to send one to each of the others. In fact 205 marriages are known to me, of which the 168 included in Table 7.4 can be traced between two lineages (the same information is graphed in Fig. 7.4). The table shows that the vast majority of links between lineages are not duplicated. There are ten instances of two women being sent to the same lineage, and one instance of three being sent. It may be noted that there are also instances of marriages between lineages of clans which form part of the great



TUNGEI TRIBE known links between minimal lineages

Figure 7.4

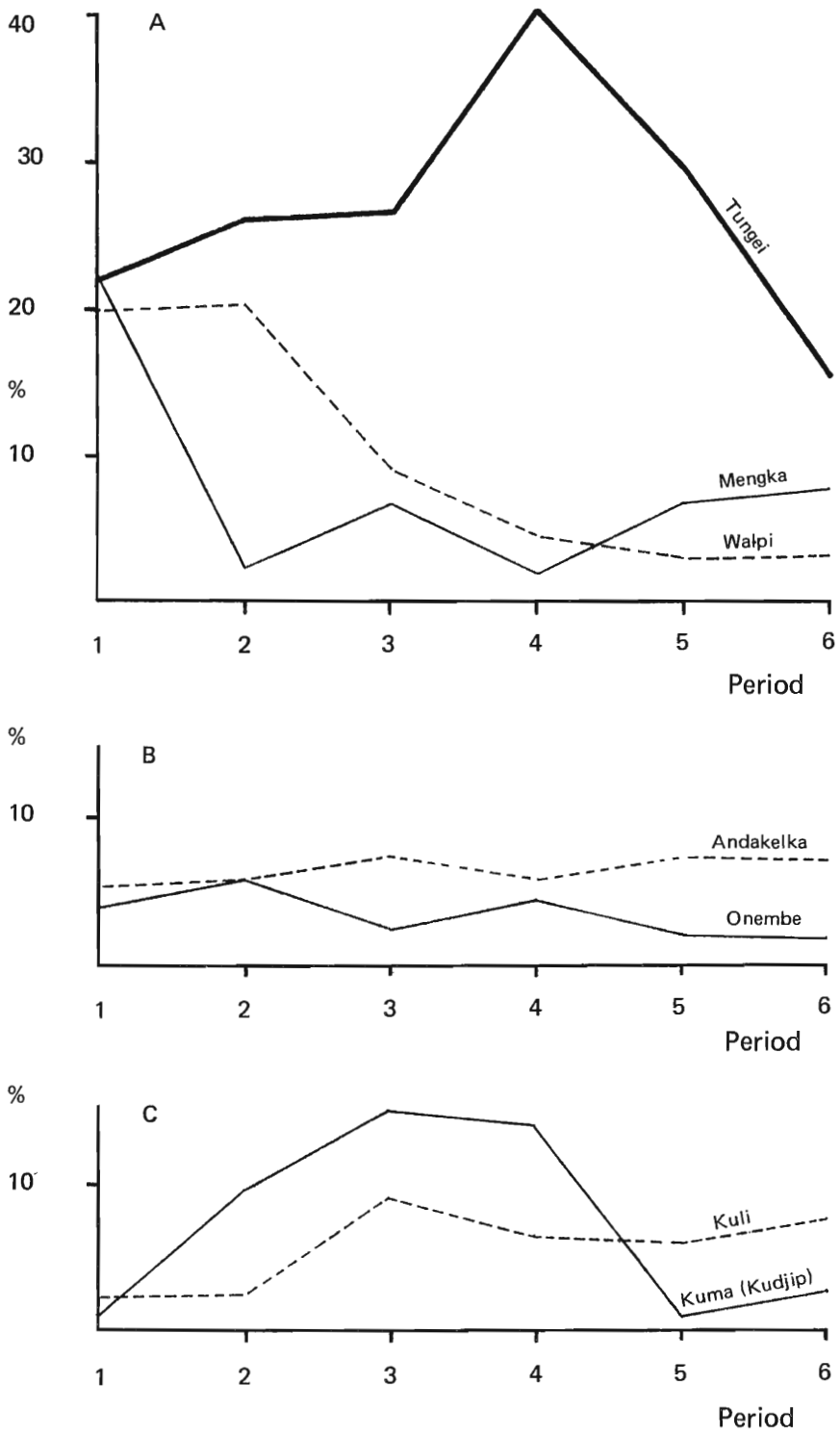
(data in Table 7.4)

clan Komnemb + Kenjpi-emb + Akamb + Ekiemb (see Chapter 2). In general the marriages are between lineages of agnates and lineages who can be traced back to non-agnates; these are mostly the descendants of Tungei women who returned home with their children when their marriages to non-Tungei husbands ended.

The possibility that population growth created an unusually large pool of eligible Tungei girls within the lineages in the 1950s still remains, but it can easily be discounted. If growth began in 1950, no 'new' and young men and women of marriageable age would be seen until the late 1960s. This is long after the effect to be explained actually occurred. If population growth was the cause, it would have to have started as early as 1933 - perhaps due to the cessation of tribal warfare - and been unaffected by the wartime dysentery epidemic that struck in early 1944. Although I have argued elsewhere (Burton 1983) that dysentery was not the cause of a massive population decline in the populous parts of the Wahgi Valley, this is far from arguing that there was actually a sharp upwards jump in population very soon after 1933. It is much more likely that the present high rate of population growth began in the late 1940s or early 1950s.

Political Change in the Tuman River Area

The relationships of the Tungei with their neighbours have often been dictated by the shifting military alliances of their area. I have noted that the Tungei fought two major wars before 1933, one around 1920 with the Mengka, and the other around 1930 with the Mamelka. As far as marriage with Mamelka is concerned, the conflict with them effected little change, since few brides had come from them beforehand. But the four Mengka clans - Epni, Kenapuł, Mengka and Mombłe - traditionally supplied a large fraction of Tungei brides. One third of the Tungei female ancestors (Period 0) were natally Mengka, while from 1900-20 (Period 1) 22% of Tungei brides were Mengka. After the Tungei-Mengka war this dropped to 2%. Clearly the viciousness of the hostilities, in which several men were killed on each side, prevented any early resumption of friendly social intercourse. The Tungei turned elsewhere for young women (Figs 7.1 and 7.5a).



TUNGEI TRIBE the importance of various sources of wives over six periods expressed as percentages of all marriages

Figure 7.5

After 1933 a similar abrupt decline also occurred in marriages with Waɨpi. Waɨpi and Tungei fought a battle in 1934 in which six Waɨpi were killed, and this clearly damaged Tungei-Waɨpi relationships for a time. From Period 2 to Period 3 the proportion of Tungei brides originating with Waɨpi fell from 20% to 9% (Figs 7.1 and 7.5a). The two groups, Mengka and Waɨpi, thus supplied over 40% of the brides taken by the Tungei before 1920, but after 1933 only 11%.

The removal of these two sources over a fifteen year period ought to have had a marked effect on the rate of tribe exogamy. But this did not happen, and until the end of Period 3 the rate remained constant. There was no change in the relationship between the Tungei and groups like Andakelka and Onembe (Fig. 7.5b), and remoter sources of extra-tribal women were found to replace the contributions of Mengka and Waɨpi, a phenomenon seen in the rise in importance of the Kuma groups groups Kurupka-Miamka to the east of the Tungei at Kudjip and, to a lesser degree, the increasing importance of Kuli, the large Melpa tribe to the west of the Tungei (Fig. 7.5c).

The scale of changes brought about by political upheaval is undeniably great and does account for some trends in wife-taking in Periods 1-4. Nevertheless these changes do not fit in with the large rise in tribe endogamy after Period 3.

The Loss of the Axe Trade

As I noted on page 141, stone axes all but disappeared from brideprices in the Western Highlands and Simbu after the Pacific War. While there may be yet more factors to accommodate, the hypothesis that the loss of the axe trade was instrumental in changing the marriage patterns of the Tungei may now be examined. I will call this the 'axe trade hypothesis', while the previous influence of the axe trade on Tungei marriage patterns may be termed the 'axe effect'.

The three intermarrying great clans of the Tungei will either have been 'saturated' with respect to each other in traditional times or there will have been room for further marriages between them under the **rapa** rule. The point of saturation would come when

no further marriages could be made because either all permissible links were taken up or permissible links existed but no further young women remained to be married.

Because there was a sudden increase in intra-clan marriages after the Pacific War, and because the factors already discussed played no part in this, it is certain that the Tungei clans were well below the saturation point before the War, when the stone axe economy was flourishing. The axe effect was the propensity of Tungei men to accumulate stone axes and give them away in brideprices for women from outside the tribe rather than for the women of other quarry-owning lines within the tribe. It would have been attractive to do so: a wider network of affinal relatives would have meant a larger set of allies for the clan and better access to shells and other traded items. More distantly situated people may also have been willing to accept brideprices comprising fewer axes than people closer to the axe factory who already had quite good access to the stone axes of the Tungei.

The View from Outside

It seems likely that, faced with a choice of a youth from Aviamp and a youth from Minj, the kinsmen of a girl from a place halfway between the two would have preferred her to choose the partner whose kinsmen could give a brideprice containing more and better axes. For the same reason, a man who was thinking of finding a suitable husband for his daughter would have been inclined to test out his Tungei contacts first. Once his daughter was married to a Tungei, moreover, he would have established more than a lifetime's access to one of the valley's more important sources of wealth, as the example given below shows.

A term heard among the North Wahgi Komblo tribe, referring to a marriage with the allies of the Tungei, Kurup-Miamka, was **nze Kunjin wusngal**, 'axe Kunjin road', or 'a way of getting Kunjin axes' (M. and L. O'Hanlon, pers. comm.). All things being equal, a girl's kinsmen preferred affines who could pay a larger and better brideprice than those who could not.

The Example of Dambe-Tungka Kanem

At Minj, the Kondika had no means of contacting the Tungei when they wanted axes; no agnatic Kondika had affines amongst them. However, in years gone by some Kisu refugees had made their home with the Kondika and their descendants form the sub-clan known as Dambe-Tungka Kanem. In remembered times the Dambe-Tungka men Pingai and Kapal Tangiɨ Tol used their relationship with the Tungei to visit them and trade for axes. This relationship had been most recently renewed by the marriage, around 1910, of the woman Sem to Komnemb Dorum (Fig. 2.19). Her son, Pou, confirmed this, listing the Kondika Dambe-Tungka men Kopile, Kouɨe, Ambre, Pop, Kapil, Kundup, Geru and Pou as men who came to trade for stone. These men were his uncles; none was his particular trading partner.[11]

In fact Damba-Tunga Kanem made a speciality of trading for axe roughouts at Aviamp; they called these **dei enj peɨ** or **dei enjim peɨ**, 'axe waste whole' (Nii: **tui enj/enjim pei**). Kopile was closely related to Sem (her FBS) and went himself on several of the visits. They used to travel into the Kubor Range at Kuling Komeng and traverse to Koukel Komeng (Fig. 2.2) at the head of the Kanye River, where they could descend into Tungei territory without meeting their enemies, the Kurup-Miamka. They typically carried **kung keɨip**, quarter of a pig, a standard middle-sized payment for giving to trade partners. Komnemb Pou listed the following goods: **kung keɨip**, **toue embin** (special bananas), Pesquet's Parrot, Princess Stephanie's bird of paradise, Black Sickle-Billed bird of paradise, pearlshells and the Gumine salt **ep kuse**.

Once they had arrived on Tungei ground they were received by their affines and made trade with them. They were not allowed into the quarried areas, where there was a **tendamb**, a screen of banana leaves, which blocked the view beyond and where outsiders had to wait if quarrying was in progress. This was, of course, the **teper** I

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[11] Interviews 18-81, 23-81, 27-81. The Komnemb considered Sem to be of Kisu origin and I have listed this Period 1 marriage under the Kisu in Table 7.2.

described in Chapter 4.[12]

At this distance from home it was clearly important for the Dambe-Tungka men to be confident of a friendly welcome, and this was solely guaranteed by the presence of their kinswoman and the Komnemb children borne by her. Both Kondika Kopile and Kondika Mond pointed out that casual travellers could not expect this kind of treatment and therefore could not trade for axes. Back in Kondika territory, Dambe-Tungka Kanem enjoyed a trading monopoly and they made the sharpening, hafting and distribution of newly finished axes to other Kondika their speciality. Notwithstanding the fact that other men had special access to other sources of wealth, such as Tangilka[13] who had particularly good links with the plume traders of East Kambia (cf. Reay 1959a:105), any men's house group at Minj who could tap the wealth of the Tungei found itself in a highly privileged position. Kondika Mond went as far as to say Dambe-Tungka Kanem were a **kampani** (New Guinea Pidgin, a company). Many men said that no group could monopolise the skills needed to trim and sharpen stone blanks or roughouts: possession of a regular source of materials was the key to wealth in axes.

Other Evidence of Changes in Marriage Patterns

A question that I have not attempted to answer is whether the Tungei were polygamists more often than their neighbours; if they could raise large brideprices, it seems likely that they could, as individuals, have obtained more wives than other men. Unfortunately I could find no evidence of this in the 1958 census book and I was unable to devise a means of accurately recovering the information from interviews.

Information similar to that which I have presented here is

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[12] **Tendamb** is the Wahgi term for the screen fence that is broken down at the climax of the pig festival when the dancers burst onto their dance ground (cf. Reay 1959a:153). In the **kung ngi** this is called a **teper**.

[13] Interview 22-81.

available for a few other groups in the Papua New Gunea highlands. One is the Kombulaku tribe of southern Simbu. Podolefsky (1984) collected genealogies at Mul, near Gumine, and extracted a sample of marriages contracted before and after European contact, which he defined at 1954, when a patrol post was first established at Gumine. Podolefsky tested the change in tribe exogamy across the contact period and found that there was a highly significant decrease in inter-tribal marriage (1984:Table 1). The two periods that he compared were an unspecified number of years before 1954, and 1966-76. Podolefsky (1984:Table 2) also found a significant decrease in intra-tribal marriages among the Central Chimbu Naregu before and after contact there in the 1930s, using figures collected by Brown (1964:Table 1). He suggests (1984:83, 85) that the change resulted from a decline in the need to maintain traditional trading links between neighbouring tribes in Simbu. The weakening of intergroup marriage ties is also put forward as a cause of the revival, in the 1970s, of tribal warfare.

Podolefsky's explanation lends support to the idea that the incentives for the inter-group exchange of women were withdrawn when it was no longer necessary to secure access to traditionally traded goods. However, he does not provide sufficient details of Kombulaku social organisation and history to rule out completely independent effects, such as political upheaval in the Gumine area or clan fission and migration. As he points out himself (1984:81), Brown's original explanation for the Naregu changes were related to clan movements at about the time of contact. His sampling method is another unknown factor. The Kombulaku number around 4000 people and comprise five clans of approximately equal size (Podolefsky 1984: 76), but Podolefsky included only a small fraction (188) of the likely number of marriages contracted by the Kombulaku in his tests of significance. It is not possible to tell how these were selected from among the five Kombulaku clans.

Other trade-related effects have been observed among the Siane and in Sinasina. Salisbury (1962:104) reported that there was a significant drift of women towards the northeastern Siane groups that lay closest to the sources of greensnail shells on the north coast of Papua New Guinea. After 1933, the presence of a government station at Goroka exacerbated the directional flows of women. Hide

(1981:181-204) provides detailed information for Sinasina and remarks on a similar drift in the direction of the government station at Kundiawa. Lastly, Nurse (1981) has claimed that movements of women from the northern highland margins were predominantly towards the north coast in response to the availability of shells there.

CONCLUSION

The economic benefits enjoyed by the Tungei by means of the control of major stone axe quarries vanished when stone axes dropped out of the wealth economy during or after the Pacific War. As is well documented, other valuables, principally pearlshells, took their place in brideprices and, by the time anthropologists settled among highlands societies in the 1950s and 1960s, pearlshells dominated wealth transactions everywhere except, perhaps, in Enga (cf. Feil 1982). The sources of the new wealth, moreover, were to be found in new places. Groups who were formerly rich, by virtue of the fact that they owned axe quarries or because they lived across trade routes from the sea, became poor; those who lived near the landing grounds of patrol stations and missions became rich (Hughes 1978). As soon as the new sources of wealth were perceived, men turned towards them. As owners of a now valueless resource, the Tungei no longer 'pulled women' as they formerly did.

Supporting evidence comes from the early patrolmen. Accounts are legion that highlanders tried to marry their daughters to the white men and their coastal New Guinean companion: in one apocryphal example they hoped to obtain cuttings of the 'pearlshell tree' (Simpson 1954:Chapter 7). Inevitably men looked to establish stronger contacts with the better placed groups of their region like the Mokei, Jika and Yamka around Mt Hagen township, once the Australian administration became an established reality.

For a time the strong incentives for the Tungei to marry girls from everywhere but among their own clans were withdrawn. According to Figure 7.3, this period lasted from the end of the Pacific War until the late 1960s. The effect was most pronounced in the 1950s when men took up 'vacant' inter-**rapa** linkages. From the late 1950s, men looked beyond traditional horizons to marry women of more dis-

tant groups and in time the cash economy reached Aviamp, coffee was planted, schools were opened and Tungei social horizons widened in a permanent way. By the 1970s a high rate of overall tribe exogamy was maintained. Over 80% of brides were from other tribes.

Chapter 8

QUARRIES OF THE SEPIK-WAHGI DIVIDE AND JIMI VALLEY

The earliest written accounts show that the Melpa-speaking part of the Sepik-Wahgi Divide and the Jimi Valley, the geographical area known to Hageners as **Kopon**, was one of the major areas of stone axe production in the 1930s. The factory on the Ganz River, owned and used by the Oklmeni and Kisingambka, is the best known of a number of stone axe quarries, but at least six other politically separate groups made axes over a broad swathe of territory some 300 km^2 in area from the headwaters of the Muka River to Tsenga (Fig. 1.1). These groups, the Kawelka, Tipuka, Palke, Tumalke, Minji and Make tribes, were all Melpa speakers, and each was in contact with other Melpa groups in the Wahgi Valley through the medium of **moka** and through kinship ties. In addition to this main group of sources, a Maring-speaking group, the Ambrakwi, made axes on the north side of the Jimi River and there may well be other minor quarries further afield in the area known as Simbai (Table 1.1).

AXE NAMES AND SOURCES

Chappell (1966) made the first systematic survey of the Jimi quarries, following preliminary investigations by A.M. Strathern among the Kawelka (1965). The sites described by Chappell were Maegmul, Tsenga, Ganz River, Mala Gap, Yambina, Pukl and Mbukl. This accounted for many, but not all, of the names in A.M. Strathern's list (1965:188-9). Hughes (1971:293-6) visited the Ganz River and Tsenga and discusses the names of axes at these two sites. Gorecki (n.d.) was able to give me a slightly different list of axe names which he obtained at Kuk from elderly Kawelka informants. He asked them to identify 110 axes which he had collected. This added to the names already known and confirmed some of the rare or suspected sources. I was able to trace several more of these and clarify the relationships of others to geographical sites.

Among Chappell's sites, Maegmul and Mala Gap can now be discounted as traditional sources (see page 184), while two formerly unlocated quarries, Apin and Repeng, can be added. Several axe names remain to be traced to actual outcrops, but it is certain that these unlocated sites can only have made a very small contribution to the total axe production of the Jimi Valley.

Another point is that informants do not refer to the quarries by the same names everywhere. Thus in the neighbourhood of the Ganz and Tsenga, two of the main quarries, the names **ketepukla**, **tingri** and **gaima** are the names of the chief products. But Melpa speakers elsewhere know of **tingri**, the dark-coloured variety made at Tsenga, as **tingrina** (e.g. Ongka 1979:25). At Tun, Menjpi Aip referred to dark and light-coloured Jimi blades as **tengrina apinj** and **tengrina angban** respectively, though the most common name given in this area and in the Middle Wahgi to all three varieties - and more besides - is **połemb**, further distinctions being made by adding a colour. Thus **gaima** blades, the light-coloured variety made at Tsenga, were called **połemb kuru**, '**połemb** white' in Ek Nii. In the Banz dialect, another name for **połemb** is **kur** while the phoneme /ɨ/ becomes /l/, so that along the North Wahgi **połemb** is also heard as **polemb**, or even **poremb**.

The Ganz River site may have been a large axe factory by any standards, but many minor sources have been worked on a much smaller scale, at least during the present century. Because the small sites have produced fewer axes over the years, they are less well known locally and less widely known regionally. It is likely that some sites have vanished from living memory and that over a period of centuries small sites have been brought into use and forgotten quite regularly. Since the modern vegetation cover is thick rainforest, field survey to find these sites would be almost impossible.

THE GANZ RIVER

The Ganz River factory, known as Ketepukla, was fortuitously visited by the Taylor-Leahy patrol, on 18 May 1933. Mick Leahy (Leahy and Crain 1937:183) described what he saw there:

> Just north of the Sepik-Wahgi Divide, we passed through a district which is undoubtedly the principal source of manufacture of the stone battle axes. This district seems to be neutral ground, the axe-makers being left in peace by all their warlike neighbours to pursue the useful art. We saw many natives engaged in working the axes, sitting by waterholes and patiently grinding away at them with sandstones, stopping every few moments to dip the stones in water and to sight with a craftsman's eye along the tapering blades, so slowly taking shape. Each beautiful axe must have required many days of patient work.

There are no indications that any of the party saw the open quarry faces and the descriptions are only of the rubbing places and the process of sharpening axe blades. Taylor's patrol diary (18 May 1933) adds more detail:

> The natives here were well built, carried bows and arrows and very fine stone axes. At 2 p.m. we moved on again to a settlement higher up on the ridge, where we saw what looked like the axe factory of the area. Here were numerous rubbing stones and pools of water and little shelters where the inhabitants were busy making stone axes. One of our carriers on seeing this said: "This is the 'house machine'".

The patrol made another visit to the area on 16 June 1933 during the patrol's next northward excursion (Fig. 2.1). On one of the two trips, probably the first, Mick Leahy took a number of photographs. One is clearly that of a group of grindstones and a small pool of water, exactly as Taylor and he describe (Plate 8.1).[1] After walking along a ridge above the right bank of the Ganz for a short while, they made camp. Taylor (18 May 1933) continued:

> The Ganz was about 1,000 ft below us, and M.J. Leahy and I dropped down to it while the others prepared the camp. A native guide who showed us the road imagined that we were seeking stone for battle-axes, and on several occasions pointed out suitable ones, scrutinising them closely, and licking them to test their value as axe blades. The people here are a robust and thriving community - are keen traders, and very hospitable. Almost every man carried a fine quality axe, and they were very keen to trade them for

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[1] The information accompanying the Leahy collection of photographs in the National Library of Australia is sketchy. The pencilled annotation to Plate 8.1 reads, 'Jimmie Valley people 1933. 1500 ft above sea level. Tropical bush. Malaria. Heat. Few people'.

> shells; steel they refused. It would appear that the best battle-axes in the Wahgi valley have come from here originally.

On early maps, such as the one made by Spinks (1936) on the Taylor-Leahy patrol, the placename is given as 'Mangarvigor'; this is the group or tribe name, Mangapka. But as far as I know, the Mangapka had in fact no rights to the site; it was worked only by the Oklmeni and Kisingambka. The Mangapka lived in the headwaters of the Ganz River, where they were well placed to exploit trade connections with the Hagen area a few kilometres to the south, but not able to visit the quarry themselves.

Plates 8.2-8.4 are apparently from the same roll as Plate 8.1; they show people from the Lower Jimi area carrying axes of high quality. P. Gorecki (pers. comm.) showed a large set of the Leahy photographs to people in three areas of the Jimi Valley: Melpa-speaking people, who extend as far north as the Gernt River, Pinai speakers north of the Gernt and Kalam speakers north of the Jimi River. All were in agreement that the photographs showed Pinai people near Ṛuti.

Comparing the photographs with Leahy's photographs of Hageners (e.g. Plate 6.9), it is worth noting the absence of any form of shell adornments among the Ruti people. Although the men portrayed might not be expected to have been wearing shells with their everyday dress, the total absence of even small strings of cowries is surprising, especially as Dendrolagus tails are worn and extremely good quality axes are carried. The apparent lack of shells hints that the exchange system between the shell-rich Hagen area and the axe-rich Jimi Valley may not have operated entirely in favour of the latter.

The comment that steel was initially refused is not a surprising one. It was a common reaction for men to think that an item of value in the wealth economy was the fair exchange for a stone axe, rather than a tool of use only in the sphere of subsistence. Taylor's remarks about the high demand for shell reinforce this.

The site was visited by the patrol officer L.G. Vial in 1938; Vial (1940:159) described the technique of removing the soil and overburden by the technique of damming and sluicing:

> The quarry was in a clearing on the hillside, and a water race led to the top of it to wash away ground and expose the rocks. Lower down there was only an inch or two of earth and loose rocks up to a cubic foot in size could be pulled out of a face about four yards wide and three feet deep.

I visited the site twice, in 1980 and in 1981. I was told that the Puklin Creek was dammed some way above the site with logs and stones; I did not see the place but ditches a metre or two wide certainly entered the site from above. The presence of large, irregular washouts, rather than neatly excavated pits, confirmed the picture of a relatively low-intensity quarrying operation, in which stone was quite plentiful and not at all difficult to extract. Fire was not used at the site, as it was at nearby Tsenga.

I was unable to determine the longer term organisation and scheduling of quarrying work, but another visitor to the site before its demise, W. Bell, an ANGAU patrol officer, discusses just these points. It comes as no surprise to learn (Lieut. W.T. Bell, PR, Hagen No.1 of 1944/45) that a large batch of raw material was removed every once in a while and that work was therefore episodic not continuous:

> The stone quarry, from which a smooth hard slate is obtained by the local natives for the making of Hagen axes, visited in the GANZ River gorge was no doubt the one inspected about 1938 by the late L.G. Vial and described in "Oceania" Vol XI No.2 Dec 1940 under the title "Stone Axes of Mt Hagen". When seen by this patrol the quarry was overgrown. Headman RUMAGAN explained that no stone had been quarried for three years as the stone previously obtained had been sufficient to make all the axes required in that period. However, as reserve stocks were on the point of depletion it was proposed to open up the quarry again. It will be worked for twelve months and then allowed to become overgrown again until more stone is required. Natives were anxious to know whether the Govt would trade gold lip shell for their axes and, if so, they would continue to make them. The axes have lost a lot of their value locally and are used now for ceremonial purposes almost entirely.
>
> Large pieces of rough stone were dug out of the ground and a demonstration given of the method used to split it with the sharp edge of another stone. Most of the stone seen was black in colour although a few pieces were light green. When the rough shape of the axe-head is obtained it is smoothed to proper shape, edge and smoothness on a sandstone with the plentiful use of water.
>
> To work the quarry all able bodied males of all groups in

> the vicinity will combine to clear the quarry of timber and undergrowth and dig out the stone. The breaking of the stone is dangerous work as chips fly in all directions and cause cuts and abrasions.
>
> The very large bride price axes, called "gaima" or "kundun" in the article referred to, are unknown to the Ganz Rv or Hagen natives. They are evidently made and used solely in the Chimbu area.

Of all the accounts of quarrying, Bell's report[2] is one of the most interesting; he was a visitor to a site at the very point when a new quarrying trip was being mooted. It is true that the economic environment in which quarrying was to take place had changed, but this does not alter the fact that the axe makers clearly had to balance a range of factors in thinking about their work.

It is also noteworthy that he says the axes had locally lost much of their value, bearing in mind that steel axes would have been extremely scarce in the poorly populated Jimi Valley at this time. Beyond the Jimi River, the Simbai area was still unpatrolled; the only metal available there took the form of sharpened bushknife blades or plane blades called **krn** and the fragments of several bombs which fell in the Maring area during the War, called **poningai** or **ponyingai** after the river where they landed (A. Rappaport n.d.). Even these cannot have been widely available in 1944 (cf. R. Rappaport 1968:9).

Varieties of Stone at Ketepukla

Chappell (1966:100) distinguished two kinds of stone at the site: a dark stone called **katabögra** and a lighter coloured stone called **gaima**, which was mainly used for hammers. Chappell's **katabögra** is what I call **ketepukla**, following A.M. Strathern (1965: 188), and after which the site, Ketepukla, is named.

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[2] Bell mentions the 'late L.G. Vial'. Leigh Vial was a famous coastwatcher during the Pacific War, and became known as 'the Golden Voice' because of the regularity of his reports from a heavily occupied part of Papua. He was killed when the Liberator bomber in which he was flying crashed on a supply drop in the Markham area (see Feldt 1946:51-3, 220).

The status of **gaima** is still unclear. I picked up a light-coloured hammerstone at Ketepukla site in 1980, but I was told the name **gaima** refers only to the light-coloured stone axe made at Tsenga, some 5 km away. Hammers, I was told, were called **ma ku** or **numa ku**.

Chappell also stated (1966:100) that debris extended over an area of half an acre; I think this can only describe one part of the site. I saw knapping wastes and surface disturbances over an area of at least five hectares.

Gorecki's (n.d.) list includes the name **rønglp** [sic]; an alternative name for part of the Ketepukla site is Røngeglp. I was told the following legend:

> A small girl went into a garden and cut her foot on a stone. Her mother wrapped the stone up in a **røngeglp** taro leaf and took it to her husband. The next day the man went to see for himself and he discovered that it was axe stone.

Another version I heard substituted two women weeding the **røngeglp** taro for the small girl who cut her foot; the women took the wrapped up stone to the men's house. Both versions are very similar to the Make legend of the finding of the Tingri site (see page 173 and Appendix A).

As with the Tuman quarries, Ketepukla had a number of sub-categories; they were **kontin, kamgan, pukei, kaikike, kerim pok, moruk** and **pukei oklimb.**[3] The names would normally be prefixed by the name **ketepukla,** as in **ketepukla moruk** for example. Note that **kaikike** appears to be the same as the Tuman **kunjin kaikiłe** (Table 3.1) and that **kontin** is a local pronunciation of **kunjin.** This may explain why some of A.M. Strathern's informants gave **kontin** as a Jimi Valley axe name (1965:188), and had not confused it with the Tuman quarry, Kunjin.

It was said that **kamgan** and **pukei oklimb** were the varieties of highest quality. One informant, Tuki at Kenints, said that a typical brideprice would have been 10 axes, 3-5 pigs and a number of

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[3] **Pukei oklimb** would seem to mean 'Conus shell navel', i.e. the hole in the centre of a Conus shell which is threaded into the nasal septum (cf. Plate 2.13). However I was told it referred to a kind of cassowary.

pearlshells (he did not state whether this was before or after the 1930s). However, if the givers had **ketepukla kamgan** or **ketepukla pukei oklimb**, they would hide them until they were sure a satisfactory return payment would be given. Only then would they part with these two kinds.

Mode of Operation

The Ganz River factory did not operate in quite the same way as that at the Tuman River. The Tungei were mainly concerned with the excavation of new pits and the winning of axe stone from an intransigent mother seam, as I have shown. However, Vial says only 'an inch or two of earth' was left at the Ganz River once the water race had done its work and blocks of stone were not hard to prise loose.

In August 1957 the Ganz River was visited by D. Attenborough (1960) who witnessed not the quarrying and manufacture of axes from Ketepukla for the purposes of exchange in the traditional wealth economy, but an essentially commercial manufacturing operation. As Lieut. Bell stated, axes were being bought by the Administration to inject cash into the Jimi Valley; the Ganz River axe makers were among those who switched their production to the exploitation of softer rocks in response to the new demand. Although the description Attenborough wrote in his diary (quoted in a letter dated 11/12/80) was made some 15 years after Ketepukla was abandoned, I see little reason to suppose that the Ganz River axe makers had radically changed their methods in that time:

> We sat and discussed the axe blades we had collected so far with them. Some, they said, had been made at Tsenga, where they said there was another factory, and others originated from here in Menjim. There were two sorts of axes, those for cutting trees which were short, stout and stubby. These are no longer made, having been replaced by the white man's 'spirit axes' (cf. cargo cult terminology). The other sort were used for 'sing-sing' and for 'chopim man' - presumably warfare. They said it took 3-6 months to make an axe.
>
> Barry [Griffin] talked to them...by the time we got up, twenty or so men, in a neat line by the flag-pole, are grinding away with their axes, using water held in banana leaves. We soon change this and say we want it in front of 'haus blong kanaka tru'. This they didn't care for - they

> said they always work by the river, which of course suited us much better. The axes they produce are used in ceremonials and in bridewealth. They grind them on blocks of sandstone, sometimes rubbing the axe on the stone (in which case the grindstone is often placed in a hole cut in a banana stem or log) and sometimes, especially in the initial stages, a long file-like piece of grindstone is rubbed on the roughly chipped axes, cutting grooves...
>
> ...we walked down the Ganz for 15 minutes, then up a side-creek on the left side of the valley to see the men getting the axe-stone - a dark green but not particularly fissile slate. They found it in boulders in the stream, brought it out to the bank and after a lot of discussion about the grain, faults and cleavage lines, they propped it in an appropriate position with logs and split it by hurling carefully shaped boulders at it from above. The slate split in large flakes, which were then shaped into blades. The wooden haft, bound with woven slivers ('pas-pas') was made rapidly - perhaps two days - the wood being shaped with an adze made from an old car-spring.

The source of axes mentioned here was probably Waspi, a new site on the Ganz River between Menjim and Ketepukla (see page 182), which, as mentioned by Attenborough, produced a green coloured stone. His account describes sharpening and haft making in more detail than the earlier reports of Vial and Bell, which are more concerned with quarrying, but it does not conflict with them. Waspi came into use in the 1950s, according to informants, but is not used any longer. I did not visit it myself.

Plates 8.5-8.7 were taken by Attenborough during his visit.[4] In comparison to the 'tourist' axes available today, which have thin, flaring blades of poor quality, the photographs show men at work preparing much thicker blades of almost traditional quality. Apparently there was some call for axes for use in traditional ceremonial contexts and in brideprice payments, but it must have been limited by 1957 and not a primary reason for keeping on with the manufacture of axes.

The scenario of 20 men sitting in a line to sharpen axes together is a particularly intriguing detail. On my visits to the

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[4] Mr Attenborough kindly sent me a set of 36 prints from the original roll of 2 1/4-square black-and-white negatives. The prints are archived with the Department of Prehistory, RSPacS, Australian National University.

Ganz River, the activity that both male and female informants most linked with axe manufacture was not quarrying, but of the men sitting down together by a stream and grinding the axe blades into shape. I was told women were excluded from the quarry site when the stone was being dug out, but I was not left with the impression that the process was either difficult or protracted. Pigs were killed when good axe stone was found and feasting of some sort was associated with a successful trip to the quarry; however, the ritually formalised quarrying operation seen at the Tuman sites was absent and there was no shaft construction, as at the Dom **gaima** quarry. I believe it was no coincidence that Jim Taylor and Mick Leahy were left with the overriding impression that the axe factory was a place where men ground stone blades into shape, that it was foremost a finishing place and incidentally a site of raw material extraction.

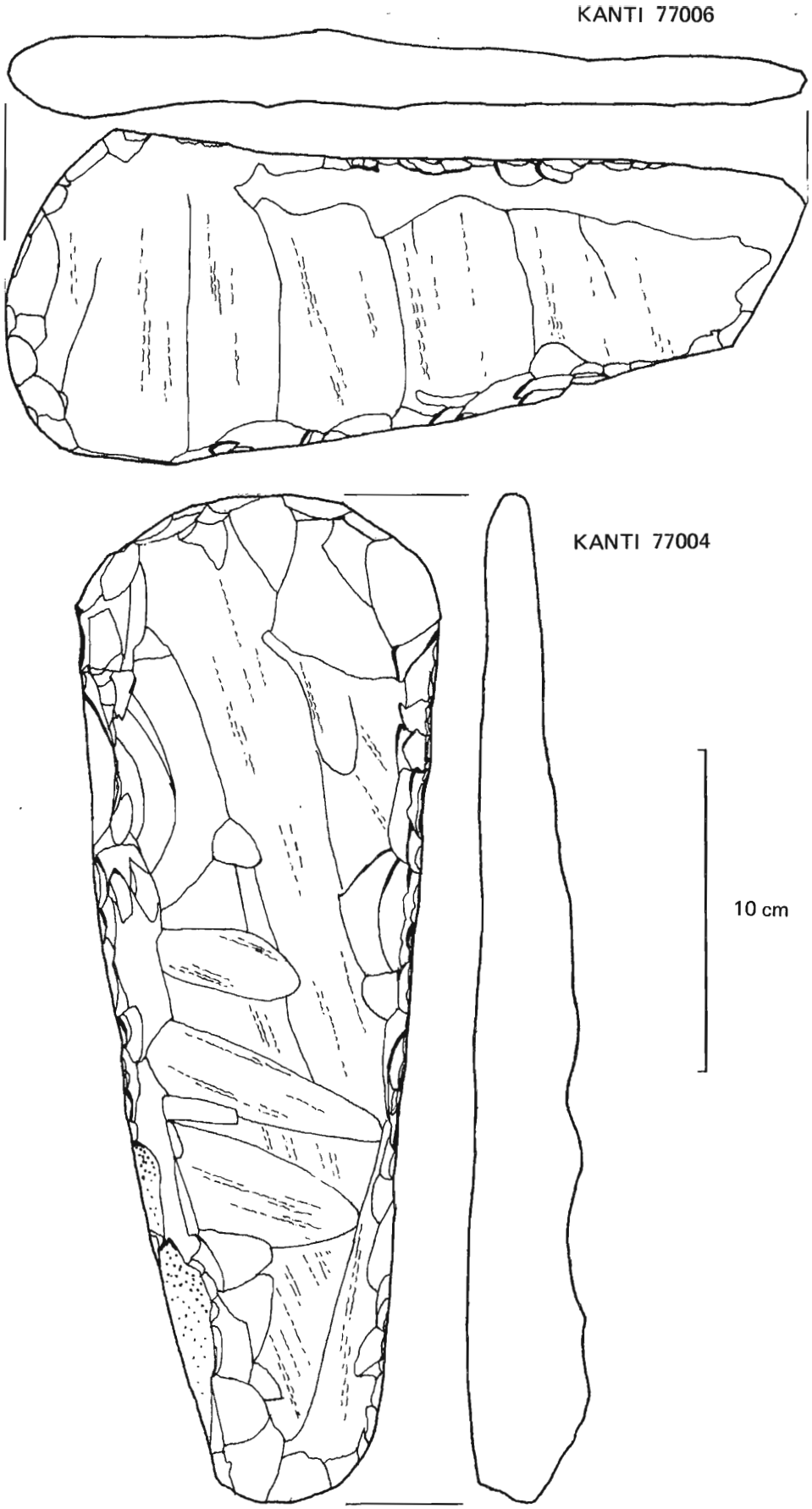
The two kinds of grindstone used on the Ganz River in traditional times were said to be from the creeks Kildamb and Tokmamb close to Menjim No.1 on the left bank of the Ganz (several kilometres upstream from Ketepukla). The detail of sharpening an axe by rubbing it with a smaller grindstone is particularly interesting as a number of the partly completed axe blades collected by P. Gorecki in this area in 1977-78 show the grooves mentioned by Attenborough. Two examples are illustrated in Figure 8.1.

TSENGA

This site was less well known to patrol officers than the Ganz River quarry and no reports from the area mention it as a traditional source of stone axes.

As described by Chappell (1966:98, Figure 3), a dark and a light axe stone were quarried at Tsenga, which is owned by the Make. The dark stone was called **tingri** and the light-coloured one **gaima**. (**Gaima** recurs through the highlands as a name for light-coloured stone.) I visited Tsenga on two occasions, once in 1980 and once in 1981.

In 1981 I took with me a dark-coloured Hagen-style axe and a light-coloured axe of the same size and shape in order to resolve the apparent confict between the names Chappell heard and the ones I had heard in 1980. The lighter coloured axe was always identified



JIMI VALLEY QUARRIES partly ground axes showing facetting

Figure 8.1

as Tsenga **gaima**, while the darker one was always named as **ketepukla**. Unfortunately I was not shown a **tingri** axe but informants agreed one would have looked very similar to the one they identified as **ketepukla**.

The place seen by Chappell was the Tingri site (Plate 8.8), where both **tingri** and **gaima** were extracted. **Gaima** was said to have been obtainable above ground, perhaps at more than the one outcrop. The neighbours of the Make, the Minji, also worked **gaima**. Ningni, the oldest current resident at Tsenga, brought out a large **gaima** roughout for me to see (Plate 8.9). **Tingri** was not exposed above ground, and only the Make worked its seam. As Chappell says (1966: 98), fire was used to fracture the rock, both at Tingri, where men tunnelled into the hillside for several metres, and at other outcrops at Tsenga. As at Ketepukla, a great deal of excavation work was probably unnecessary, even in the case of the underground workings at Tingri. These only superficially resemble true mine galleries; they are formed from natural rock overhangs or fissures that have been enlarged to yield axe stone.

I was shown two cliff outcrops 5-8 m high and 20-40 m long a short distance from the Tingri site; one at a place east of Tingri called Kukla Kukli was said to be the source of an axe called **nembi** or **ngembi**, the other was to the west of Tingri where the stone was called **yembine** or **yambina**. While many flakes and other axe making debris formed a talus several hundred metres long below the first of these sites, there were no traces of flaked material below the second, so that although the names are probably those of traditional axe types the precise location of their sources cannot be clearly fixed. I also heard the name **yembine** at Maegmul, where it was said to have been a Tsenga axe. This is not to be confused with the Palke site of Yambina (see page 178). **Nyambi** crops up among axe names given by Maring informants (Chappell 1966:Table 3) and was applied to axes of **tingri** or **ketepukla** appearance; this may be **nembi**.

A discovery myth was related to me by Ningni of Make Tsendembo clan. Like the other discovery myths which relate to quarries, a woman is the main actor:

> A long time ago an old woman went to her garden near the stream called Tingri. She dug up some sweet potato tubers and took them to the stream to wash them. As she was doing this, a stone in the streambed banged against another, making a ringing sound. The stone sounded strong so she took it home to her husband, Win Kang, the ancestor of the Make. He broke it and saw how good it was. Then he made it into an axe and saw how well it could fell a tree. In modern times men lit torches, went into the tunnels and dug the stone out with sticks.

A male-centred version about a different ancestor[5] is given by the missionary Hermann Strauss (Strauss and Tischner 1962:45-6), who was based at Ogelbeng, near Mt Hagen, both before and after the Pacific War. A translation of this appears in Appendix A.

Informants at Tsenga related how the Taylor-Leahy patrol camped at their settlement at Rombakla. They were at that time engaged in digging for **gaima** and the women called to them that 'Kombukla **tipo**', Kombukla spirits, had come.[6] The Tsenga men were given a white powder to put on their tongues; this proved to be salt. They were also given some shells and two steel axes; the axes were soon appreciated and used for work. Unfortunately the men still had no knowledge of the properties of metals and were unable to remove the stubs of the handles from the hatchet heads when they broke. So instead of inserting new handles, they remounted the hatchets in the 'normal' way, i.e. they put them in the same kind of binding as used for stone axes. Later they were shown how to burn the wooden stubs out of their sockets. In Figure 2.1, Taylor's Camp 23 corresponds

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[5] Note that in my version Win Kang means 'stone-flake boy'.

[6] The usual Melpa word is **kor**, spirit. **Tipo** is given as a Kopon dialect word in Strauss' glossary (Strauss and Tischner 1962:477). Kombukla tribe, through whose land the patrol passed on their way to the Jimi, live near Kotna (cf. A.J. Strathern 1971:Map 2). However, the women may have meant **kombuł**, the Wahgi Valley term for the people and the area east of Minj, where the patrol originally came from.

to Rombakla, which is at or near the modern Tsenga Aid Post.[7]

The organisation of quarrying at Tsenga seems to have followed the general principles seen on the Ganz River and the Tuman sites, but in this case there are no early descriptions of quarrying to fill out the picture gained from a limited number of interviews. The Make certainly gathered together to work the various faces and one informant seemed to suggest they went into seclusion as at the Tuman sites, with the women bringing sweet potato to them each day. Unfortunately my stay with the quarry owners was no longer than that of either Chappell or Hughes and I do not have the evidence to resolve these points.

MBUKL AND PUKL

The sites of Mbukl and Pukl are located not far from one another in the upper rainforest territories of Kawelka and Tipuka tribe-pair near the crest of the Sepik-Wahgi Divide. A.J. Strathern (1971:Map 2) shows the distribution of clan territories in the Buk area. The site of the Mbukl quarry lies on the land of Kawelka Klammbo (Nglammbo) clan section (see below, page 176) and its use was shared between Mandembo and Membo clans, according to A.J. Strathern (letter dated 6/10/81). The territory of the Klammbo section of Mandembo clan lies at the head of the Muka River in an area bordering Membo clan's territory. I heard the same in interviews I held with Klammbo Top and Membo Pana and Endepi at Buk in December 1981;[8] there was no indication that the remaining Kawelka clan, Kundmbo, participated. In historical terms, indeed, Mandembo and Membo were paired in opposition to Kundmbo (A.J. Strathern 1971:

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[7] In another story associated with the coming of 'the first kiap', a big-man named Kanjuwo was shot and killed along with a number of other men. An argument broke out when the Tsenga men were trading food with an early patrol and the police opened fire. The date of the patrol is unknown, but in all probability the incident took place between the beginning of the Pacific War and before the Tabibuga Patrol Post was set up in the early 1950s.

[8] Interviews 58-81, 59-81, 60-81.

59). Both Pana and Endepi said that their ancestor Kauil Weipkang was the first man to work at Mbukl. Endepi said that Weipkang went into the bush to hunt marsupials, slipped on a rock in some broken ground and cut his foot. This was how he found the axe stone.

Pukl is located on Tipuka land and was worked by the Tipuka clans Jikmbo (Ndikmbo), Wanyembo and Oklembo (A.J. Strathern 1971: Map 2), together with some men from other Tipuka clans whose territories were further removed from the site. Chappell visited the site in 1965 and found debris on a steep hillside (1966:101), though his guides did not actually locate a quarry or outcrop of axe stone (pers. comm.). In 1977 P. Gorecki visited the Pukl Kumanga rockshelter (site code MSP) and collected further samples of Pukl stone from the shelter floor, which he kindly allowed me to sample for geochemical analysis. The Pukl stone proved to have a very distinctive infrared signature (Appendix H). In 1983, while excavating at the rockshelter, Gorecki made further inquiries about the Pukl site and located a substantial pit or excavated hollow where the stone was obtained. His report on this visit is reproduced as Appendix F.

The name **pukuri**, picked up by A.M. Strathern (1965:189) and linked with the Pukl quarry, was not offered by informants either at Buk or in the Jimi Valley. Pukur, however, is a place name near Rank or Ran and is not far from Pukl.

The existence of either Mbukl or Pukl was not known to early patrol officers and consequently no reports exist predating that of A.M. Strathern (1965). Nevertheless an incident on the Taylor-Leahy patrol is remembered by the Kawelka and can be used to state confidently that Mbukl, at least, ceased production at this time. When 'Jim Taylor', I was told, came through the area he went down the Baiyer Valley - which some of the Kawelka territories overlook - and returned via Mbukl. However, a black policeman called 'Parka' (literally: Raggiana bird of paradise) died and was buried 'in' the stone quarry at Pukl. I received the impression that after this event the Kawelka did not work at Mbukl. At Pukl, 'Jim Taylor' gave six men hatchets when 'Parka' was buried, according to Tipuka Mak: the Tipuka men Andi, Kol, Pana, Kona, Mel and Ok.

The route of the Taylor-Leahy patrol on the second trip into the Jimi Valley followed the Baiyer and Lai valleys almost as far as the Yuat River and reached the Muklpin River just below Rulna. By

the time the patrol reached Camp 39 on 13 June 1933 (Fig. 2.1), many of the carriers were sick and the patrol split into two parties. Taylor and Mick Leahy explored the lower Ganz area, while Ken Spinks and Dan Leahy moved slowly up the Muklpin with the sick, finally arriving at Mt Hagen on 20 June, two days later than Jim Taylor and Mick Leahy. Taylor wrote in his diary:

> They told us that Leahy's boy, Iau who had been sick on the road died at 3.30 a.m. on the 18th. We were all very grieved and he was a fine type and had struggled hard for life.

The importance of the incident is, of course, that it provides a fixed point which Kawelka and Tipuka accounts can be related to. 'Jim Taylor' was in this instance actually represented by the personages of Ken Spinks and Dan Leahy, and the man they called 'Parka' was Iau.

As at the Tuman sites, the Kawelka say formal quarrying trips were made. I was told that all Kawelka men went to work at once and that they slept at the site, their wives bringing food to them daily. Like the Tuman sites, but unlike those at Ganz and Tsenga, the quarry is far removed from areas of cultivation and Kawelka settlements. I raised the question of how the men could leave their homes and gardens unprotected; I was told this was not a problem - no men were isolated by this action and the women were not liable to be attacked.

A.J. Strathern (letter dated 13 May 1983) was kind enough to clarify some uncertain points with Ongka in 1983. One of these was Gorecki's (1979a:98) suggestion that Mbukl had not been discovered before the Kawelka fled from Kuk to Buk around the turn of the century. Gorecki's argument was that the Tipuka, who granted the Kawelka some empty land, would not knowingly have given away a stone axe quarry. I quote Ongka's reply in Strathern's letter:

> The **rui mur** ['axe quarry'] belonged to the Mandembo. The Klammbo lived nearby and looked after it. The Klammbo would tell the other Kawelka to come and work the site with them. Each group made its own temporary sleeping hut, **manga kuwa**, and used this to operate from. We said that the site belonged to all the Kawelka and they should all work it. When the Kawelka fled from Kuk, those Kawelka who were already living down in Kopon [i.e. at Buk] had found the **mur** previously. Those two quarries, Mbukl and Pukl, they are on either side of the same mountain.

> If Membo Pana spoke about Weipkang or Tilkang, well, he is spoken of as the first ancestor of all the Kawelka, and perhaps that is why Pana said he was the first to work the quarry. Yes, Tilkang saw a place where a stone area was opened up, he found a stone slab and took it to the Mbakla river, rubbed it there and made an axe blade from it. He found the quarry for all of the Kawelka. It was the Tipuka Oklembo who quarried at Pukl on the opposite side of the mountain.
>
> When Taylor came, we did not at once leave the quarry, no. At that time I was just an adolescent boy, and we gave up going to the quarry only after I had married and fathered my first child, that is my daughter Raem. We carried on using the stone axes because there were not enough steel ones. We used them to cut **kwang** [Castanopsis] trees or later to cut firewood when we used the steel ones, **kor rui** ['spirit axes'], to cut the trees. At the time we gave up the quarry, we were fighting with the Tipuka Kengeke clan.
>
> We found the steel axe useful, because it could be used in either hand, whereas the stone axe could not. We asked a friend to borrow a steel axe much as one asks nowadays to borrow the services of a boar pig to impregnate a sow; it was a favour, and the steel axes were scarce, so we had to keep on using the stone ones.

Ongka says that 'all' the Kawelka participated, though the Kundmbo were not mentioned in my interviews. It could be that the Kundmbo did at one time go to the quarry, but that recently they did not. Ongka also says that the quarry was not abandoned straight after the first Australian patrol and he relates the disuse of quarry to specific events. I am sure that his answer is more accurate than the ambiguous 'at the time of the patrol' that I heard.

I visited the site in July 1980 with J. Golson; it lies at about 2150 m in the upper reaches of Mbukl Creek, a tributary of the Muka River. The axe stone, **rui mbukl**, was uncovered by diverting the creek to wash off overburden. On the left bank of the stream we saw excavated hollows on the steep hillside rather than discrete pits. Quarrying debris was abundant over an area of about a hectare.

I was given a number of names for varieties of Mbukl stone: **mbukl maemb**, **mbukl nambroi**, **mbukl røngeglp**, **mbukl winj minj** and **nunt**. **Maimb** was said to be the best stone, and green in colour. **Nunt** was a useless stone discarded by the quarrymen. According to A.M. Strathern (1965:186), **nambroi** was named after a reddish tree, **maemb** after the roughness of the surface of a stone hammer and **nunt**

after the prickly leaves of the bush of the same name (a stinging nettle). Note that **røngeglp** is a name at the Ketepukla site as well. At Buk, however, the Kawelka denied that it was the name of a taro variety (see page 168).

Mbukl and Pukl were minor sources, with probably an insignificant output of large-bladed 'ceremonial' axes. I am personally unable to identify axe blades from Mbukl - I saw only one small hafted example - but I understand that its products were generally small work axes (A.M. Strathern pers. comm.). Large blades that I showed to informants were never, at any interview site, identified as **rui mbukl**. In addition, the nature of the raw material that Gorecki obtained at Pukl, and his remarks about its occurrence, suggest that only nodular stone was available there. As at Gapinj Aka Nui (Chapter 3), the sizes of the cortex-covered nodules are unlikely to have allowed the production of large-bladed ceremonial axes at Pukl.

YAMBINA AND RUMNA

Chappell (1966:101) found that the site of Yambina corresponded to a petrological group he had earlier defined as 'Upper Muklpin II'. The quarry lies on Palke land, at the summit of the regular walking track between Palg and Kurunga. I visited it in 1980 and 1981, but did not find the exact outcrop or excavation from which the stone was obtained. However, flaking waste and broken roughouts testified to the proximity of the quarry. A light-coloured stone called **kraep** was, as far as I could ascertain, obtained from the same place.

A.M. Strathern (1965:188-9) listed the two names, **yambina** and **yimbina**, which she thought represented separate axe types. I discovered another instance of the name at Tsenga, as mentioned on page 172, and this may explain the distinction.

Another Palke axe name was **rumna**, listed with **roklemana** and **yimbina** in A.M. Strathern's Region C (1965:189). I attempted to find this source in 1980 and was shown a garden in a lower altitude part of the Palke territory containing two small rock outcrops. There was no sign of debitage and this was probably not the site itself. All the same, Rumna is said to have been a traditional

source of axe stone, not one brought into use in more recent times. No details are known of the operation of either site. I was never volunteered the name **roklemana**.

APIN

An untraced source name **nøpilye** or **øpin** was placed by A.M. Strathern (1965:189") in her region D. Chappell failed to find this one and assigned the names to Yambina (1966:101). Nevertheless Strathern's information was quite correct and the Apin (or Øpin) site lies above the Apin River near the hamlet of Kumai. It was owned by the Tumalke (Romalke) and lies directly on the main walking track from Kumai which joins the Kurunga-Palg track just below Yambina. A small spur just above gardens, about one hectare in area, has been dug over for axe stone. Two small shafts were still open in 1980, each about 1 m in diameter and clear of infill for a depth of 1.80 m in one case. Debitage lay scattered about in some quantity. The site seemed to be a very small source of axe stone and the size of the workings indicates that only individuals, or small groups of men, can have visited it to obtain raw material.

The axe name **apin** is not common - it only occurs twice in the list compiled by Gorecki (n.d.) - although informants at Tun used variants of the name, such as **tui apinj** and **tengrina apinj**, when identifying dark-coloured Jimi axes.

The similar name **apina** crops up on labels on axe blades collected in Enga Province and held at the Enga Cultural Centre. These blades are usually particularly black in colour. I elicited the name **apin** near Wabag when making casual enquiries in 1980 and was told the axe type originated in the direction of Mendi. This probably indicates that it came from either Mendi itself or from the Hagen area via the Nebilyer and Mendi. It is hard to imagine that it was connected in any way with the small Apin site that I saw, unless I missed seeing the main part of it.

MARING AND SIMBAI QUARRIES

Outside the main area of Sepik-Wahgi and Jimi quarries, there may have been several minor sites. One is reported (P. Gorecki pers. comm.) to be located between Dusin (BQ 132261) and Tsengapi (BQ 031326), but this has not been investigated. However, in the Maring language area I was able to locate the minor quarry of Repeng.

Repeng was first reported in 1972 by C.J. Healey under the name Golum, and given the PNG site code MCZ. I was directed to the site in 1981 at the Ambrakwi village Yimpgema (Plate 8.10). After my visit, C. Davenport, an aid program volunteer living at Koinambe, kindly inquired further about the name Golum. It is almost certainly another placename near Yimpgema, or an outcrop name, where the stone **repeng** was obtained (letter dated 17/11/81). At Tsembaga in 1981, R. Rappaport heard from a 65-year-old informant, Mer, that 'the name of the axe is R9peN [sic], and that the place it comes from is Golum or Gorum' (letter dated 25/11/81).[9]

R. Rappaport (1968:103, Note 3) commented that the most commonly used axes in the Tsembaga area just north of the Jimi River were 'black basaltic blades' known as **dangunt**, followed by 'blades of light green, grey or white stone' known as **gema**. On my visit to Koinambe, Maring speakers recognised the dark-coloured Hagen-style axe that I took with me, and which was elsewhere said to be a **ketepukla** blade, as **dangunt**. The light-coloured blade, elsewhere identified with Tsenga **gaima**, was said to be **gema**. This confirms Chappell's (1966:114) comparison of the Maring identifications collected by A. Rappaport (n.d.) with his own petrographically based identifications; he classed **dangunt** blades with **ketepukla** or **tingri**,

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[9] In the Rappaports' orthography '9' was used to signify the schwa and 'N' as the 'ng' sound in 'singer'. I have therefore preferred the rendering 'Repeng' to Chappell's 'Ropen' (1966: Table 3).

while **ngema** and **tinglingi** were identified as **gaima**.[10]

The set of notes compiled by A. Rappaport (n.d.) includes the following information on sources:

> Two sources of blades were recognised. The principal source for those blades labelled 'daNunt, Ngema, etc.' was the area known as 'Ambia', and sometimes the more restricted local name 'Kumom'...the other area known as a blade source lies a little west of the Narak area on the north side of the Jimi River, further down from its source. The government census village of 'Ambrakwi' or 'Yimbgema' was considered to be the source of 'r9peN' and of 'kira'.

These places are shown on R. Rappaport's location map (1968:10-11). In A. Rappaport's notes Kumom is rightly noted to be a patriclan at Wum, an hour's walk north of Tsenga. An informant there, Polimb, about sixty years old, gave an account of a defeat of the Kumom at the hands of the Cenda at Koinambe. The Kumom, a Maring-speaking group, were forced to take refuge in the Wum area during his early childhood. This would place the event between 1920 and 1935. The name Kira is that of a hillside adjacent to Yimpgema village; men at Yimpgema said there was only one quarry and that Kira was not a separate source. The other name, 'r9peN', may be equated with Repeng.

Near Yimpgema in October 1981 I was taken to the Repeng site at Yambiong. A string of small pits had been dug into the steeply sloping hillside near large communal gardens (Plate 8.11) and the surface was littered with rock chips and discarded roughouts (Plate 8.12). The outcrop was said to have been exploited at three places on Yambiong hillside; I saw the place called Senangau but not the other two.

The stone from Repeng is pale green in colour and could be mistaken for a pale variety of Tuman stone in a Simbai collection. Confusion would be unlikely to arise further from the source, since Repeng was an axe type of restricted distribution. Only 17 blades

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[10] Note that Chappell's usage of names at Tsenga differs from those used here (see page 171); for **epaldi** in Chappell's Table 3 read **tingri**. **Tinglingi** was misspelt **tinglingl** by Chappell who copied from notes compiled by A. Rappaport (n.d.). The original notes carry the spelling **tinglingi**.

in the Rappaport's collection of 174 from Tsembaga, 11 km from the quarry, were identified by informants as coming from Repeng or 'Kira' (A. Rappaport n.d.). Very few can have been traded as far as the Wahgi and the names are quite unknown there.

RECENT SOURCES OF AXES FOR CASH SALE

Although most of the axe quarries mentioned in this chapter were abandoned in the period between 1933 and the Pacific War, softer stone from new sources began to be made into axes for cash sale in the early 1950s. Traditional quarry owners were apparently able to find new materials suitable for axe making without difficulty, while a number of new sources have been opened up where none was formerly present. As I have suggested in the case of the Ganz River, the continuation of axe making long after the appearance of steel axes can provide clues to how the Jimi axe makers worked in traditional times.

Since about 1970 the industry has declined, as other forms of economic activity, such as coffee-growing, have become more important and, in the areas mentioned below, I met no-one making axes at the time of my visits. I do not know where the axes sold in Mt Hagen today are made.

The Ganz River

In the vicinity of Tsenga and Menjim (the patrol post on the Ganz River), axes were made for sale at least into the 1960s. Informants say they abandoned the old quarries around the time of the Pacific War, an event marked by the establishment of a police post at Kamuk, near Menjim. A member of the Territory of New Guinea police, No. 4227 Constable Sandagai of Karawok, Wewak, was stationed there from 1942 onwards to keep a watch for Japanese patrols (Lieut. W.T. Bell, PR, Hagen No.1 of 1944/45) and he is well remembered.

After the War axes were bought for cash by the Administration and new sources of softer stone were opened up, such as Waspi, which is probably the site visited by Attenborough. Unfortunately it is impossible to be sure when the transition from Ketepukla to Waspi occurred and Waspi itself is no longer used today.

More recently, another source, Rukmimb, has been used downstream of Ketepukla, on the right bank of the river; I saw this in 1980. A blue-grey shale or slate-like stone with distinctive streaky markings is found there in the bed of a small stream flowing into the Ganz River. No excavation was necessary to obtain it and the site may still be used from time to time. Further afield there are one or two sources known as Wendama and Mendama. Mendama, as Chappell records (1966:101), is located on a tributary feeding into the Ganz River, probably below the junction of the Ganz and Apin. Wendama may be somewhere closer to Menjim, if it is indeed a separate source, possibly near Waspi on the left side of the valley. I did not investigate either of these sites.

Tsenga

Two new sources have been used by the makers of **tingri** and **gaima** axes, the Make. They are Lipaldi and Kupan. Lipaldi was used only 'in the time of the Luluais', which was before the establishment of Local Government Councils in the early 1960s. Hughes (1971: 293) heard the name of this site as 'Ilipol'; it produced a blue coloured stone from an outcrop several hundred metres from the Tingri site at a rather lower level. Chappell (1966:98) recorded the stone below **tingri** as **epaldi**; if **epaldi** is what I and Hughes heard as Lipaldi/Ilipol, this is technically true, but he was mistaken in saying that **tingri** and **epaldi** were the two main traditional products at Tsenga. They were **gaima** and **tingri** as I explained on page 171. The second source, Kupan, may well have been brought into use since Chappell's visit to the area; certainly, Hughes (1971:293) saw axes being made from the stone from Kupan.

Station correspondence I have seen at Mt Hagen dating to the 1950s and 1960s is notably preoccupied with the sale or disposal of axes - thousands must have passed through the District Office over the years, as the following extract (J.A. Edwards, PR, Hagen No.3 of 1960/61) shows:

> WUM Rest House 45 axes were brought forward for inspection. At TSENGA Rest House I counted a further 267 of excellent quality. A native official from the MENJIM area assured me that his people had approximately 115 axes prepared for sale. Details are as follows...

> To say the least the people are disheartened by the Administration's neglect, now and in the past, to provide funds for the purchase of these axes as they become available...It is to be pointed out here that the sale of these axes is the sole means of cash income for the people in this area. I have assured them that eventually all axes will be purchased and they, the people, have been asked to continue in the manufacture.

Average prices paid in this instance were f1 14s. 6d. at Wum (5 km north of Tsenga) and f2 at Tsenga (where the quality was better). This was worthwhile at a time when no cash crops had yet been introduced, bearing in mind the low bulk and high value of the product, in relation to the long distance to market. In contrast, coffee is presently grown at Tsenga but it must be carried for six hours to the nearest road, at the Tsau River below Tabibuga. The growers must then pay a high price (1981, K6 per person) for transport to Banz, or accept a very low buyer's price.

Maegmul

Maegmul was one of Chappell's traditional sites, though he noted that the stone was only suitable for making ceremonial axes, not work axes (1966:98). When I visited Maegmul in 1980, however, I was told that Tsenga was the nearest source of traditional axes. The Luluai at Maegmul - the government headman - was engaged in making axes for the tourist trade in the early 1960s, according to Chappell, but whether the site 'was used by his forefathers for making ceremonial axes' (Chappell 1966:98) must be doubted. None of the axe names in A.M. Strathern (1965) or Gorecki's (n.d.) lists, and none that I heard myself, have ever been traced to Maegmul.

On the other hand, the land holders, the Wenambka, have recently exploited an inferior source on the Tsau River to make axes for sale at the Hagen Show. The source, Yenglimb, is the talus below an unstable cliff of shales and mudstones, one phase of which is tough enough to be flaked and ground into decorative axes. Chappell's description of the source near the Aid Post - that its stone was not hard enough for work tools - fits well with the hypothesis that the Wenambka are among those groups to take up axe making since the arrival of Europeans.

Mala Gap

No informant mentioned the Mala Gap source visited by Chappell (1966:100) several hundred metres to the west of the regularly used track - now a vehicular road - over the pass into the Ganz valley from Mala. Puklepi (Chappell: Pöglabe) is however the correct place name. No patrol records describing the nearby Ganz site include any mention of it. The site has probably been used in recent times for the manufacture of 'tourist' axes.

Hughes' axe No.36 (1977a:Plate 9) carries the identification 'Tsenga poglabe'; the place of origin was Tsenga, which is no great distance away. It is a fresh-looking axe roughout and may be a recent product of the Mala Gap site. The place may be discounted as a traditional source of axes.

DISCUSSION

I have suggested in earlier chapters that the high level of production sustained at the Tuman quarries was supported by the traditional wealth economy. Even stronger arguments may be advanced for the quarries of the Jimi Valley, where the axe makers adapted to the introduction of steel and new economic media and where it is known that production, albeit from sources that were easier to work than the traditional ones, continued into the 1960s.

If the picture I have given of Ganz and Tsenga axe production, in particular, is reasonably accurate, how does it compare with my model of Tuman quarrying? The quarry owners were not faced with problems of scale and seem to have been able to continue obtaining modest amounts of stone whenever they saw it as a worthwhile investment of time and energy. Moreover, the axe makers probably did not export more than a small fraction of their output in the form of roughouts; many neighbouring groups worked small quarries - perhaps as a means of tapping the wealth of the Central Melpa tribes - and the local demand for roughouts may have been relatively low. Thus, if I am correct, the makers had more control over their output, because they finished most of their axes themselves. They could have made a more flexible response to economic changes than the Tungei.

The Tuman approach to quarrying was characterised by a rigid ideology perfectly geared to motivating a 200-strong workforce for long periods of dangerous work. It actually discouraged the kind of casual digging which might have seen the survival of the quarries beyond 1933. I have only a vague knowledge of the ideology at Ganz and Tsenga, but if the men did make formal quarrying trips, they cannot have lasted so long as those mounted by the Tungei and the sites do not bear the physical traces of sustained excavation work. The use of the non-intensive techniques of sluicing and damming at Ketepukla, and firing at the Tsenga sites, hints that the raw material was neither so hard to extract nor the expedition system so important to the overall operation as it was at the Tuman quarries.

Some aspects of my model of Jimi operations do have testable implications, though they are not ones that I take up in this thesis. In their concentration on self-contained production, the Ganz and Tsenga factories were able, I suggest, to turn out a stylistically more consistent product than seen elsewhere. If unresharpened blades from large collections are compared, they may be seen to conform more closely to the paradigmatic shape of Enk Ru's axe (Fig. 6.1a) than do Tuman blades to the shape of Pou's axe (Fig. 6.1b). Furthermore, this ideal shape was that of the 'ceremonial' blade - the kind hafted and exchanged almost exclusively as a wealth item and carried about - in fact worn - as an essential part of men's attire.

In my view, the essential ingredients of Jimi Valley production - the scale of operations, the peripheral position of the axe makers to the Hagen wealth economy and the geological disposition of the rock - may all be seen to have contributed to a distinctively different 'marketing strategy' than that seen at the Tuman quarries.

THE JIMI VALLEY

Plate 8.1

Grinding hollow at the Ganz River. Note the pool of water for keeping the axes wet and the profusion of grindstones and grindstone stubs. Evidently two or three men had been sitting here, to judge by the arrangement of the leaf mats around the pool. From the M.J. Leahy collection.

Plates 8.2-8.4

These photographs are from the same roll as Plate 8.1. According to P. Gorecki's information they show Pinai speakers from Ruti. At all events they are the among the few photographs to have been taken of Jimi Valley people in the early 1930s. Note the large axes, the absence of shell, and the long Dendrolagus tails worn by the men. From the M.J. Leahy collection.

AXE MAKERS AT MENJIM, GANZ RIVER, AUGUST 1957

Plate 8.5

The use of a hammerstone to prepare a roughout. Photo: D. Attenborough.

Plate 8.6

A man uses a thin filing stone to sharpen an axe blade, fixing the blade on the ground and grinding the stone back and forth across its surface. The use of this sharpening method leaves characteristic facets on partly-completed axes (see Fig. 8.1). Photo: D. Attenborough.

Plate 8.7

Fixing the two parts of the haft together. Note the backward sweep of the handle part in the example at centre. The youth at centre background is holding a partially shaped crosspiece, showing the natural angle of the stem to the bole of the tree. Photo: D. Attenborough.

TSENGA

Plate 8.8

The Tsenga tingri site. The open joints of the outcrop have allowed the Tsenga quarrymen to exploit otherwise inaccessible layers of axe stone.

Plate 8.9

Ningni of Tsenga, holding a large gaima roughout.

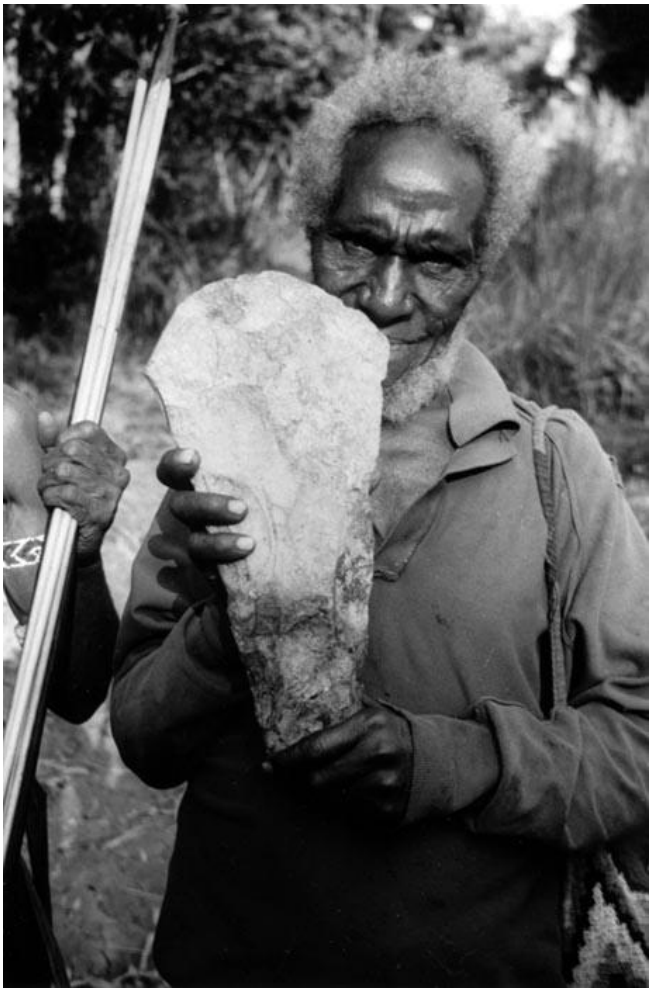

Plate 8.10

Yimpgema village, located below the summit of the mountain at centre, from the south. The Maring quarry, Repeng, is located 0.5 km to the east of Yimpgema.

Plate 8.11

Communal swidden garden at Yimpgema on Yambiong hillside. Note the 400-500 m of pig fences encircling the garden. (The forest fallow system is not used in the Wahgi Valley, where the Tuman quarries are located.)

Plate 8.12

Quarry pit at Repeng. The group of men are standing in a circular hollow on the Yambiong hillside.

Chapter 9

THE DOM GAIMA QUARRY

Clans drawn from the tribes and phratries of the Dom language area of Simbu Province (Fig. 9.1) make up the last axe making community of importance within the study area. Their quarry, the Dom **gaima** quarry (Fig. 9.2), has been the subject of several previous reports, including eye-witness accounts of the quarrying technique (Vial 1940:160-2; J.A. Costelloe, PR, Chimbu No.7 of 1946/47; L.C. Noakes pers. comm.) and ethnographic interviews (Hughes 1977a: 142). In 1980 and in 1981 I spent a total of two weeks at the hamlet of Aulabol[1] and was able to interview around a dozen former axe makers drawn from each of the clans of the owning Goroku tribe (Fig. 9.3) and from some of the clans of their neighbours.

SITE OWNERSHIP AND RIGHTS OF USE

The site lies at the place Tonmai, on the land of Kaupa Bia Gau clan within the territory of Goroku tribe (Plate 9.1). Working parties were drawn from individual Goroku clans (Fig. 9.3), except in the case Kirin Kaupa and Kalu Bia Gau clans, when a pair of clans worked together. In addition, and at variance to the rule elsewhere, outsiders were permitted to dig for the **gaima** axe stone. Clans from the neighbouring Yuri, Era and Kurpi groups bought or leased the right to make mineshafts at Tonmai, while Kwiwaku, neighbours of the Goroku on the eastern side of the Wahgi gorge, did not participate (Fig. 9.1). I am unsure whether these groups are phratries, tribes or federations of tribes; for instance, Kurpi is the collective name for many clans living to the north of the Goroku, of which Nonku and Ileku are examples.

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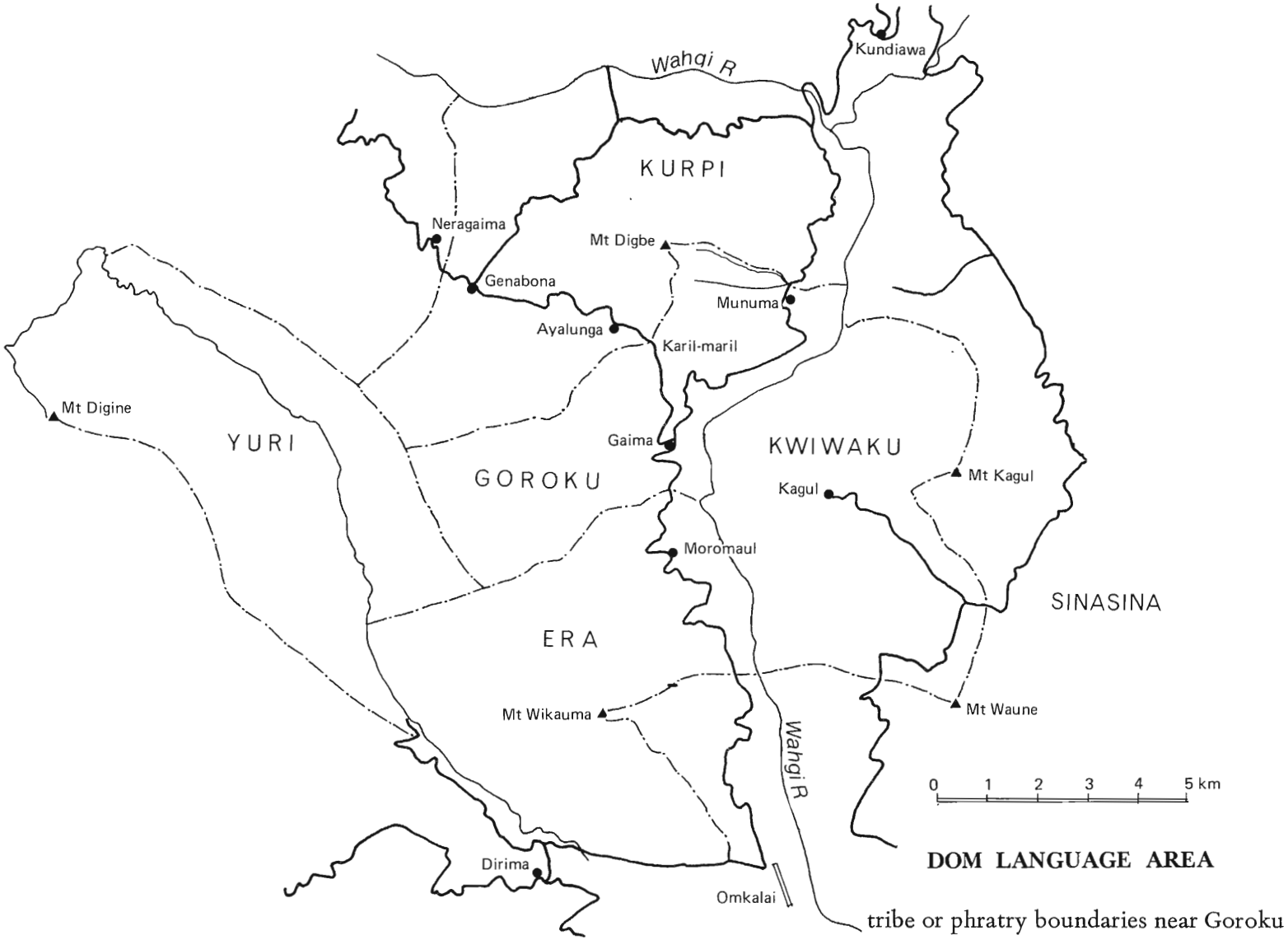
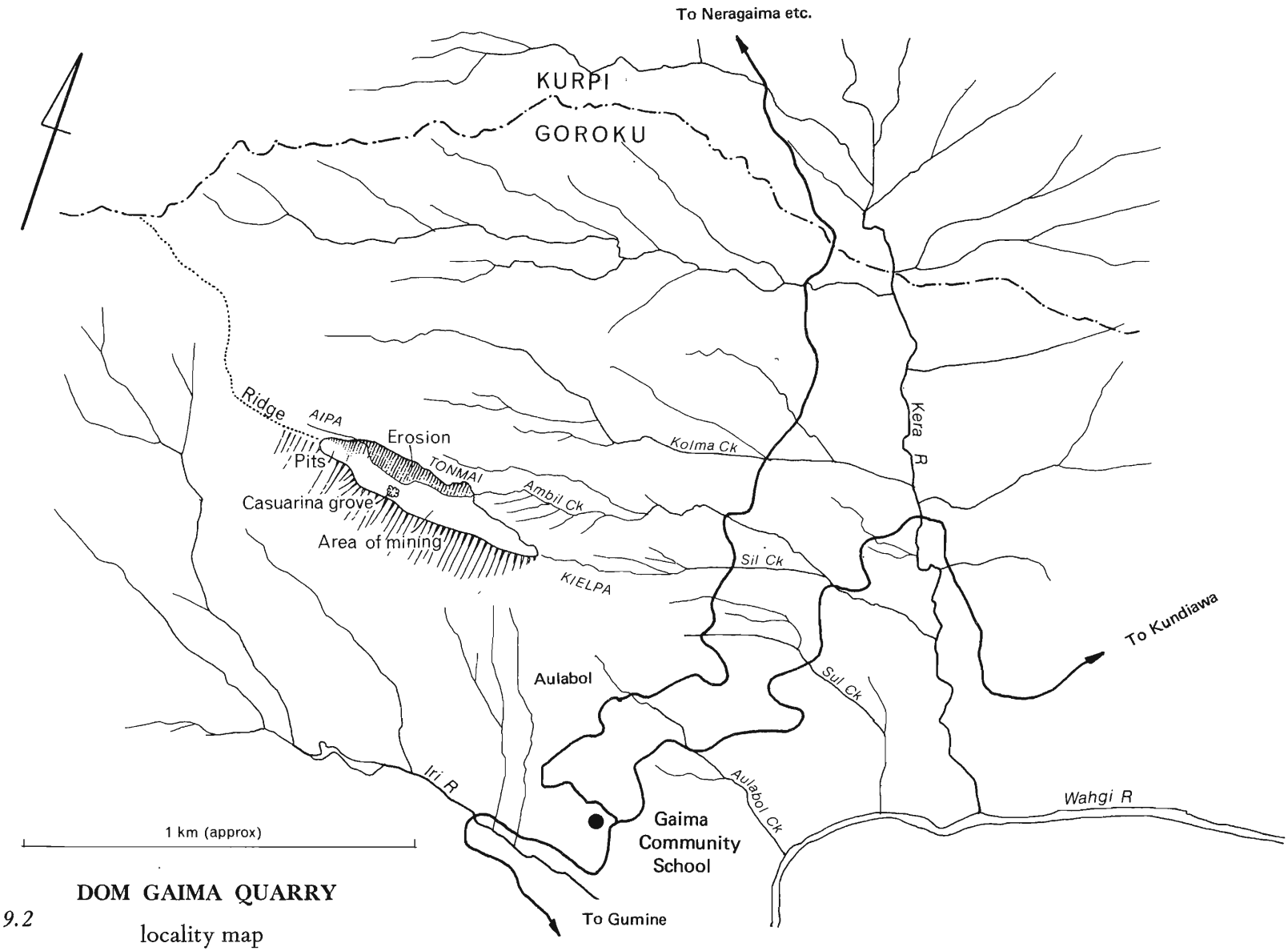
[1] As the guest of Henry Goi of Kopil Kane clan. Interviews 18-80 and 37-81 to 47-81 inclusive.



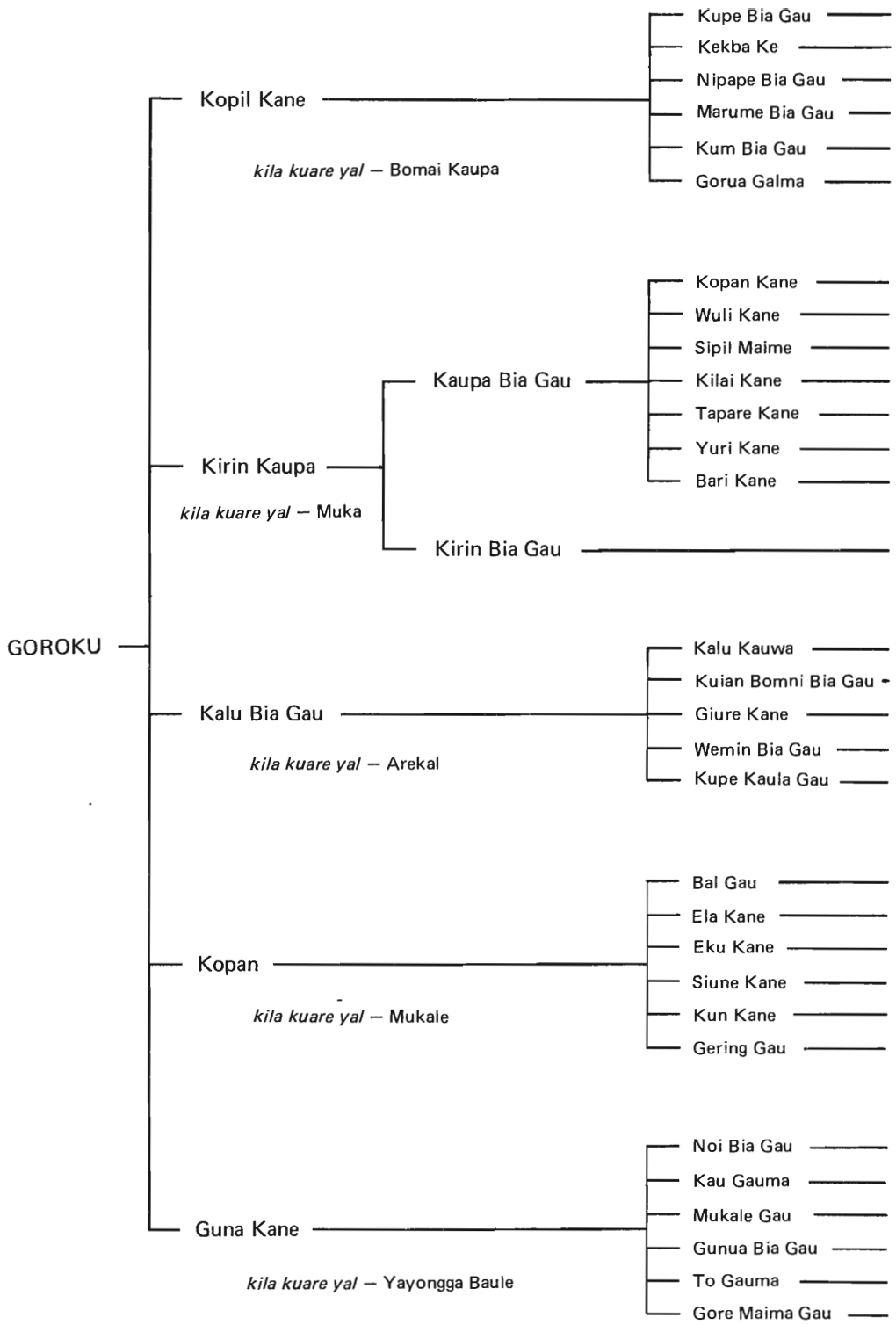
DOM LANGUAGE AREA *Figure 9.1*

tribe or phratry boundaries near Goroku



DOM GAIMA QUARRY

Figure 9.2 locality map



DOM GOROKU modern pattern of segmentation

Figure 9.3

Men of Nonku explained that they were granted the right to sink mineshafts at the site by making payments in pigs and other valuables and by giving brides to the Goroku without expectation of brideprice. Each of the five Nonku sub-clans had to find a marriageable girl and a large pig to give away and their magical specialist, the **kila kuare yal** (Plate 9.2) had to pay another pig himself. Whereas I have described massed expeditions to the Tuman quarries, at the Dom quarry the clan-based working parties acted independently of each other, digging deep shafts through soft overburden at a much more measured pace.

MINING TECHNIQUES

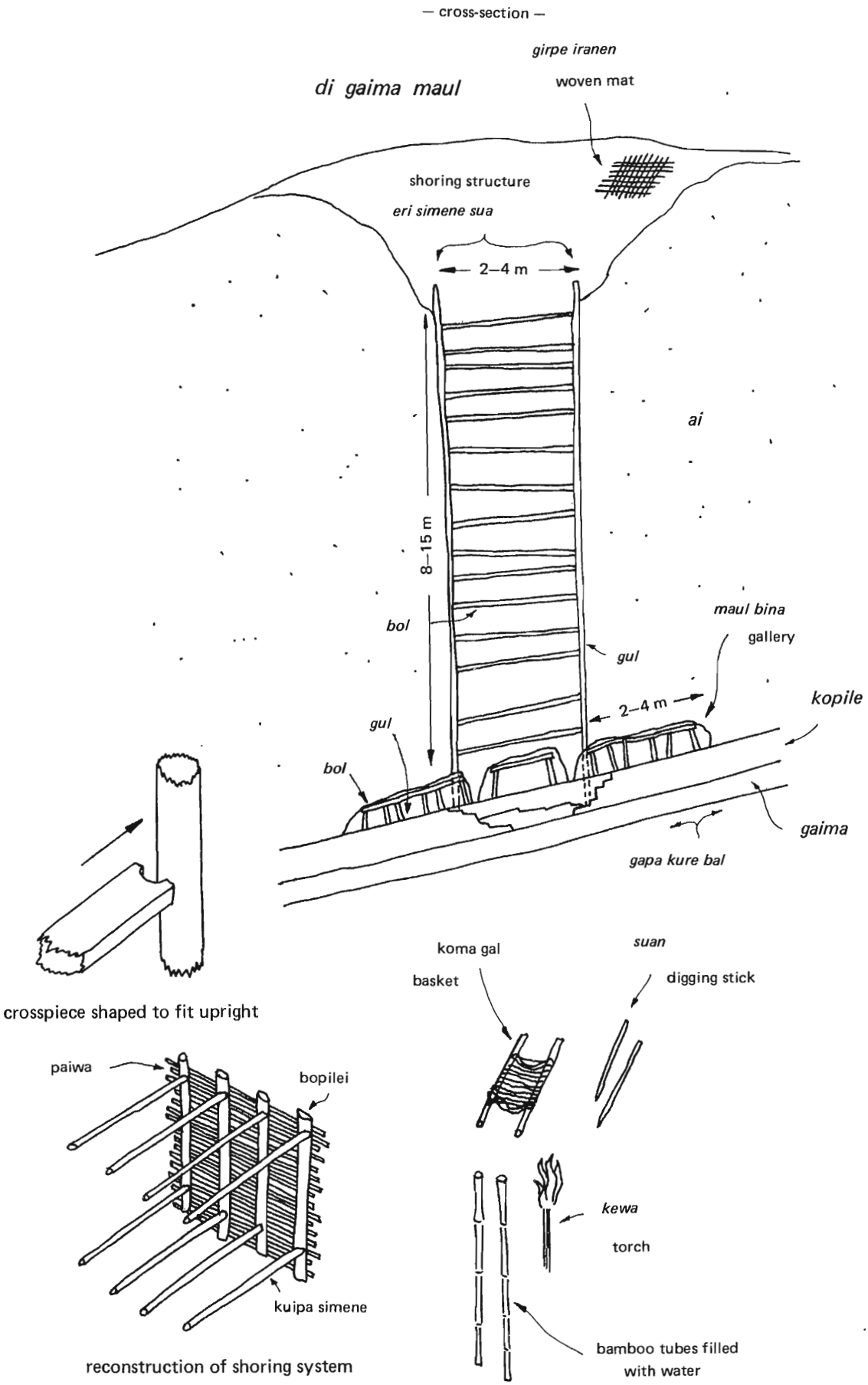
Vial's description (1940:161) is the starting point for discussion; he visited the site in May 1939:

> Only one shaft was being worked, but there were signs of twenty or more old shafts, now partly filled and choked with wild sugar-cane. The shaft was about thirty feet deep, cut in the side of a hill, and was well timbered to prevent the loose weathered diorite from falling in. Near the top grass thatching had been used to hold loose soil.

Shafts, **maul** ('hole'), of exactly this kind were readily described to me during my visits, and I was told a typical one would have been 10-15 m deep - informants pointed to tall trees when they wanted to estimate depths. Costelloe wrote (PR, Chimbu No.7 of 1946/47) that the shaft he saw was somewhat deeper:

> In 1943, in company with Dr McInerney I visited this place and at that stage the industry had not died out. Some eighty feet of overburden had been removed by primitive methods to get at the particular type of stone used in the axe making. Blinds, or mats, woven from pit pit reeds and bamboo were used to keep the earth back.

Plates 9.3 and 9.4 are Vial's photographs of the shaft he saw in 1939; I showed enlargements to the Dom informants, who gave me the terms used to describe the various parts of the construction. They usually held up pieces of wood to demonstrate how the shoring timbers were held together (Fig. 9.4; Plates 9.5 and 9.6). The materials were obtained from **ere yopa**, Nothofagus sp., a forest tree



DOM GAIMA SITE reconstruction of mineshaft with terminological details

Figure 9.4

that has the qualities of strength, straightness and durability. It was not in short supply, although it grows today at rather higher altitude than Tonmai and several kilometres away to the west. Other trees that were acceptable substitutes were **ere dala** (another Nothofagus), **ere gale** and **ere wel**. Shoring was used because the soft 'rock' overlying the axe stone, known as **ai** ('earth, clay'), was crumbly and likely to slump into the hole.

The **ai**, to judge from the various estimates of shaft depth, covered the site to a thickness of 10-25 m and overlay a series of layers of very hard rock, collectively known as **kopile**, 'stone'. **Gaima**, the axe stone, lay below and within the **kopile**, which was discarded. The **ai** fits the description of the diorite sill described by the Government geologist L.C. Noakes as being 'almost completely weathered to a brownish overburden' (Vial 1940:160). It is so friable that men with digging sticks known as **suan** would have no difficulty in excavating it. Thin quartz veins which criss-crossed the original rock are the only depositional features remaining in the sill. Vial (1940:160) continued:

> Eight natives lived in a small hut beside the shaft and for five months had been working at it. Their wives lived with the rest of the Dom Gondigu and brought food daily. When the patrol arrived the miners were feasting - the food was being taken out of the ovens made by filling a hole in the ground with heated stones. They told us that they had worked through the overburden, and expected to find suitable stone for blades on the next day, and that the feast was to celebrate the completion of that stage.
>
> Next morning I went to the shaft again and watched the method of working. One man worked at the bottom, loosening the ground and stones with a sharp stick, scratching away a little at a time. It was shattered stratified rock, and usually broke into smaller pieces under the stick. When a larger piece was found he threw it against another and if it did not break it was put to one side for future examination of its possibilities for making a small work blade (**di**). The useless rocks were shovelled into baskets which were piled on top of each other, nine of them. For shovelling he used his hands and a small wooden paddle a little larger than a hand. When all the baskets were filled, some of the eight men lifted them one by one half way up the steps leading into the shaft where others carried them outside and tipped them on the pile that had accumulated.

The method of removing spoil was as described by Vial. He saw nine baskets filled and carried from the shaft at one time. According to

my information, these were called **koma gal** ('cane basket') and were passed from hand to hand by men sitting or standing on the cross-pieces of the wooden shoring system (Fig. 9.4). A basket of this kind can be seen carried by the two men standing in Plate 9.3. The woven mats in the background are called **girpe iranen** ('mat kunai-grass') and were placed there to prevent soil running into the shaft. The two men were not recognised at first, but men of Goroku Guna Kane clan thought the second man was their kinsman Gore of Gunua Bia Gau sub-clan. Gore is still alive and lives several kilometres from Goroku land beyond the Chimbu River, but I did not visit him.

The picture of eight men laboriously excavating a deep shaft at the pace of a scratching digging stick is a far cry from the impression I have sought to convey of the Tuman quarries - hundreds of men labouring in lines to remove massive quantities of rock - and is also at odds with the model of Jimi production, where there was much more emphasis on the grinding and styling of the Hagen type blades. What are the social and technical factors which lay behind this operation?

The Number of Miners

Firstly the figure of eight miners is small but consistent with informants' assertions that only some men from each named sub-clan worked at one time. Men only became miners if they were 'interested' in that kind of work. Unlike the Tungei, who would have found the option incomprehensible, the Goroku say many men simply did not want to participate, or alternatively were 'afraid' to go down the holes and did garden work instead and helped the miners in other ways.

Wamil of Kirin Kaupa clan said that about 10 men worked at once, but when some got 'tired', others could go and take their places. In this way a continuous mining effort could be sustained for the length of time it took to complete a shaft. Other men said 'a few men from each of six sub-clans' worked and, in another case, I was told that 20 men made up a working party - 10 stood on the beams in the shaft to lift out the baskets and 10 dug at the bottom.

A point to bear in mind is that the shafts were too cramped to

hold many men. They were constricted, very deep and had to be artificially lit at the bottom with torches, **kewa** (a pitpit variety). It is difficult to see how more workers than the 8-20 quoted could have been accommodated.

The Time Taken to Finish a Shaft

The length of time needed to exhaust a single mine seems to have been much longer than at any of the other sites in the highlands. No informants questioned on this point said that it took less than one year to build a shaft and extract the **gaima** stone from it. I was quoted on different occasions 20 months, 23-24 months, 'years', five years, five karuka pandanus seasons (twice mentioned) and a period of time long enough for a toddler to grow to about the size of a seven-year-old. There is, apparently, no calendar of 'moons' like the one used in the Wahgi, but I was assured that in any case the appropriate span of time would have been measured in solstices rather than moons.

Solstice 'seasons' are marked in relation to garden productivity. The sun is perceived from Aulabol as travelling 'up' to Tonmai (north) in the first half of the calendar year and 'down' (south) to Mt Kagul in the second half. These two seasons are distinguished by being a time when food is scarce and much garden work needs to be done, at the end of the dry season and the start of the wet, and a time when food can be harvested in plenty, at the end of the wet season and start of the dry, respectively.

I cannot say precisely which answer was the most accurate but I suggest that 1-2 years must be accepted as the absolute minimum, if work was continuous. This may not always have been so and I was told of one instance where fighting broke out before a shaft was finished; the miners, from the Kurpi clan, Nonku, had to suspend operations until it was safe to go back to work. They covered the shaft entrance up in the meantime. Vial's (1940:160) 'five months' for shaft construction is a misleadingly low figure, according to what I heard.

It is of interest to note that working parties from several clans could work at once in different places, such as at the lower end of the site at Kielpa, in the centre at Tonmai, and at the top

end at Aipa (Fig. 9.2). Unlike the Tungei, the Goroku had no ideological beliefs constraining the clans to work simultaneously; they were independent of each other and probably each started a new shaft a little time after finishing an old one, in their own time. Wamil said that they spent rather more time mining than they did resting between finishing one shaft and starting another one.

THE EXTRACTION OF STONE AT THE SHAFT BASE

Once the miners penetrated the **ai** and completed construction of the timber linings, they met the hard layer of hornfelsed rock mentioned above, the **kopile**. In and below this lay the layers of **gaima** that they wished to exploit. The **kopile** is exposed in several places today, which gives some clue to the kinds of problem faced by the miners in removing it. A dynamited road cutting below the site at Waulme, near Kolma hamlet, shows that the surface of the rock dipped quite markedly, but parallel to the slope of the mountain-side, that is, northeast towards the Kera River. Another exposure, within the site in the dry bed of the creek known as Urege or Ambil, shows that the surface was quite smooth and met the soft **ai** quite abruptly.

Shafts were likely to have been rectangular rather than circular in cross-section: it would have been easiest to brace a shaft with more or less parallel sides. The width of a such a shaft would have been limited by the length of the cross-braces put in to keep the walls apart. Vial's photographs show that these were 2.5-3 m long (Plates 9.3 and 9.4). One informant said both sides could be touched with outstretched arms; another said the space at the bottom was as big as one section of a men's house - room enough for a dozen men to stand up in. If the method of construction Vial saw was typical, then one method of increasing the size of the shaft base was to extend the length of the rectangle. In Vial's photographs this appears to have been about 5 m, giving a basal area of 10-15 m^2.

The Use of Fire

It was not possible to remove the **kopile** merely with the digging sticks, **suan**, used on the **ai**. Informants described how they fired the rock to crack it first. Fires were lit on the surface of the **kopile** and the miners retreated. Bamboo tubes were filled with water and emptied onto the heated rock with the result that the top layer exploded and could be lifted or prised off. The cracks that remained could be further exploited with stone hammers. It may seem that fires would have damaged the supporting timbers, but it turns out that this was not a problem. The depth of the shaft ensured that the timbers remained damp, and although they may have charred, their greenness and thickness prevented any serious threat to mine safety.

Once they found **gaima**, the miners stopped firing the bedrock and turned to using picks and hammers only. Costelloe (PR, Chimbu No.7 of 1946/47) saw this part of the process:

> Sharpened wedges of the hardwood GUL were driven into cracks in the stone mass and unshaped blocks of stone (DI) were levered out. The wedges were called MABILAPIGAE. The cracks were caused by hammering with hardwood and by making fire, heating the stone and then throwing water on it. The blocks of stone (DI) were raised to the surface with bamboo and bush ropes and there struck with other lumps of hard stone until pieces of varying size broke off from the block.

I did not come across the term **mabilapigae**; however **gul** is a general name for wooden posts or staves, rather than a type of hardwood; **di**, 'axe', was used in the same sense as Ek Nii **tui**, namely it referred to axe stone in situ, blanks before fabrication, small samples of axe stone like flakes, as well as chipped out axe roughouts and finished axes.

The Use of Galleries

Considering the depth of shaft, 10-15 m^2 of **gaima** at the bottom would seem to have been poor reward for the effort involved in reaching it. In fact side chambers were dug out from the main shaft. L.C. Noakes (pers. comm.) remembers seeing these features during his visit with Vial in 1939; unfortunately any photographs

that he might have taken were destroyed during the Pacific War. The side chambers, or galleries, were called **maul bina** ('hole side'). Another term was also used, **ai noal**, which translates as 'a small space' (C. Lamb pers. comm.).

Informants compared the size of the chambers with the depth of a small house, that is, 3-5 m back from the doorway. As the shaft was lined, so were the galleries. The same terms **bol** ('bed') and **gul** ('fence') were used for horizontal and vertical members respectively (Fig. 9.4) and, in the same way, bushrope was use to fasten the supports to each other. The same methods were used as in the centre of the shaft to remove the **kopile**, but it is important to note that the galleries were not cut through the bedrock as such; they followed the surface of it initially, being cut through the **ai**. Once room to work had been made, the miners started to remove the hard stone underneath. An objection to this idea might be that firing would be impossible in the confined space of the galleries. However, I suspect that most of the rock removed from them could have been loosened with hammers and wedges from the side, the miners working outwards from a face in the **kopile** made at the centre of the shaft.

The suggested depth of the galleries, 3-5 m, means that the **gaima** seams could have been exploited within a circle of up to 15 m in diameter from the shaft centre. The Dom miners could thus have excavated a warren of wood-lined galleries using the the room-and-pillar technique, in which dead space is left between the galleries to support the roof. How nearly the Dom miners were able to extract the theoretic maximum amount of stone must have depended on the efficiency of their shoring techniques in relation to the stability of the overburden, and on the degree of difficulty of removing the **kopile** in the side chambers.

The Seam of Axe Stone

Informants say that **kopile** was removed to a depth of about 80 cm before layers of **gaima** were found. Hand specimens collected at the site show the laminar nature of the rock in which **gaima** is found. Green-grey bands of homogeneous, fine-grained **gaima** alternate with bands of a whiter rock, giving fist-sized samples a

'neapolitan' appearance. The **gaima** bands are as little as 1 mm thick; only when bands of **gaima** attained 2 cm or more in thickness could the rock be used for making axes. Finished blades often have laminar markings too; they are the last traces of the white unusable bands when the rock is dominated by **gaima**. The laminations invariably run in parallel with the planilateral sides of the axes - contrasting with the banding in Tuman axes, which is quite random in orientation.

As at the Tuman quarries, the Dom miners gave names to each of the layers of stone they encountered in the seam of axe stone. Bopa of Kopil Kane clan provided the list which follows. **Gekma marai** and **aiyopla** were found just above the seam; they were discarded. **Kerule** was the topmost layer of **gaima** - the name given to the whole seam. It was followed by **yuru, galu, nini, kore, paume, pau, korkewa, kerwal deime, di gule** and **gaima** [sic]. Another informant, Kuman, added the name **ablame**, which he said occurred above **kerule**.

Kua of Kopil Kane clan said that 15-20 cm of **gaima** lay beneath about 80 cm of **kopile**, but I find it difficult to see how such a thin seam could have given rise to so many varietal names. Perhaps each layer was this thick; there is a dynamited road cutting below the site at Waulme where several metres of hard stone occurs in 10-15 cm bands. At any rate, the layers of **gaima** were prised off in thin slabs until the mine was exhausted. The seam which sloped downhill, parallel to the ground surface and below it there were only layers of clay or other soft deposits; they were called **gapa kure ba**, 'ground white yellow'.

The Number of Shafts

When a mine was abandoned, the miners left their hammerstones and digging sticks in the old tunnels and partly backfilled the shaft. The wooden cross-braces were kicked down so that the shaft was allowed to slump. Apparently it was not unknown for galleries from subsequent and adjacent shafts to meet the old workings, so it seems reasonable to assume that shafts in general were quite close-packed over the whole site. Vial (1940:161) says that he saw traces of 20 or more old shafts, but I think this understates the number that must have been opened over the working life of the site.

Measured from aerial photographs, the area of the site was about 10 hectares, much of which was mined. In theory more than 100 and as many as 300 shafts would fit into a site this size. For example, a 15 m diameter circle, corresponding to a rectangular shaft base and the galleries extending from it, has a ground plan of 177 m^2. If 80% of the 10 ha were exploited, more than 500 of these could be packed in. The appearance of the site does not suggest that anything like this number were actually dug. Circles 20 m and 30 m in diameter have areas of 314 m^2 and 707 m^2 respectively; assuming no interstitial space was wasted, 255 and 113 shafts with ground plans of these two sizes would have fitted into 80% of the site area.

If these estimates are of the right order of magnitude, then it is reasonable to imagine that the three present-day clans and one clan-pair from Goroku, together with an unknown number of clans from Yuri, Era and Kurpi, would have needed a span of time measured in hundreds of years to excavate them all.

THE MAGICAL SPECIALIST

If the Dom miners had an obsession, it was with the risks of flooding and the effects of heavy rainfall on the sides of the shafts. Even at the Tuman sites rising groundwater was a worry, but it posed no physical threat to the quarrymen and could be baled out as I have described in Chapter 4. But just as the Tuman quarrymen followed strict rules of avoidance and abstention to please the spirit guardians, it was the job of the **kila kuare yal**, the '**kila kuare** man', to magically prevent rain (Plate 9.2) and to put spells on the miners' tools, such as their digging sticks, to ensure success. While the Tuman quarrymen were not permitted to eat pork (because of its femaleness) or see women, the **kila kuare yal** lived in a separate house from the rest of the working party and strictly avoided eating any foods with the attributes of wetness. These included steamcooked vegetables - sweet potato, taro, yams and 'greens' - and fruits like marita and karuka pandanus and ripe bananas. He did not drink water or chew sugarcane. This may seem to rule out almost all the foods available, but in fact by restricting himself to 'dry' cooking methods he could eat sweet potato,

taro, yams and green bananas. He cooked them in the ashes of his own fire: **kepa dogwa ila bilua**, 'sweet potato fire inside under'. Some men said he was allowed to eat pork; others said that all kinds of meat were ruled out. However the emphasis seems to have been on the method of preparation, not on the food itself.

In his 'separate' lifestyle, the **kila kuare yal** resembled the **mowi** man at the Tuman quarries, but he played a much more active role in mineshaft construction and he may even have been a mine director or leader. This position is not one identified at either the Tuman sites or in the Jimi. Some informants say he was usually an older man and therefore more experienced; at any rate, under his magical guidance men shaped the timbers, braced them in the shaft and fired the bedrock. He had a number of divination methods to tell whether the mine would be a success. One of these was described to me by Bopa of Kopil Kane clan.

A rat should be caught alive; one side of its face should be blackened with charcoal, while the other was plastered with mud. The tips of its ears should be cut off and the rat released at the top of the shaft when the miners were about to fire the bedrock at the bottom. If the rat ran away into the bush it was a bad sign, but if it ran back towards the hole the men believed they would get plenty of axes from the mine.

The **kila kuare yal** carried a **gal kapan** ('bag small') with secret things in it and he had magically prepared tobacco to blow at the shaft walls. If a pool of water formed at the bottom, he went down to dry it up with magic, whereas if it began to rain he climbed out and circled the top of the shaft, muttering spells to make it stop. Some said he had no physical work to do, and it was widely agreed that he became very thin indeed by the time the mine was finished, because of his extraordinary diet. After the lengths of time quoted above this is not surprising and it is tempting to think that he suffered from scurvy and other diseases of vitamin deficiency. However, no **kila kuare yal** is known to have died of starvation and, for that matter, no miners are said to have died in accidents.

I hesitate to say the **kila kuare yal** was a technical director, but it does seem likely that he was in the best position to gain a wide experience of mine operations as a whole. The other men in a

working party could rotate with men who stayed at home, but the **kila kuare yal** remained on the job until a particular mine was completed. The only exceptional case was when fighting interrupted the work; the **kila kuare yal** should nonetheless have kept up his ritual observances during the interlude. Because of his duty to see a mine through from start to finish, his secular experience should at least have matched his magical craftsmanship. He was not a big-man and he did not achieve extra wealth and position by virtue of being a magical specialist. His skills, however, were inherited - just as in the festivals of the Wahgi and Simbu 'pig house' type (cf. Reay 1959a:152) ritual specialists inherit their roles from their fathers.

THE MANUFACTURE OF DOM GAIMA AXES

The immediate vicinity of the quarry site at Tonmai was not strewn with flakes and chips from axe making. This is unusual as the Tuman sites are surrounded by chipping floors, and gardens in the Tun and Tuman valleys are littered with struck flakes and hammerstones. One Goroku man, Muka, said that a sharp stone was used to 'cut' the pieces of stone in half, or that the stone was 'broken' with a hammer. In fact I think it very likely that the axe stone needed very little percussion flaking to create axe blanks ready for grinding. This was a function of the tabular - if not laminar - nature of the slabs of stone when they were lifted off the mine floor.

The description of 'cutting' pieces of axe stone with a sharp flake refers to a method of scoring a groove at the spot where the axe maker wanted to break the stone. Dom **gaima** blades in museum collections typically show these scoring grooves. An unprovenanced blade in the National Museum measuring about 40 x 15 cm has a deep groove down the middle of both faces where an attempt has been made to divide the axe into two long, thin blades. Hughes' axes Nos 4 and 5 have shallow grooves along the edges of each face (1977a: Plate 4).

A specimen in the J.K. McCarthy Museum, Goroka, Eastern Highlands Province, is of particular interest as the blade is approximately 20 cm in width and, under the binding, may be as much as

50-60 cm in length. The upper limit for blades shaped by percussion flaking is set by the tendency of large blades to snap in half during manufacture (Chapter 5), but the sawing method sets no such limit to the maximum size of axe blades. The size was only restricted by the dimensions of the laminar slabs taken from the floor of the mine shafts. Judging by the size of the Goroka axe, these were extremely large indeed. No mechanical strains were placed upon the axe blades when they were cut to their final shape by sawing.

Ethnographic Descriptions of Sawing

The technique is well attested in Maori ethnography. Best (1974:43) defines the following term:

> Sawing. This implies the act of cutting stone by means of a sawing motion imparted to another thin-edged piece of stone used to cut a groove with. Such a saw or rubber was often used in connection with sand, or other hard grit, and water.

The reasons cited for sawing in preference to chipping were those of economy and the technical difficulty of reducing nephrite by percussion methods (1974:58). Numerous descriptions are given, showing that the method could be used in a quite casual fashion by individuals or that it could be made more formal and capital-intensive by fixing the rubbing stone to a double handle reminiscent of a crosscut saw. Several descriptions mention the suspension of a water container over the place to be cut, such that it dripped continuously into the groove. It was also quite common to add sand to the groove (Best 1974:58-71). I did not ask Dom informants about these finer points, but I do not think they hafted the sawing stones.

Since the **gaima** was likely to have been the desired thickness when lifted from the floor of the mine (see page 195), the kind of shaping required may be likened to that needed to cut cement slabs to the correct shape; it would not appear to be so hard as nephrite and sawing was probably preferred for reasons of economy.

THE DISTRIBUTION OF AXES

As in the other quarrying areas, some of the axe stone was distributed to outsiders in exchange for valuables like pigs and shells which men brought to give to the miners. Apparently the clansmen who did not work could still expect a share of the axe stone at the end of mining, and it was probably their job to arrange the **komina mire** ('food salt') feast which, it is said, was held afterwards. Vial (1940:161) mentions feasting:

> Suitable stones, when found, are stored, and on the decision to abandon the shaft the friends and relatives of the miners gather and feast. Signs of these feasts could be seen at some of the old shafts.

As I understand, it this type of festival was similar to the Central Chimbu 'food pile' distribution (Brown 1970; Criper 1967), but it seems that it was an occasion for visitors to kill pigs for the miners in return for axe stone. I am not sure whether Vial would have seen signs of the feasts (cooking stones, emptied hearths) actually at the site; what he did see may have been to do with special pig kills made by the miners to their ancestors - such as he observed at the time of his visit. During a **komina mire** the miners still ate apart from outsiders, **donga ole more more** 'fire make different', and the magical specialist, the **kila kuare yal**, was supposed to have had his own oven, which was opened first.

A peculiarity of **komina mire** was that rats were killed and cooked. Unfortunately I do not know what was meant by the term 'rat'; it could just as well refer to the giant marsupial rats like Hyomys goliath as to the smaller animals like Uromys caudimaculatus, which were a popular catch among Yawio and Yuro hunters in southern Simbu, according to Hide (1984:354).

Brideprice Axes

Above all, Dom **gaima** axes were hafted in a non-functional way and used in brideprice payments. Vial (1940:158, 162-3) made a personal distinction between 'ceremonial' axes, by which he meant the Hagen-style axes he saw being made on the Ganz River, and

'brideprice' axes, by which he meant the giant blades made exclusively at the Dom **gaima** quarry (Plates 9.7-9.9). One of his photographs (Plate 9.9) shows a set of **di gaima** lined up for a compensation payment; he described (1940:162) their 'use' as follows:

> A man finds little cutting work for his ceremonial axe - he may use it in battle, or may nick a length of sugar cane before breaking it. The axe becomes important when he has to make a payment, after killing or assaulting someone, or when a bride-price is being collected. The payment for a bride consists principally of axes. (At one wedding sixty were counted, and twenty or thirty on several other occasions.) Three or four of these are **gaima** or **kundun** (bride-price axes) and the rest are ceremonial axes. In all payments of axes they are laid on the ground in order of size, the blades pointing in the same direction.

As Hughes has already pointed out (1977a:142), Vial made a mistake when he saw **kundun** axes in the Dom area (Vial 1940:158) and thought they were made there. They were in fact **di kurin** (or **kurun**) and were from the Western Highlands, the name being a corruption of the Tuman **kunjin.** I also found that the name was applied indiscriminately to Jimi and Tuman products by older informants, so long as the blades were dark in colour.

Vial (1940:158) named the 'ceremonial' axes as **kenduaubu** and **di kurugu** and said they were the most common type seen in the Wahgi and Central Chimbu areas. Like the Dom men, I think he included Tuman blades in the 'ceremonial' category; I cannot make out what the first name is, but **di kurugu** must be **di Goroku**, 'the Goroku's axe' - another way of referring to **di gaima.** Note that Vial wrote down Goroku tribe as 'Gondigu' (e.g. Vial 1940:161). Smaller Dom **gaima** blades were mounted in more functional handles and, though quite distinctive of the area, could have been counted by Vial among the 'ceremonial' axes he saw in Simbu.

The handles of hafted Dom axes small enough to be considered simply as 'ceremonial' axes are distinctively canted forwards in the direction of the blade, rather than backwards in the direction of the 'counter-balance', as in axes mounted in the Hagen style. Their blades are in the range 25-40 cm long. (Note that work axes with blades 5-15 cm long were also produced at the site as these form a small component of ethnographic and archaeological collections.)

Plate 9.8 shows Vial's photograph of a man with one of the large brideprice axes described above. His name was Kora Kama; many informants identified him independently from the photograph during my visits. Apparently he was from the Kwiwaku hamlet of Kagul and he died sometime in the 1970s. I was able to discover a few details about the history of this particular axe. Kora Kama's full brother (Plate 9.7), Gore of Kwiwaku tribe, Mepil Gau clan, said that the two of them went across the Wahgi to the place Gaima to trade. Kora Kama took with him a pig of the largest size with which he bought the axe. Later he contributed it to a brideprice payment on behalf of another man who was being married to a girl called Suaiku of Nimai tribe, Wolaku clan. The axe was never actually used for work and it was only a part of the total payment.

Murphy (1938:Plate A) illustrates a large brideprice axe, with the caption 'Chimbu natives with marriage axe made at Mount Hagen'; this is wrong, it is a typical brideprice axe from the Dom **gaima** quarry.

THE ABANDONMENT OF THE QUARRY

Some confirmation of the relative importance of different 'markets' to the operation of each type of quarry can be found in the timing of the abandonment of the sites. The Tungei never quarried after 1933, although they may have continued to make axes for five years or more afterwards, by which time steel had made considerable inroads into the potential market for work axes. Vial (1940:163) wrote that:

> In the tribes near the government and mission stations probably seventy per cent. of the men and youths possess steel. Any scrap of iron or steel is sharpened and fitted into a handle, making an axe. But the steel is replacing the work axe only - the ceremonial axe is carried for display, and payments are made with it and the bride-price axe, not with steel.

Vial attributed the contemporary strength of the Jimi industry to the greater quantities of shell by then available and the higher prices being paid. At the same time, quarrying and axe making continued at Tonmai through the Pacific War, but it stopped sometime

between Costelloe's visit in 1943 and the submission of his patrol report in April 1947.

Goroku informants remembered Costelloe as 'Kotole'; they personally fixed the time of the disuse of the quarry at about 'the time the bombs fell on Mingende', i.e. May 1943. As to the reasons for going out of production, one informant said it was Kotole who told them to stop making axes! Nevertheless, the fact that new shafts were still be sunk at Tonmai some 10 years after the Tuman sites had fallen into disuse is a sign of the greater proportion of high-value axes, compared to other products, that could be manufactured there and for which there was still a demand some years after Europeans had entered the highlands.

DISCUSSION

The geological peculiarity of the Dom **gaima** site, enhanced to the full by an eminently suitable method of producing axe blanks, can be seen to have set the stage for the emergence of the non-functional Dom axe style. At the other quarries informants often said that the largest (conventional) axes were never used in case they were damaged and there can have been little actual difference between these and a Dom brideprice axe. Both were reserved for high-value transactions and may be considered to have simply been wealth tokens.

Nonetheless, the special attribute of Dom **gaima** axes was the extreme size which they could attain, compared to the axes from other quarries. A mounted blade could be so large that, according to Vial, two men were needed to carry it about (1940:162). Examples like this are very scarce in collections and there is only one in the National Museum (number E5435, MNH3) and one, as mentioned on page 198, in the J.K. McCarthy Museum, Goroka. Loose blades which would have been mounted in this way are also extremely rare. This should be compared with many dozens of hafted, and many hundreds of unhafted, Tuman and Jimi blades in collections from nearby areas.

I do not think that the rarity of Dom **gaima** axes can be accidental - even in Simbu the quarry seems never to have supplied more than 15% of axes in collections (e.g. Chappell 1966:Table 2) - and the inescapable conclusion is that the Dom **gaima** quarry actually

had a very low output of axe stone. Bearing in mind the huge investment required to open the shafts, a low output is only consistent with the quarry having produced a small quantity of extremely high-value axes, namely that it specialised in the production of brideprice axes.

In terms of the organisation of the mining community, operations at the Dom **gaima** quarry would certainly have had different social and economic side-effects from those at the Tuman quarries or in the Jimi Valley. The cult-orientated effort mounted by the Tungei was not an appropriate method for the Dom miners since, in shaft construction, the demand for skilled, patient workmen overrode the need for conscripted muscle, which the Tungei system supplied proportionately more of. It could be that the Dom mining community was setting up the preconditions for a division of labour because only some men participated in quarrying. However, the point can be made that other kinds of specialism already existed (or were being developed) in every axe making community that possessed hafting specialists and knappers who were hired by others without their skills (Chapters 5 and 6).

THE DOM GAIMA QUARRY

Plate 9.1

The mining area at Tonmai, a view looking due east from Aipa. Kielpa lies in the middle distance. Note the grove of Casuarina trees at centre right (cf. Fig. 9.2). The depth of the trench between Aipa and Kielpa is an artefact of mining; spoil has been removed by the Ambil Creek and by dumping onto the steep upper slopes of the Iri valley, out of picture at right.

The Wahgi River is visible in the distance, as well as the Kundiawa-Gumine road. Foreground: Henry Goi.

Plate 9.2

Kama of Kurpi Nonku clan demonstrating how the magical specialist, the kila kuare yal, cast spells to prevent rain from falling (photo taken in a light drizzle near Dirima). Kama and his kinsman Wemin, who was also present at the interview, are both former kila kuare yal.

Plate 9.3

Two men carrying a basket (koma gal) from a shaft at Tonmai in 1939. The head of a third man can be seen at the top of the shaft. Photo: L.G. Vial (reproduced with the permission of the Editor of Oceania).

Plate 9.4

The same shaft from a different angle. Note the fact that the shaft is not circular, but rectangular, and that the cross-braced timbers are set in one direction only. The widths of all shafts will have been restricted by the length of these braces. Photo: L.G. Vial (reproduced with the permission of the Editor of Oceania).

Plate 9.5

Bopa of Goroku, Kopil Kane clan, demonstrating the manner in which timbers were fitted against each other in Dom mineshafts.

Plate 9.6

Nulai of Kopil Kane clan (centre) demonstrating the methods of shoring mineshafts. He has used the horizontal and vertical sticks to represent the crossbraces and upright timbers used in the shafts.

Plate 9.7

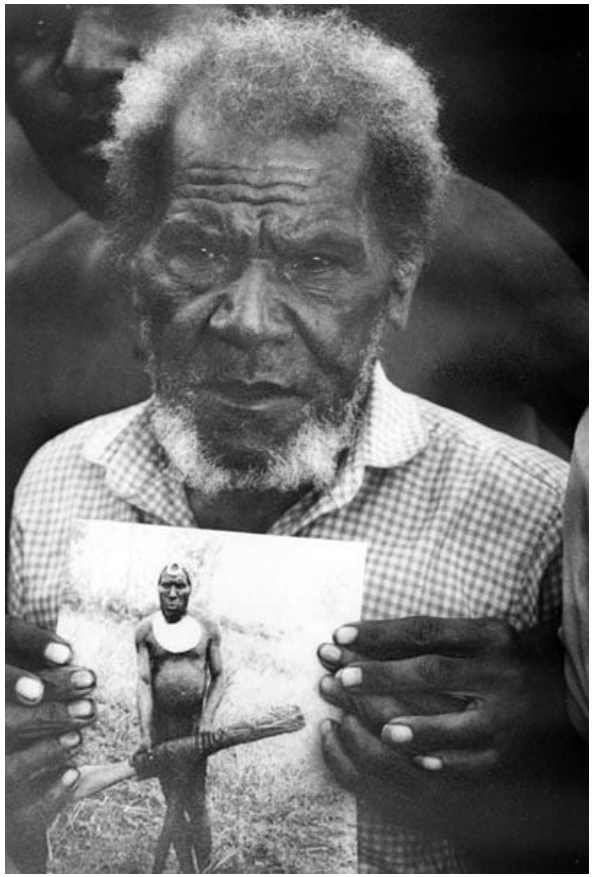
Gore of Kwiwaku, Mepil Gau clan, was the full brother of Kora Kama, the man pictured by Vial in Plate 9.8. He lives at Kagul.

Plate 9.8

Kora Kama of Kwiwaku, Mepil Gau clan. Many informants recognised him in the photograph and directed me to Kagul, his former home. He is holding a classically styled gaima brideprice axe. Photo: L.G. Vial (reproduced with permission of the Editor of Oceania).

Plate 9.9

"A row of ceremonial axes: part of a compensation payment after a killing." Note that this was not a row of so-called brideprice axes. They were gaima axes but - following Vial's remarks on the distinction - were of lesser size than Kora Kama's axe. Photo: L.G. Vial (reproduced with permission of the Editor of Oceania).



Chapter 10

THE HIGHLANDS-WIDE DISTRIBUTION OF QUARRY PRODUCTS

Up to this point I have been concerned with the details of axe manufacturing techniques and, where possible, the kinds of personal interaction which give rise to trade in the highlands. Most of these points lie outside the conventional archaeological record; they are not normally aspects of a past society which are accessible to prehistorians. In this chapter, however, I move squarely into the realm of observable material culture to build up a picture of trade patterns over the highlands in recent times and to state the likely antiquity of trade in quarried stone, based on archaeological evidence. The data consist of some 3000 stone axes, spread among 20-odd ethnographic collections, and excavated materials from a dozen prehistoric sites.

THE CHARACTERISATION OF HIGHLANDS AXE SOURCES

The starting point lies with Chappell's (1966) visual/petrographic approach to distinguishing the thirteen quarries he located in the field. Chappell was able to identify many of the different axe types in hand specimen, a method that is quite reliable when dealing with fresh and unpatinated specimens from certain quarries. In this he had assistance from informants throughout the highlands, whose customary - indeed only - method of identifying and naming the axes they handled in trade was by inspecting the shape of the blades and the colour and texture of the stone. Chappell tied other axes to particular quarries by comparing the mineral fabric of thin sections from them, but of the 1200 axes examined, he cut sections from about fifty only, or less than 5% of the total. For the most part it was unnecessary to (in fact desirable not to) section axes with a clear provenance in hand specimen.

In my experience, the following axe types from collections made

in the Western Highlands can be picked out by eye: Tuman axes, black Jimi Valley axes, light-coloured Tsenga **gaima** axes, Dom **gaima** axes and axes made from local (non-quarry) sources. Most Tuman axes have distinctive grainy markings, swirling veins and a deep green colour. Jimi Valley axes are thinner, more flared towards the cutting edge and mostly deep black in colour; the light-coloured **gaima** blades from Tsenga weather easily, taking on a distinctive chalky white cortex, but they are identical in shape. Dom **gaima** blades are grey-green and sometimes have tell-tale saw marks; when weathered, the laminations in the stone tend to show up more and the type can easily be distinguished from specimens of Tsenga **gaima**. Axes made from informal sources like streambeds - 'local' axes - are highly variable in appearance and have a much rougher finish. They generally do not conform to a paradigmatic shape like the Tuman and Jimi axes (Fig. 6.1). Naturally, the axes that are left over in a collection, or that cannot be sourced with confidence, may include discoloured or abnormally shaped specimens of any of the above-mentioned types.

So diagnostic is the shape and colour of many Tuman and Jimi blades, they can even be picked out in photographs (e.g. Vicedom and Tischner, 1943-48, II, Plate 17.1). But among those that are not so typical, some Tuman axes are dark enough to look like black Jimi axes and further work is needed to tell them apart from real Jimi axes.

No informants in 1980-81 were able to make further distinctions, though this may not have been the case in the 1960s when Hughes and Chappell made inquiries. In addition to the main categories I have put forward, Chappell (1966:Table 2) distinguished 'Ganz-Tsenga' axes and 'Mbukl-Muklpin' axes; the latter category included those made at Mbukl, Pukl and Yambina. However, I was unable to make the same distinctions and Ganz **ketepukla**, Tsenga **tingri**, Pukl, Yambina and Apin axes all appeared very similar to me, in so far as I could match them with samples from each of the quarries by geochemical means. While there may be markings uniquely attributable to the individual quarries, I was not able to discover them. I was only once shown an axe blade in good condition in the Jimi Valley - the **ketepukla** blade given to me by Enk Ru of Palg (Fig. 6.1a) - and I did not learn much from the museum specimens I

carried with me. I was also unable to identify Mbukl axes by eye, and I cannot distinguish between axes made at the individual Tuman sites, Yesim, Kunjin or Ngumbamung as Chappell did; my informants were too inconsistent to justify this.

In terms of the degree of precision with which individual outcrops could be recognised, Chappell (1966:96) came up against a fundamental characteristic of the highlands axe industry. A 'repetition of the geologic environment' was encountered throughout the region where axes were made; in other words, the axe makers tended to use the same kinds of rock at widely separated locations.

This is a situation quite unlike that in Britain, where the Council for British Archaeology's Implement Petrology Committee has successfully overseen the sourcing of some 3000 stone axes from England and Wales over the past 40 years. The sources have been found to come from a heterogeneous set of rocks; raw materials include gabbro, epidiorite, hornfelses, epidotised tuff, augite-granophyres, porcellanite and spotted dolerite (cf. Stone and Wallis 1951). The main British factories can easily be distinguished under the petrological microscope and sources which are similar to them tend to be of much lesser importance. In contrast, the rock types exploited in the Papua New Guinea highlands are all fine-grained hornfelses (Chappell 1966:96) with a much more uniform texture.[1] Chappell finally distinguished each source by a suite of characteristics (1966:Table 1) rather than by virtue of unique mineral compositions.

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[1] A recent geological analysis of the whole study area can be found in Bain et al. (1975). D.E. Mackenzie visited one of the Tuman quarries (probably Kunjin) and the other quarries found by Chappell are correctly positioned on 1:250,000 scale maps. Information on geochronology is given by Page (1976), while parts of the area have been remapped at 1:100,000 scale by the Geological Survey of Papua New Guinea. This includes the 'Minj' sheet, where the geological position of the Tuman quarries is changed from Pzo, the Omung metamorphics (Mackenzie), to Rt, part of the Kana volcanics. Relevant absolute ages are about 220-240 Myr in a part of the sequence just above the Omung metamorphics, and about 200 Myr for the Kana formation. (Another Kana member, Rt3, could include the **tingri** and **gaima** outcrops at Tsenga.)

INFRARED SPECTROSCOPY

An examination of Chappell's original slides (courtesy of the Department of Anthropology, University of Auckland) showed that distinctions were being made in types of secondary alteration, rather than in primary mineral fabric. The typically fine grain size of 5-10 microns was a hindrance to optical examination and, following the advice of A. Watchman, I carried out a program of bulk chemical analysis based on infrared spectroscopy (Garsden 1975).

Only 20 mg of powdered rock is needed for infrared spectroscopy, but it is normal to drill out several grams of material and homogenise it before taking the 20 mg sample. The fine grain size was a distinct advantage in carrying out this procedure because there were few worries of sampling a non-uniform patch of stone. In tests, two or more samples from the same piece of rock or from the same artefact gave almost identical results; the exception was rock from the Dom **gaima** quarry which proved to exist in two phases (see Appendix H). The samples were easily obtained with a hollow drill bit of 5 mm internal diameter and their preparation for analysis followed a standard laboratory procedure.[2]

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[2] A highspeed drill was used to drill a 3 cm-long plug of rock from the artefacts. In most cases, planilateral axes were drilled through the unpolished butt end to minimise surface damage. A filler was later used to hide the drill holes. I also tested a 2 mm drill, which could have been used to sample much smaller axe fragments. This was not successful and the extreme hardness of the hornfelses made it easy to destroy the thinner drill bits.

The drill plugs were crushed in a mill, yielding 2-3 g of coarse powder; 20 mg were ground in an agate vial for 10 minutes with a few drops of ethanol. The fine residue was dried and 2.5 mg blended with 1 g potassium bromide, an inert medium, for 1 minute. Disc wafers were pressed from the mixture in a vacuum die (minimum pressure for 2 minutes; 10 tonnes for 2 minutes).

The principle of the technique is that electromagnetic radiation in the infrared band (wavelengths of 2.5-25.0 microns) is beamed at a disc wafer while a detector on the far side of the wafer measures the amount of absorption by the sample as the beam is tuned through the waveband. Different crystal lattices resonate at different frequencies, absorbing more of the beam's energy as they do so. A pen trace records these as distinct absorption peaks. A Pye Unicam SP2000 spectrophotometer was used for the analyses (courtesy of the Department of Geology, the Faculties, Australian National University).

The technique identifies mineral species rather than the actual elemental composition of the sample, as in the case of X-ray fluorescence, neutron activation, electron probe and the PIGME-PIXE techniques of proton excitation (Smith 1982). Any of these other methods can be used to complement to the information provided by infrared analysis.

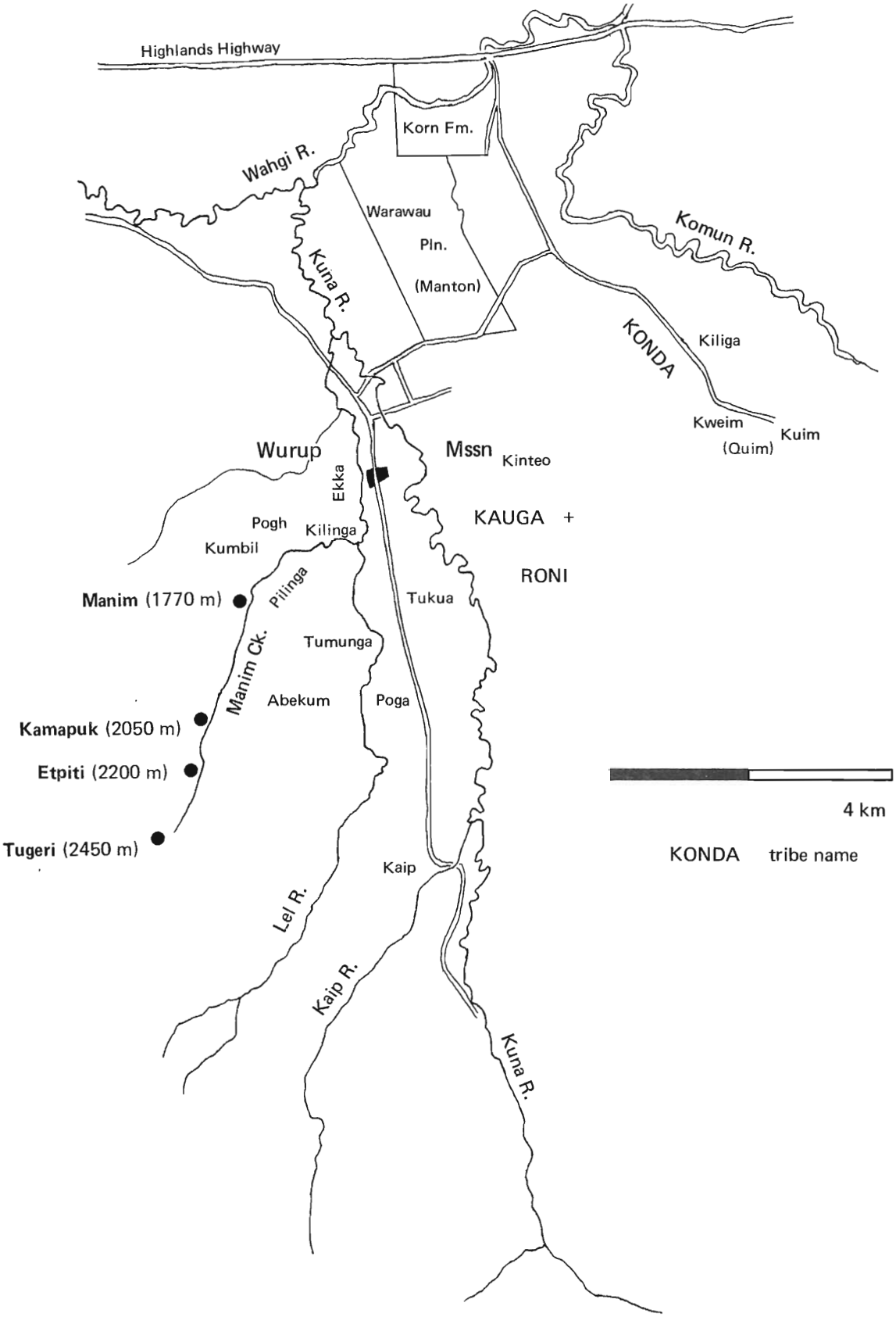
In the course of fieldwork approximately 100 samples were taken from outcrops at the following quarries: Kunjin, Ngumbamung, Yesim, Apiamb, Gapinj, Gapinj Aka Nui, Mela, Ganz, Tsenga, Mbukl, Pukl, Yambina, Apin, Repeng and Dom. These formed a reference series against which artefact spectra could be matched. A small number of axes with secure quarry associations could also be included with the quarry samples. They included Hughes' axe No.29, which was found by Hughes (1971:293) beside a track about five minutes walk from the Tingri site at Tsenga, and the **ketepukla** axe of Enk Ru. Hughes was told by the Tsenga men that No.29 was made there, and Enk, a man in his early sixties, told me his father, Ru (deceased), made his axe from **ketepukla** stone at the time that the Ganz quarry was open.

Hand specimens of Dabiri rock collected by Hughes in 1973 were a late addition to the reference samples, when the almost identical spectra of three axes from Wurup suggested the existence of an unknown source; O.A. Christensen's informants had previously identified the axes with Dabiri and spectra obtained from Hughes' samples confirmed this (see Appendix H).

The Collections

Two major axe collections were sourced in detail. The first was a large collection made at Wurup (Fig. 10.1) by O.A. Christensen in 1973. Christensen purchased any ground or chipped stone fragments which were brought to his house during his fieldwork period (White et al. 1977a).

The second collection is from Kuk (Fig. 10.2) and comprises axes, and fragments of axes, collected at Kuk Agricultural Research Station by J. Golson over the years 1972-81, by P. Gorecki from Kawelka garden land in 1977 and 1978 (Gorecki 1982), and by myself in 1980 and 1981. Golson's finds are mainly axes of recent date dug up by station employees from the topsoil at the Research Station; a



WURUP archaeological sites and placenames

Figure 10.1

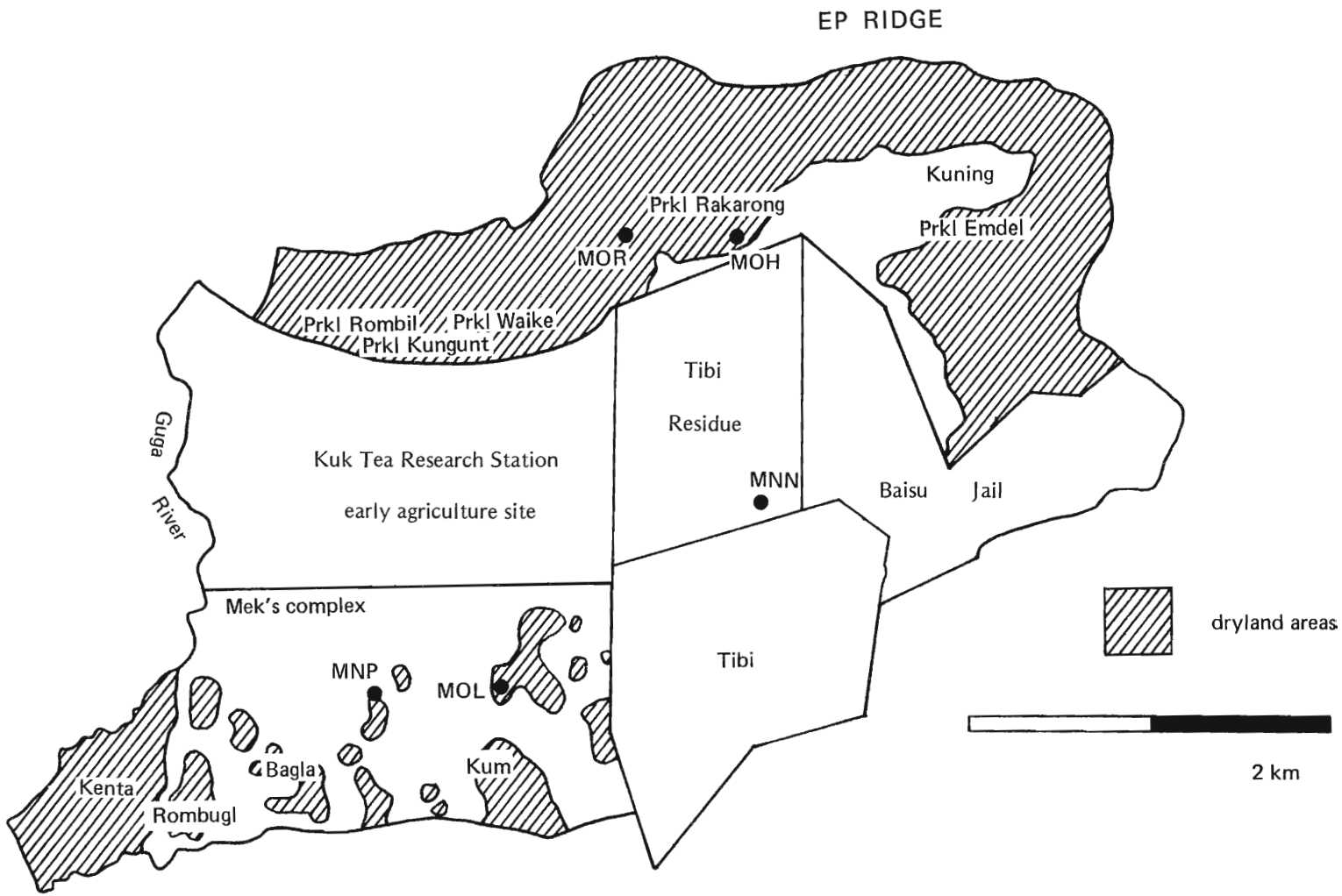


Figure 10.2 **KUK** places and archaeological sites

much smaller number of axes and fragments comes from stratified contexts in excavations (Fig. 10.2).

Gorecki's finds from the same area are located by Kawelka placenames and can be put into three groups: axes from Dryland Gardens at Kuk village, axes from wetland gardens (the Swamp), and axes from the higher ground of Ep Ridge, the prominent landform just to the north of Kuk (Plate 2.6). My finds are either from the Swamp or from Ep Ridge. All my finds from Ep Ridge and all Gorecki's finds from the place known as Prkl Rombil (Fig. 10.2) were collected by Joseph Walua, Gorecki's assistant who has been collecting axes since the late 1970s (Gorecki1982:44). A full catalogue of axes in the Wurup and Kuk collections is given in Appendix G.

I also attempted to identify a small quantity of polished stone found by M-J. Mountain in her excavations at Nombe rockshelter in Simbu Province (Fig. 1.2). Most of the finds are small flakes with some polish, and came from her Strata A and B. The dating of these levels is currently not precise and the finds can only be placed within the last few thousand years (M-J. Mountain pers. comm.).

The drilling procedure placed a restriction on the size of axe or fragment that could be included in the sourcing program. None of the small fragments from the rockshelter collections, for example, could have been sampled with a 5 mm drill. In these cases, a few of the larger fragments were selected and portions were sawn off with a diamond wheel. In the large surface collections there were also considerable quantities of broken axes. These factors call into question the manner in which the finds could be counted without bias.

For the present analysis it must be assumed that axes from different quarries have had the same chance of entering the various collections, whether they were lost and have been dug up again in gardens (cf. White and Modjeska 1978a), or whether their former users had curated them since buying steel axes (by storing them as keepsakes). However, bias could arise in a number of ways. Axes from one factory with a typically thin cross-section might be found in a broken state more often than axes from another where the section is thicker. If fragments were not counted, the thin products of the first quarry would be under-represented. Equally, two quarries might have produced the same volume of stone annually,

but the first may have produced twice as many axe blades half the size of those produced at the second.

I have chosen to disregard these possible distortions, but I adopted a rule of inclusion for the large surface and ethnographic collections from Kuk and Wurup. Any pieces which were not 'substantially complete axes' were rejected and, of the remainder, those axes that were too small to drill were also rejected. I accepted as a 'substantially complete axe' any axe of a recognisable shape which retained at least two thirds of its original length. My intention was to recognise as axes all the broken blades that could readily be resharpened and rehafted, but to class as fragments all the pieces that were too small for this, or were only a small part of the original. (Whole axes that were too small to drill were few in number.)

After this, there were 196 axes with known provenances in the ethnographic collection from Wurup and 144 in the Kuk collection. In addition there were 31 fragments large enough to drill in the collection of stratified finds from Kuk.

Many of the Tuman axes could picked out by eye: 63 in the Kuk collection and 78 in the Wurup collection. Minor axe types which were classified visually were local (non-quarry) axes (Kuk, 17; Wurup 36), Tsenga **gaima** and Dom **gaima** axes (3 and 1 in each collection respectively). A minority of the blades in each collection, therefore, remained to be sourced spectroscopically: 60 from Kuk and 78 from Wurup. Added to them were 20 stratified fragments from Kuk and 11 stratified fragments from the Manim Valley and Nombe rock-shelters to make a total of 169 artefactual samples.

Discrimination Between the Sources

The infrared spectral characteristics of each source of quarried stone were discovered by taking the artefactual and outcrop samples together and visually comparing their spectral charts. It did not prove possible - with notable exceptions - to match axe spectra with unique, tightly grouped sets of outcrop spectra.

I also attempted to classify spectra by means of numerical taxonomy, but this was a complete failure and I mention it only parenthetically. I designed a digitising system to convert the

analogue information output by the spectrophotometer into numerical readings, using a graphics tablet, which proved to be extremely accurate. I was able to use the normalised heights of the 27 most significant peaks in a discriminant analysis (Klecka 1975), but I obtained poor results. One of the problems was that each artefact was given an equal prior probability of coming from a particular quarry, when in fact other information about the axes often argued for unequal prior probabilities - for example surface markings on an axe or a shape that made one quarry a stronger candidate for the source than the others.

Although Chappell's petrographic description made it clear that the tool stone from each source was very similar, distinctions between the quarries can be expected to exist in their mineralogy, if the means of measurement is fine enough. Chappell identified the four main mineral constituents of highlands axes as epidote, albite, quartz and tremolite-actinolite (1966:Table 1) and, with the exception of epidote, infrared analysis confirmed this. The main spectral types prove to be dominated either by quartz (Tuman, Repeng, Mbukl, Tsenga **gaima**) or by amphiboles, most probably actinolite (Tsenga **tingri**, Apin, Yambina and some Ganz). Others may be characterised by the presence of albite (Pukl and most Ganz) and prehnite (Dom **gaima**). To confirm the spectral identification of prehnite, I had a thin section made up from a sample of Dom **gaima** stone, but the ultra-fine grain size made a petrographic description impossible (A. Watchman pers. comm.). I give a detailed description of the infrared spectrum of each source in Appendix H.

I found that Tuman, Ganz, Pukl, Tsenga **gaima**, Dom **gaima** and Dabiri axes can be identified with confidence and that, of the major sources, only Tsenga **tingri** axes could not be identified at all.

In the case of Tuman axes, the spectral type was dominated by quartz and I did not find it possible to distinguish between any of the seven Tuman sources. In hand specimen, Tuman axes were only likely to be confused with the amphibole-rich black axes from the Jimi Valley, because they occasionally acquired a black patination. This meant that a positive identification generally rested on the obvious differences between quartz-dominated and amphibole-dominated spectra. Nonetheless, confusion was possible between the spectra of Tuman and Mbukl axes.

As I mention below, this was a special problem when dealing with the Kuk collection; the Kawelka, the recent owners of the Mbukl quarry, have strong historical links with Kuk (A.J. Strathern 1972: 36-9) and it is reasonable to think that Mbukl axes have a good chance of being found there.

Tuman axes could not be confused in hand specimen with the spectrographically similar Tsenga **gaima** axes. Although the appearance of Repeng axes is unknown, confusion between Tuman and Repeng spectra would only be a problem within 10-20 km of Repeng, because the latter had a very localised distribution, according to informants. The Kuk and Wurup collections are more than 50 km away and I hesitantly identified only one axe with this source (Fig. H.19).

At the Ganz River there appeared to be two facies of tool stone. The first, represented by some outcrop samples, Enk Ru's **ketepukla** axe and most of the axes in the collections identified as Ganz, had a spectrum reminiscent of Pukl outcrop samples. I labelled this type 'PX' ('Pukl-X' group) before obtaining enough analyses to be certain that the type could be firmly tied to the Ganz River (see Appendix H). It would be possible to confuse Pukl and Ganz-'PX' spectra, but, in the majority of cases, the differences are discernible.

The second type at the Ganz River, represented by a number of outcrop samples, belongs to what might be called the 'generalised Jimi facies'. The spectra are dominated by amphiboles, are rather variable and cannot normally be distinguished from Apin, Yambina, and Tsenga **tingri** spectra. Apin and Tsenga **tingri** could not be picked out in the axe collections at all and the three identifications of axes as Yambina (at Kuk, see page 215) were extremely tentative. There were, however, four spectral types among axes of the Wurup and Kuk collections that I could not properly match with any of the known outcrops; I labelled these unknown types 'A', 'B', 'C' and 'D'. The unknown types 'A' and 'C' were closest in spectral appearance to the generalised Jimi facies.

The spectra of the 'B' and 'D' axes were radically different from any of the outcrop samples and they represent either undiscovered minor sources in the Jimi Valley or facies of subsidiary importance at known sources. In hand specimen, all the axes that I

identified with 'A', 'B', 'C' and 'D' were black and shaped like axes from Kuk and Wurup that were confidently sourced to the Ganz River.

To achieve a finer degree of resolution, I obtained X-ray fluorescence analyses of 50 outcrop samples, drawn from the following quarries: Tuman (10), Ganz (10), Tingri (10), Yambina (9), Apin (6) and Mbukl (5). Seven elements were measured; they were nickel, zinc, rubidium, strontium, yttrium, zirconium and niobium (courtesy of the Department of Geology, the Faculties, Australian National University). A discriminant function analysis (Nie et al. 1975) was run on these data with quite good results. This is summarised in Table 10.1 and scores on the first two discriminant functions are plotted in Figure 10.3.

The results show that Ganz **ketepukla** and Tsenga **tingri** samples can be cleanly separated, mainly on the second discriminant function. The major contributors to the second function were zirconium, with a strongly negative coefficient, and niobium, with a strongly positive one (Table 10.1). Unfortunately the Apin and Yambina samples do not form very distinct groupings using this range of elements. If anything, Apin is closer to Ganz **ketepukla** and Yambina is closer to Tsenga **tingri** (Fig. 10.3).

The five Mbukl samples form a tight group apart from most of the others. In terms of raw counts Mbukl was richer in strontium than the other sources, although there was some overlap with the Tuman samples on this element; in the discriminant analysis the only confusion was with Tuman samples. The XRF results show that elemental analysis has promise as a diagnostic method; however, I was unable to use it to source artefacts.

THE SOURCES OF AXES AT KUK AND WURUP

Figures 10.4 and 10.5 display the percentage contribution made by each identifiable source among the axes of the surface and ethnographic collections from Wurup and Kuk. The most likely sources of individual axes in the collections, together with other documentation, is given in Appendix G; statistical summaries of this information may be found in Tables 10.2 and 10.3.

As might be expected from the proximity of the collections to

Function	Eigenvalue	Percent of variance	Cumulative percent
1.	1.6187	49.20	49.20
2.	1.0229	31.09	80.29
3.	0.4808	14.61	94.90
4.	0.1305	3.97	98.86
5.	0.0374	1.14	100.00

Standardised discriminant function coefficients (functions 1-3)

	Function 1	Function 2	Function 3
Rb	-0.0920	0.2126	-0.0442
Sr	-0.2449	0.2976	0.8941
Y	-0.1557	0.1882	0.0748
Zr	0.2043	-1.5248	0.1266
Nb	0.3811	0.9120	0.4214
Zn	0.5604	0.4714	-0.2544

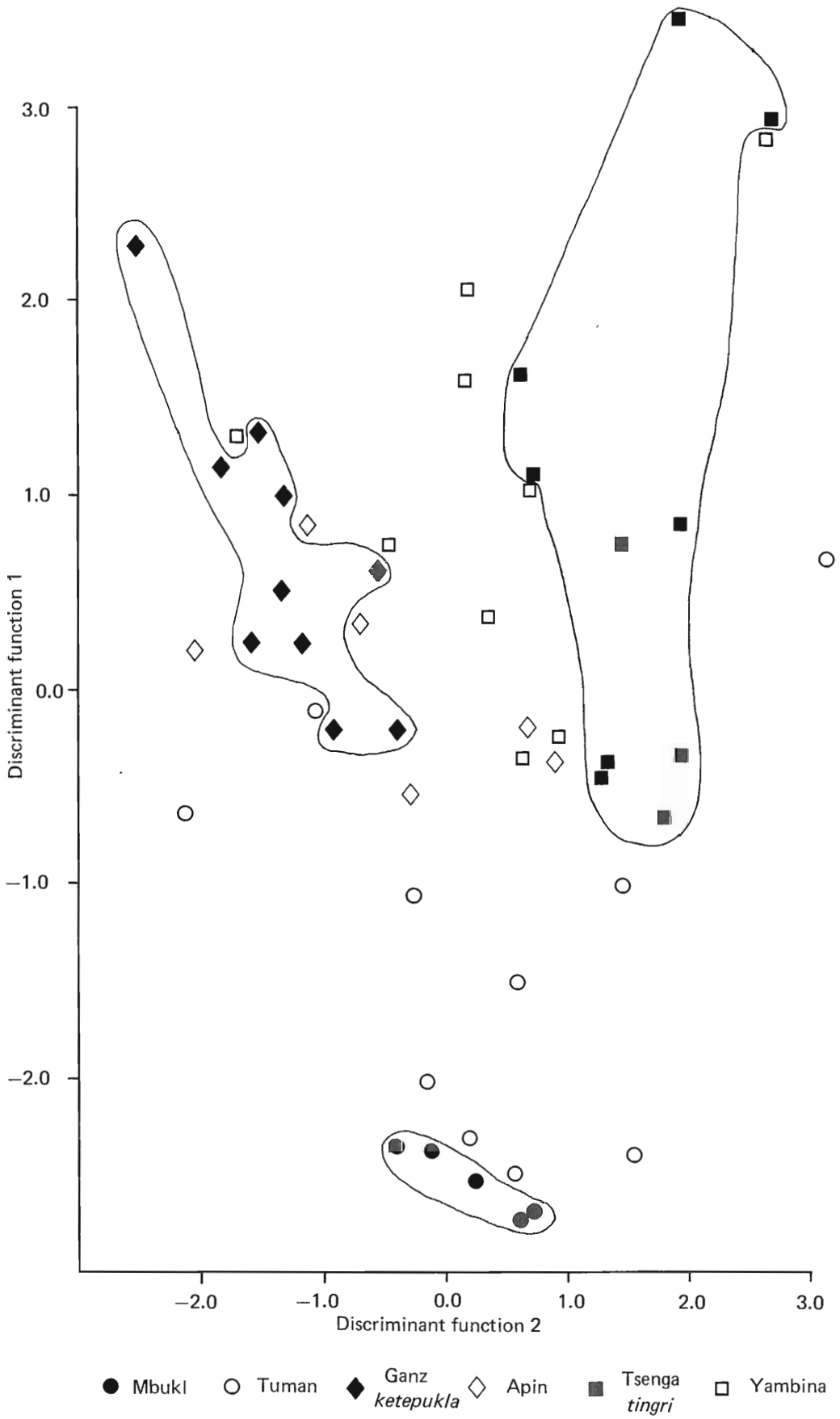
Results of reclassification

Actual group	No. of cases	Predicted group membership 1.	2.	3.	4.	5.	6.
1. Tuman	10	5	0	1	0	2	3
		50.0%	0.0%	10.0%	0.0%	20.0%	20.0%
2. Ganz	10	0	8	0	0	2	0
		0.0%	80.0%	0.0%	0.0%	20.0%	0.0%
3. Tsenga *tingri*	10	0	0	9	1	0	0
		0.0%	0.0%	90.0%	10.0%	0.0%	0.0%
4. Yambina	9	1	1	3	2	2	0
		11.1%	11.1%	33.3%	22.2%	22.2%	0.0%
5. Apin	6	0	2	1	0	3	0
		0.0%	33.3%	16.7%	0.0%	50.0%	0.0%
6. Mbukl	5	0	0	0	0	0	5
		0.0%	0.0%	0.0%	0.0%	0.0%	100.0%

64% of all cases correctly classified.

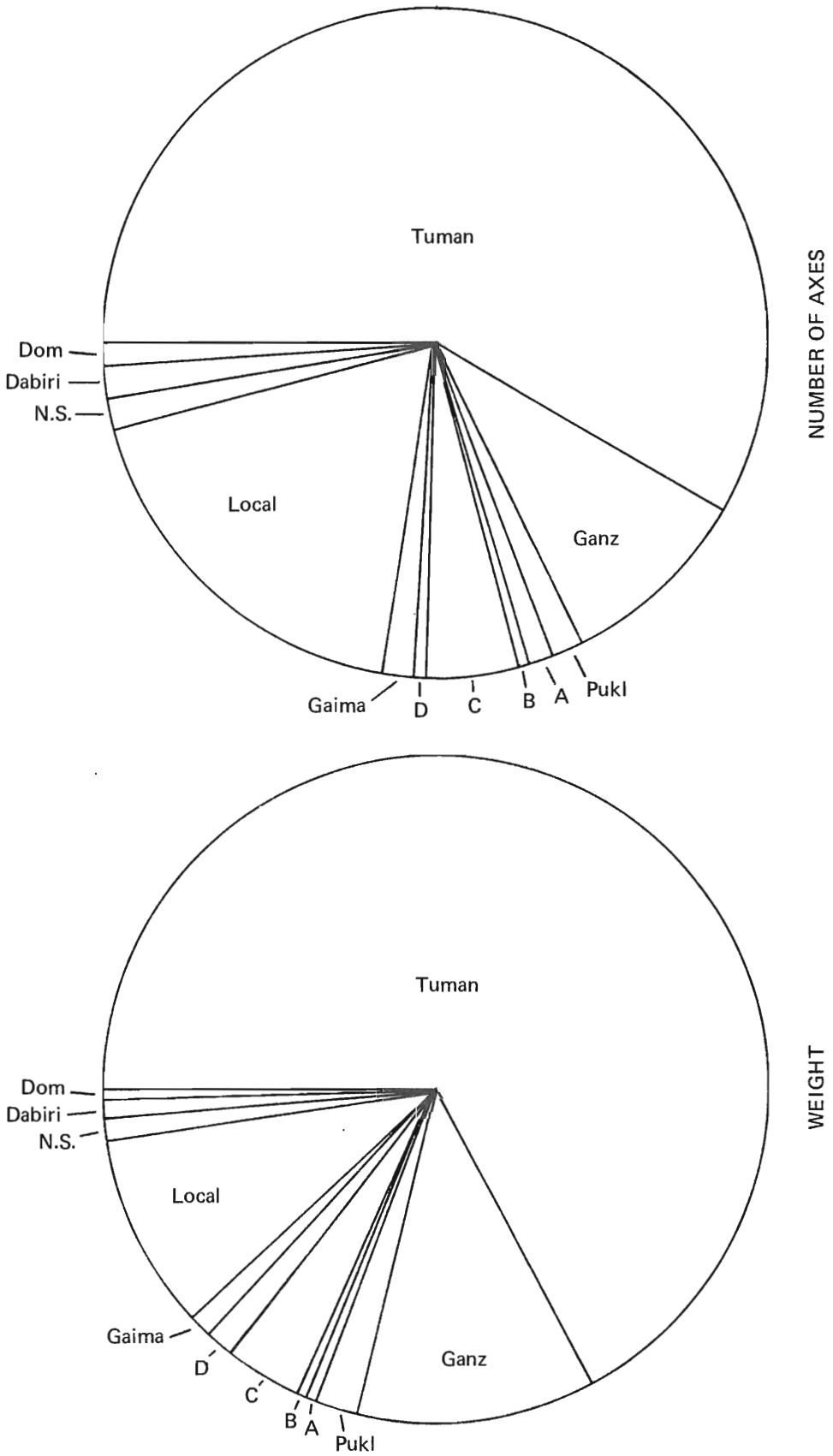
X–RAY FLUORESCENCE summary of discriminant function analysis results

Table 10.1



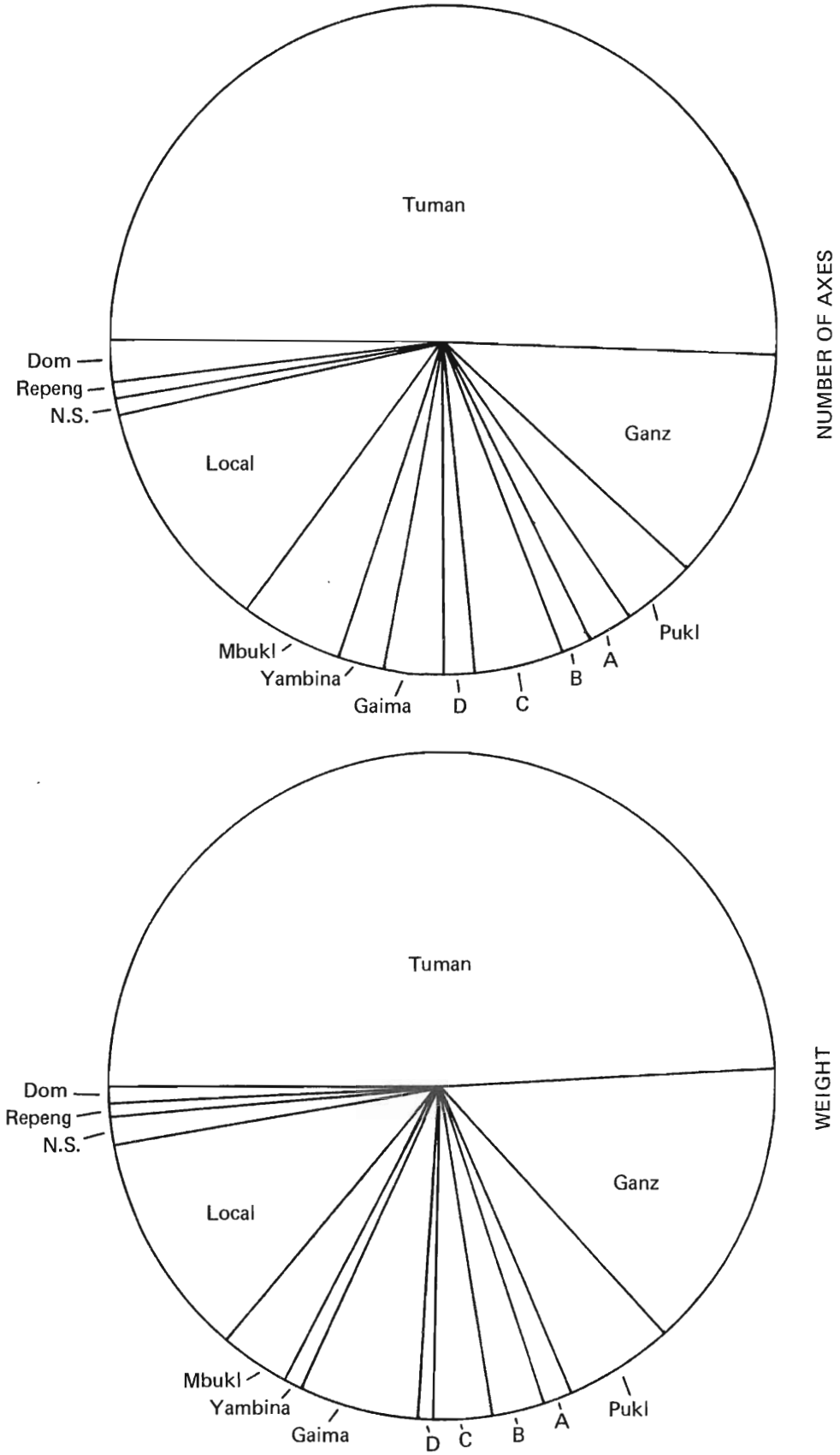
XRF results plotted discriminant function scores

Figure 10.3



WURUP (O.A. Christensen collection) breakdown of sources by number and weight

Figure 10.4



KUK (Drylands, Swamp, & Ep Ridge) breakdown of sources by number & weight

Figure 10.5

Quarry	No.	%	WEIGHT (g) Sum	Mean	S.D.	LENGTH (cm) Mean	S.D.
Tuman	114	58.2	20881.4	183.2	119.1	10.5	2.9
Ganz River	18	9.2	2959.2	164.4	98.7	10.2	3.2
Pukl	3	1.5	636.6	212.2	24.2	11.8	1.4
A	2	1.0	153.6	76.8	3.0	6.8	0.4
B	1	0.5	66.1	66.1		7.5	
C	9	4.6	1233.5	137.0	46.6	9.0	1.1
D	1	0.5	435.1	435.1		17.5	
Tsenga Gaima	3	1.5	351.9	117.3	43.7	8.8	0.3
Dabiri	3	1.5	339.5	113.2	61.4	6.7	1.8
Dom Gaima	2	1.0	132.9	66.5	27.5	11.3	8.8
No source known	3	1.5	351.3	117.1	53.0	7.5	1.8
Local	37	18.9	3676.7	99.4	62.6	8.4	2.5
Whole sample	196	100.0	31217.8	159.3	108.4	9.8	2.9

Means of identification		
IR Spectrum	78	39.8%
Hand inspection	118	60.2%
Total	196	100.0%

Table 10.2 **WURUP (O.A. Christensen collection)** breakdown of sources by number, weight & length of axes

Quarry	No.	%	WEIGHT (g) Sum	Mean	S.D.	LENGTH (cm) Mean	S.D.
Tuman	73	50.7	15322.3	209.9	143.0	10.4	2.4
Ganz River	16	11.1	4460.8	278.8	272.6	12.3	4.7
Pukl	5	3.5	1558.6	311.7	319.3	13.6	4.1
A	3	2.1	416.7	138.9	25.4	10.2	1.6
B	2	1.4	763.5	381.8	121.3	17.0	4.9
C	6	4.2	894.8	149.1	56.4	9.3	1.6
D	2	1.4	239.3	119.7	20.7	10.3	1.8
Tsenga Gaima	4	2.8	1806.3	451.6	727.3	10.9	7.8
Yambina	3	2.1	513.5	171.2	63.5	10.3	2.8
Mbukl	7	4.9	1096.1	156.6	111.6	9.0	3.2
Repeng	1	0.7	175.6	175.6		14.0	
Dom Gaima	3	2.1	216.3	72.1	9.5	6.8	0.8
No source known	1	0.7	291.7	291.7		13.5	
Local	18	12.5	3347.1	186.0	116.1	10.8	3.2
Whole sample	144	100.0	31102.6	216.0	196.0	10.7	3.3

Means of identification

IR Spectrum	60	41.7%
Hand inspection	84	58.3%
Total	144	100.0%

Table 10.3 **KUK (Drylands, Swamp, & Ep Ridge)** breakdown of sources by number, weight and length

the quarries, Tuman axes are by far the most common types at Kuk and Wurup, accounting for more than half the total number of axes. Axes from the Jimi Valley (Ganz, 'A', 'B', 'C', 'D', Tsenga **gaima**, Yambina) and Sepik-Wahgi Divide (Pukl, Mbukl) collectively comprise around one quarter, with the remainder being made up of local (non-quarry) axes and a small number of exotics (Dom **gaima**, Dabiri, Repeng, and unknown).

One difference between these collections lies in the apparent discovery of Mbukl and Yambina axes at Kuk but not Wurup. But as I have already indicated neither of these sources can be identified with confidence. If the Mbukl identifications are wrong, they should be added to the Tuman total; if the Yambina identifications are wrong, they should be added to the 'A' or 'C' totals.

Another difference is that Wurup has three firm Dabiri identifications - this is the first time Dabiri axes have been found in any collection. The Dabiri axes, shown in Figure 10.6, are square-sided work axes not unlike Tuman axes of the same size. However, they have acquired a grey patina through weathering, when Tuman axes would have turned black. The sides are almost parallel; Tuman work axes usually have sides which diverge somewhat. Two of the axes have linear markings; this is hardly ever seen in Tuman axes.

The existence of Dabiri became known through the testimony of Christensen's Kauga informants in the Wurup Valley; the site was visited in 1973 by Christensen, Hughes and J. Rhoads (Hughes 1977a: 135). The Kauga knew of a mountain track at the head of the Kuna River that led into the Kubor Range and small trading parties were accustomed to use it to visit southern Kubor groups and - amongst other things - to obtain Dabiri axes. Christensen recorded the names given by informants to his axes and White et al. (1977a) later prepared a list of the complete collection, together with the source identifications given by Chappell. The list included six axes identified as 'Dabiri' and one each as 'Mbukl/Dabiri' and 'Dabiri/Abiamp(K)' (Appendix G). Axes No.84, No.106 and No.216, which I found to have the spectral characteristics of Dabiri axe stone, were among the six firm identifications (made by the Wurup informants, not by Chappell).

Being more isolated than comparable axe makers elsewhere, the owners of Dabiri may have had more to do with individual parties of

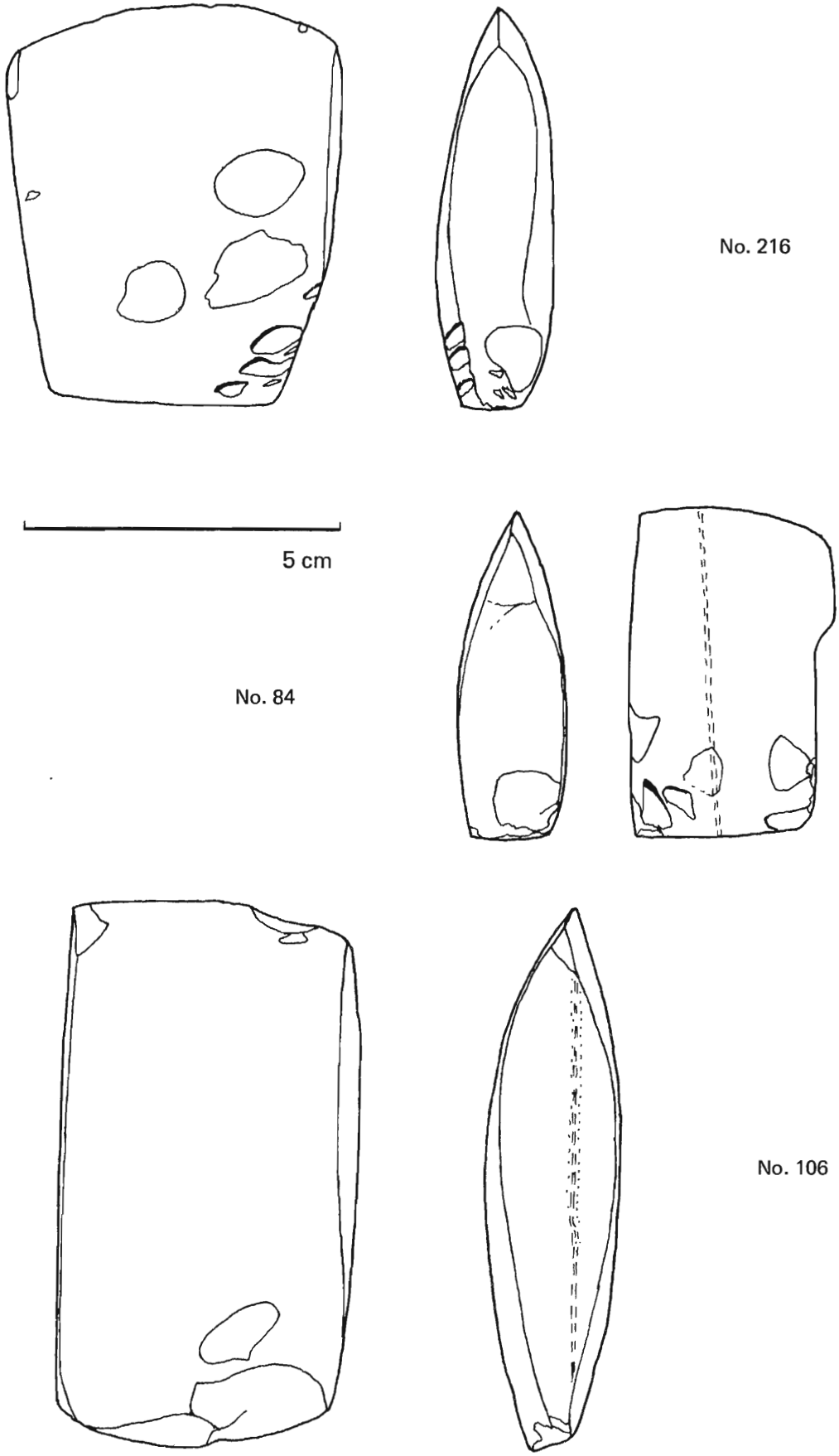


Figure 10.6

WURUP COLLECTION axes identified as Dabiri by infrared spectroscopy

traders, rather than the web-like exchange economy of the central part of the region. Certainly, as far as the Wahgi Valley was concerned, contact with the Dabiri axe makers was reliant on intermittent personal contacts. The fact that Dabiri axes were only found in the Wurup collection is consistent with this interpretation.

There are a few more Tuman axes at Wurup than at Kuk and this is in line with the fact that Wurup is closer to Aviamp than Kuk, and that Kuk was socio-politically orientated more towards the North Melpa area than were the Wurup people. The Wurup Tuman axes are also slightly longer and heavier than the average at Wurup, while at Kuk they are fractionally shorter and lighter. It would be wrong, though, to read too much into this - Kuk and Wurup are not far away from each other and the sample sizes are not large.

Functional differences were searched for among the different environments in which axes were found at Kuk (Table 10.4). Few of the axe types were present in sufficient numbers to make this exercise meaningful, but chi-square tests for the three most numerous types, Tuman axes, locally made axes and Ganz River axes, show that there are no significant differences in their rates of discovery in the Dryland Gardens, the Swamp or on Ep Ridge. The suspected Mbukl axes were all found in the Swamp, but the identifications are too insecure for taphonomic or other conclusions to be drawn.

The sourcing of the Wurup collection may be compared with the earlier work of Lampert (1972) in the same area. One of the three collections he studied was from the 'Upper Wahgi' and comprised 121 axes collected mostly from Manton's Warawau Plantation at the mouth of the Wurup Valley. Lampert, aided by Chappell, identified 45.6% of the axes as Tuman, 28.1% as Mbukl, 17.3% as Jimi, and 9% as local stone, using hand inspection only (1972:Table 8). These figures do not differ greatly from what I found, with the notable exception of Mbukl. I did not find sufficient evidence to justify Lampert's high number of Mbukl axes at Wurup.

	Dryland	Ep Ridge	Swamp	Totals
Tuman	13	24	36	73
Ganz	5	5	6	16
Pukl	1	2	2	5
A	0	2	1	3
B	0	1	1	2
C	0	2	4	6
D	0	0	2	2
Yambina	0	2	1	3
Mbukl	0	0	7	7
Tsenga Gaima	1	1	2	4
Repeng	0	0	1	1
Dom Gaima	1	2	0	3
No source known	0	1	0	1
Local	3	5	10	18
Totals	24	47	73	144

Table 10.4 **KUK** breakdown of axe sources by environment of findspot (Dryland gardens, Ep Ridge & Swamp)

ISOPLETH MAPS OF STONE AXE DISTRIBUTION

The localised observations made at Wurup and Kuk can be repeated, though with less precision, for many parts of the highlands to provide a picture of trade over the whole region. Again, the starting point lies with Chappell's (1966:Fig. 5, Table 2) sourcing of six medium large to very large ethnographic axe collections from Western Highlands and Simbu Provinces: Baiyer, Kaironk, Tsembaga, Buk, Womkana, Chuave. Five of the collections he examined were dominated by Tuman and Jimi Valley axes - note that Chappell called these 'Abiamp' and 'Ganz-Tsenga' axes - while the remaining collection, made at Chuave, was almost exclusively composed of Eastern Highlands and local axes. Lampert (1972:Fig. 4) sourced three collections to the south and west of Chappell's area: Upper Wahgi, Nebilyer and Kaugel. Thus, with the addition of the collections from Wurup and Kuk, information from a total of eleven collections has been available up to the present time.

In 1980 I had the opportunity to examine 825 axes from Enga Province, collected by P. Brennan and kept at the Enga Cultural Centre, Wabag, and in the Western Highlands and Simbu, at locations not sampled by major collections, I was able to arrive at qualified estimates of the importance of Tuman and Jimi Valley axes by holding interviews and by inspecting casual finds. Since I completed fieldwork, R. Hide (pers. comm.) has collected about 130 axes at Karimui, Simbu Province and, although I did not examine this collection, which is in the National Museum, I was able to make qualified estimates for the percentage of Tuman axes at Karimui. The locations of each place at which axes have been collected or at which other information is available are shown in Figure 10.7.

The Brennan collection was assembled from various parts of Enga Province, from Kudjip, Tun and elsewhere over the years 1967-73 (cf. Brennan 1979). The following information is recorded on paper labels on most of the axes: village name, date of collection and a serial number. Sometimes the given name of the axe, the name of the seller and the name of the seller's clan are also given. I was able to sort the axes into six sub-collections corresponding to the

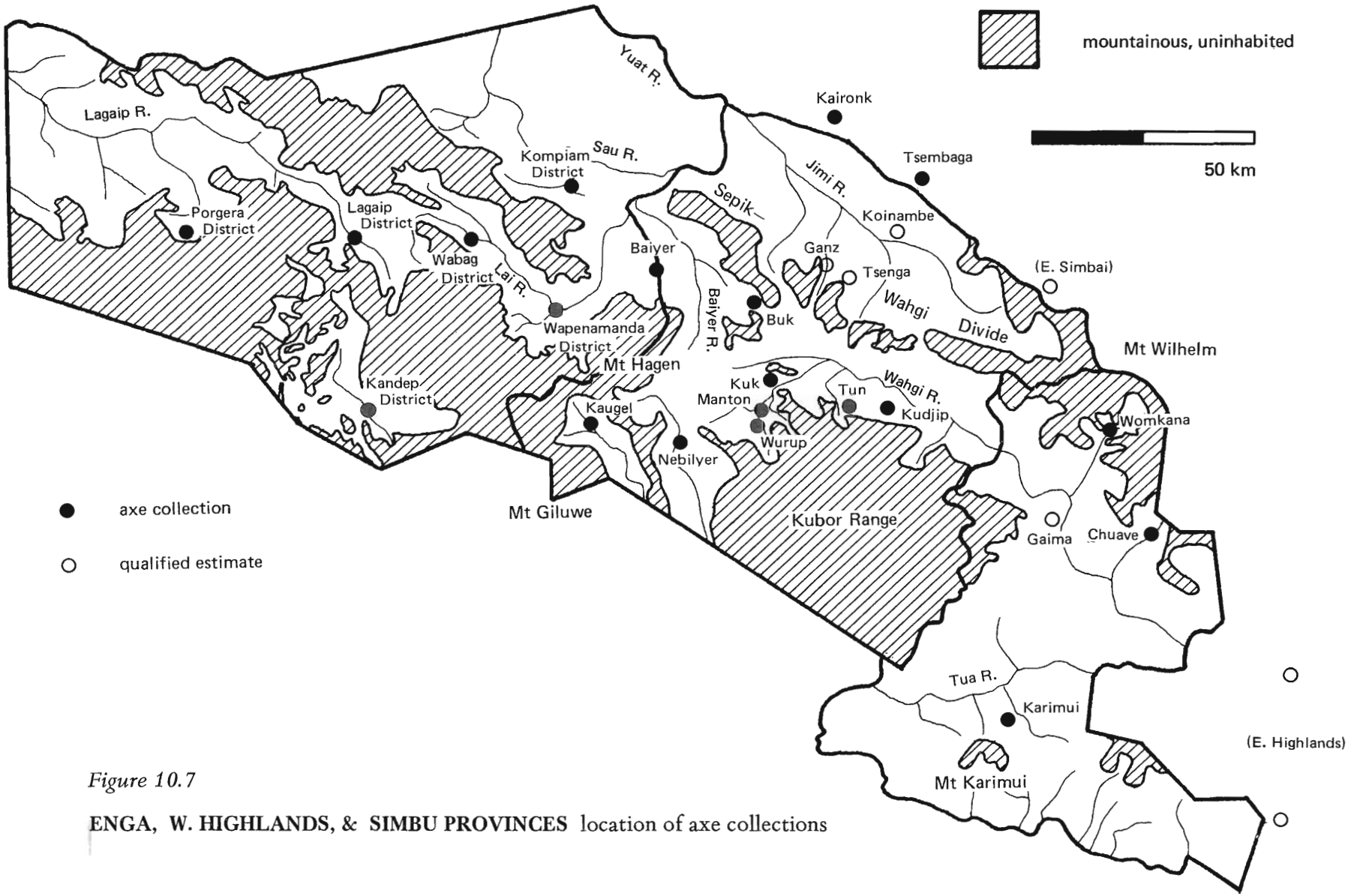


Figure 10.7

ENGA, W. HIGHLANDS, & SIMBU PROVINCES location of axe collections

administrative Districts of Enga Province.[3]

I only attempted to identify Tuman axes in the Brennan collection, doing so by hand inspection (Table 10.5), but other axe types are identified by the labels, including the type known as **sambe**, whose source is near Wabag, in the headwaters of the Luanda River (Fig. 1.1). Of the 623 axes with known Enga locations, only 25 (4%) are **sambe**. Not surprisingly, most come from close to the source and 18 of the 25 known are from Wabag and Wapenamanda Districts. The Sambe quarry must have been a very minor source.

A good number of the remaining axes in the Brennan collection are from Jimi Valley sources, being black in colour and comparable in shape to axes in other collections known to have come from the Jimi Valley. The name **apina** is commonly seen on the labels of these axes but, as I have discussed in Chapter 8, this probably has no connection with the Apin quarry of the Jimi Valley. About half of the collection consists of axes that I did not recognise as being from any of the known sources. At the same time, I was not able to find axes to match the full list of names recorded by Brennan (Table 1.1) and, while the main supply of axes was from Western Highlands Province, a thorough field and petrographic survey would obviously be needed to discover the sources of Enga Province itself.

In November 1971 Dr Brennan visited the Nazarene missions at Kudjip and Tun, taking the opportunity to collect axes. In 1973 a further small collection was made at Tun by Christensen. Together, the Christensen and Brennan axes number 32 from Tun and 7 from Kudjip. In 1980-81 I was often shown axes when interviewing at Tun, but I felt that a policy of purchasing axes would have been seen to be at odds with my stated intentions of collecting information about the quarries for academic study. I cannot add to these previous, small collections. Among the axes obtained by Brennan and

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[3] This was quite difficult as many of the labels were damaged and, more importantly, many Enga placenames recur several times across the province, with alternative spellings. I sorted a list of the axes by date of collection, thus grouping together places which were presumably visited by Dr Brennan on the same day or on consecutive days. Unknown or ambiguously named places were tied to well-known centres by this method and in most cases identified on maps of the province.

	TUMAN QUARRIES				OTHER SOURCES				
	Axes		Length (cm)		Axes		Length (cm)		N
Enga District	no.	(%)	Mean	S.D.	no.	(%)	Mean	S.D.	
Wabag	55	(32.5)	11.6	3.1	114	(67.5)	10.4	2.9	169
Wapenamanda	57	(40.7)	10.2	3.0	83	(59.3)	10.1	2.7	140
Lagaip	43	(31.6)	11.2	2.7	93	(68.4)	10.6	2.5	136
Kandep	42	(42.4)	11.6	2.9	57	(57.6)	11.0	2.6	99
Porgera	6	(21.4)	9.8	2.4	22	(78.6)	9.2	3.7	28
Kompiam	15	(29.4)	15.8	3.7	36	(70.6)	14.2	4.6	51
Other axes									
Middle Wahgi	18	(85.7)	15.3	3.1	3	(14.3)	12.2	4.3	21
Unknown places	54	(29.8)	11.5	3.4	127	(70.2)	11.2	3.7	181
Whole sample	290	(35.2)	11.6	3.4	535	(64.8)	10.9	3.3	825

Table 10.5 **Axes from the Brennan collection** numbers and sizes from the six Enga Province Districts

Christensen, only one axe was not from the Tuman quarries; the collections are small, but they help fill in a gap between Wurup and the two collections seen by Chappell in Simbu (Fig. 10.7).

I used the computer program SYMAP to display the importance of axes from the Tuman quarries (Figs 10.8-10.10) and the quarries of the Jimi Valley (Fig. 10.11) and Sepik-Wahgi Divide (Mbukl/Muklpin) (Fig. 10.12) on base maps of Enga, Western Highlands and Simbu Provinces. The maps display the percentage importance of each category of source at points on the National Grid corresponding to the locations of the collections and places where estimates can be made. In Figure 10.11, the percentages are supplied by Chappell's category of 'Ganz/Tsenga' axes for the Baiyer, Kaironk, Tsembaga, Buk, Womkana, Chuave, Nebilyer and Kaugel collections, and by the sum of Ganz, 'A', 'B', 'C' and 'D' at Kuk and Wurup. In Figure 10.12, they are supplied by Chappell's category of 'Mbukl/ Muklpin', which was the sum of Mbukl, Pukl and Yambina in the collections that he sourced (1966:112), and by the sum of Mbukl and Pukl at Wurup and Kuk.

At the places where there were no collections, I arrived at two kinds of estimate. The first kind was made in places where actual observations of axes were available, or could in principle have been made. For example, I did not see a collection of axes on the Ganz River or at Tsenga, but it seems quite justifiable to assume that most of the axes used there would also have been made there. The dominance of Tuman axes in the Brennan and Christensen collections from Tun, and the fact that the overwhelming majority of axes I saw there myself were Tuman axes, supports this argument. I simply guessed that 89% of the axes in the vicinity of the Ganz and Tsenga factories would have been from the Jimi Valley quarries (i.e. Ganz and Tsenga themselves), that 10% would have been from the Tuman quarries and that 1% were from 'Mbukl/Muklpin'. Not far away at Koinambe, I was shown a storeroom at the Anglican Mission in 1981; I estimate that it contained a couple of dozen axes, most of which were Jimi Valley axes (many, in fact, were Tsenga **gaima**). I estimate that 90% of axes at Koinambe were from the Jimi and that 10% were from the Tuman quarries.

In the same way, I was able to estimate the proportions of different axe types which would have been found at the Dom **gaima**

quarry. At Gaima village I guessed that 20% of the axes would have been from the Tuman quarries. Vial (1940:160) saw Tuman axes at this place, which he recorded as **kundun**, mistaking them for Dom products (see Chapter 9). Tuman axes seem to have been the most important single type south of the Dom area; a conservative estimate (R. Hide pers. comm.) is that Tuman axes accounted for 35% of the Karimui collection.

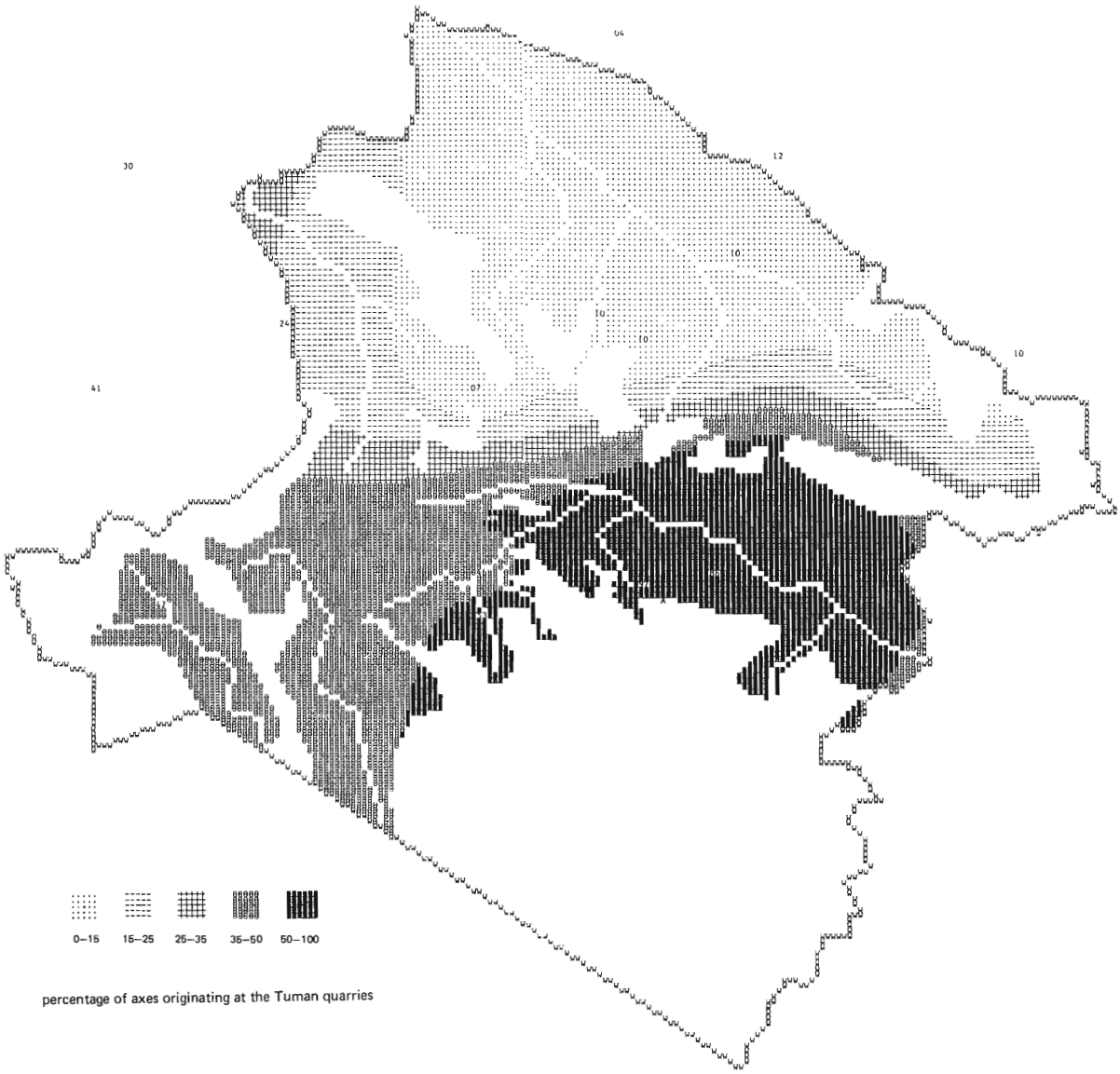
A second kind of estimate was used to provide evenly spaced data points in marginal locations. For example, in the eastern part of Simbai no collection has been made, but it is certain that this was an area dominated by Jimi Valley axes. I assigned percentages copied from Tsembaga and Koinambe to the west. In the Eastern Highlands I copied values taken from the Chuave collection.

I stress that the results obtained with SYMAP simulate the likely state of affairs in any particular place, based on the most recently available information. The maps are not interpolations of perfectly spaced grid-points with exact values assigned to them and, bearing in mind the scale at which they have been produced, variations as high as 15% at any of the data points would not cause large changes in their appearance.

The Distribution of Tuman Axes

The heartland of the trade in Tuman axes lay in the Middle Wahgi (Fig. 10.8), centred on the immediate neighbourhood of the quarries. The South Wall Wahgi groups from Wurup to Minj and North Wall groups from Kimil to Nondugl lay in the immediate zone of hand-to-hand exchange with the axe makers and this is indicated by a percentage importance of 50-100%.

Trade was strong to the east and Tuman axes were traded to the Chimbu Valley groups in substantial numbers. High numbers of Tuman axes were also traded westwards to the Central Melpa region. From this point they were more likely to be traded with men living to the south in the Nebilyer Valley than to the north and into the Baiyer Valley. The Nebilyer collection (Lampert 1972:4) and the Baiyer collection (Chappell 1966:110) monitor this difference well. The southern collection has almost twice the proportion of Tuman axes as the northern one.



WESTERN HIGHLANDS PROVINCE distribution of products from the Tuman quarries

40 km

Figure 10.8

From the Nebilyer Valley, the axes were traded in three different directions: west to Tambul and into Enga, south to Mendi and southeast along the Kaugel to groups like the Daribi (Hughes 1977a: 177-181).

Figure 10.9 shows the importance of Tuman axes over the six Enga districts covered by the Brennan collection. In the populous eastern Enga centres of the Tsak and Middle Lai Valleys and Kandep, Tuman axes are extremely strongly represented, accounting for 35-50% of all axes. This fits with the opinions of Wabag informants that the axes they called **kundina** and **kombamoka** came from the directions of both Mendi and Mt Hagen. As might have been predicted from the noted unimportance of Tuman axes in the Baiyer collection, the route from the Baiyer Valley into Enga was not a major trade route for Tuman axes. It seems likely that two streams of Tuman axes emanating from the Nebilyer Valley ultimately converged on Enga, one taking the short route into the Middle Lai area and the other going by way of Mendi. Most of the Tuman axes found around Kandep probably took the latter route.

To the west, in the Upper Lai and Lagaip valleys, Tuman axes are more weakly represented, until in the extreme west of Enga at Porgera they make up less than 15% of the total supply of axes. This is quite in line with the conventional view of the diminishing importance of raw material sources with distance. Porgera is 150 km west of the Tuman quarries.

The map of Simbu Province (Fig. 10.10) is not based on the positive information of major collections. Rather, it contrasts the known high percentage values of Tuman axes in the Middle Wahgi and the Chimbu Valley with their almost complete absence across the eastern border into Eastern Highlands Province. For other parts of the province, there is indirect evidence as to the importance of Tuman axes. Thus according to Hughes (1977a:177-181), Tuman axes predominated in the area to the south of the Kubor Range. They were traded from the Nebilyer Valley and also through East and West Kambia via the headwaters of the Kuna, Tuman and Minj rivers. The region to the south of the range is very sparsely populated and it is not at all certain that continuous contact was maintained between neighbouring groups (Hughes 1977a:177). Nevertheless, the strong presence of Tuman axes at Karimui (estimated as previously discussed

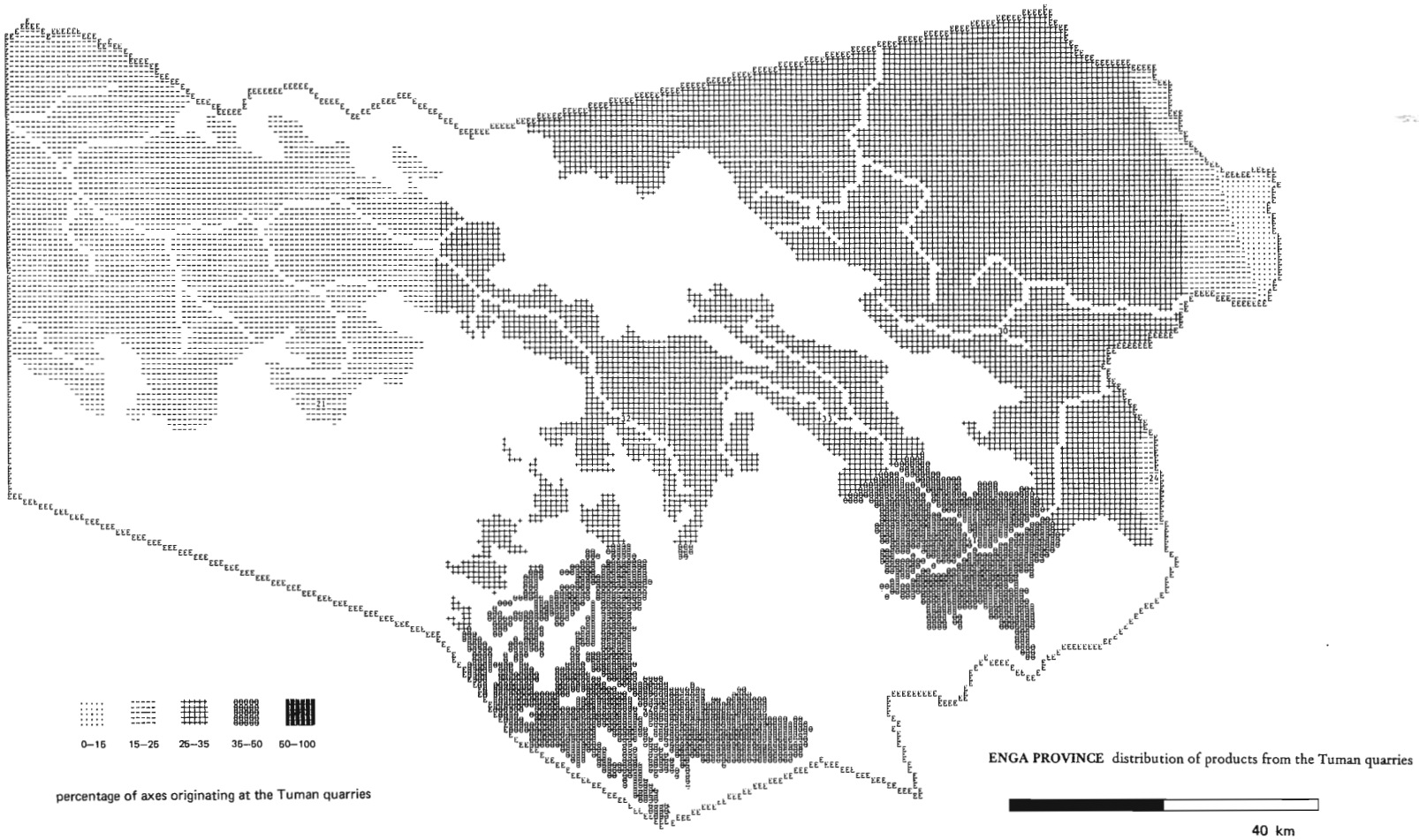
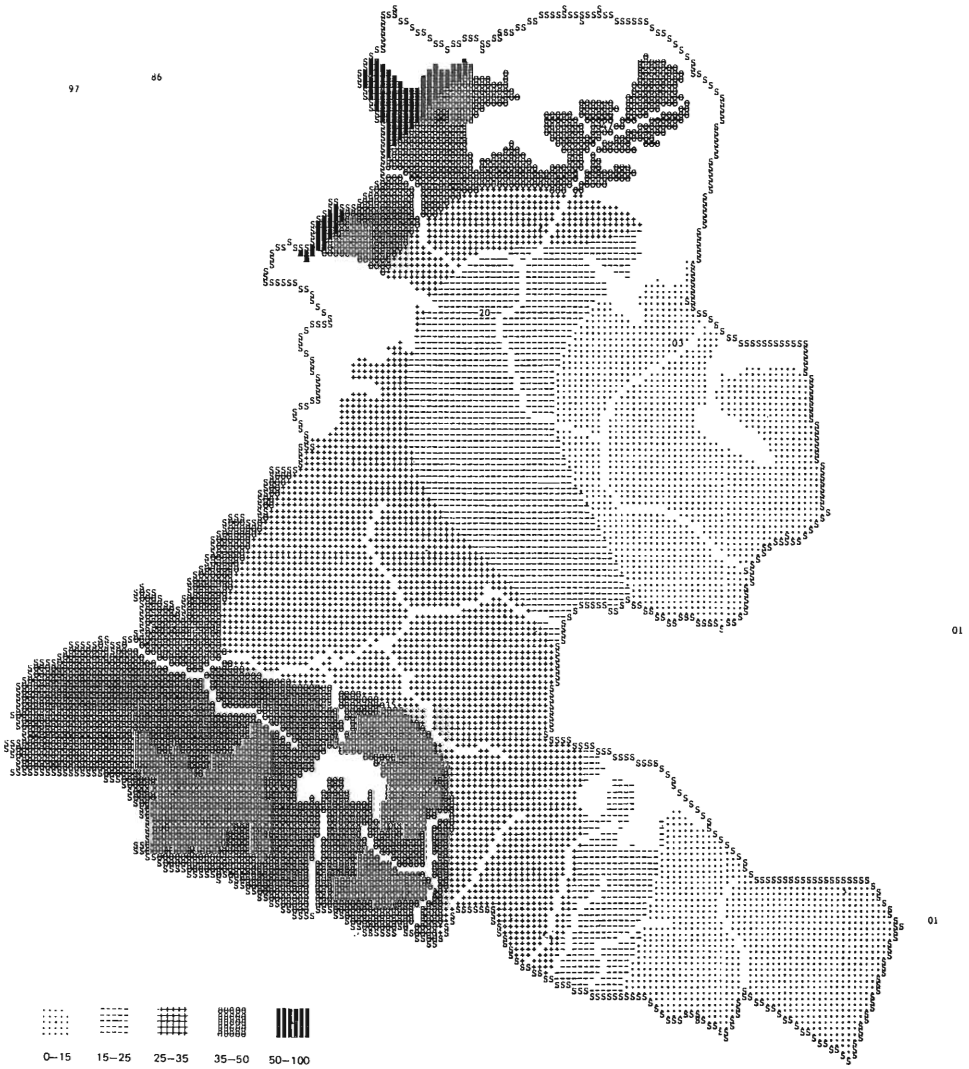

0–15
15–25
25–35
35–50
50–100
percentage of axes originating at the Tuman quarries
ENGA PROVINCE distribution of products from the Tuman quarries
40 km

Figure 10.9



percentage of axes originating at the Tuman quarries

SIMBU PROVINCE distribution of products from the Tuman quarries

40 km

Figure 10.10

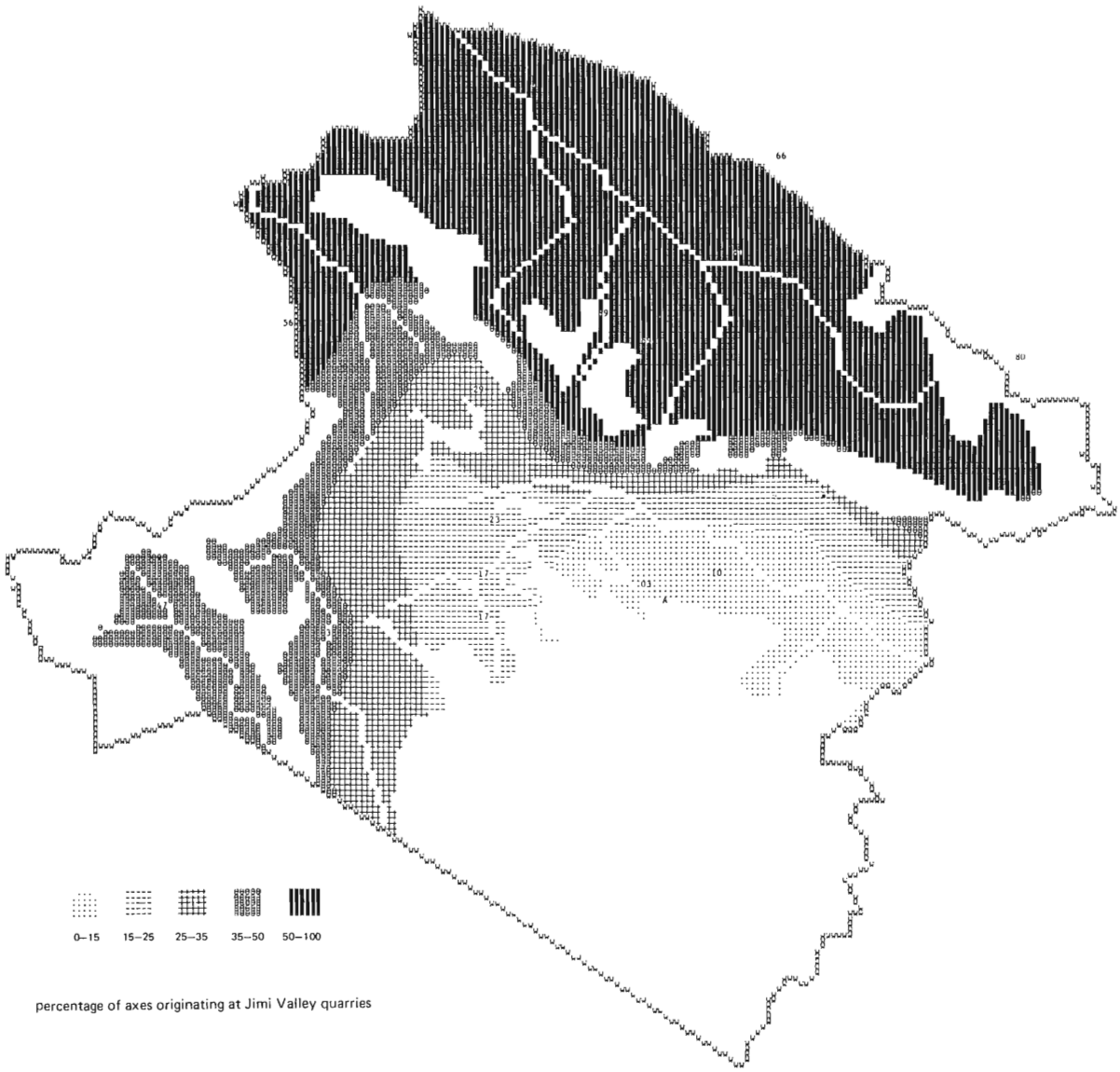
from Hide's collection) contrasts with their virtual absence further east.

In the eastern part of Simbu, different axe sources were exploited and trade into the area from the west seems to have been restricted. The majority of Siane axes were supplied by Asaro Valley sources like Kafetu in Eastern Highlands Province (Salisbury 1962:85; S. Bulmer 1964:247), though it would not be surprising to find that this quarry was only one of many in the same area. The Chuave collection was made in the Siane area and only 2.7% of the axes were from the Tuman quarries. I have assumed in Figure 10.10 that only 1% of the axes circulating in Eastern Highlands Province itself would have been Tuman axes. It is also worth noting that the eastern margin of trade in Tuman axes corresponds well with a cultural and linguistic boundary between speakers of the Central and East-Central Families of Wurm's East New Guinea Highlands Stock (Read 1954; A.M. Strathern 1966:118-19; Hughes 1977a:183).

The Distribution of Jimi Valley Axes

Only the collections of the Western Highlands are a reliable guide to the extent of trade in axes from the Jimi Valley: Ganz, Tsenga, Apin and 'A', 'B', 'C' and 'D'. Figure 10.11 shows their northern dominance. In the Wahgi Valley, reliable figures attest to the subsidiary importance of Jimi axes at Wurup, Manton's (Lampert's 'Upper Wahgi' collection) and Kuk. Estimates must be made for points east, and in the Middle Wahgi the absolute dominance of Tuman axes leaves little room for high numbers of Jimi axes. Thus I have guessed 3% and 10% for Tun and Kudjip respectively, guided by the (small) numbers of axes collected by Christensen and Brennan (see page 218).

The Hagen area was undoubtedly receiving a mixture of Jimi and Tuman axes and must have been an area of competition for the two kinds of axe. The competition may have been unequal, to judge by the different markets for Tuman and Jimi axes. Mick Leahy's photographs from 1933 and 1934 show many dozens of 'Hagen', i.e. Jimi, axes being worn in the belts of men in the vicinity of the Hagen aerodrome, but few Tuman axes. As I have already suggested, the Jimi axe makers probably had a more standardised product than



WESTERN HIGHLANDS PROVINCE distribution of products from Jimi Valley quarries

40 km

Figure 10.11

the Tuman axe makers, due to the way manufacture was organised. The photographs confirm that the Hagen-style axe from the Jimi Valley was the type preferred for dress and ceremony. The bulk collections do not monitor this and simply emphasise the numerical dominance of Tuman blades.

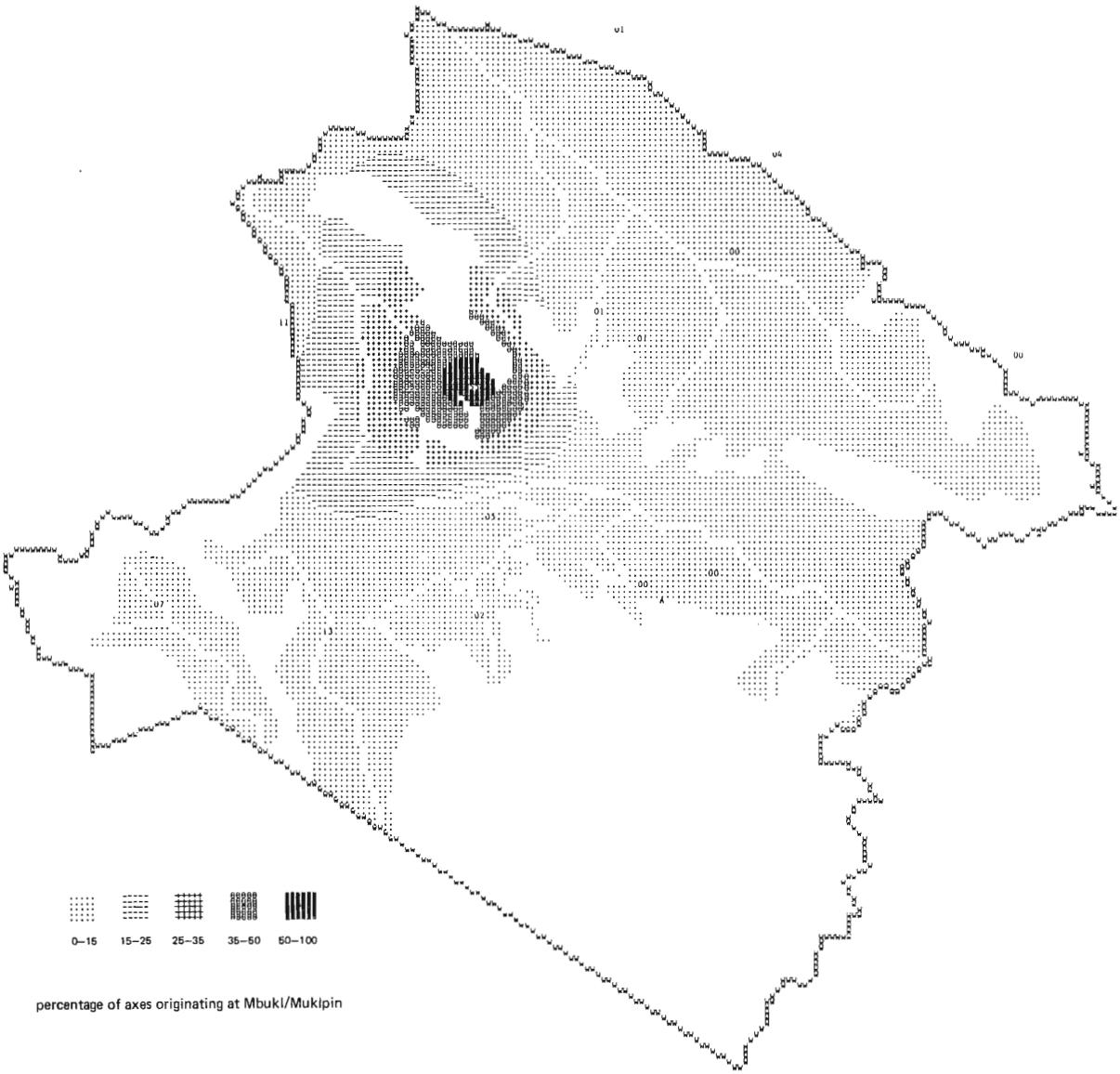
To the west, Jimi axes were traded into Enga, but not in the same quantities as Tuman axes. To the south and east their importance was also reduced by the great number of Tuman axes in circulation. But to the north of the area mapped, Jimi axes were more important than any other type (Hughes 1977a:179-80). Along the Simbai Range, collections of axes are almost exclusively composed of Jimi blades (e.g. Kaironk and Tsembaga).

One exit northwards from the highlands to the Ramu Fall lay through the head of the Chimbu River, over the mountain passes to the Gende and to Aiome. Descriptions of axes seen there (Moyne and Haddon 1936:272; Aufenanger 1979:44-7) have been taken to confirm the strength of trade in axes from the Jimi sources (Chappell 1966: 112), while Hughes (1977a:179) argues that Aiome could well mark the edge of the highlands distribution area in this direction, since locally made lenticular blades were also important there.

'Mbukl/Muklpin': Trade from Minor Quarries

The distribution over the Western Highlands is shown in Figure 10.12. The only collection with any major input from the three sources - Mbukl, Pukl and Yambina - which Chappell summed as 'Mbukl/Muklpin' was made at Buk by the Stratherns (Chappell 1966: 110, Table 2). Accurate figures for Pukl are only available from Wurup and Kuk, demonstrating the very minor importance of this quarry (I have omitted the Manton collection from the map, not considering Lampert and Chappell's high figure for Mbukl reliable). Neither Mbukl nor Pukl axes were traded widely and their names are unknown at any distance from the sources.

Figure 10.12 is an extremely useful demonstration of a common trading pattern in the region. Minor sources of many kinds of raw material and trade good are far more numerous than exceptional ones like the Tuman, Ganz and Tsenga factories. Among the other minor quarries known in the study area, the trade hinterlands of Repeng



WESTERN HIGHLANDS PROVINCE distribution of products from Mbukl/Muklpin

40 km

Figure 10.12

and the Enga axe type **sambe** are certain to have exemplified this pattern of quickly decaying importance with distance.

ARCHAEOLOGICAL FINDS OF STONE AXE MATERIALS

In the recent past, trade in stone axes has obviously been extensive. How long the modern quarries had been in operation is a matter which must be referred to specifically archaeological evidence. Datable finds of stone axes have been made at a number of rockshelters and open air sites (see Fig. 1.2) over the past 25 years. Unfortunately the quantities of material recovered are extremely small, with the exception of Kafiavana, which lies outside the region in which specialised quarries emerged. I will review the main assemblages here, although it not my intention to enter into a detailed analysis of them.

Batari

White (1972:20) found one polished stone fragment in a stratified context. It was a chip of hornfels from a hearth dated at 850 ± 53 BP. Three other specimens were unstratified.

Aibura

Nine pieces of axe came from sealed levels and, according to Chappell (pers. comm. in White 1972:63), all were made from locally occurring rocks. A complete axe of planilateral shape, 6 cm in length, came from Level 6, otherwise the pieces came from Level 4, which is dated to 770 ± 100 BP, or more recent levels.

Kafiavana

The total assemblage from Kafiavana is large: 54 whole and fragmentary axes were recovered (White 1972:95). However, according to Chappell, they were probably all made from local rocks, except for two pieces, from Horizons II and III, identified as being from

the Kafetu quarry, 50 km to the northwest. A date of 4690 ± 170 BP came from the base of Horizon II. The pieces which preserve the cross-section of the original axe show that the majority were lenticular in section; one axe from Horizon III had 'narrow ground sides and might be called planilateral' (White 1972:95). But, having examined this assemblage, I find there is no comparison between the shape of any of the Kafiavana axes and those passing today as planilateral axes.

The earliest fragment was the cutting edge of an axe from Level IX, dated, as far as can be judged from the insecure radiocarbon measurements from the earlier levels, to about 9000 BP. It shares with the Manim axes (Christensen 1975:31) the distinction of being among the oldest finds of ground stone axes in the highlands.

Yuku

Three axe fragments were found during the excavation of Yuku rockshelter. They occurred in the top of the site only, in Layers 2 and 3 (S. Bulmer 1966:Table 6). Layers 3-7, which date to between 5000 BP and 12,000 BP, contain an assemblage of waisted blades and flake tools (S. Bulmer 1977). The raw material type is not reported.

Kiowa

A total of 17 axe fragments was found at Kiowa, in Levels 2, 3, and 5 (S. Bulmer 1966:Table 2). Radiocarbon dates are 4840 ± 140 BP for Level 3 and 6100 ± 160 BP for Level 6. Thirteen fragments came from Level 2, including planilateral examples, which are therefore younger than the 4840 ± 140 BP date. The remaining four specimens were found in the same levels as two waisted blades made by percussion flaking (S. Bulmer 1977:44-5). A 'waisted blade' made from a broken polished axe was claimed from Level 2.

Wanlek

The open site of Wanlek is said to have had a workshop floor containing 'a full range of debris from the manufacture of lenticular-sectioned axe-adzes' (S. Bulmer 1975:40; see also S. Bulmer 1977); two radiocarbon dates, 2840 ± 90 BP and 2865 ± 90 BP, were obtained from oven pit charcoal within the habitation layer. Again, the nature of the raw materials found at the site is unknown.

Kuk

Information about the prehistoric trade in axes at Kuk is provided by the collection of 31 axe fragments recovered during excavations conducted by J. Golson and E.C. Harris (Harris 1977). All the finds belong to the last phase at Kuk, dated to 400-100 BP (Golson 1977a:626-30). The axes and pieces of axes were systematically sourced with infrared analysis and hand inspection - all were pieces large enough to sample with a 5 mm drill.

The sourcing results are summarised in Table 10.6 and diagrammatically displayed in Figure 10.13. No examples of Pukl, Tsenga **gaima**, Yambina, 'B', Dabiri or Repeng were identified, but all other types found in the surface collection from Kuk are present in comparable numbers. An exception is the low proportion of axes made from locally occurring materials, which cannot readily be explained. An important point to note is that - in so far as their shape can be determined - the axe fragments cannot be distinguished typologically from whole blades in the surface collections. There has been no evident change in axe style at the known quarries over the past few centuries.

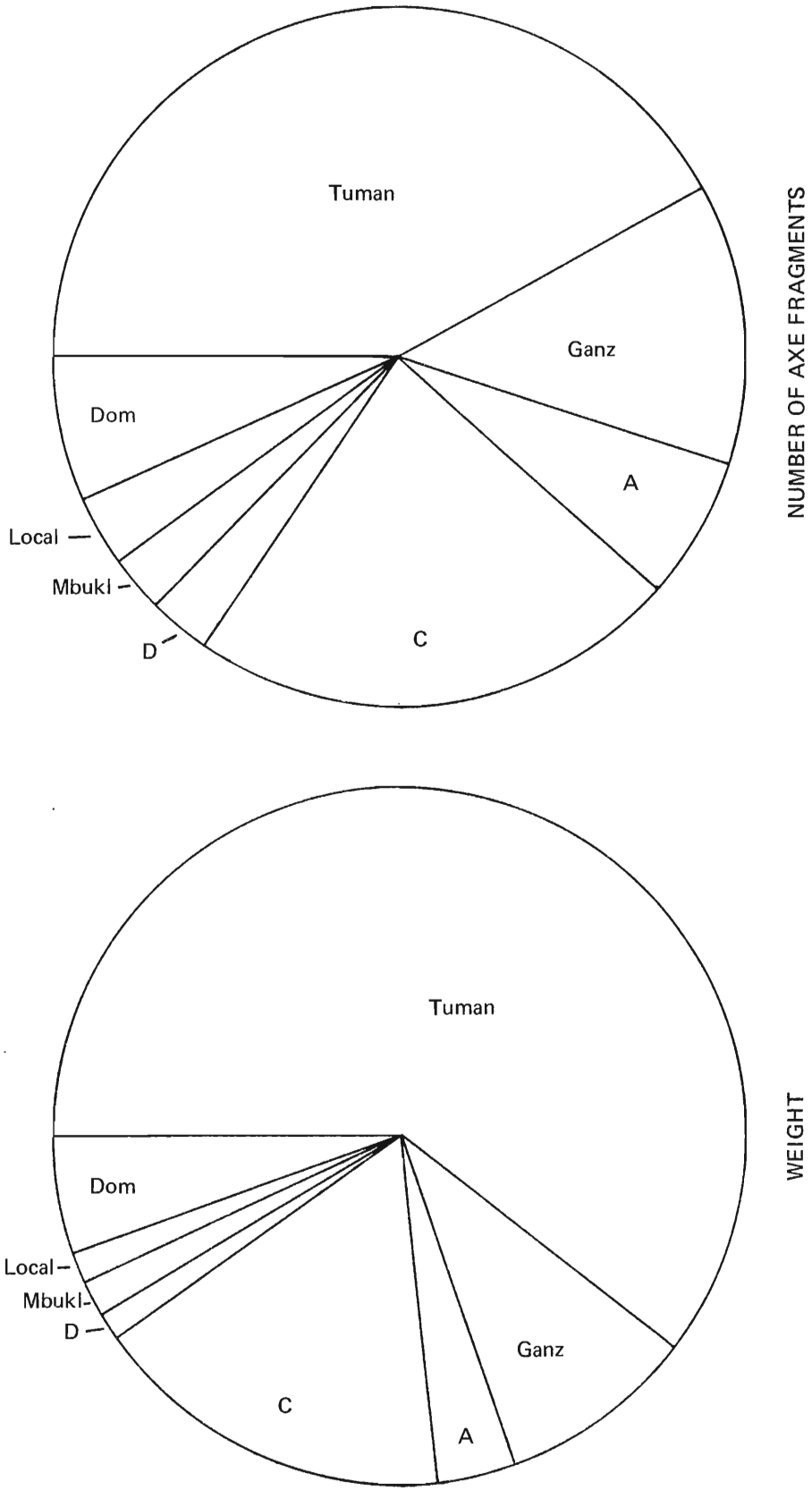
Nombe

Analysis to date has provided 44 fragments of polished stone from M-J. Mountain's excavations at Nombe, ranging in weight from 0.29 g to 100.89 g. They are drawn from Strata A and B (Table 10.7). The great majority of the fragments are made from

Quarry	No.	%	WEIGHT (g) Sum	Mean	S.D.
Tuman	13	41.9	1881.9	144.8	172.1
Ganz	4	12.9	281.8	70.5	31.4
A	2	6.5	107.6	53.8	15.7
C	7	22.6	526.9	75.3	43.8
D	1	3.2	40.7	40.7	
Mbukl	1	3.2	67.1	67.1	
Dom	2	6.5	165.2	82.6	39.8
Local	1	3.2	46.5	46.5	
Whole sample	31	100.0	3117.7	100.6	118.0

Means of identification		
IR Spectrum	20	64.5
Hand inspection	11	35.5
Total	31	100.0

Table 10.6 **Recent prehistoric axe finds from KUK** breakdown of sources by number & weight of fragments



Recent prehistoric axe finds from KUK breakdown of sources by number & weight

Figure 10.13

local stone. Five pieces were taken for infrared analysis, the results of which suggest that two cutting edge fragments were from the nearby Dom **gaima** quarry and the butt of an axe was from the Ganz River. One of the Dom fragments and the Ganz butt were from Stratum A and the other Dom fragment was from Stratum B (M-J. Mountain pers. comm.).

Manim Valley

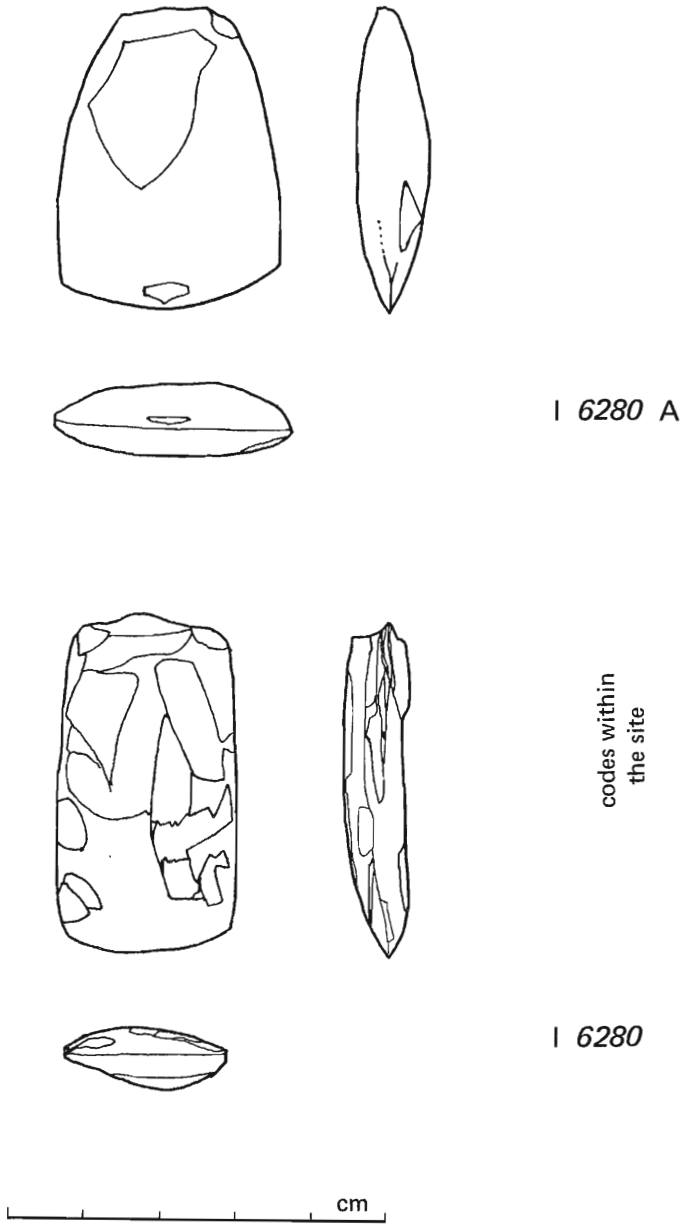
A summary report, with radiocarbon dates, has been published for the sites in the Manim Valley excavated by Christensen (1975). Further analyses of material from Kamapuk and Manim have been carried out by Aplin (1981) and Mangi (1984).

The earliest finds of ground stone axes were made in Manim Level 21, dated to 5860 ± 130 BP (Christensen 1975:31); the finds, seen in Figure 10.14, were two miniature axes of ovoid section made from local stone. Most of the ground stone axe finds from Manim were of local origin, but one cutting edge fragment may have come from the Tuman quarries (Table 10.7). This find, stratified below a date of 3580 ± 80 BP, is difficult to place in context because it is such a small fragment and also there was a marked fall-off in the density of occupation in later levels at Manim. In addition, part of the material from the last 5000 years of occupation at Manim was destroyed in a fire at Christensen's field base.

Nine specimens were found at Tugeri, Christensen's site at an altitude of 2450 m at the head of the Manim Valley. The deposits were only 50 cm deep and dates of 2450 ± 70 BP, from Level 8, and 1640 ± 70 BP, from Level 4, came from the lowest parts of the site in two different places. The site thus represents a relatively short period of occupation; nothing conclusive can be said of the material.

At both Etpiti and Kamapuk, fragments of polished stone were recovered in quantities just sufficient to make a statistical analysis worthwhile. As elsewhere, Christensen wet-sieved the deposits and the fragments ranged from 0.05 g to 75.59 g in weight, making it necessary to avoid a comparison based on numbers of specimens alone.

I have tabulated the quantities of axe stone by level at Etpiti



Manim rockshelter ground stone axes from Level 21

Figure 10.14

MANIM ROCKSHELTER FINDS

SITE	ARTEFACT NUMBER	SQUARE	LEVEL	DATE (BP)	WEIGHT g	MOST LIKELY SOURCE
Kamapuk	C28	C	8	>2540 ± 70	4.65	Tuman
Kamapuk	C33b1	C	8	>2540 ± 70	1.74	Tuman
Kamapuk	C33b3	C	8	>2540 ± 70	1.66	Tuman
Manim*	#327	I	19/2	>3580 ± 80	1.22	Tuman
Etpiti	G150	G	7	<1310 ± 70	9.70	Tuman
Tugeri	36	E	8	ca. 2450 ± 70	6.60	Tuman

NOMBE ROCKSHELTER FINDS

SITE	CONTEXT	STRATUM	DATE (BP)	WEIGHT g	MOST LIKELY SOURCE
Nombe*	J71 Spit 2	A	<100	1.69	unknown
Nombe*	PQR71 Spit 1	A	?0-4500	4.19	Dom
Nombe†	A1:2 (16)	A	ca. 5030 ± 110	68.50	Ganz
Nombe	A2:2 (49)	A	ca. 5030 ± 110	4.74	unknown
Nombe	C3 Spit 3 (45)	B	<8320 ± 840	1.64	Dom

* indicates cutting edge fragment
† indicates butt of an axe

ARCHAEOLOGICAL FINDS OF AXES IN THE HIGHLANDS

samples taken for infrared analysis: details of dating and most likely sources

Table 10.7

and Kamapuk in Table 10.8. I sorted the finds into fragments that were evidently from quarries and those that were made from local stone or unrecognised sources. The identifications were made by hand inspection, with three Kamapuk fragments and one Etpiti fragment also being tested with infrared spectroscopy (Table 10.7; Appendix H). Most of the fragments identified as coming from a recognised quarry were small chips or flakes from Tuman axes; some were chips of black stone from the Jimi Valley sources. Fragments of the same stone without evidence of grinding were not included in the analysis.

In the sixth column of the table I have distinguished the weight of stone from quarries as a percentage of the total amount of polished stone in each level. In the seventh column I have smoothed these percentages with a simple running average calculation. The sixth and seventh columns of Table 10.8 are graphed in Figure 10.15.

The graphs show that stone from the modern quarries enters the archaeological record sometime between about 2500 and 1500 years ago and that, following the running averages, the proportion of quarried stone at both sites rises steadily from zero to almost 100% of the assemblages. This trend is not based on perfectly secure data, however, and urgently needs confirmation at further, well-stratifed sites in the study area.

As opposed to shapeless axe chips, the first fragments large enough to be recognised as being parts of planilateral axes are found in Etpiti Level 7, dated to 1310 ± 70 BP, and Kamapuk Level 4, dated to between 2540 ± 70 BP and the present. Nevertheless, Figure 10.15 is the more valuable of the two pieces of evidence: it can always be argued that solitary finds are out of context, but the graphs show an increase in the density of quarried stone in the topmost stratigraphic levels that cannot be ignored.

TRADERS AND TRADE: THE DISTRIBUTION OF AXES IN THE HIGHLANDS

Hughes (1977a:206) has stated that trade in the highlands took a directional aspect only through the 'sum effect of myriad transfers of goods taking place in many different directions'. This was largely dictated by the fact that men could not venture far without

KAMAPUK ROCKSHELTER FINDS

LEVEL	QUARRIED STONE Wt. g	OTHER STONE Wt. g	TOTALS No. of pieces N	TOTALS Wt. g	PROPORTION OF QUARRIED STONE Raw	PROPORTION OF QUARRIED STONE Smoothed
1	3.40		2	3.40	100.0%	98.9%
2	22.53	0.74	5	23.27	96.8%	96.7%
3			0			
4	0.81	0.06	2	0.87	93.1%	95.8%
5	0.22		1	0.22	100.0%	98.3%
6	0.79		1	0.79	100.0%	90.7%
7	0.52	0.31	4	0.83	62.7%	76.4%
8	14.22	3.47	13	17.69	80.4%	55.9%
9			0			20.1%
10			0			
11			0			
12		40.48	2	40.48	0.0%	0.0%
13			0			
14			0			
15		0.22	1	0.22	0.0%	0.0%

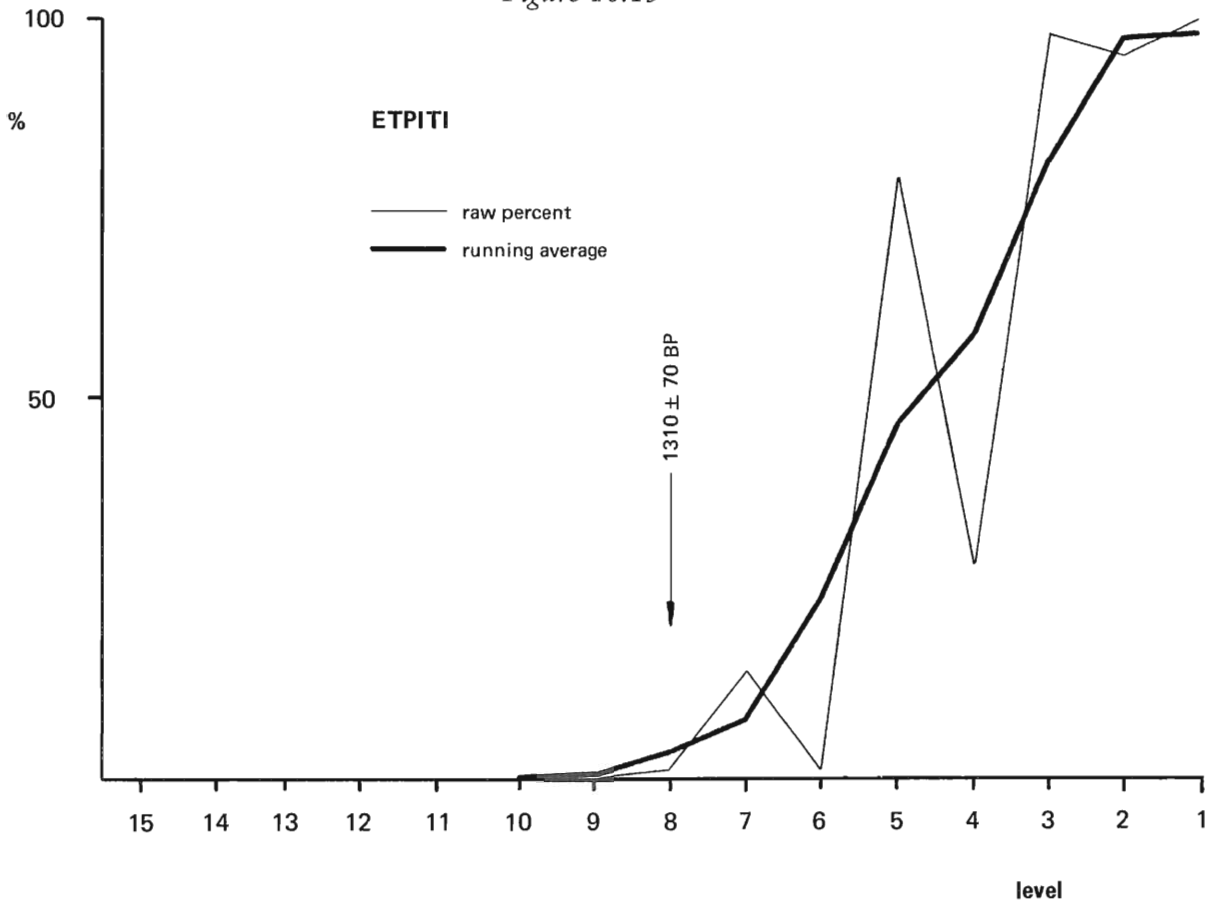
ETPITI ROCKSHELTER FINDS

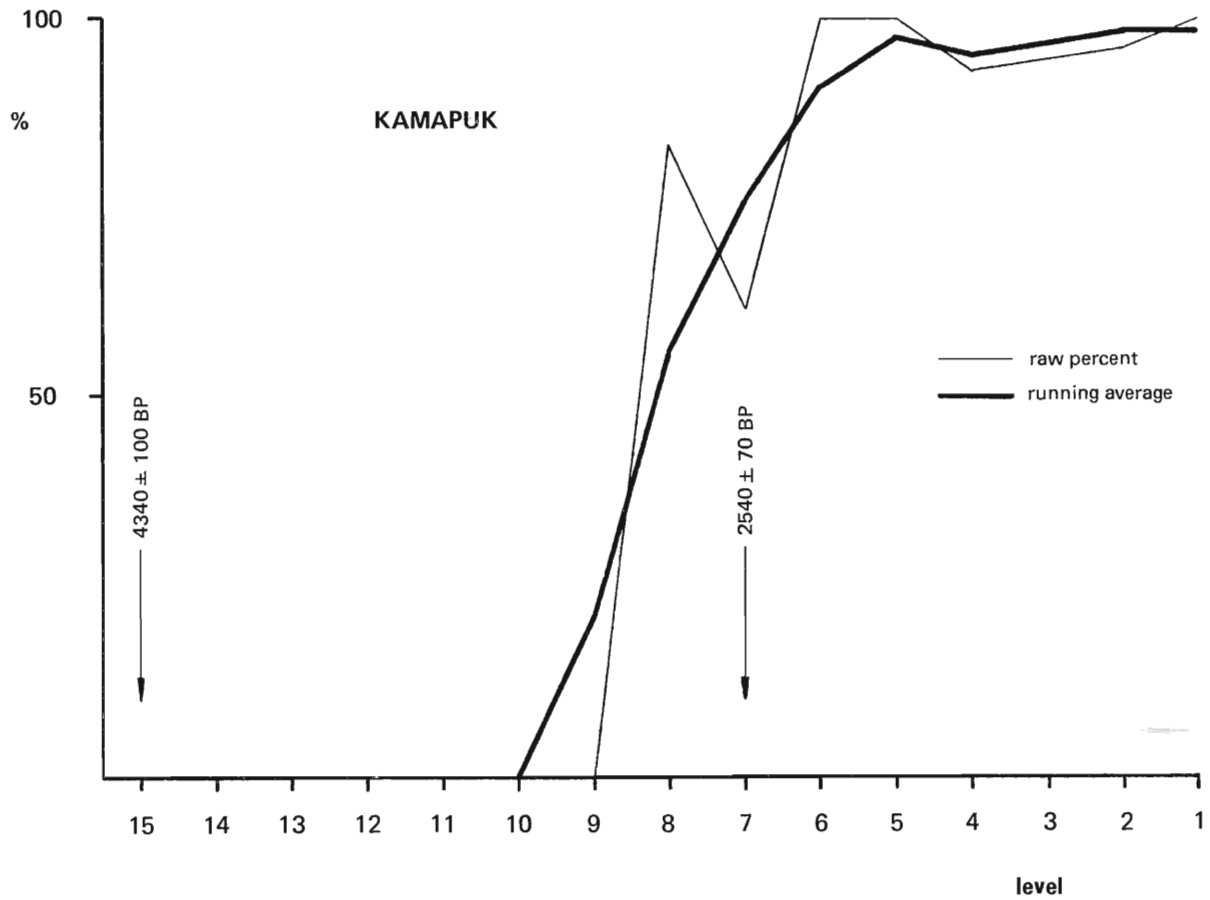
LEVEL	QUARRIED STONE Wt. g	OTHER STONE Wt. g	TOTALS No. of pieces N	TOTALS Wt. g	PROPORTION OF QUARRIED STONE Raw	PROPORTION OF QUARRIED STONE Smoothed
1	68.88		2	68.88	100.0%	98.5%
2	13.11	0.61	3	13.72	95.6%	97.3%
3	15.21	0.28	6	15.49	98.2%	80.1%
4	31.47	78.63	16	110.10	28.6%	58.1%
5	1.85	0.47	8	2.32	79.7%	47.0%
6		3.19	3	3.19	0.0%	23.7%
7	10.14	58.02	6	68.16	14.9%	7.6%
8	0.63	139.51	11	140.14	0.4%	3.9%
9		33.56	4	33.56		0.1%
10		24.30	2	24.30		
11		0.34	1	0.34		
12			0			
13			0			
14			0			
15		0.48	0	0.48	0.0%	0.0%

MANIM VALLEY ROCKSHELTERS ground stone axe fragments

Table 10.8

Figure 10.15





MANIM VALLEY ROCKSHELTERS quarried stone as a percentage by weight of all axe stone

fear of attack (Hughes 1977a:203); the densely settled highland valleys did not afford a free passage to wayfarers bearing goods from distant places. For this and other reasons, interpersonal trade in the highlands is predictably conducted, as I discussed in Chapter 7, between traders who are related to one another. In general, traded items took small steps of 5-15 km across the region as they were passed from hand to hand, but the steps became much longer when trade routes passed through sparsely inhabited territory. Several finds from the Papua coast testify to the fact that traders to the south of the Kubor Range made extremely long trading trips indeed.

A Tuman blade, in the National Museum and approximately 20 cm long, was collected in 1971 by G. Graig [sic] at Pawaia village in the Upper Purari area (then in Kikori Sub-District). Its position on the National Grid is approximately CM 000860. An even bigger specimen, 25.5 cm in length and weighing 1.818 kg, was collected by S. Bowdler some 5 km from Kikori in the Gulf of Papua at the PNG site OAE, grid reference AM 880800. The Pawaia and Kikori axes are remarkably large compared with axes from, say, western Enga that have been traded a similar distance. In 1848, during the voyage of HMS Rattlesnake, artefacts were purchased from local traders in the Torres Strait. Among those that are stored in the Museum of Mankind, London, is an easily recognisable Tuman axe (J. Hughes pers. comm.).

To travel a long distance within the highlands, any trade good must change hands many times and, since their supply was finite, smaller, poorer examples tended to get handed on. But Gulf Province, across which the Pawaia and Kikori axes must have been traded to reach the sea, is thinly populated and the traders must each have travelled long distances. If they were originally owned by East Kambia men with relatives in the Wahgi Valley (as is possible), the two blades may have reached their destinations in as few as two or three exchanges.

Occasional finds like these illustrate a principle that may not have been seen before: that the physical distance that goods are traded is almost an irrelevance - it is the social distance that counts. This idea may have applications in the analysis of lithic finds from other periods and areas; if there is sufficient data to

be able to produce prehistoric distance-decay patterns across an area in several different directions, then fewer, larger items should be found at a given distance into sparsely occupied areas, while smaller items should be found in larger numbers at the same distance into a densely occupied area. This kind of analysis, however, cannot be attempted in the highlands at the present time.

In terms of the relative importance of the recently used quarries, the infrared sourcing program described here confirms most of the findings of Chappell and others in previous years. The Tuman quarries have again been shown to have the greatest output and widest distribution; their dominance is especially marked in the collections at Kuk, Wurup and Manton's Warawau Plantation. I have been unable to add to the earlier Baiyer Valley and Simbai collections which Chappell (1966:Table 2) showed were dominated by axes from the Jimi Valley quarries - in fact principally from the Ganz River and Tsenga. I have, however, differed from Chappell in attributing little importance to Mbukl. I think it was a minor quarry.

Chapter 11

AXE QUARRIES AND THE PREHISTORY OF THE HIGHLANDS

The questions I have attempted to answer in earlier chapters have mainly been those of 'What?', 'Where?', 'How?' and 'When?': 'What are axe quarries?', 'Where were they?', 'How was labour organised at the Tuman quarries?', 'How did the Jimi and Dom systems differ from the Tuman quarries?' and 'At which archaeological sites can quarried stone be identified?'. Conspicuous by their absence have been the important questions of 'Why?'. It is now appropriate to ask them: 'Why were axe quarries needed?', 'Why was quarrying undertaken in some parts of the highlands and not others?' and 'Why did organised quarrying arise when it did?'.

As I suggested in Chapter 1, there are two fundamentally different ways of looking at the development of axe quarries in prehistory. The two views may be simplified as follows:

1. Axes are part of the subsistence equipment that human societies use in adapting to their environment. The rise of centralised quarries, or their introduction from somewhere else, was a better means of adaptation.

2. The demands of the subsistence economy would neither have been sufficient to justify the enormous cost of intensive mining and quarrying at the Tuman and Dom quarries, nor could it have sustained the proliferation of smaller quarries in the Jimi Valley. Each of these production systems was developed in response to demands from the wealth economy.

These positions have ramifications which extend to many aspects of Papua New Guinea prehistory, as axes are among the few durable artefact types in the archaeological record. I will discuss some of them in this chapter under the following three headings: the reasons for trade, the economic geology of the study area, and the prehistoric background to the rise of axe production at quarries.

TRADE AND THE REASONS FOR HAVING AXE QUARRIES

A widely held model of trade is that commodities for which there is an established demand move about in response to conditions of natural scarcity. This is a theme developed by Hughes (e.g. 1973:121, 125; 1977a:211, 214), as it holds good for trade in commodities like shells which can only be found on the coasts of Papua New Guinea and which are sought after inland. In Melanesia as a whole, a clear expression of the model is to be found in Harding's (1967) analysis of trade in the Vitiaz strait, where the Siassi middlemen could make personal visits to both producers and consumers. Harding could say with justification that the Siassi depended on and at the same time intensified a 'geographic differentiation of production' (1967:242). The subjects of his study were seafarers who enjoyed a high degree of mobility.

In the highlands, only a small proportion of traders ever met the primary producers and the question of how demand was transmitted from remote consumers to remote producers is therefore not a trivial one, as Sillitoe (1978:265) has argued. In connection with the emergence of stone axe quarries, it is not enough to posit an abstract demand for axes: a means by which that demand can be transformed to motivate quarrymen must also be provided.

Sillitoe addressed some of the theoretical obstacles of the scarcity theory among the Wola of the Southern Highlands (1978: 265-8). Were people to be motivated purely by economic considerations, he argued, they would obtain quantities of scarce things - such as axes, salt, oil from Lake Kutubu, and shells - from neighbours closer to the sources than themselves. They would then satisfy their needs for these goods and trade the remainder with neighbours further from the sources. However, this is not the pattern observed. The Wola exchange substantial amounts of these goods with people <u>nearer</u> the sources than themselves. The reason lies with the kinds of transactions in which these goods are exchanged; only 26.3% of the total were made out of what Sillitoe classed as 'economic motives' (1978:Fig. 3).

Looking at trade in this way, it can be seen that the means by which objects move from regions of plenty to regions of scarcity across the Wola area are side effects of personal relationships

rather than the intended outcome of an explicit trade in commodities (Sillitoe 1978:274). This does not deny that there is a gradient of abundance and demand across Wola territory, but it may be concluded that the motion of a good from one side to the other is a series of random walks rather than a set of short, directional steps.

This difference in conceptual emphasis is an important one. It is often assumed that an abstract demand is sufficient to 'pull' goods into areas where they are scarce. This may be true in a statistical sense, but I would argue that the articulation between central producers and remote consumers was too weak to give an adequate explanation of how the producers were motivated to sustain a high output.

I remain unconvinced that extravagant prices - as reckoned in terms of other valuable goods - were paid for axes among the Wola or among other peripherally placed societies such as the Ipili, Wiru and Huli. Axes were simply scarcer there, men made do with poorer quality blades from the main quarries and they took to making their own from lower grade local sources (Meggitt 1957:40; A.M. Strathern 1969:320; Glasse 1968/69:572). Meggitt says that 'only the worst and smallest axes' reached the Ipili from the quarries of the Western Highlands (1957:40), but, bearing in mind a small sample size, I found that the difference between the size of Tuman axes at Porgera, the Ipili area, and the size of Tuman axes at Wapenamanda, closest to Mt Hagen, was slight (Table 10.5); in fact the mean lengths differed by only 4 mm. The number of Tuman axes at Porgera was, of course, much smaller than at Wapenamanda, but this emphasises my point that quarried axes were simply in short supply at a distance from their sources in Western Highlands Province.

On the question of sizes of payments for axes, Meggitt (1957: 40) says that the exchange rate among Ipili was a drum, a set of plumes or a pig for one stone axe, while Glasse says the Huli gave a pig weighing 50 to 60 pounds (1968/69:572). I do not find these prices excessive by Wahgi Valley standards, where a small pig or a plume or two would be given for a 10-15 cm blade.

I suggest that trade in stone axes was qualitatively different from trade in marine shells in two important respects. Firstly, the marginal consumers of axes like the Huli and Ipili were faced with the choice of either paying for imported axes or obtaining their own

from local sources. They did not, according to Glasse (1968/69: 571), place a value on stone axes for the purposes of wealth exchange. By contrast, the demand for marine shells, fixed in their role as wealth tokens, was closely related to their scarcity. This increased the value of shells, but it served to remove axes from the nexus of wealth exchange altogether and caused men to adopt alternative supplies of axes for subsistence use.

Secondly, the exchange value of marine shells was highest furthest from their sources (Hughes 1977a:189-90). Shells were probably traded inland for some considerable distance before their value appreciated substantially. But at the highlands fringe the value probably rose sharply to the point where shells could rate as wealth items.

As a matter of interest, the local value of shells can be shown to have depended on the weight given to them in different kinds of exchange ceremonies. For example, the Mae Enga valued pigs above pearlshells, whereas the Central Melpa valued pearlshells above pigs, while the Laiapu, who lived between them, exploited the differential rates of exchange to their own advantage (Meggitt 1974: 86-7).

In the case of Tuman and Dom axes, a remote region where they possessed a high value - on the model of marine shells - did not exist. The sources were already situated at the heart of a wealth economy where axes circulated as wealth tokens. The Dom and Tuman axe makers produced their axes for a high-velocity, high-demand economy, whereas the coastal peoples exported shells in spite of their relatively low local value and what must have been a modest level of demand from the immediate interior.

In the Jimi Valley, the low density of population meant that a purely local wealth economy could not have sustained axe production at the high level observed in the 1930s. However, the axe makers were in personal contact with the buoyant economy of the Wahgi Valley and were in a position to respond to its appetite for wealth items. In all three cases - Tuman, Dom and Jimi - axes were in greatest demand close to the quarries. The idea that the quarry owners perceived and acted in response to an abstract regional scarcity of axes is not appropriate: they acted for immediate gain in dealings with their neighbours.

A last, and by no means insignificant point, is that the economic basis of the areas where axes were in greatest demand is not swidden cultivation in a rainforest environment, where cutting tools might be thought essential, but grass fallow horticulture and, in some areas, intensive, continuous cropping (e.g. Brown 1978: 78-87). Spades and grass-cutting equipment (Golson 1977b) are much more important to the subsistence economy here than axes.

In this light, the first of the two views of quarrying set out in Chapter 1 and on page 231 is seen to be at best a roundabout explanation for the function of quarries. It might be objected that the term 'adaptation' can be broadened to include a concept of the wealth economy as a means of regulating or mediating between absolute needs - for food, shelter and security - and a society's capacity for production. This is, of course, the gist of a neofunctionalist argument advanced by R. Rappaport (1968:106-7), commented on by A.J. Strathern (1971:112-4) and Hughes (1977a: 212-3), and used in the design of a computer simulation by Wright and Zeder (1977).

My own response is to suggest that all complex systems, of which human societies (and, among other things, legal constitutions and the rules of games) are examples, have an inbuilt capacity for acting in ways which are not foreshadowed in their earlier evolution, in the case of unplanned systems, or which are unsuspected by their designers, in the case of planned systems. These systemic behaviours are often neither harmful nor particularly adaptive; equally, some are dysfunctional or beneficial only in restricted terms. In relation to axe production, the first individuals and communities to begin trading wealth tokens in the highlands, as opposed to purely utilitarian goods, could not have foreseen the eventual pre-eminence of the wealth economy and the ultimate rise of centralised quarries. Equally, they could not have anticipated many of the less savoury expressions of inter-group competition, such as combat mortality at between 20% and 33% of the male population (Chapter 2), the abduction of women in warfare (e.g. A.M. Strathern 1972:84) and the complete routs suffered by some groups in traditional times (e.g. O'Hanlon 1983:320).

It may be true in a wide sense that, by competing in the exchange of wealth, groups in the highlands, such as the Tsembaga

studied by Rappaport, gained the capacity to bargain for life-sustaining commodities which they could otherwise not afford to import to their region. But if this 'explains' trade, it hardly gives a satisfactory account of its more complex ramifications nor of the mechanisms through which trade motivated primary producers, such as axe makers. Rappaport's particular account also neglected to explain why the Tsembaga, who lived at some distance from the Jimi Valley sources of most of their axes, did not help to stimulate local axe production at Repeng, which lay only a few kilometres to their south, actually between their territory and the Jimi quarries. This leads directly onto my next topic: the uses to which different societies put their natural resources in the highlands.

GEOLOGY, AXE PRODUCTION AND SOCIETY

One of the crucial tests of the ideas I have advanced throughout this thesis is whether the observed distribution of quarries coincides with the distribution of suitable hard rocks. A comparable assumption is often held by prehistorians investigating widely separated areas and time periods, and very frequently it passes unchallenged. Some thought should perhaps be given to the mineral exploration industry, which employs a battery of scientific prospecting methods, while at the same time operating under a variety of political and economic restraints.

In his historical account of oil exploration, Menard has argued (1981:54-5) that random drilling in the sedimentary basins of the United States would have yielded no less than five times the actual amount of oil found up to 1902 and would have been as good at finding giant oil fields as the real oil industry up to the present day. Furthermore, a theory known as the 'Zapp hypothesis', after the geologist who first proposed it (Menard 1981:55), holds that the chance of finding oil in undrilled sedimentary rock is the same as that of finding it in rock that has already been drilled. In the Papua New Guinea highlands this is the equivalent of saying that - as long as the search excludes areas where their occurrence can be ruled out - the chance of finding axe rocks is the same away from the existing quarries as is it in their vicinity. I cannot prove that further occurrences exist, but I can show that the geological

environments of the known quarries have quite a wide distribution. I can also point out some remarkable coincidences in their distribution and the forms of society that supported axe production.

In Chapter 2 I briefly alluded to the fact that the societies of the study area - Melpa, Wahgi, Simbu and Enga - differ in a number of respects and in the course of discussions in Chapters 4, 8, 9 and 10 it will have become clear that axe production took on different forms in each of the first three areas. In the North Melpa area almost every autonomous group across a wide swathe of sparsely populated territory owned and exploited a source of stone axes, while in the Wahgi and in Simbu single groups in areas of very high population density quarried for axe stone using contrasting engineering and organisational methods.

In Enga, so far as is known, axe production at quarries was almost non-existent, so that this 'non-option' might be seen as bringing the number of production methods to four - three cases of actual output and one case of relying on other areas and casual, local sources for stone axes.

To relate these four responses in a more general way to geology, the four broad social groupings should be broken down in a different way. The North Melpa tribes should be distinguished from those of Central Melpa on the grounds of geography and population density. The Wahgi and Simbu categories should be amalgamated on the grounds of cultural similarity (cf. Rubel and Rosman 1978: 329-32) to give an East Wahgi grouping. The Central Melpa and Enga are culturally, as well as linguistically, different, but the ceremonial foci of Hagen and Enga, **moka** and **te**, are more institutionalised systems of exchange than anything found in the East Wahgi, where periodic pig killing and produce giving festivals of a different kind are held (Reay 1959a:157-62; Brown 1970). Thus a Central Melpa-Enga grouping may be formed for present purposes (cf. Rubel and Rosman 1978:332-6).

Having defined these culture areas, it can be seen that the quarries of the study area fall very unevenly among them. Two major quarries - Tuman and Dom - were worked in the East Wahgi group, no less than six and as many as eight or nine quarries were worked in the North Melpa group, but none was worked in the Central Melpa-Enga group at all. Does this distribution reflect more than geological differences?

Solid Geology

Serious geological investigation in the highlands began in 1937 (Bain et al. 1975:11) and maps at a 1:250,000 scale are available for most areas. Recently, mapping has started at the scale of 1:100,000, to match the existing 1:100,000 topographic sheets which cover the whole country. If nothing else, the geological maps emphasise the geological heterogeneity of the study area, which includes parts of two structural regions, the Kubor Anticline and the New Guinea Mobile Belt (Löffler 1977:7). Periods of sedimentary deposition, volcanism and, since the late Pliocene, massive uplift associated with movements of the Australian continental plate have combined to create a very varied geology.

In the area of interest, hard rocks suitable for axe manufacture are bound to occur in units which have been subjected to regional or contact metamorphism, as well as in dykes, sills and other igneous features. (Note, however, that igneous rocks were never used for the manufacture of axes in the highlands.) Somewhat to the south and west of the study area - and the rock exposures actually quarried for axes - extensive areas of limestone contain cherts which were, at least, used for making chipped stone tools (White et al. 1977b:Appendix). In contrast, there are only two kinds of landscape where axe rocks are not likely to be found. These are extensive floodplains and deltas covered in alluvium, such as the lower reaches of the Sepik River, and those parts of the highlands in the immediate vicinity of the Hagen, Giluwe and Ialibu strato-volcanoes (Löffler 1977:72-4) that are covered by volcanic cones and eruptive material.

Bain et al. (1975:104) stated that all suitable occurrences of axe rock in the Maril Shale and Omung Metamorphics, two of many geological units in the Wahgi-Simbu area, had been mined for axe stone. Hughes was equivocal (1977a:144) as to whether this meant there could have been further sources in other units, stating on other grounds that 'potential stone quarries with surface indications' would all have been known to the inhabitants of a given area (1977b:32). Both of these positions leave open the possibility that important hard rock sources were present in places other than those that actually produced axes and that they may, for a variety

of reasons, have been left unexploited. I cite as evidence the fact that the useful rock at two of the most productive sites of the study area, the Tuman and Dom quarries, is buried deep below the surface and cannot be said to be represented today by 'surface indications'.

A related issue is whether casual prospecting by highlanders would have been effective enough to find all the occurrences of rock suitable for making axes. However, the area is topographically extremely rugged and dissected by fast-flowing streams, which act as efficient natural sampling transects. To give an idea of the number of streams in a typically mountainous area, I measured the lengths of all streams in two 1 x 10 km strips of the 'Hagen' 1:100,000 topographic map with a digitiser. The first strip, with its lower lefthand corner at the head of the Komun River (at BP 100400), contained 51.03 km of marked streams and the second, with its lower lefthand corner in the Apin-Ganz area (at BP 100840), contained 41.54 km; over the tens of thousands of square kilometres of the highlands this suggests that there are hundreds of thousands of kilometres of streambed exposures. Although there is at present no detailed evidence on the occurrence of suitable rocks in places other than at axe quarries, it is a testable hypothesis to propose that such occurrences are numerous. As I have shown here, the rocks would be easily discoverable if they exist near the surface.

A variety of interesting consequences may be deduced from this. If axe rocks occur where there are no quarries, such as in Enga and Central Melpa, then there must be economic or social factors at play which have discouraged quarrying. Such an area may then be contrasted with another where there are many quarries, such as the North Melpa area. Equally the multitude of small quarries in the North Melpa area may be contrasted with the larger scale operations at the Tuman and Dom quarries. What are the relevant factors in each case?

Central Melpa and Enga Society

In the areas flanking the volcanic massif of Mt Hagen no exposures of axe stone are likely to have existed, but adjoining parts of the South and East Melpa areas (Bain et al. 1975) and Enga (Pain et al. 1982) are located in a varied geological environment of Tertiary and Mezozoic rocks. If sources of axe stone existed, they were not exploited on a wide scale. The dominant sources of axes in Enga were those of the Western Highlands (Chapter 10).

According to Meggitt (1974:68, 72), initiatory gifts in the Enga **te** traditionally started in the eastern parts of Enga and comprised, among other things, stone axes obtained from Hageners and the Kakoli of the Kaugel valley. In contrast to most kinds of ceremonial exchange in the highlands, which are directionally random, a characteristic of the **te** is that it follows well-defined routes across Enga country. This would have had the effect of efficiently ducting axes into the Enga hinterland and providing serious competition for potential Enga quarrymen. It may simply not have been worth opening major quarries if an efficient means of obtaining them elsewhere already existed.

As mentioned on page 234, there were permanent differences in the way Hageners, in the east of the area, and the Mae Enga, in the west, valued pearlshells and pigs; the former rated pearlshells above pigs while the latter rated them below pigs. The Laiapu Enga, situated in eastern Enga between Hagen and the Mae, were able to buy cheap and sell dear in both directions (Meggitt 1974:86-7). The Mae were close to the sources of salt owned by the Yandapu (Meggitt 1958:326) which was produced in quantities comparable to the availability of axes in Hagen. Again the Laiapu sat across the principal routes between the Mae and Hagen, and the economic power of their big-men to move these goods in and out of Enga may have a further bearing on the absence of axe quarries in Enga.

From the published accounts of early visitors (e.g. Ross 1936; Vicedom and Tischner 1943-48), Hagen society was one in which individuals competed to achieve high social status through wealth transaction in a more intense way than almost anywhere else in the highlands. As A.J. Strathern discusses (1971:204-8), Vicedom pictured Hagen as a stratified society, and while this is not entirely

in line with subsequent ethnographic work in the highlands, it certainly attests to the importance in Central Melpa society of the classical big-man (Sahlins 1963) and the ability to deploy wealth and attract followers.

A.J. Strathern (1969) has also contrasted **moka**, an institution which emphasises the financing of wealth transactions, with the pig festivals of the Middle Wahgi, Simbu and nearby areas, where emphasis is laid on the production of new wealth, chiefly in the form of pigs. The main point of **moka** is to 'win' by attracting more wealth than other men, not by out-producing them (A.J. Strathern 1971:221). Just as axe production may not have been worthwhile in Enga, it may have been out of place in the Central Melpa economy. The ethic of community action to hew axe stone, which was so highly developed at the Tuman quarries, conflicts with the Hagen ideal of 'drawing in' valuables by managerial skill and with the magical assistance of rituals performed at the home **moka** ground and its men's house (cf. A.J. Strathern 1971:38).

North Melpa Society

All the quarries of the Sepik-Wahgi Divide and the southern half of the Jimi Valley lay in the North Melpa cultural area west of Maegmul and they are all in similar geological positions, as far as can be determined. The land to the east of Maegmul has every appearance of being geologically identical (Bain et al. 1975), but there are no known or suspected quarries for 50 km in this direction.

The concentration of quarries on the contiguous territories of six North Melpa groups may simply be coincidental; if so, it was fortunate that the quarry owners had strong cultural and demographic ties with the much wealthier Central Melpa, who could absorb their production. However, it is my suggestion that the emergence of quarries in the Jimi Valley was a direct response to the economic dynamism of the Central Melpa economy. As I have described them, the quarrying and manufacturing operations of the Jimi Valley, which specialised in the output of ceremonial axes, could not have been more perfectly tailored to the nature of demand in Hagen.

Good Jimi axes could be exchanged - at least in Hagen itself -

at the rate of an axe for one large pig or one pearlshell. Vicedom also noted that 'the [ceremonial] axe has the same character for payment as the **moka** shell' (Vicedom and Tischner 1943-48, I, 121) and his photographs show ceremonial axes - a mixture of Jimi and Tuman types - being lined for exchange in **moka** (e.g. 1943-48, II, Plate 17.1). What is still largely unknown is the extent to which the axe makers, living on the periphery of the Hagen economy, benefited from the high rates of exchange in the Central Melpa area.

The territories of the quarry-owning groups are located in such a way that individuals could have crossed the Sepik-Wahgi Divide to visit the Central Melpa tribes in the northern part of the Wahgi Valley for the purposes of trading and making **moka** with them, and vice versa. Only in times of war would the traffic have been interrupted; then indirect trade between the axe makers and the Wahgi Valley Melpa would have taken its place.

The Leahy photographs thought to have been taken among the Pinai at Ruti (Plates 8.2-8.4), show men with good axes but no shell ornaments. Though they could obtain axes, perhaps the Pinai, and other groups in the Jimi Valley, could not obtain shells. A possibility is that the Central Melpa tribes bought axes from the axe makers at low rates of exchange, to sell them later in their home area for the high prices mentioned by Vicedom. In this way, axes may have been exported from the Jimi Valley without a corresponding influx of shell wealth. The axe makers may have been just close enough to Hagen to see the benefits of adapting production to the ceremonial market there, but not so close that they could dictate the terms of trade.

At a further remove, the owners of the Repeng quarry had no means of capitalising on the potential export market to their south. It is true that Repeng axes were not up to the standard of the axes the Maring knew as **dangunt** from Ganz and Tsenga, but this is not to say the stone was of poor quality; the materials I saw scattered about at Repeng belie this. However, the quarry is peripherally located and its owners had no means of trading locally with any dense population or with a wealth economy as strong as that of the Central Melpa area; ceremonial demands of comparable strength to those perceived by the North Melpa axe makers did not underwrite a more intensive exploitation of axe stone or specialist system of manufacture.

East Wahgi Society

The Tuman quarries undoubtedly had the largest output of all the highlands axe factories; at the same time Tuman society, as a representative of the East Wahgi group as a whole, is founded on slightly different principles than Melpa or Enga society. There is no preoccupation with institutions like **moka** which, as I have discussed, tend to encourage the financial management of wealth at the expense of its production through human labour. The antiquity of this cultural difference is unknown and it may not have been marked when the quarries were first established.

Perhaps more to the point are the questions of why there were only two quarries in the East Wahgi area, and why they were exploited so intensively. All informants in the Middle Wahgi agreed that the axe makers enjoyed what might be termed a high standard of living and one went as far as to say that the Tungei were the 'Kiaps' (Australian patrol officers) of the valley in traditional times. However, another rejected this idea of extreme wealth, saying that different peoples could obtain different kinds of wealth by exploiting their trade links with groups in other areas, for example through the Kubor Range to East Kambia where forest products were plentiful.

What neither informant suggested is what would have happened if all groups in the Wahgi were to have quarried stone and made axes. Geologically, all the groups of the Middle Wahgi had access to units of the Omung Metamorphics or Kana Volcanics in which the Tuman quarries lie (Chapter 3), and it is not unreasonable to suppose that there are unexploited occurrences of axe rock in the valley. In this hypothetical case, trade in axes would have been unnecessary - each group would have been self-sufficient - and the incentives to produce ceremonial axes would have disappeared. This is, indeed, one scenario for the period before the rise of the large modern quarries; it also resembles recent axe production in the Eastern Highlands (Radford and Radford 1980), where local sources of stone, together with trade over short distances, satisfied the demand for cutting tools.

A scenario in which many quarries operated in the Wahgi Valley, would not resemble the proliferation of medium to small quarries in

the Jimi Valley, since production there was not underwritten by intra-community trade but by export to a wealthier region nearby. The actual case of there being two intensive quarries in the East Wahgi group must be seen as the historical achievement of a balance in the ratio of primary producers to secondary consumers.

A point that is worth noting is that extraordinarily large brideprices seem to have been paid in the Tuman area before the Pacific War, around ten axes on average, compared with the area around Banz on the other side of the Wahgi River, where around three axes were given on average (Chapter 7). This suggests that the number of people who derived financial benefit from axe production was larger than the population in immediate contact with the quarrymen. The neighbours of the Tungei, some 20-28 named groups (Table 7.2) with perhaps ten times their population of around 200 adult men (Chapter 2), traded for axe stone, sharpened and hafted axe blades, and thus participated in wealth creation. This second tier of axe makers would thus have numbered about 2000 men. But a third tier, the people further from the quarry to whom the second tier paid brideprices, shared in wealth creation if they succeeded in obtaining higher brideprices than they paid to people still further away.

One conclusion is that in a zone around the Tuman quarries, bounded perhaps by the Komun and Minj Rivers to west and east, there was a relationship between distance from the axe makers and the 'purchasing power' of axes. It certainly seems that the quarry owners could not obtain the standard rate of exchange that may have pertained in the Hagen area. It is likely that the neighbours of the Tungei could demand and obtain large brideprices, on the principle that those who have more should pay more, rather than for the reason that axes were of intrinsically lower value in the Tuman area than elsewhere.

The Dom axe makers worked at a similar level of intensity to the Tuman axe makers, but their output was more specialised and more clearly aimed at exploiting the demands of the local wealth economy. The success of the Dom axe makers demonstrates that large axe quarrying operations were viable without cashing in on the large, low value market for work axes. The Tuman operation resulted in the ancillary production of axe stone for subsistence use - in large

amounts - but it is unlikely that quarrymen made many work axes personally. They included the stone in exchange payments and other men made them into work axes at some distance from the quarries.

THE ECONOMIC BACKGROUND TO THE EMERGENCE OF AXE QUARRIES

The only stratigraphic sequences where firmly dated axe fragments may be confidently ascribed to quarries of the study area are those of Pukl Kumanga, which may be 500-1000 years old (Appendix F), and the Manim Valley rockshelters of Etpiti and Kamapuk (Chapter 10). Etpiti Level 7 is dated to 1310 ± 70 BP and Kamapuk Level 4 to 2540 ± 70 BP, both dates coinciding (Fig. 10.15) with an increase in the density of quarried stone in the sites. As I have already argued, with the caution that the Etpiti and Kamapuk data need confirmation, this may be equated with the rise of the recently used quarries and the emergence of the set of distinctive axe styles associated with them in recent times. What are the artefactual and economic precursors of these developments?

Precursors and Contemporaries of Quarried Axes

The question of the antiquity of the modern trade in stone axes has never been satisfactorily answered because many of the excavations conducted over the past 25 years have been at rockshelters falling outside the area where the major quarries would be expected to have been represented. Exceptions are Yuku, Wanlek, Nombe and sites in Manim Valley.

At Yuku, the number of axe fragments found would not justify far-reaching conclusions, but the site is important in that it contained an assemblage of waisted blades dating from before 12,000 BP to 5000 BP, raising the possibility that these artefacts were still in use when the earliest ground stone axes were made. Of White's upland sites with stratified axe stone, only Kosipe, in Central Province, and Nombe, in Simbu Province, also contained waisted blades. At Kosipe, both waisted blades and 'axe-adzes' occurred in Levels 6-2, dating from 26,000 BP to 9000-4000 BP (White et al. 1970:159-60, Tables 4 and 6). Only one fragment of axe was

ground and it occurred in Level 2. At Nombe, a rockshelter whose excavation has since been continued by Mountain (Gillieson and Mountain 1983), White (1972:132) found ground stone axes, including Dom fragments, in the Upper Horizon and waisted blades in the Lower Horizon. More Dom fragments and what is probably a Ganz fragment have been found by Mountain (Table 10.7). The precise function of waisted blades, together with their relationship with ground stone axes, if any, remains unknown.

The earliest finds of stone axes functionally comparable to recent quarry products are the cutting edge fragment from Kafiavana Level IX (White 1972:Fig. 18j) and two small, complete axes from Manim Level 21 (Fig. 10.14), at about 9000 BP and 6000 BP respectively. However, finds like these are too few in number, and too fragmentary or too small, to warrant the label of a 'type' being applied. The axes do have a lens-shaped (or ovoid) cross-section, but the distinction of being called 'lenticular axes' is not justified. The material from which they are fashioned is the kind of stone used to make recent 'local axes'.

Blades with oval and lenticular cross-sections were recently made in other parts of the highlands from local sources of stone; locally made axes within the study area also had this shape. Such axes are, so far as it is possible to tell, the implements that were used before stone from the modern quarries was exploited. A characteristic of both is that they were obtained from streambed sources by individuals, as seen in the ethnography of Blackwood (1950, 1978) in Eastern Highlands Province, rather than from deeply buried sources by groups of men (see also Radford and Radford 1980; Wise 1981).

At Wanlek, S. Bulmer found a chipping floor where axes had been made. She has argued (1977:66) that the Wanlek finds contrast with the axe manufacture seen by Blackwood, claiming that the bifacial (lenticular) flaking on the Wanlek axe blades showed a different technique which was 'probably imported to Papua New Guinea'. Without a description of the raw materials, however, it is impossible to judge what technique would have been suitable, and ceteris paribus, there are no particular grounds for supposing that the Wanlek tools - like the later planilateral blades (S. Bulmer 1964: 267; 1975:45) - were anything but local developments. At all

events, the phase at Wanlek which contained these materials terminated at around 3000 BP (S. Bulmer 1977:68-9).

If labels must be applied at all, the Kafiavana and Manim finds are 'not planilateral' or 'not quarried' axes. Equally the general distinction made, principally by S. Bulmer (1964, 1975), between 'lenticular' and 'planilateral' types should be discarded in favour of the more relevant 'quarried' and 'not quarried' categories. I hasten to add that the label 'planilateral' remains valid, as the nature of production at the quarries discussed in this thesis ensured that standardised types of axes were made in the planilateral style. No such thing can be said of 'lenticular' axes; they are not a type in any meaningful sense of the term.

Note that there was nothing to prevent the individual axe maker from fashioning flat-sided (i.e. 'planilateral') axes from streambed materials, but axe collections show that this never routinely happened. This was probably because the streambed stone was not amenable to quadranglar flaking methods; it may have been too smooth, and usable pieces too small, for the axe maker to be able to set up the correct percussion platforms. At any rate the deep-mined stone of the major quarries had a typically tabular or prismatic fracture and was easily worked with a quadrangular flaking technique.

Changes in the Economic Basis of Highland Societies

No complete settlements have been excavated and little information on ranking or social status has emerged from the rockshelter sites. Indeed, few non-utilitarian artefacts are to be found in any excavated assemblages; notable exceptions are marine shells, which were found as far back as Horizon VII at Kafiavana, dated to 9000-6000 BP. There is, however, plenty of evidence for change over time in the subsistence economy of the highlands, with far-reaching consequences for social change and the rise of the modern ceremonial economy.

The factor which has troubled New Guinea prehistorians more than any other has been the date of introduction of the sweet potato, Ipomoea batatas, and its effects on settlement and demography in the highlands. In general, sweet potato enables growers to

obtain higher yields from existing land and to found settlements at higher altitudes than they could if they planted comparable crops like taro, Colocasia esculenta (e.g. Watson 1965; Brookfield and White 1968). However, there are two chronologies: the short chronology, which states that the sweet potato was brought to Southeast Asia after 1500 AD by Spanish and Portuguese sailors, and the long chronology, which states that the sweet potato arrived much earlier from Polynesia, perhaps around 1200 BP. The second position was argued on the basis of pollen evidence by Golson (1977c:51) and fitted to the transition from Phase 4 to Phase 5 at Kuk - Golson later retracted this idea (1977c:54).

In a more recent publication Golson (1982) has discussed the Kuk evidence in the light of criticism from Modjeska (1977), who argued that the various phases at Kuk witness more than a series of subsistence responses over time. Modjeska also suggested that wetlands like Kuk were centres of intensive taro production brought into cultivation to fuel large-scale political and ritual enterprises based on pigs and other valuables. In the light of the present discussion, it is enough to note that in the garden systems seen at Kuk the greatest change occurs between Phases 3 and 4, around 2500 BP (Golson 1982:117, 120). In Phases 1-3, dating to the period 9000-2500 BP, generalised evidence for gardening was found, while in Phases 4-6, dating to 2500-100 BP, a more intensive network of garden ditches was found. Golson suggests that the latter phases witness the intensive cultivation of a single crop; he proposes taro for Phases 4 and 5 and sweet potato for Phase 6 (1982:120). Note that if they can be substantiated, these changes usher in an economy of essentially modern aspect at the same time as the rise in modern stone axe materials at Kamapuk and Etpiti. On present evidence the introduction of the sweet potato had no bearing on the socio-economic changes leading up to axe production at quarries.

I have said that the date of the rise in quarried axe stone took place during the period 2500-1500 BP, but further precision is impossible on present evidence. The evidence is statistical in nature and some vertical movement may be expected in finds as small as the axe fragments recovered by Christensen. They may easily have been trampled into the surfaces of the rockshelters during prehistory and their true 'chronological' depths might be interpreted as

being 10-15 cm higher or lower than their stratigraphic depths. Note that each level was about 10 cm in depth at Kamapuk, according to Aplin (1981:23). I am not prepared to accept the possible find of Tuman stone from Manim below a date of 3580 ± 80 BP (Table 10.7) since it is a solitary fragment and its stratigraphic context cannot be confirmed.

AXE QUARRIES AND PAPUA NEW GUINEA PREHISTORY

General accounts of the prehistory of the Papua New Guinea highlands stress the importance of dated finds of stone axes to an understanding of past patterns of trade and exchange, because there are few other kinds of artefact durable enough to survive in archaeological deposits (e.g. White and O'Connell 1982:190). In this thesis I have attempted to show that stone axe production - complex in itself - was linked to causative factors in the realms of both nature and society and can provide a much wider window on the past than has previously been suspected.

Quarrying has previously been seen as determined by nature - by the distribution of suitable rocks - but I have sought to present an alternative model, in which human decision-making is given credit for the eventual exploitation of what amounts to few sources over a large area. The role I ascribe to nature lies in the side-effects of having to adapt mining operations and manufacturing techniques to suit local conditions. Geology was a strong influence on the shape and size of the different quarry products and even helped to determine the type of market - through the balance of work axes to ceremonial axes and the greatest size of brideprice axes - that each type of quarry was able to service.

Social factors, on the other hand, have been seen at work in the different emphasis placed in different parts of the highlands in various kinds of exchange and in the highly regulated manner in which the Tuman quarries, in particular, were operated. They have also been seen at work in the dynamics of a population of axe makers in the Tuman area during the twentieth century. The methods and economics of axe making - the Black Box that prehistorians tend to call an 'industry' - has been shown to be intimately linked with the relationships of the quarry owners to their trade partners.

In the areas that I have discussed, the output of low-valued work axes fulfilled the universal need for subsistence tools in a stone-using economy; universal needs, however, must be distinguished from explicit demands backed by the ability to offer rewards for their satisfaction. In the cases of all the major quarries, the large investment of time and effort needed to keep them open was financed by the ceremonial economy, not by the subsistence needs - however real - of highlanders in general. Without doubt, the same kinds of investment must have been made during prehistory when evidence of modern quarrying first appears and, had the ceremonial economy never developed, it can be confidently stated that the modern quarries would all have remained minor sources with a localised distribution of work axes, perhaps like Repeng and Dabiri.

Stone axe production and exchange can claim a central place in the long historical process of wealth creation and manipulation in the highlands. The ceremonial economy of the Wahgi Valley, Central Melpa and Enga must have attained a modern level of importance and intensity at least as early in prehistory as the appearance of quarried axe stone in archaeological excavations and, in hindsight, an understanding of the context within which axe makers have recently operated provides new insight into the past and helps to illustrate the long development of contemporary societies in the Papua New Guinea highlands.

Appendix A
MYTHS AND LEGENDS OF THE AXE MAKERS

ONEM'S STORY OF HOW THE AXES CAME TO TELAN KOMENG

Lee Eby recorded this story while living as a Nazarene missionary at Tun in the early 1960s. It clearly sets out the quarrymen's idea that the stone lay in a straight line along the Tun valley (Chapter 3). The storyteller's name was Onem; he is most likely to have been the Onem in Figure 2.20 and, if so, he died during the early 1970s.

Eby seems to have taped the story; at least there are two slightly different transcripts. The first is annotated and uses a preliminary Ek Nii orthography. The second version uses the Blowers-Ramsey orthography and incorporates some changes of meaning as well as of spelling. I have generally followed the second version, occasionally seeking clarification from the first:

Tui pape oɨem ek ei puɨ ei nimbi end. Nim piiken muɨi!

Tui toɨmen ei, tui pape oɨem ei, am wuɨ tone, wuɨ tone, wuɨ tone, wuɨ Kumndi pape oɨem. Wuɨ Wanep pape oɨem. Ope Wanep, 'Eɨe pimbi,' ni eɨem. Kung ek tangɨem. Kung kei niɨem. Amb kangeɨ ek tangeɨmen. Piipe si kindpe orem meɨ orem. Orem meɨ orem.

Ope Nimeɨ peram orem. Ope, 'Pimbi,' nipe errem ei. Ope eɨe pirem meɨ wulteng alteng amb kangeɨ ek tengnjeng. Ei piirem. Piipe kin amb kangeɨ kei ek nangne, piipe kin orem meɨ orem, orem meɨ orem.

Wara Tuman noɨ Kiltei Ku mane orem. Orem meɨ orem.

Teɨan ope eireng komeng simb ei embi pirem. Pape ope, 'Eɨe pand,' ni errem ei. Kung kei ku nirem. Amb kangeɨ kei ku nirem. Pepe si kindpe eireng tumbɨam Teɨan tumbɨam alteng orem. Ope, ope, 'Ya eireng eɨe pimbi,' ni errem. Errem meɨ kung kei ku nirem. Ambeɨ kangeɨ ek ku tengk. Piipe sape pendpe, am eireng peram alteng orem.

Ope, ope, ope, sinem tui toɨmen tui paɨem. Kumb sepe orem tui Ngumbamung orem. Ngumbamung ope kumb sirem. Ope wultengdeng orem. Tui kumb sepe orem. Aɨ ope ope aɨ tui Ngumbamung ope altengdeng purem.

Pange, wultengdeng buł mongreng orem. Tui Kunjin orem. Ope altengdeng pange wultengdeng orem ei tui Tepi orem. Tui Yesim orem. Ope ełe ope altengdeng purem. Ope wultengdeng alteng tuk pange, wultengdeng erpe nipe nim kin tui Apiamb orem. Apiamb ope altengdeng pange si kindpe wultengdeng orem ei. Wałpi tui Gapinj orem. Ope kuan turem.

Ope, ał mane kumb sirem Ngumbamung pirem kone ełe ope, 'Pend,' ni errem. Kung kei ende piinenrem ku. Amb kangeł kei ende piinenrem ku. Ope ał kupek tope ał pirem. Pepe wulteng kindange, wulteng tui nind tui ei ope ełe pirem. Pape, ełe pirem meł kung kangeł ek kei ende piinenrem. Amb kangeł kei ende piinenrem. Ope ełe pirem. Pape wultengdeng orem meł wultengdeng tui Tepi ope, kumb ełe pirem. Pirem, amb kangeł kei ek piinenrem.

Kumb kem tangpe wultengdeng kindrem meł wulteng tui Opiemb pirem. Pape wulteng kindrem meł kumb kem ał kulte kend turem. Kulte kend tange kin wu kei orem meł pii tundpe ał pape kapłe erpe wulteng orem. Wulteng ope Wałpi tui Gaping ełe, 'Pend,' ni errem ei, ope ał, 'Bi,' errem ei.

Ał pape mane kindrem. Pape wultengdeng orem meł wultengdeng Gapinj tengrem meł pii tundpe, ya kung kei nirem. Amb kangeł kei nirem. Wereł minj pii tundpe tengrem (pirem) meł am ełe enj.

Pirem meł pirem. Ei pore ninem.

Translation

The following translation is an attempt to find agreement between Eby's notes and the two slightly different transcripts; however, there are some words which I do not understand. I have not heard the tape and as I did not hear this story during fieldwork, I was unable to check my interpretation with literate Tungei informants:

I will tell you how the axe stone came to lie where it is. So you stop and listen!

The stone we used to get, the stone that came to lie there, came from far up in the west, up the west at Kumndi.[1] It came from west at Wanep. When it got to Wanep, it thought 'I'll listen here.' But the pigs were talking to one another, the pigs were making a noise. The women and children were talking to one another. When it heard this, it left and kept on coming.

It came to the mountainside called Nimeł.[2] When it arrived there, it thought 'I'll listen.' But the voices of women and

children rang out from west to east. This is what it heard. It heard the women and children chattering to each other and it came away from the place.

It came down to the Tuman River and to Kiltei Ku.[3] And it kept on coming.

It came on southwards to Teɬan and lay at the foot of the mountain. 'Here I lie,' it thought. But the pigs were making a noise and the women and children were making a noise too. It left the place and went on southwards and eastwards along the side of the mountain Teɬan. It went on a bit further, lay down again and thought, 'I'll listen here.' But it could still hear the pigs squealing and the women and children talking to each other. It got up again and went as far south and east as it could.

Now it reached the place where 'our **tui**' used to be - the place where we used to cut axe stone.[4] The stone at the front came to Ngumbamung. When it reached Ngumbamung it was at the front. It came from westwards to get there. Our **tui** was at the front too. It came east until it came as far east as Ngumbamung.

Now the stone went backwards to the west. It came back to Kunjin. Reaching the east it came back westwards to Tepi; it came to Yesim.[5] East and west...it came to Apiamb. Reaching Apiamb, it came westwards. It came to the Waɬpi's quarry at Gapinj. It came to this place last.

Down in the east,[6] the first stone at Ngumbamung thought, 'I will lie here.' It could not hear the pigs any more, nor could it hear the cries of the women and children. It came out and listened in the east...it listened at the **tui** place I mentioned. It came and listened there. Lying there listening, it could not hear the cries and talk of pigs and children. It could not hear the cries of women and children. It came and listened there. It came west to Tepi and listened. It listened, but it could not hear their cries.

All of a sudden (the sun) came up as it was listening in the west at Apiamb. It was lying in the west when suddenly a cock crowed...there were voices of men and it was confused... it formed a line from the east and came to the west. West it came to Gapinj. 'I'll stop here,' it thought, 'I'll go away,' it thought.

It put down and lay in the east. Where it lay in the west at Gapinj it was confused by the daylight and the cries of the pigs, the women and the children. Close to the surface where it heard the confusion...it became ?rubbish.[7]

It listened thus. That's all.

Translation Notes

1 This refers to the place Kumndi northwest of Hagen near the Baiyer Valley; it is one of the most distant and westernmost places visible from the slopes above the Tun valley. Note that all the other places mentioned in the story lie on the same line of sight, approximately 300° from Kunjin.

2 Nimeł (another name Kanim) is a mountain between Andakelka and Kuli territory (Fig. 2.2; Plate 2.1).

3 Kiltei Ku is the legendary origin site of the Tungei on the left bank of the Tuman River (Fig. 2.2).

4 'Our **tui**' is a reference to the site of Kunjin. Onem, according to Eby's notes, would not actually say the word 'Kunjin', although it was typed into the transcript in the next paragraph. I found that Komnemb Malimbe was also unwilling to say the names of quarry sites at which he worked. The fact that Onem refers obliquely to Kunjin as 'our axe' indicates that he worked there, rather than any of the other quarries.

5 Tepi and Yesim are synonyms for the same place.

6 Technically Ngumbamung lies at a higher position in the east, but the Tungei always refer to places in the Wahgi Valley as being **wuł tone**, 'up west', and **ał mane**, 'down east'.

7 I do not understand the sense of the last sentence. I think it means that where it lay close to the surface, a skin - **tui enj** - formed on the axe stone. I understand this to refer to the fact that at Gapinj (includes Gapinj Aka Nui) only nodular, cortex-covered stone is found.

KO'S VERSION OF THE TUNGEI ORIGIN MYTH

Georg Vicedom (Vicedom and Tischner 1943-48, III, No.32) recorded this story before the Pacific War at Ogelbeng and a much shortened translation from the original German has already been published (Vicedom 1977:41-2). Vicedom's informant was Jamka (Yamka) Ko.

The Discovery of the Axes

How the Rungi discovered the manufacture of the axes is related as follows. Two old people went into the forest. The old woman collected vines and the old man went to hunt marsupials. He killed a fine **mutl** marsupial, and, finishing the hunt, the two went homewards. At a spot, a little way from the settlement, they decided to cook it. The man slit open the marsupial and took out the insides. The woman went out and fetched cooking leaves. While the man was still cutting up the marsupial, the old woman returned with with an armful of **kengenga** banana leaves. She went over to the cooking pit and bent down to line it with banana leaves. At this moment the man saw that the woman's vagina was free. He jumped up, ran over to the old woman, took hold of her, laid her down and entered her. While he was having intercourse with her, the old woman felt something stick into her back, so that it hurt and blood came out. She said to the man, 'Something is sticking into me, let's just see what it is!' So they looked and found that the blade of a **kumbamon** axe was just showing above the ground. They took her digging stick and dug deeper, finding that further under the ground there were many blades of the **kumbamon** and **ndima** types. After they had done this they quickly cooked the marsupial, took all the axe blades out of the ground, wrapped them up and packed them in a string bag. Then they went home. When they reached home they said that every man, old and young, should assemble. Everyone came together. Then the two old people showed them the axe blades and said, 'Let's now go into the forest and hunt marsupials for the axes. When we've killed some, we shall make a sacrifice to the spirit of the axes.'[1]

They ran around hunting and killed a great many marsupials. When they had sacrificed them they went out to the place where the axes had been found, cleared it, sharpened digging sticks and wedges, dug up the ground, drove the wedges into veins in the rock and struck off the axe blades. Then they built houses for themselves and slept there. They sharpened the axes there and made bindings for them. Then they traded the axes to other people. If they had no more axes, they went back again and struck new ones. That the Rungi people now manufacture axes, is thanks to these two old people. The two discovered the axes and the other people took over the production from them, and thus the Rungi continue to make and trade axes. The two who discovered the are long since dead. When the present people go to make axes, so do they first hunt marsupials and sacrifice them to the two old people as they pray to them. Then they climb down into the pit and burn torches, which they impregnate with resin. With these torches they light the way. When they have found the veins they drive in wedges and make axes.[2]

Vicedom's Footnotes

[1] There are two axe manufacturing centres in inland New Guinea. One is on the foothills of the Bismarck Range and the one mentioned here is in the bordering range with Papua (see volume one). Hunting kills are steam-cooked straight away in the bush, so that one can consume them undisturbed. In Hagen each instance of meat-eating is a sacrifice to the ancestors, in connection with which sexual intercourse is strenuously avoided; other religious observances are also made here. **Kumbamon** is a heavy axe for splitting timber, **ndima** is a fight axe (see volume 1). Only an activity that enjoys the benefaction of the spirits is crowned with success. One therefore seeks to procure the help of the spirits through sacrifices and to show oneself thankful towards them.

[2] This refers to an actual shaft in the ground, to a mining operation, primitive style.

The Tungei are referred to here as the 'Rungi', which is a pronunciation heard sometimes. The **mutl** marsupial is called **ka melka** by the Tungei, while the first axe type named by Ko, **kumbamon**, is the Melpa name for **ngumbamung**, the axe type made at Ngumbamung. **Ndima** is not an axe type known to me; it does not occur in any other published list of names. It is conceivably a corruption of Yesim.

I heard this story many times from the Tungei. Their versions are essentially identical to Ko's, except that the Tungei name their ancestors, Jimbe and Doimbe, as the couple who went into the bush. They do not agree among themselves, however, as to which of the two was the husband and which the wife.

THE LEGEND OF HOW THE MENJPI CAME TO THE TUMAN RIVER

If asked about the first stone axe, the Menjpi normally relate the legend of Jimbe and Doimbe, except that they may say that Jimbe and Doimbe were the ancestors of the Menjpi rather than of the Tungei as a whole. Some informants substitute a Menjpi founding pair, Ben and Esemb. At the same time, the Menjpi concede that they originated near Mt Hagen at a place called Num Kala.[1] I was never given a more lengthy explanation, probably because it is customary for the Menjpi to stress their current and undoubtedly long-standing relationship

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[1] It is at the site of the present Ela Motors (formerly Kala Motors) on the eastern outskirts of the town.

with those Tungei clans who say they arose at Kiltei Ku. One day, however, a visitor named Koi[2] from the small Hagen tribe Kime (Keme) narrated the following story:

> The Kime ancestor Tendik Wu prepared a garden and he cut and burnt off all the grass. The women came and planted beans, sugarcane and bananas among other things, but during the night there was a heavy rainstorm. Rain fell throughout the night until dawn.
>
> In the morning, the old woman who had planted the garden remembered that she had hung her string bag in a tree in the garden and that she had forgotten to take it home at the end of the day. Now she went back to find it, but when she arrived at the garden, all the newly planted food had been washed away and there was a big lake where the garden had been. She became frightened and looked up to see an old man standing beside the lake. He came up to her and gave her a small parcel. She took it and saw that he had wrapped up a piece of axe, some pig bristles, some small pieces of pearlshell, and some Nassa, Conus and baler shells. Then he told her to keep the valuables safe and to kill a large red pig which she had at home.
>
> The old woman went home and told her husband what had happened but he did not believe her and accused her of inventing the story to cover up her adultery with the old man that she had seen. He refused to kill the pig and threw away the things in the parcel. The man's brother, however, came along later on and saw the broken axe on the ground. He picked it up and looked for the place it might have come from.
>
> He came and slept at Baisu and tried to match the axe against the stone which lies there on land of the Penambe. It was not the same kind of stone. He came to Kindeng and tried to match the axe with the stone there. Then he came to Tun and went into the bush and found the stone that was the same as the broken axe.

The storyteller said that the Kime comprised four clans, the Waspeka, the Tokmbo, the Mekenjpi, and the Menjpi. It was from the Kime Menjpi that the Tungei Menjpi were said to be an offshoot. The introduction in the story of the brother who picks up the stone is probably a device to convey the fact that the Tungei Menjpi are the 'brothers' of the present-day Kime, whose ancestors failed to heed the signs in the parcel of valuables and thus stayed behind at Mt Hagen.

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2 Interview 9-81. Tape 11.

The outcrops of stone on the way from Hagen to Tun are noteworthy. There is an outcrop of limestone (J. Golson pers. comm.) near the road skirting the western boundary of Tibi Plantation near Kuk at BP 058577, and I presume the storyteller meant this, rather than the small obelisk at Kuk (Gorecki 1979b). The stone at Kindeng probably refers to the cliff on the border of Kuli and Onembe ground at BP 150555.

THE ORIGIN MYTH OF THE MAKE

This is the version given by Strauss (Strauss and Tischner 1962: 45-6):

> The Make live in the **kopon** district, in fact in the headwaters of a tributary of the Jimmi [sic].
>
> "When our ancestor Mak, travelling through the area, slept overnight on the bank of a river, he woke in the night and heard a sound like stones falling against one another. In the early morning he went out and saw that a light-skinned man was turning stones over in the riverbed. Then the man was gone. On the bank a fire had been lit. The embers were still alight. Our ancestor Mak went to fetch a cut of meat that he had left wrapped up indoors. He made an offering of it. When he went to examine the place where the light-skinned man had been turning stones over, he saw a beautiful flat stone lying there with a remarkably fine, sharp edge to it. He polished it and a marvellous veining stood out. He said to himself, that was an artful piece of work! This will be my **kona uglimb**! The name of the Make will be great!
>
> He took his grinding stone, sat down by the water, dipped the stone in again and ground the edge razor sharp. Then he made a handle and fixed the blade to it. He took the axe and bought a wife with it. The couple bore five sons. He named them Kui, Krake, Nggolk, Kopon and Krang. After them our five Make off-shoots are named.
>
> The stone is our **tei-medl**. If we are accused of something we have not done, we take an axe blade, lick it and say: we have not done it - Make **mi**! We only say this when we are innocent, otherwise the **mi** would eat us; we are afraid of it."

Strauss' Footnotes

These origin myths or legends about the **mi** groups or sub-groups are not kept secret among the Mbowamb. They are in fact recounted by others. Under certain circumstances they get detached from the **mi** group they belong to and become more or less general legends and stories. In Vicedom and Tischner, III, No.32 the myth of the Rungi people is given, who make Hagen axes like the Make (see Chapter 3, 1:4). However it was not narrated by a Rungi, but by Jamka Ko, because we were confined within the area around Ogelbeng before the war. Ko frequently used the word **kor**, spirit (Chapter 20, 1), as when he said: '...then we shall make a sacrifice to the spirit of the axes'. But it does not appear to us that the notion of 'spirit' has yet been encountered in the origin myths and legends. If one lets the old people of the respective **mi** groups or sub-groups tell these myths and legends, then it will be remarked that, taken together with the whole complex through which the concepts of **kona wingdi**, **mi**, **tei-medl**, **kona uglimb**, birds, light-skinned men, 'upper' or **tei** people (Chapter 9, 11) are conveyed, they do employ this concept of 'spirit'. It is used only in the realm of nature spirits and spirits of the dead (Chapter 20). The concepts which are attached, that I would like to call the '**mi** complex' for the sake of brevity, were not at that time known to us for the most part; and the context and full meaning of those that were known were not yet clear. Quite correctly G. Vicedom remarked in a note on the Rungi myth, 'In Hagen each instance of meat-eating is a sacrifice to the ancestors, in connection with which sexual intercourse is strenuously avoided; other religious observances are also made here'. It is of course not the case - as might be thought from this - that between Hagen and the area near the Kubor Mountains, essentially different religious observances pertain, but that belief in spirits and spirit cults belong to a different level in the religious experience of every Mbowamb to the **mi** complex discussed here, which revolves around procreation and increase, descent, exogamy, social structure, tribal law and sacrifice to the 'upper' or **tei** people. In this connection it can be seen in the Rungi myth narrated by Jamka Ko that it was not the custom for the two old people to be abstemious when making a sacrifice, nor was this a characteristic which could be used to distinguish the Rungi in their religious observances from the Koma [sic] people, for the taking of a woman and the procreation of children as an expression of the autonomous power of fertility and increase is an essential theme of the origin myths and legends of all **mi** groups and sub-groups of the Mbowamb.

Strauss uses a number of Melpa terms which he glosses as follows:

kona uglimb 'Navel' place, central place of a tribe

kona wingdi	Creation place
mi	A tribe's divination substance
tei-medl	'Thing laid down', designated divination substance

THE STORY OF GUIM AND GAPAL AND THE AXE STONES OF TONMAI

This story was given to me by Bopa of Goroku Kopil Kane clan, Kekba Ke sub-clan in 1980; the translator was Nul, also of Kopil Kane clan.[1] It invites direct comparison with the legend of the discovery of the salt springs in Salt Census Division, Gumine District, Simbu Province; one version is given by Gaisseau (1957:60) and several others are cited by Hughes, who also heard the story himself among the Kere (1977a:86-7).

In the salt legend, the mortal characters - two youths out on a visit - see one or two beautiful spirit girls dancing at the future site of the salt springs. The apparitions appear for long enough only to attract attention to the place; they vanish whenever the mortals try to find them. In Hughes' own version (1977a:87) there is the additional detail that the two youths lay down to sleep and had dreams in which they were instructed in salt-making techniques. The axe discovery legend contains each of these details, though, in common with the legends of Western Highlands Province, it is not men, but women who discover the axe stone:

> When the world was made the stones came to Mt Kagul facing the place Tonmai. Seeing a pleasanter place on the opposite side of the Wahgi River, however, they moved across to Tonmai. They crossed at Iri Kople [where in living memory there used to be a bridge]. The best stones went up to Kielpa and Tonmai, but those which were not as good did not get as far and are found on the slopes which run down to the Wahgi from Kielpa. Many, many years passed by until the two sisters Guim and Gapal lived at Kielpa, with their father Yonma and their half-sisters Mol and Alwa. Guim was the elder daughter of Yonma's first wife and Mol was the elder daughter of Yonma's second wife.
>
> One day Guim and Gapal went up to Tonmai to look for mushrooms. In the afternoon, when they returned, two spirit sisters appeared on the slope above them, dancing and singing. Guim and Gapal looked back and said, 'Who can they be, no-one lives nearby?' Guim stayed behind at Kielpa while Gapal went back to find out who they were. When she got to

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1 Interview 18-80, Tape 'Dom 1'.

Tonmai, there was no sign of the two strange girls at all. She returned to Kielpa, where Guim had continued to see the girls dancing all the while. This time Guim went up to Tonmai to find them and Gapal stayed behind. Now Gapal could see the girls dancing, but Guim could not. Guim returned and they had an argument. Finally they both went to Tonmai together, but they could not find the dancing spirit sisters. While they were at Tonmai, however, they took the opportunity to collect some stones to put in an earth oven and then returned to Kielpa, where they told their parents what had happened.

In the night Guim and Gapal were visited in dreams by the spirit sisters. They were told to tell their parents about the axe stones in the ground at Tonmai and Kielpa and they were given full instructions on how to dig them out. The next morning they did this, but their parents would not believe them, even though both had experienced the same dream. The following night Guim and Gapal had exactly the same dreams and again they told their parents about the axe stones. At last their parents took notice of them and decided to follow the precise instructions given in the dreams. First they killed pigs, dogs, possums and rats and had a feast. Then they dug at Tonmai and found the axe stones just as the spirits had said they would, quite close to the surface. Ever since the time of Guim and Gapal, people have done the same thing, finding axe stones, sharpening them and trading them to obtain wives and many kinds of valuable things.

Guim and Gapal's people were known as the Bema and were chased away from Kielpa by the Goroku. They now live near Banz and speak the Middle Wahgi language. Unfortunately, when the Bema left they told the stones, 'Our grandfathers found you, we are your fathers, now go down deep into the ground so that the Goroku will have to work hard to find you.' And they pushed the stones into the earth with their feet.

This story has two themes. One is supplied by the Simbu-style discovery myth and the other by references to the disposition of the axe stone. This second theme may be contrasted with the legend of the Tuman axe stones given on page 251. There the storyteller emphasised the linear alignment of the stones and their incompatibility with pigs, women and children. In the Dom story, the storyteller includes sufficient historical detail to 'explain' the necessity of having to mine the stone with deep shafts. As I have brought out in my accounts of Tuman and Dom methods (Chapters 4 and 9), the forms of quarrying operation in the two areas reflect these differences in emphasis.

Appendix B
A TWENTIETH CENTURY TUNGEI CHRONOLOGY

I have given a brief outline of Tungei history in Chapter 2. Here it is my intention to add details which, while they provide a background to my investigation of quarrying before 1933, do not have a direct bearing on the thread of my argument in the text. The chronology set out in this appendix is a relative one, though with few points of reference to relate the events to, some parts may be in the wrong order.

ORIGINS

The Tungei have an origin myth to explain their own beginning. They say their ancestors, Jimbe and Doimbe, arose at Kiltei Ku (Plate 2.8), a small knoll adjacent to their present territory. The narrators of the origin stories (see Appendix A) do not actually explain how the ancestors arose; nevertheless they conceive of lines of people - principally of men - descending from them, ultimately reaching living people. The sub-clan is the present-day representative of such a line of men.

Links cannot as a rule be made between the sub-clans, though it is not disputed that their members are close relations, either through descent from apical male ancestors or by blood ties through females. Clan members typically know the men of their grandfather's generation, and sometimes several generations before this in less detail. But by the standards of Polynesian societies, genealogical depth is not great.

ALLIANCE AND WARFARE

The Tungei are 'traditional' enemies with a number of groups around them - Mengka and Sikeing in particular - and 'traditional' allies with others - Andakelka and Kurup-Miamka, for example. But on closer inspection, 'traditional' patterns of alliance and warfare in the Tuman area were marked by their extreme fluidity during the early part of the century. Tungei and Mengka land holdings were inter-

spersed in the Tun valley (Fig. 2.2) until 1920-25, when a major war broke out and Mengka were routed from their settlements at Temek, Kupang and Gapinj to the places Tuning and 'Kar Tanim Eri' ('car turn do'). Tungei's modern pair-tribe and ally, Mamelka, also suffered a rout between 1930 and 1933 from Kisik, Keɨmbei and Kemning to Ningei and the Wahgi flatlands, where they live now (Fig. 2.2). Other wars were fought, even inside Tungei, but none is thought to have resulted in territorial change, nor did they result in permanent changes to the rights of men to visit the Tuman quarries (which was certainly the outcome of Mengka's flight from Tun). Wars were also fought between neighbours of the Tungei - between Andakelka and Kuli, between Andakelka and Mengka, between Mamelka and Onembe, and between Sikeing and Kurup-Miamka - and all affected the Tungei to some extent. Occasionally Tungei men took sides and were killed; sometimes they even faced each other on the battlefield, as in the case of Kisu, mentioned below.

THE SEQUENCE OF EVENTS

Many men mentioned the main events to me, or told me of the deaths in combat of their kinsmen when tracing their genealogies for me. However, I was principally helped by four men, Malimbe, Kandeɨ, Kombra and Aus (two 'older' men and two 'younger' men), in putting these things into sequence.[1]

Before 1900

This period is extremely hazy; probably in the 1800s Komnemb and Ekiemb were living at Rugus, at the head of the Tuman. Several generations before living men were born, it is thought that they moved to their present territories at Temek and Keɨmbei, and at Aviamp, respectively. A part of Komnemb is also thought to have sought refuge in East Kambia (the '**kambi** Komnemb', see Chapter 2), where they are believed to live today.

In this distant past also, Menjpi Kundika section invited Kenapuɨ to assist them in digging for axe stone. Menjpi Pingka section disputed this and Kundika and Pingka are said to have lined

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1 Interviews 48-81, 49-81, 52-81, 53-81, 55-81.

up and fought with spears and shields. Since no casualties of this engagement are recorded in the genealogies of Figures 2.9-2.36, it is certain to have occurred before the births of old men known in childhood to the present generation of elders, and long before 1900. In all probability it took place before 1850. In this dimly remembered period, a rockfall occurred at Wi Pendi, somewhere between Kunjin and Ngumbamung, killing men of Eska clan, who are said still to be buried there.[2] Knowledge of this incident is vague.

Only a handful of living people were born before the turn of the century: probably Menjpi Kandeł (Fig. 2.28), Menjpi Kenan (Fig. 2.26), and Wałpi Pam Wu.

1900-1920

The oldest living informants were small children in the earlier part of this period; nevertheless a number of relevant events are remembered. There was a rockfall at Yesim, killing Kuri Jelke of the Mengka clan Kenapuł and 'many men' of his sub-clan. I was shown the place in 1981 by Komnemb Malimbe, who said the place was already overgrown by the time he saw it.[3] He pointed me to a place slightly uphill of Yesim Pit 1, but this was too vague for closer identification. The incident with Kuri Jelke was also well known to Menjpi Kandeł.

Kenjpi-emb Ombung (Fig. 2.10) was killed by Mamelka around this time. Later, around 1915, a fight broke out between Ekiemb and Kenjpi-emb. Ekiemb were **pund puł wu**, 'trouble root men', the 'owners of the trouble', and Kenjpi-emb Tuap (Fig. 2.12) was killed in a stick fight. The term used for this type of fighting was **nginmał e-**, 'stick-fight do'; it was supposed to be less lethal than all-out fighting with axes and spears. Tuap's kinsmen, Ngengi (Fig. 2.12), a polygamist who I was told had 'ten' wives (I was able to document only one wife, who bore him a daughter; he had no male off-spring and was eventually killed fighting with Mamelka), and Kełam (Fig. 2.12) took spears and killed Ekiemb Kombułe (Fig. 2.24). Ekiemb now fought their way to Kumndi Ku, the ceremonial ground and traditional last retreat of Kenjpi-emb.

The conflict between Ekiamb and Kenjpi-emb caused a deep schism

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2 Interviews 31-81, 51-81

3 Interview 50-81.

within the Tungei; the Menjpi, who were not involved, were forced to seek refuge with their allies for fear of attacks from Tungei's exterior enemies. Malimbe was a boy at this time and was living with the Menjpi, his mother's natal clan. Malimbe and Kandeł, who were still quite young, were taken to stay with relatives among Miamka and Sikeing respectively. Kandeł returned to home territory a little while later and was married, so he must already have been in his late teens at the time of the fighting. Malimbe was younger, probably in his early teens. He was a member of the Menjpi sub-clan Komn-Tungei-emb and went on to make his first quarrying trips at Yesim. He took up residence with his father's clan, Komnemb, later on (see page 266).

In this period Mamelka lived at Kemning and Mengka had land holdings at Temek. In killings apparently not leading to major warfare, Komnemb Wandake (Fig. 2.17) died at the hands of Mamelka and Komnemb Komb (Fig. 2.17) died in an ambush at Rogamp. Another quarrying accident took place, this time at Ałame, an unidentified quarry at Kunjin, and at least two men of Epni Komnemb clan were killed, Gispe and Suka.[4]

1920-1933

In this period, many of the older informants were grown men and a later set of age-mates were going through childhood. Between 1920 and 1925, when Kenjpi-emb Aus (Fig. 2.11) was four or five years old, a serious war erupted between Mengka and the Tungei. Mengka were still settled at Temek and along the Tun valley, but as a result of this war were routed to Kar Tanim Eri and Tuning.

Shortly after they had moved to the new territory, a battle took place in which the following incident occurred. Kupał, Aus's father (Fig. 2.11), threw his three-pronged spear, **kiłeng jimben**, at Mengka Kułou, killing him as he stood in the Tuman River. Normally, a warrior would not throw this kind of spear (see Plate 2.13), unless he was certain of a kill. Kułou's kinsman Wemb, seeing Kupał drop his defences as he closed in with his stone axe, ran forward and speared him in the thigh. Kupał fell and was carried back to Tungei territory, where he died a few days later.

Mombłe Tang was also killed and his body thrown into the Tuman River. Malimbe sang a song to commemorate the engagement

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[4] Interviews 5-80, 55-81.

(Appendix C); he also received a spear wound in the right calf, from a **kiłeng bune** ('spear black-palm'), the plain type of spear made from palmwood. The wound healed safely.

The rift between the Tungei clans seems to have closed by this time and Ekiemb and Es-Kupaka gave an **opał** (food giving ceremony) to Menjpi, Komnemb and Kenjpi-emb. However, there was now fighting between Andakelka and Onembe, Melpa-speaking tribes to the west of the Tungei. Komnemb decided to go to the assistance of Onembe and Kenjpi-emb went to fight on the side of Andakelka, so that the two Tungei clans faced each other on the battlefield.

Normally kinsmen, whether affines or men of 'brother' clans, should not face each other in combat (cf. Vicedom and Tischner 1943-48, II, 155-6). In the worst case, of confronting, say, a brother-in-law (**gułem**) on the battlefield at close quarters, men say they should hit out with the flat of their axe, or otherwise feint to one side with whatever weapons they are carrying. Unfortunately, it was not enough in this case and Kenjpi-emb Kisu (Fig. 2.13) was 'accidentally' killed by Komnemb men.

Other deaths in the middle 1920s were Komnemb Kula (Fig. 2.16), who was speared through the sternum by Mamelka, Kenjpi-emb Jimau (Fig. 2.13) and Kenjpi-emb Mek (Fig. 2.9), who were killed by Sikeing. In the last case, Mek, who had married into Sikeing Meka clan, was alleged to have been waylaid and killed by Sikeing men at the instigation of the previously vanquished Mengka. This type of killing is referred to as **kepi tuk**, 'stick they-hit', an idiom meaning to waylay and kill. Years later, a patrol officer recorded what appears to have been a war compensation payment given by Mengka to Sikeing on behalf on killings like this one (see page 269). Mek's death was probably a single manifestation of the long term alliance between Mengka and Sikeing.

Malimbe was now in his early twenties and went to work with Menjpi clan at Yesim. However, as a young unmarried man, he was claimed back by Komnemb, his father's clan. He rejoined them and thereafter quarried only at Kunjin. This is the only instance I know of a quarryman having worked at both sites as a full member of one of the owning groups; I do not think his brother Teie (Fig. 2.17) was old enough to have worked with him at Yesim. Komnemb made a payment of bird of paradise plumes to Menjpi by way of compensation.[5]

A major war erupted between around 1930 and 1933 with the Mamelka. Younger informants, like Komnemb Kombra (Fig. 2.20), born

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[5] Interview 28-81.

after about 1915, are able to describe it in detail, confirming its late chronological position. (Note that older men, born from the turn of the century onwards, had already experienced ten or fifteen years of adult life and tended to confuse the order of events or merge several events into one.) One day Parke, one of the Ekiemb bigmen (Fig. 2.24), and Paɨ (Fig. 2.25) were attacked at Keɨmba and killed by Mamelka. In the late afternoon, Komnemb attacked the Mamelka at Kisik and their big-man Dupal (Fig. 2.20) was killed. Komnemb retreated, then counter-attacked and killed Nui and Tumbune of Mamelka. So enraged were the Komnemb men, they threw Tumbune's body on to a fire and burnt it; in fact the place is remembered as Tumbune **dup ngi kone**, 'Tumbune fire house place'.[6] Two other men who were killed at the same time were Ekiemb Asip (Fig. 2.24) and Menjpi Pup (Kundika Preka sub-clan). The latter is not shown in Figure 2.26. Kupaɨ, a man shown as killed in fighting, died assisting Onembe in a fight with Mamelka and Kenapuɨ. This could be 'Pup', or he could be someone else.

Mamelka left their hamlets at Kemning and Kisik after this and went to live at Ningei and the Wahgi flats, where they remain today (Fig. 2.2). Komnemb settled at Kemning in their place. Shortly afterwards, the Tungei were attacked on three sides and were hard pressed to hold their territory. The Sikeing fought at Aviamp, the Mamelka fought at Kisik and the Mengka fought at Pekan.[7]

From their lookout at Kumndi Ku the Kenjipi-emb could see the Sikeing gaining ground at Aviamp, so they took the chance that neither the Mamelka nor the Mengka would see them leaving Kumndi Ku lightly defended, and went down to Aviamp to fight off the Sikeing. Menjing of Awalka clan was killed and they burnt his body to add insult to his death. In the meantime, five men had been left behind at Kumndi Ku, including two men with shields. One was a left-hander and the other was a right-hander and they stood side to side to gain extra protection; between the two of them they managed to make enough noise to trick the attackers into believing they faced more defenders than existed and the day was saved.

The Tungei continued to fight with the Mengka and killed Mombɨe Ngumbamung and Kenapuɨ Onem. In another anecdote, Komnemb Emi (Fig. 2.20) was fighting against Mengka and found his stone axe too heavy to carry. He hid it in the bush and Kombra, then a teenager,

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6 Interview 2-81.

7 Interview 8-81.

fetched it for him. Sikeing lost an important war with the Kuma clans Kurup and Miamka and were temporarily routed. They took refuge with their relatives among Komblo, Sekaka and Bamblinge. Kandeł took the opportunity to obtain his fourth wife, a refugee of the fighting from Sikeing Eperi clan (Table 7.1).[8]

Events Related to the Arrival of Europeans

The Tungei made a quarrying expedition and were - in different accounts - either clearing away the overburden (**tui oi**) or had actually reached the axe stone, when the DH50 of the Taylor-Leahy patrol flew overhead (Fig. 2.1). At any rate, at Yesim there had been a substantial rockfall during the work; Menjpi Kuli's wife Yang bore him a son whom they named 'Bok', or 'fall down' (Fig. 2.27), from the verb **bok to-**, to fall or collapse.

Malimbe was at Kunjin when he learned that his house was on fire. He ran down from the quarry to find that ten valuable **parke** (Paradisaea raggiana) plumes had been destroyed in the fire; he covered himself in mud and went into mourning. Jim Taylor and Dan Leahy came soon after (37 days after the flight) and the Tungei completed their quarrying trip. I have given further details of the meeting of the two cultures in Chapter 2.

A certain amount of fighting took place after 1933; Komnemb Dał (Fig. 2.19) was killed by Mengka and in perhaps 1934 the Tungei fought Wałpi, killing six of their men some months after Taylor had camped at Kuimi. The Wałpi had strong links with the Sikeing at the time and fought against Komnemb, Kenjpi-emb and Menjpi. The Wałpi men Goi, Kaken, Numndi, Asip, Tangan and Mas died. The Tungei were not involved in further fighting until September 1980.

Very shortly after this, perhaps in 1935, Wałpi were reunited with Tungei and together they held a **kung ngi** (pig festival). No previous festivals had been held by the Tungei in the lifetime of either Kandeł or Malimbe, due to the frequency of fighting.

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8 Interview 5-81.

LATER EVENTS AND HISTORICALLY RELEVANT PATROL RECORDS

In 1944, a dysentery epidemic swept the highlands. It probably struck the Tungei most acutely during the first three months of the year, although it is known that sporadic cases occurred for some years after this. Demographic statistics show that 5% of the population are likely to have succumbed to the disease (Burton 1983), but the genealogies suggest that little of the mortality occurred among adult males. Kenjpi-emb Munung, a younger brother of Aus and a married man by this time, is known to have died, and a lineage of Komnemb Kenapuł Kanem was named Eingał Kanem, 'obscure kind', because of the deaths to dysentery of Kumbe, Asip and Parke, all of them married men with children.

As I mentioned on page 266, the Mengka and the Sikeing were allies when it came to fighting with the Tungei. This is further confirmed in a patrol report dated 1948 (B. Bunting, PR, Hagen No.7 of 1947/48), which recorded a war compensation payment between Mengka and Sikeing:

> On Sunday 27/6/48 a great ceremony took place outside the rest house at TUMAN RIVER. This was a great payment made by the MENGE people to the KUJIPI people in return for alliance in a fight many years ago. Before the advent of white civilisation the MENGE people were fighting with the MUNGA from the eastern side of the TUMAN Divide. During one fight the KUJIPI assisted the MENGE and succeeded in beating them. In doing so they lost two great fighting men. Now MENGE were repaying them for this aid...
>
> ...the MENGE danced to their areas where the pigs were laid out. These were laid out in a long line like a stack of cards blown over. There were 156 pigs in the four lines. A shield of fern with 12 gold lip shell, 12 ropes of girigiri had been prepared and this was brought to where the pigs lay, accompanied by much singing and dancing.

Note that 'MENGE' and 'MUNGA' refer to the Mengka and the Tungei Mongka. The 'KUJIPI' means 'Kudjip people' or, in this case, the Sikeing; two of the Sikeing clans were normally censused at Kudjip.

By the 1950s fighting had long since ceased and the activities of the administration began to be felt by the Tungei and their neighbours. The first men left for work on coastal plantations under the Highlands Labour Scheme; they are now the oldest age-set to have a knowledge of New Guinea Pidgin. Census began at Aviamp patrol post in 1949 and was placed on a regular footing during the 1950s; village book revisions were made in 1958, 1968 and 1972. In 1973, Mamelka tribe applied for re-affiliation to the Wahgi Local Government

Council area (M.J. Deasy, PR, Minj No.2 of 1972/73), in a move harking back directly to the pre-colonial past - in fact to the war just before 1933 that I have described above:

> The western border discussions revolved around the MAMILKA tribes, currently censused in the Mt. Hagen Local Government Council area...the group has distinct Wahgi origins and they were originally resident in the foothills of the Kubor Range, overlooking Aviamp and the Tumun [sic] River...In-fighting amongst the Aviamp tribes forced the MAMILKA from their ancestral land holdings onto the Wahgi flats, and across the Tumun River.
>
> ...The matter was resolved at a joint meeting, convened at the Tumun River on the 3rd of July 1973, between representatives of the Mt. Hagen and Wahgi Local Government Councils and the MAMILKA tribes. The MENGAMP, KULTAMP and KOMUNAGIMP clans elected to join the Wahgi Local Government Council and their requests were acceded to at the Wahgi Council's general meeting convened at Kerowil on the 4th of July 1973...
>
> ...The MONKA, MAMILKA and MENKA tribes all claim descendancy from a single putative ancestor...all clans lay claims to land in the Aviamp area but the MONKA tribe, being numerically superior, has defeated, at differing intervals of time, both the MENKA and MAMILKA in tribal fights. This has caused the MAMILKA to re-settle on the Wahgi flats and the MENKAs to re-settle in the Tun River area with ONDEGELIKAs of Hagen origins.

Note that the tribe names 'MENKA, MONKA, MAMILKA, ONDEGELIKA' may be read Mengka, Mongka, Mamelka, Andakelka, and the clan names 'MENGAMP, KULTAMP, KOMUNAGIMP' may be read Mengemb, Gultemb and Komn-Ekiemb. 'The foothills of the Kubor Range, overlooking Aviamp and the Tumun River' refers to Mamelka's old territory at Kemning and Kisik; 'in-fighting amongst the Aviamp tribes' refers to the routing of Mamelka from Kemning about two years before 1933; 'the Tun River area' is incorrect, it should be 'on the left bank of the Tuman and in the headwaters area' - it was Mengka's former territory that was in the Tun River area.

The excerpt is an interesting example of the influence of historical processes upon modern institutions. In many senses the events described here continue to permeate contemporary life, not just in the continuation of old customs, such as the recent resumption of fighting between the Tungei and the Sikeing, but also in the spheres of legal and de facto ownership of land and in the present composition of local government bodies.

Appendix C
SONGS OF THE TUMAN QUARRYMEN

The Tungei made up songs to celebrate their exploits as quarrymen and as axe makers. Their wives undoubtedly sang songs about their menfolk and about quarrying expeditions, though I heard only one of these. I recorded the songs given here and played them back to have their meanings clarified to me.

GERI'S SONGS

Kenjpi-emb Geri (Fig. 2.11), a blind and extremely infirm old man, volunteered this selection in 1980.[1] Komnemb Sike, Ken, Mela and Oura kindly helped me with the transcriptions.

Song to Kumndi Deing

Kumndi Deing-a kumi tu-a, Kumndi Deing-a kuman tu-a
Kumndi Deing bring **kumi** sugar, Kumndi Deing bring **kuman** sugar!
Kirkilt-a weiwei-a olka-a
[Refrain]

Kumndi Deing-a por tu-a, Kumndi Deing-a pendang tu-a
Kumndi Deing bring a leg of pork, Kumndi Deing bring a shoulder of pork!
Kirkilt-a weiwei-a
[Refrain]

Kumndi Deing-a embin tu-a, Kumndi Deing-a grembi tu-a
Kumndi Deing bring **embin** bananas, Kumndi Deing bring **grembi** bananas!
Kirkilt-a weiwei-a olka-a
[Refrain]

---

1 Interview 16-80, Tape 3.

Kumndi Deing-a tum tu-a, Kumndi Deing-a tam tu-a
Kumndi Deing bring **tum** pandanus, Kumndi Deing bring **tam** pandanus!
Kirkilt-a weiwei-a
[Refrain]

This song was sung by the Kenjpi-emb at Kunjin. 'Kumndi Deing', the man to whom the song is addressed was a Kenjpi-emb big-man (Fig. 2.10) in his middle forties at the time of the last expedition - he died in 1959 according to the Aviamp village census book. The quarrymen are imploring him to bring all the nicest foods they can think of, because the work is so hard. They know, in fact, that they will have to wait until they finish quarrying to savour these delights. The refrain **kirkilt-a weiwei-a** was also given to me by Malimbe as a quarryman's chant or shanty; it was the sort of thing sung to keep up a rhythmic pace on the basket lines. 'Kumndi' refers to the Kenjpi-emb place Kumndi Ku (Fig. 2.2).

Marsupial Song

Pii-na ei-na ka kane aia, Kunjin ku ei kane aia
Take a good look, see the marsupial! See the stone at Kunjin!

Pii-na ei-na ka kane aia, Kunjin ku ei kane aia
Take a good look, see the marsupial! See the stone at Kunjin!

Pii-na ei-na ka kane aia, Kunjin ku ei kane aia
Take a good look, see the marsupial! See the stone at Kunjin!
[repeated several more times...]

The marsupial referred to here is **ka melka**, the animal caught and eaten before the axe stone was removed. The song was sung at the quarry.

House is like Tumbe and Mek

Kumndi tone moɨep o-ei, por ku sap o-ei; por ku sap o-ei, pendang ku sap o-ei
Stayed up at Kumndi, put a leg of pork with a cooking stone; put a shoulder of pork with a cooking stone

Kumndi tone mołep o-ei, tumbe ngi pap o-ei; tumbe ngi pap o-ei, mek ngi pap o-ei
Stayed up at Kumndi, slept in **tumbe**'s house; slept in **tumbe**'s house, slept in **mek**'s house
[singer broke off at this point...]

In this song the singer relates how wealthy he has become - presumably through making stone axes - that his house resembles the 'house', i.e. nest, of **tumbe** and **mek**, the Black Sickle-Billed and Princess Stephanie's birds of paradise. We are left to imagine that he owns so many bird of paradise plumes that the walls of his house are lined with them. The other things mentioned, **por** and **pendang**, which are two cuts of pork, and the cooking stones, suggest that the singer is so well-off he can afford to get his oven ready to cook meat whenever he feels like it. These are otherwise only eaten on special occasions. The phrases **por ku sap** and **pendang ku sap** ('put a leg of pork/shoulder of pork with a cooking stone') mean to put a hot stone wrapped up right inside the meat so as to cook it completely. Geri continued the song by substituting different pairs of birds for **tumbe** and **mek**:

[singer resumed...]
Kumndi tone mołep o-ei, muł ku sap o-ei; muł ku sap o-ei, wał ku sap
Stayed up at Kumndi, got out a big stone; got out a big stone, got out a small stone

Kumndi tone mołep o-ei, kupał ngi pap o-ei; kupał ngi pap o-ei, kełam ngi pap o-ei
Stayed up at Kumndi, slept in **kupał**'s house; slept in **kupał**'s house, slept in **kełam**'s house

Kumndi tone mołep o-ei, dua ngi pap o-ei; dua ngi pap o-ei, koułe ngi pap o-ei
Stayed up at Kumndi, slept in **dua**'s house; slept in **dua**'s house, slept in **koułe**'s house

Kumndi tone mołep o-ei, por ku sap o-ei; por ku sap o-ei, pendang ku sap o-ei
Stayed up at Kumndi, put a leg of pork with a cooking stone; put a shoulder of pork with a cooking stone

Kumndi tone mołep o-ei, nekinj ngi pap o-ei; nekinj ṅgi pap o-ei, ape ngi pap o-ei
Stayed up at Kumndi, slept in **nekinj**'s house; slept in **nekinj**'s house, slept in **ape**'s house

Kumndi tone mołep o-ei, ngi ku sap o-ei; ngi ku sap o-ei, anda ku
Stayed up at Kumndi, put my house stones out; put my house stones out, the stones outside

The birds are: **kupał**, Pesquet's Parrot, and **kełam**, White Cockatoo; **dua**, Harpyopsis eagle, and **koułe**, Hornbill; **nekinj** and **ape**, two lory's or lorikeets. These pairs of species are considered to be related to one another as 'brothers', **angam angam**, and their feathers - in some cases the whole birds - are used in personal decoration for dancing.

Smoke Rising at Kunjin

This is another quarrying song. Ken, Mela and Oura helped with the transcript and they added that the song mixed Ek Nii and Middle Wahgi:

Na ond pałem-a, na ond pałem-a
I'm living in the bush, I'm living in the bush
Kunjin dup enem-a
At Kunjin there's a fire

Na ond pałem-a, na ond pałem-a
I'm living in the bush, I'm living in the bush
Kunjin dup enem-a
At Kunjin there's a fire

Na ond-ika, na ond-ika
I'm in the bush, I'm in the bush
Kunjin dup enem-a
At Kunjin there's a fire

Na ond-ika, na ond-ika
I'm in the bush, I'm in the bush
Kunjin dup enem-a
At Kunjin there's a fire

The singer is living at the quarrymen's camp - he actually says 'I'm living (among) the trees'. Smoke can be seen rising from Kunjin and everyone will know that the Tungei have gone to get axe stone again.

Tepi and Kunjin Song

Mela, Ken and Oura helped to transcribe this song and they said it mixed Ek Nii with Melpa expressions:

Mond kum tonem-a, mara kum tonem-a
Mond covered, **mara** covered
Olka weipe, olka weipe nga-a
[refrain, no meaning]

Tepi ku wak tonem-a, Kunjin ku dak tonem-a
The stone at Tepi is thirsty, the stone at Kunjin is strong
Olka weipe, olka weipe nga-a
[refrain, no meaning]

Mond kum tonem-a, mara kum tonem-a
Mond covered, **mara** covered
Olka weipe, olka weipe nga-a
[refrain, no meaning]

Tepi ku wak tonem-a, Kunjin ku dak tonem-a
The stone at Tepi is thirsty, the stone at Kunjin is strong
Olka weipe, olka weipe nga-a
[refrain, no meaning]

Ning kum tonem-a, neng kum nonem-a
Ning covered, **neng** covered
Olka weipe, olka weipe nga-a
[refrain, no meaning]

Tepi ku guk ninem-a, Kunjin ku dak ninem-a
The stone at Tepi falls down, the stone at Kunjin is strong
Olka weipe, olka weipe nga-a
[refrain, no meaning]

Tuii ake tonem-a, tuał ake tonem-a
Tuii turns over, **tuał** turns over
Olka weipe, olka weipe nga-a
[refrain, no meaning]

Tepi ku gułu ninem-a, Kunjin ku dak ninem-a
The stone at Tepi falls down, the stone at Kunjin is strong
Olka weipe, olka weipe nga-a
[refrain, no meaning]

Tuii ake tonem-a, tuał ake tonem-a
Tuii turns over, **tuał** turns over
Olka weipe, olka weipe nga-a
[refrain, no meaning]

The meaning of this song is not entirely clear to me. I include it here because of the reference to the stone being 'strong' at Kunjin but falling down at Tepi (Yesim). Geri was a Kunjin quarryman and the song may be a jibe at the Menjpi for allowing the stone to collapse during the 1933 expedition (see Appendix B). The trans-

lators omitted to explain to me what the references to the various species meant, but when Malimbe referred to the leaves of **mond** and **mara** turning, he was referring to the quarrymen (see next section). **Mond** and **mara** are forest trees; their leaves are probably referred to here also. **Ning** and **neng** are vegetable greens. **Tuii** and **tuał** are vines.

MUR'S REFRAIN

Mur, an elderly woman born in Eska clan and married to a Wałpi husband,[2] gave this refrain which the women used to sing when they came to break down the **teper** at the end of a quarrying expedition:

Kunjin mond ei kane, Kunjin mara ei kane
See the **mond** (leaves)! See the **mara** (leaves) at Kunjin!
Pii-na ei-na, ka ya kane
Look at that! How good it is!

The women had to call their menfolk by circumlocutions, such as **mara wał**, 'little **mara** leaf', and here they are shouting to the men and going into the quarry site. They see all the work that has been done and they express astonishment. I asked Malimbe about Mur's song and he gave a slightly different version:

Kunjin mond ongu̇ł ake tonem, Kunjin mara ongu̇ł ake tonem
The **mond** leaves turn, the **mara** leaves turn at Kunjin
Pii-na ei-na
Look at that!

By the leaves 'turning', he meant that the wind blew and rustled them. Again the **mond** and **mara** leaves refer to the quarrymen.

MALIMBE'S SONGS

These are anecdotal songs which tie in with the Tungei chronology given in Appendix B.

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2 Interview 55-81. Not taped.

Song of Geltang

As I mentioned in Chapter 7, the North Wahgi Kelaka tribe rarely visited the Tungei, despite the fact that they shared many aspects of culture. Geltang was a Kelaka big-man and he was killed by his enemies, the Andpang, at Kełmba (Fig. 2.2), while on a visit to the Tungei to trade for axe stone. The song is noteworthy merely because it is one of the few references to contact between the North and South Wahgi tribes in this part of the valley.

Wulteng ei wu Geltang, mene alteng ei wu Geltang
Is Geltang in the west, or is he in the east?

Ma na ei-ei, ma na wu Geltang ei-ei
Oh my mother, oh my mother Geltang (is dead...)

War with the Mengka

This song relates to the war between the Tungei and the Mengka dating to between 1920 and 1925 (Appendix B):

Tun kep mane wamb, tumbe konj punem
I came down the steep place at Tun, **tumbe** escapes alive
Ya tolten wei-a tolten wei-a
[refrain]

Tun kep mane wamb, tumbe konj punem
I came down the steep place at Tun, **mek** escapes alive
Ya tolten wei-a tolten wei-a
[refrain]

Nip nip mołpe Pekan tone wamb, Ngum Nger pou ninem
I talked, talked and then stopped, I came to Pekan and Ngum Nger was still
Ya tolten wei-a tolten wei-a
[refrain]

This war resulted in the Mengka fleeing from the Tun valley. The song is remembered as Malimbe's song, but he says it was first sung by his grandfather, Kombuł Dał (Fig. 2.17); he merely revived it.

The singer comes to Tun and has escaped injury in the fight. He says that **tumbe** and **mek**, the Black Sickle-Billed and Princess Stephanie's birds of paradise, fly free. He means that he is still alive himself. He comes to Pekan, the Komnemb dance ground and burial place, and looks out over the Tun valley. He looks at Ngum

Nger, where there was a Mengka settlement, and sees no movement in the late afternoon. The Mengka have departed.

The Flies at the Cemetery

This song relates to a war between the Andpang and the Kelaka; strictly it has nothing to do with the Tungei or axe making, but I include it anyway.

Ołma ya, ołma ya, ołma ya o-ei
Oh fly, fly, fly!
nim puken muri puł mułio, nim puken olto puł mułio o-ei
You go and stay under a **muri** flower! You go and stay under a **olto** flower!

Ołma ya, ołma ya, ołma ya o-ei
Oh fly, fly, fly!
nim puken jimben puł mułio, nim puken nengen puł mułio o-ei
Oh fly, fly, fly! You go and stay under a **jimben** tree, you go and stay under a **nengen** tree!

The Kelaka spear a man and the spear breaks off in the wound. He lies dying on the battlefield and is covered in flies. He sings this song to get rid of the flies. He tells them to go and wait under **muri** and **olto** flowers, which are typically planted at cemeteries, and under **jimben** and **nengen** trees, which are often planted at the graveside. The flies can have his body, if only they will wait until he is dead.

Appendix D
PETROGRAPHIC DESCRIPTION OF GRINDSTONE FABRICS

by Alan Watchman
August 1983

Kanye River Stone: Fine-grained Lithic Greywacke

The rock is composed of closely packed, well-sorted, angular to sub-angular grains less than 0.5 mm in diameter. The clasts include quartz, plagioclase, rock fragments, ferruginised mafic minerals, chlorite, mica and kaolinite set in a clay matrix.

Abundant quartz occurs as fragments of individual crystals and as microcrystalline quartz clasts. Plagioclase ranges in composition from andesine to labradorite. Volcanic rock fragments have a hyalopilitic texture and andesitic composition. Minor minerals within the rock are ferruginised pyroxene and amphibole, green chlorite, sericite, composite metasedimentary grains of quartz and sericite and kaolinised feldspar clasts.

Ga River Stone: Fine-grained Lithic Greywacke

This rock is composed of closely packed angular to sub-angular grains less than 0.5 mm in diameter. The main minerals are quartz with feldspar, with subordinate rock fragments, ferruginised mafic minerals and kaolinite, and a minor amount of composite grains.

Quartz occurs mostly as individual clasts and also as microcrystalline mosaic aggregates. Plagioclase is generally sericitised and is of oligoclase to andesine composition. The altered volcanic rock fragments are sub-rounded and range in texture from hyalopilitic to hypocrystalline. The glass in the rock fragments is usually altered to brown chlorite. Kaolinite has developed by strong alteration of feldspar clasts. There are also a few grains of composite quartz and sericite, representing fragments of metasedimentary rock. All the clasts are set in a fine-grained clay matrix.

Kunjin Whetstone: Fine-grained Greywacke

This rock contains well-sorted and closely-packed angular to sub-angular grains less than 0.5 mm in diameter. It consists essentially of quartz, plagioclase, rock fragments, altered mafic minerals and glass set in a clay matrix.

Quartz occurs as individual grains and as mosaics of microcrystalline silica. The plagioclase is andesine or anorthite and a few clasts are sericitised. The volcanic rock fragments contain laths of plagioclase set in a glassy groundmass. Original mafic minerals are ferruginised and kaolinised. There are several rounded green clasts of chloritised glass.

The mineralogy, texture and grain size of this rock indicates that it is probably derived from the same geological formation as the outcrop samples from the Kanye and Ga Rivers.

Kełmbei Whetstone: Very Fine-grained Greywacke

The rock is composed of moderately well-sorted angular grains mostly less than 0.2 mm in diameter. There are several larger grains up to 1 mm in diameter.

The rock consists essentially of abundant quartz, plagioclase and ferruginised mafic minerals set in a fine clay matrix.

The microscope slide was too thick for observation of any other characteristic features. A notable difference between this rock and the others is a much finer grain size. This stone may be derived from a formation which contains fine-grained equivalents of the other specimens examined.

Glossary

Hyalopilitic	Fine-grained interstitial fabric in which the glass occupies minute spaces between microcrystals.
Hypocrystalline	Texture of rock consisting mainly of crystalline material and partly of glass.

Appendix E
TUNGEI BRIDEPRICE TRANSACTIONS

To say that men of the Tuman River area paid (and still pay) brideprices for their wives is misleading; the main payment, **amb kuime**, is merely one stage in a system of lifelong obligations to affinal relatives. Both givers and recipients should be widely drawn from the existing relatives of the bride and groom, and in this respect brideprices are sub-clan to sub-clan payments - not all are, but this is the ideal (cf. Sillitoe 1979:Figs 11-12; Strathern and Strathern 1969:146).

A paradigmatic series of payments might proceed as follows, assuming the girl has never previously been married (Fig. 7.2). The boy or his father, or both, make a few small payments to the girl and her father as betrothal payments. These are known as **kuime mak tonem**, 'brideprice **mak** do' or **kuime top tonem**, 'brideprice buy do'. I could not tell whether **mak** is New Guinea Pidgin (from English, 'mark') or a traditional term. At any rate it is so well established in usage, according to young men, that it is the modern idiom. Ramsey (1975:110) gives a possible related Middle Wahgi term **mak endi ngo-**, 'to give live pigs' as part of a brideprice exchange. These small gifts would typically have been special bananas (**toue embin**), or cuts of pork (**kung simb** or **kung keɨip**) and the like. They are not contractually binding on either party.

Once a marriage has been arranged, either through the choice of both boy and girl after a period of courting, or by agreement between their fathers, the bride is readied for marriage (cf. Reay 1959a: 57-63, 98-102; Brown 1969). In a ceremony known as **amb kopeng enmen**, 'woman grease they-do', or **kopeng eripen kindmen**, 'grease they-do they-send-away', the bride-to-be is decorated and oiled and she and her close relatives spend the night before she is to be given away singing in front of a very hot fire. Traditionally she must sit as close to the fire as possible, to sweat and cleanse the skin. (In New Guinea Pidgin this is known as **wasim meri**.) Note that for marriage as a whole, the woman is said 'to go to a man', **wu pu-**, while the man is said 'to take a woman', **amb si-**.

On the day she is given away, the bride's relatives pile up vegetable foods like **marita** pandanus to give away as a form of dowry - **kune bi ngonmen**, 'food **bi** they-give'. Several men provide pigs, which are butchered and cooked. At this point the groom's kinsmen

enter the bride's hamlet, and after several hours of formal speeches known as **ope ek**, 'fight talk', and cooked food distribution, they leave with the new bride. No payment is yet made by them. Brown (1969:89) indicates that in Central Chimbu, where custom is similar in the essentials to the Middle Wahgi and Tuman River area, the main marriage payment is handed over at the same time as the girl leaves home (even if the marriage is not consummated for several months). In Hagen, the Stratherns state that a first showing of the brideprice takes place before the bride goes to live at the groom's settlement (Strathern and Strathern 1969:146-7). She may begin to live with him as his wife as soon as the transactions are completed, typically a fortnight later.

After a settling-in period of some months, the bride's father and her other kinsmen agitate for payment of the brideprice proper. At this point the bride will either have run away from her new home - in which case the idea of the marriage will be dropped - or she will have accepted, and been accepted by, her husband. In the latter case, the groom's kinsmen assemble the components of their large payment to the bride's kinsmen. This is the **amb kuime**, 'woman brideprice'. Those of the groom's kinsmen who contribute cash or pigs (formerly shells, axes or plumes) do so in the knowledge that when the groom's sister is married, they will receive a like share of her brideprice. This is of course generalised to include other close female relatives, in whichever order he or they are actually married.

This pattern is broken only when two men marry each other's sisters at the same time in **amb rop**, 'wife exchange'. The main part of each brideprice considered to be a compensatory payment is either waived or is small and celebratory gifts are exchanged instead. The other form of prescribed exchange in Tungei society takes place over three generations. In **nam peng**, 'my own head', a father gives away a daughter to the clan from which his mother came (but probably not to the same sub-clan as his mother). He says **nam peng ngond**, 'my own head I give'. Unlike **amb rop**, **nam peng** involves a full payment of brideprice.

When the **amb kuime** is handed over, certain other people must be compensated for their role in setting up the marriage. The **ondłam kanłem wu**, 'road seeing man' or **ondłam kanłem amb**, 'road seeing woman', is a person who already has affinal links with the clan the girl is going to. In one example a Kurupka woman married a Komnemb clansman and bore him two sons. In the next generation a girl of their age from another Komnemb sub-clan married back into Kurupka, to their mother's sub-clan. The eldest brother was given a small cash payment (K4) from the girl's father as a 'road seeing man'. Such payments are called **ondłam ep**, 'road payments/things'.

Another person who receives road payments is the **angeł ambeltem wu**, 'hand holding man', also referred to as the **amb ol wu**, 'wife negotiate man'. He (or she - **angeł ambeltem amb**) is the go-between in negotiations between the bride's father and the groom's father, for example over the size of the brideprice. This person is ideally neutral and related to both groups. In one example, a Komnemb clansman wanted to marry his son to a girl from a distant Hagen tribe, the Jika. He approached his FMBSS's wife who was from the same area.

Road payments fall into the class of semi-obligatory gifts which must continue to be made over a man's lifetime to maintain his marriage (A.J. Strathern 1971:140). Those who 'stand on' the roads must be paid to stand aside: **ondłam se kun er-**, 'road straight do'. Failing this, their resentment or protest anger **popuł** (A.J. Strathern 1968; A.M. Strathern 1968) will prevent the wife from conceiving children, or cause other harm.

At the time the **amb kuime** is given, a return payment must be made to show the goodwill of the recipients: **tekan to-** or **tekan ngo-**. It can be substantial, amounting to a third or even half of the so-called 'brideprice'. This must be assembled separately from the brideprice; it is not correct to receive the payment of the groom's clansmen, and return part of it. This naturally gives both parties the opportunity to exchange different wealth objects.

Other payments consolidate the bond between the bride's and groom's peoples after the birth of children. If a child is born at the wife's birthplace, and the umbilical cord is cut and buried there, a man may do **ołemb sem tukpe tonem**, 'navel leaf hole hit', to buy back his child's affiliation. This might be a gift of a leg of pork. Similarly **kang-ambeł enj ngo-**, 'boy-girl faeces give' is a gift to the wife's people after the birth of a child, especially the first child. When the child is a few months old relatives on both sides may join to kill one or two pigs on its behalf; this is called **kang-ambeł embe sinmen**, 'boy-girl name they-call'. When the first children are seen to have grown beyond infancy, it is proper for a man to present his wife's relatives with a more substantial gift, **kang-ambeł mam ting er-**, 'boy-girl **mam ting** do'. Reay indicates (1959a:100) that Kuma child payments, at least for the first child, should be about as large as the original marriage payment. I am not certain that this is so among Tuman River groups; in one example, a man of Komnemb clan gave his wife's relatives three pigs and K100, 10-20% of a current brideprice.

Even after the death of the wife further payments may be made. The woman's sons may decide to give **ek bi** to their mother's kinsmen, especially if their father was a poor man who failed to give **mam ting**

during his lifetime. Later still, the woman's grandson may give an **arim peng**, 'father's head', payment to her brother's descendants. None of these gifts are obligatory, or automatic, and many marriages will differ from the paradigm I have presented. But it is clear that 'brideprice' is the English gloss for a lengthy and complex series of exchanges that only begin with the handing over of an initial lump sum payment.

Appendix F
PUKL STONE AXE QUARRY

A Visit to the Site in 1983
by P.P. Gorecki

In August 1983 I excavated a test pit at the rockshelter Pukl Kumanga, PNG site code MSP, close to the quarry of Pukl, one of the well-known stone axe quarries located on the Jimi side of the Sepik-Wahgi Divide. This rockshelter was selected as being the most suitable to gather data on the history of the quarry, following surveys carried out in the area in 1977, 1978 and 1982. I took the opportunity during this excavation to visit the quarry itself and to make brief enquiries regarding stone axe manufacture at Pukl.

DESCRIPTION

The quarry is located at about 2200 m asl. As one approaches it, an increasing number of broken blanks and flakes of all sizes are seen on the ground surface, and it is by following their litter upslope that I found the main quarry. My two local guides, who claimed to know its location, were in fact leading me towards two minor quarry holes located a few minutes further away and did not know of the existence of the major one. While the vegetation surrounding the quarry consists principally of primary rainforest, at the site itself the cover is lighter, disturbed, and consists of a secondary forest with a very thick lower canopy hiding the quarry pit.

To my surprise, it is not a rock face which was mined (unlike the Yesim quarry which I visited in 1977), but rather a clay slope within which loose rocks suitable for axe making are found. One cannot escape the overall impression of looking at a 'controlled' landslide rather than an axe quarry. The mining area is huge, tons and tons of dirt have been removed. It is possible that mining excavations at this location have dug over an area more than 20 m long x 15 m wide x 3.5 m deep. The rocks found in this clay are of all sizes; some are very large and were obviously broken in situ into smaller portable sizes, while others are small and may have a natural axe-like shape. I suspect the latter would have been of interest to

the miners since they would have required a limited amount of flaking and grinding to produce a perfect fully-formed planilateral axe. The waste litter surrounding the quarry is extensive and probably covers an area of a few hectares. Six old house platforms were seen near the quarry and evidence of large-scale flaking activities was found at each. Not one ground flake was found, suggesting that the sharpening of axes was an activity carried out elsewhere. This could be partly explained by the fact that the quarry area - at high altitude - is a damp and cold place.

It appears that Dan Leahy and Ken Spinks, on their return trip from Ruti to Ogelbeng in June 1933, passed less than one hour's walk from the quarry. One of their carriers died nearby of pneumonia and was buried by the side of two major trails, one linking Rank with Buk (and passing by the Pukl and Mbukl axe quarries) and the other linking Rulna with Kotna (taken by the patrol party). The grave, at BP 041825, was marked with Cordyline and may still be seen today. Since no comment about Pukl was made in the accounts of the patrol, it is impossible to say whether the quarry was being used at the time or not.

INTERVIEW AT BAGEL

Two old men at Bagel hamlet, Pang Melpi and Manga Tikimp, remember the patrol passing across their land when they were small boys. I interviewed them about operations at the quarry, which lies on Tipuka land. Here is an edited version of their story:

> A long time ago, there were two men called Ogimp and Wanemp. Wanemp's father went into the bush one day and discovered a real stone axe. He told his people about the find and everybody followed him to the location. There were stone axes everywhere and each man collected one. They all came and dug many holes in the ground and took these stones. They all had enough stones and went back to the settlement. You went to see one of these holes yesterday [the day I went to visit the quarry] and there are two other holes that you did not see. Everybody cleared and dug the ground, then took the axes, covered the holes and finally planted Cordyline. By planting Cordyline, it was possible later on to find the exact place where stone had been found.
>
> When the stones were collected, everybody built a house in the bush near the quarry. They broke pieces of stone from the big rocks with hammerstones. One man was specialised in marking the large rocks with charcoal to show where they should be struck. When a pile of stones was ready, all men and children present received sweet potato, pork and other

good food. Earth ovens were made in the bush where they had a feast. Then all the stones were divided between the workers. The stones were then taken down to the settlements. All the men went down to Rulna to find good grindstones; some of these were very large. These were carried back home. It is on these stones that the axes were ground. When this was done, the men went to get bush rope and materials for making axe handles. When the axes were finished, they were used to cut down **kraep** and other forest trees so that gardens could be made.

Later on, when the gardens were ready, the people set a day when the good axes would be exchanged for very big pigs. On that day they lost their stone axes. Because of this, the men had to return to the quarry and start working axes again.

All the work was done in five days: one day was spent clearing the bush, three days were spent breaking the ground and collecting the stones, and one day was spent covering the holes again. The stone was **rui pukl**.

EXCAVATION AT PUKL KUMANGA

The site MSP, located at BP 038814, is a small rockshelter with hundreds of flakes covering its surface; there was no sign at all of recent occupation, in the form of European-introduced artefacts or newly abandoned hearths. Because of this, I suspect that it was last occupied when the Pukl quarry was still operating. It is said to be the nearest shelter from the quarry and, unlike the latter, which is remote from a water source, it is located beside the junction of Pukl Creek and one of its tributaries. Extensive surveys carried out along the creek beds failed to locate axe grinding grooves.

Only one metre square was excavated at MSP, just outside the dripline. There was an extremely high density of debitage at the top of the deposit - the top 7 cm spit included over 4000 flakes. The density reduced with depth and a sterile deposit was reached 85 cm below the surface. Large quantities of charcoal were found throughout the sequence. With exception of an axe blade found on the surface at the side of the shelter, no polished axe fragments were recovered at MSP. However, numerous roughouts were found in the cultural deposit. Overall, and pending the analysis of this archaeological material, I suspect that MSP points towards a relatively

recent age for Pukl quarry.[1]

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[1] [Gorecki (pers. comm.) has since obtained four radiocarbon dates from MSP. The acid fractions of samples ANU 3846 and ANU 3942, which came from the debitage levels, date to 'modern' and 760 ± 80 BP respectively. From below these levels, the acid fraction of ANU 3945 dated to 1070 ± 60 BP, while the insoluble and soluble fractions of ANU 3847 dated to 1120 ± 80 BP and 1490 ± 360 BP respectively.]

Appendix G
INFRARED SOURCING OF AXES FROM KUK AND WURUP

AXES FROM THE WURUP VALLEY COLLECTED BY O.A. CHRISTENSEN

The axes listed here form a subset of those previously catalogued by White et al. (1977a). Only those with known findspots within the Wurup Valley (Fig. 10.1) are included in the present list. The source attributions given by Chappell on the basis of hand examination and cited by White et al. (1977a) form the third column below, while the fourth column gives my initial opinions, if any. The most likely sources after infrared analysis are in the seventh column.

Catalogue no.	Findspot	Source attribution: Chappell	JB	Weight (g)	Length (cm)	Most likely source
-	Manim			182.7	13.0	*Tuman
-	Kinteo			183.4	12.0	*Tuman
-	Pugh			27.6	5.0	*Local
-	Kinteo			129.8	8.0	*Local
-	Kinteo			65.9	6.5	*Tuman
-	Abekum			388.1	16.0	*Tuman
-	Dungadi			499.4	16.5	*Tuman
-	Tumunga			216.3	13.5	*Tuman
-	Kinteo			321.0	13.5	*Tuman
1	Kunbai	Mbukl		189.2	11.0	Pukl
2	Wurup	Ab(K)	Tuman	221.7	14.0	*Tuman
3	Quim	Ganz/Tsenga		292.0	13.0	Tuman
4	Wurup	Ab(K)	Tuman	149.4	9.5	*Tuman
5	Kiap	Mbukl	Tuman	246.9	13.0	*Tuman
6	Manim	Mbukl		147.0	9.5	Tuman
7	Ekka	N.S.		210.0	11.0	Pukl
8	Ekka	Ab(W)	Tuman	194.0	9.5	*Tuman
9	Manim	Mbukl/Ab(K)		242.9	13.5	Tuman
10	Kone	Ab(U)	Tuman	347.8	13.0	*Tuman
11	Pin			227.3	10.5	*Tuman
13	Dungadi	Ganz/Tsenga		193.7	11.5	Ganz
14	Kumbil	Ab(U)	Tuman	162.8	10.5	*Tuman
15	Poga			146.6	10.0	*Tuman
16	Kilinga	Ganz/Tsenga		289.5	15.5	Ganz
17	Kundiwa	Mbukl		159.0	9.0	C
18	Wurup	Ab(U)	Tuman	180.3	10.5	*Tuman
20	Kaip	Ganz/Tsenga		170.2	10.5	Ganz
21	Ekka	Ab(W)	Gaima	167.7	9.0	*Gaima
23	Koning	Ganz/Tsenga		259.8	15.0	Ganz
24	Ekka	N.S.		161.0	9.5	C
29	Poga	Mbukl/Dabiri		56.0	5.5	Tuman
33	Abekum	Ab(K)		28.0	5.0	Tuman
37	Kum Konda	Ab(K)	Tuman	72.8	7.5	*Tuman

40	Ekka	Ganz/Tsenga		66.1	7.5	B
42	Piling	Mbukl	Tuman	86.7	8.0	*Tuman
43	Kilinga	Ab(U)	Tuman	76.3	6.0	*Tuman
46	Ekka	Dabiri/Ab(K)	Tuman	114.4	8.0	*Tuman
47	Wau	Ab(K)	Tuman	118.8	8.0	*Tuman
48	Poga	Mbukl	Tuman	146.2	10.5	*Tuman
49	Ekka	Ab(K)	Tuman	125.9	8.0	*Tuman
50	Piling	Mbukl		114.0	8.0	N.S.
51	Manim			121.0	9.0	Tuman
52	Nori	Mbukl		139.6	9.0	Tuman
53	Poga	Ab(K)	Tuman	140.9	11.5	*Tuman
54	Konda			130.1	8.5	*Tuman
55	Kilinga			85.9	17.5	Dom
60	Manim	Mbukl		171.6	9.0	N.S.
68	Lel	Ab(K)	Tuman	195.0	10.0	*Tuman
69	Ontega	Ab(W)	Tuman	142.9	10.5	*Tuman
70	Wurup			258.9	13.0	*Tuman
71	Pogh	Ab(U)	Tuman	122.1	11.0	*Tuman
72	Poga	Ab(U)	Tuman	129.9	10.0	*Tuman
73	Ontega	Ganz/Tsenga		142.1	9.5	Tuman
74	Poga	Ab(U)	Tuman	109.9	10.0	*Tuman
75	Puge	Ab(U)		84.0	7.5	Tuman
76	Poga			163.8	11.5	*Tuman
77	Poga	Ab(K)	Tuman	136.3	11.0	*Tuman
78	Abekum	Ab(K)	Tuman	150.3	10.5	*Tuman
79	Ekka	Wui/N.S.		237.4	13.5	Pukl
80	Poga	Dabiri	Dom	47.0	5.0	*Dom
81	Lel	Ab(K)	Tuman	66.2	7.5	*Tuman
83	Manim	N.S.	Local	23.4	5.0	*Local
84	Lel	Dabiri		55.0	5.0	Dabiri
90	Middle Komun	Ab(K)	Tuman	322.6	13.5	*Tuman
91	Upper Komun	Ab(K)	Tuman	262.3	13.0	*Tuman
92	Middle Komun	Ab(U)	Tuman	340.6	17.0	*Tuman
93	Ekka			65.7	5.5	N.S.
100	Kiliga	Ab(K)	Tuman	81.4	8.0	*Tuman
101	Kilien			39.3	6.0	Tuman
102	Kiliga	Ab(W)	Tuman	46.6	7.0	*Tuman
103	Lel	Mbukl	Tuman	251.0	13.5	*Tuman
104	Kaip	Ab(K)	Tuman	570.2	16.0	*Tuman
105	Manim	Mbukl/G/T		133.0	11.0	Tuman
106	Kaip	Dabiri		177.4	8.5	Dabiri
107	Manim	Ab(U)	Tuman	500.3	18.00	*Tuman
108	Kaip	Ganz/Tsenga		435.1	17.5	D
109	Kaip	Ganz/Tsenga		61.6	8.0	Ganz
110	Poga			79.2	7.5	C
111	Poga	Ab(W)	Tuman	159.6	10.0	*Tuman
112	Laip	Mbukl	Tuman	343.8	14.0	*Tuman
113	Manim	Ganz/Tsenga	Gaima	93.8	8.5	*Gaima
114	Wurup	Ganz/Tsenga		81.4	8.0	Ganz
117	Poga	Ab(U)	Tuman	101.2	8.5	*Tuman
118	Kaip	Ab(U)	Tuman	196.9	12.5	*Tuman
120	Lel	N.S.	Local	96.4	8.5	*Local
121	Poga	Ab(K)	Tuman	67.7	7.0	*Tuman
122	Ekka	N.S.	Local	103.9	9.5	*Local
123	Ekka	Local	Local	89.9	9.0	*Local
124	Poga	Mbukl	Tuman	51.6	7.0	*Tuman
126	Dungadi			63.8	6.5	Tuman
127	Enga	Ganz/Tsenga	Tuman	644.3	14.5	*Tuman

128	Konda	Ganz/Tsenga		108.4	11.0	Tuman
129	Porombel	Ganz/Tsenga		111.4	7.5	Ganz
130	Kintep			160.0	9.5	Tuman
131	Pe	Ganz/Tsenga		78.9	7.0	A
132	Ramduk	Ganz/Tsenga		157.4	10.0	Ganz
133	Quim	Ganz/Tsenga		83.2	8.5	Tuman
134	Kap	Ab(U)	Tuman	138.3	10.0	*Tuman
135	Kinteo	Ab(U)	Tuman	158.8	8.5	*Tuman
136	Pointilina			41.9	6.0	*Local
137	Memil	Ab(W)	Tuman	172.8	10.0	*Tuman
138	Kumbai	Ganz/Tsenga	Tuman	552.5	16.5	*Tuman
157	Piling	Local	Local	55.6	6.0	*Local
158	Poga			58.0	6.5	Tuman
159	Kumbil	Local	Local	27.0	5.0	*Local
160	Ramdum	Local	Local	56.0	7.0	*Local
201	Poga			173.8	11.0	Tuman
202	Kinteo			180.2	13.0	Tuman
203	Ekka	Dabiri		119.6	10.0	Tuman
204	Wurup	Ab(U)	Tuman	78.3	6.5	*Tuman
205	Poga	Local	Local	43.0	5.0	*Local
206	Manim	Ganz/Tsenga		200.1	11.0	Ganz
207	Poga	Ab(W)	Tuman	95.1	9.0	*Tuman
208	Ekka			157.3	8.5	Tuman
209	Ekka	Ab(U)	Tuman	232.8	9.5	*Tuman
210	Ekka			171.8	8.5	Tuman
211	Kilinga	Ab(K)	Tuman	84.9	8.0	*Tuman
212	Pogh	Local	Local	53.1	6.0	*Local
214	Kumbil	(Mbukl)	Local	209.7	13.0	*Local
215	Manim			237.0	9.0	Tuman
216	Kumbil	Dabiri		107.1	6.5	Dabiri
220	Manim	Ganz/Tsenga		54.6	6.0	Ganz
221	Kilinga	Ab(U)	Tuman	220.0	14.0	*Tuman
225	Puger	N.S.	Gaima	90.4	9.0	*Gaima
226	Kumbil			215.4	10.0	C
227	Manim	Ab(W)	Tuman	47.0	5.5	*Tuman
229	Kumbil	Local	Local	58.4	10.0	*Local
231	Pogh	Ganz/Tsenga	Local	41.3	7.5	*Local
232				51.5	6.0	Ganz
233	Lel	Ab(U)	Tuman	205.2	14.0	*Tuman
234	Manim			74.5	8.0	*Tuman
235	Upper Komun	Ab(K)	Tuman	106.4	10.0	*Tuman
236	Kumbil	Local	Local	129.8	9.0	*Local
237	Poga			190.6	10.5	Tuman
238	Kilige Konda			184.3	11.0	Tuman
240	Kilinga	Ganz/Tsenga		97.7	8.0	C
241	Ramdum	N.S.	Local	90.9	8.0	*Local
243	Komun	Mala/G/T		152.4	9.5	Tuman
244	Pugadul	Mala Gap	Tuman	94.8	7.5	*Tuman
245	Mug	Ab(U)	Tuman	439.0	16.5	*Tuman
246	Manim			95.6	8.5	C
247	Mug	Local	Local	66.2	10.5	*Local
248	Kinteo	Local	Local	103.3	8.0	*Local
249	Dungadi			158.8	9.0	Local
250	Kinteo	Ganz/Tsenga	Tuman	110.5	8.5	*Tuman
251	Ramdum	Local	Local	203.3	10.5	*Local
252	Tugeri			95.8	8.5	C
253	Dungadi	Ganz/Tsenga		190.8	13.0	Tuman
255	Tukua	Local	Local	86.5	13.5	*Local

256	Lel	Local	Local	67.0	7.5	*Local
258	Kum River			153.0	9.0	C
300	Poga	Local	Local	45.3	6.5	*Local
301	Ekka	N.S.	Tuman	94.4	8.0	*Tuman
302	Manim	Ganz/Tsenga		143.7	9.0	Ganz
303	Kaip	Ab(U)	Tuman	122.6	11.0	*Tuman
304	Poga	Ab(K)	Tuman	74.8	9.0	*Tuman
305	Manim			385.6	15.0	Tuman
306	Ekka	Local	Local	192.3	12.0	*Local
307	Upper Komun	Ab(U)	Tuman	62.5	8.0	*Tuman
308	Poga			379.3	15.5	Tuman
309	Ekka	Mbukl		298.7	13.5	Tuman
310	Ekka	Local	Local	145.0	9.5	*Local
311	Pogu	Local	Local	144.8	9.0	*Local
313	Lel			154.9	7.5	Tuman
314	Wurup	Ganz/Tsenga		109.0	9.5	Ganz
316	Manim	Ab(K)	Tuman	178.3	12.0	*Tuman
317	Lel	Local	Tuman	175.1	11.0	*Tuman
318	Abekum	Local	Local	299.2	16.0	*Local
319	Wurup	Ab(W)	Tuman	154.8	9.5	*Tuman
320	Kumbil	Local	Local	87.4	7.5	*Local
321	Kilinga	Local	Local	88.3	8.0	*Local
324	Kaip	Ab(K)	Tuman	298.9	14.0	*Tuman
325	Upper Komun			107.0	8.5	Tuman
326	Ekka	Local	Local	40.1	7.5	*Local
327	Manim	Local	Local	60.7	6.5	*Local
331	Kilinga	Ab(K)	Tuman	63.8	6.5	*Tuman
332	Ramdum	Ganz/Tsenga		123.3	9.0	Tuman
333	Kwim	Mbukl	Tuman	255.4	12.5	*Tuman
334	Kum Konda			176.8	11.0	C
335	Puka	N.S.	Local	107.2	8.0	*Local
337	Pukh	N.S.	Local	200.0	10.5	*Local
338	Kinteo			150.7	11.5	Ganz
339	Ku	Dabiri		198.2	11.5	Tuman
340	Kinteo	Local	Local	157.1	10.0	*Local
341	Kilige Konda	Mbukl		396.1	14.5	Tuman
342	Kiliga	Local	Local	55.9	6.0	*Local
343	Kori			74.7	6.5	A
344	Puger	Ab(K)	Tuman	172.0	12.0	*Tuman
345	Pwinga	(G/T)/Local	Local	90.6	6.0	*Local
467	Kaip			328.2	14.0	*Tuman
471	Dungadi			431.4	17.0	Ganz
472	Mug			275.8	12.0	Ganz
473	Manim			104.5	7.5	Ganz
474	Wurup			134.4	8.0	Tuman
475	Ekka			112.9	8.0	Ganz
476	Kinteo			95.0	8.5	Tuman

Note: Chappell's source attributions were based on hand examination only. Where I have listed an attribution alongside those of Chappell, this indicates agreement/disagreement based on surface markings, shape, etc. Numbers 471-476 are not listed by White et al., they are new numbers assigned to unmarked axes by me that were drilled for IR spectroscopy.

* indicates hand examination only

AXES FROM THREE ENVIRONMENTS COLLECTED AT KUK 1972-81

The artefact numbers KUK 77001 to KUK 78252 refer to axes collected by P.P. Gorecki. Axes with the findspot 'Prkl Rombil' are from the gardens of Joseph Walua, on the southern slopes of Ep Ridge (Fig. 10.2). The artefact numbers starting 'K/80..', 'EP 80..' or 'EP 81..' were also collected by Joseph Walua in that area.

*
indicates hand examination only

Catalogue no.	Findspot	Environment	Weight (g)	Length (cm)	Most likely source
K/M/S1	Kuk (Golson)	SWAMP	187.2	12.5	Ganz
K/M/S3	Kuk (Golson)	SWAMP	167.2	12.0	A
K/M/S4	Kuk (Golson)	SWAMP	149.2	9.0	*Tuman
K/M/S10	Kuk (Golson)	SWAMP	180.1	11.5	*Tuman
K/M/S11	Kuk (Golson)	SWAMP	154.1	10.0	*Tuman
K/M/S12	Kuk (Golson)	SWAMP	114.6	9.5	Mbukl
K/M/S13	Kuk (Golson)	SWAMP	123.0	8.0	*Tuman
K/M/S14	Kuk (Golson)	SWAMP	104.1	8.0	*Tuman
K/M/S15	Kuk (Golson)	SWAMP	170.0	10.0	*Tuman
K/M/S16	Kuk (Golson)	SWAMP	261.0	12.5	*Tuman
K/M/S17	Kuk (Golson)	SWAMP	183.0	9.5	Mbukl
K/M/S18	Kuk (Golson)	SWAMP	171.4	10.5	Pukl
K/M/S19	Kuk (Golson)	SWAMP	121.6	10.5	*Tuman
K/M/S20	Kuk (Golson)	SWAMP	132.8	9.5	*Tuman
K/M/S22	Kuk (Golson)	SWAMP	60.8	5.5	Mbukl
K/M/S23	Kuk (Golson)	SWAMP	106.7	7.5	Mbukl
K/M/S24	Kuk (Golson)	SWAMP	137.7	8.0	*Tuman
K/M/S25	Kuk (Golson)	SWAMP	157.8	8.5	*Tuman
K/M/S26	Kuk (Golson)	SWAMP	1073.9	20.0	Ganz
K/M/S27	Kuk (Golson)	SWAMP	396.4	15.5	Mbukl
K/M/S29	Kuk (Golson)	SWAMP	158.9	11.0	*Tuman
K/M/S30	Kuk (Golson)	SWAMP	146.6	10.5	Tuman
K/M/S35	Kuk (Golson)	SWAMP	233.4	13.5	*Local
K/M/S36	Kuk (Golson)	SWAMP	174.9	11.0	*Local
K/72/S9	Kuk (Golson)	SWAMP	81.9	7.0	*Gaima
K/72/S11	Kuk (Golson)	SWAMP	489.8	14.5	Tuman
K/72/S16	Kuk (Golson)	SWAMP	285.0	13.5	*Local
K/72/S17	Kuk (Golson)	SWAMP	134.5	9.5	Yambina
K/72/S32	Kuk (Golson)	SWAMP	340.2	14.5	*Local
K/72/S40	Kuk (Golson)	SWAMP	231.5	11.5	C
K/72/S42	Kuk (Golson)	SWAMP	232.5	11.0	*Tuman
K/72/S48	Kuk (Golson)	SWAMP	108.1	8.0	*Local
K/72/S63	Kuk (Golson)	SWAMP	93.2	7.0	Ganz
K/72/S64	Kuk (Golson)	SWAMP	123.3	7.5	Mbukl
K/72/S65	Kuk (Golson)	SWAMP	110.4	8.5	C
K/72/S66	Kuk (Golson)	SWAMP	158.5	14.0	*Local

K/72/S68	Kuk (Golson)	SWAMP	135.6	9.0	Ganz
K/72/S69	Kuk (Golson)	SWAMP	107.2	8.0	*Gaima
K/72/S70	Kuk (Golson)	SWAMP	206.1	10.5	*Tuman
K/72/S71	Kuk (Golson)	SWAMP	185.8	10.0	*Tuman
K/72/S72	Kuk (Golson)	SWAMP	231.1	11.0	Tuman
K/72/S73	Kuk (Golson)	SWAMP	155.9	11.5	*Tuman
K/72/S97	Kuk (Golson)	SWAMP	95.2	10.5	*Tuman
K/74/S27	Kuk (Golson)	SWAMP	126.5	9.0	*Tuman
K/74/S38	Kuk (Golson)	SWAMP	132.8	7.5	*Tuman
K/75/S193	Kuk (Golson)	SWAMP	161.9	9.0	*Local
K/76/S24	Kuk (Golson)	SWAMP	46.8	6.0	*Local
K/76/S25	Kuk (Golson)	SWAMP	205.8	11.0	*Tuman
K/80/S1	Kuk (Golson)	EP RIDGE	96.0	6.5	*Local
K/80/S4	Kuk (Golson)	EP RIDGE	291.7	13.5	N.S.
K/80/S8	Kuk (Golson)	EP RIDGE	118.2	9.5	A
K/80/S11	Kuk (Golson)	EP RIDGE	77.7	8.0	*Local
KUK 77001	Plantation	SWAMP	193.5	11.0	*Tuman
KUK 77011	Block B2	SWAMP	211.3	9.0	*Tuman
KUK 77012	Block B10	SWAMP	467.5	20.5	B
KUK 77015	Kenta	DRYLAND	963.3	15.5	*Tuman
KUK 77051	Mek's complex	SWAMP	208.5	11.0	*Local
KUK 77052	MNP	DRYLAND	54.7	7.0	*Tuman
KUK 77055	Kum	DRYLAND	115.6	9.0	*Tuman
KUK 77057	Mup	SWAMP	210.2	11.0	C
KUK 77065	Kuk	SWAMP	111.3	8.0	Mbukl
KUK 77072	Kukrumdi	SWAMP	221.5	10.0	Ganz
KUK 77114	Prkl Rombil	EP RIDGE	338.2	12.0	*Tuman
KUK 77118	Prkl Rombil	EP RIDGE	176.1	10.5	*Tuman
KUK 77119	Kukrumdi	DRYLAND	439.5	16.0	*Tuman
KUK 77121	Kukrumdi	DRYLAND	813.3	24.0	Ganz
KUK 77127	Prkl Rakarong	EP RIDGE	219.9	12.5	*Tuman
KUK 77128	Prkl Rakarong	EP RIDGE	483.7	13.0	*Tuman
KUK 77129	Prkl Waike	EP RIDGE	222.1	13.0	Pukl
KUK 77130	Prkl Kungunt	EP RIDGE	160.5	10.0	Ganz
KUK 77131	Prkl Rombil	EP RIDGE	240.0	10.0	*Tuman
KUK 77132	Prkl Waike	EP RIDGE	123.4	9.0	C
KUK 77137	Prkl Rombil	EP RIDGE	191.5	10.0	Tuman
KUK 77138	Kukrumdi	DRYLAND	134.6	7.5	*Tuman
KUK 77145	east boundary	DRYLAND	113.5	8.0	Tuman
KUK 77146	Bagla	SWAMP	151.4	9.5	*Tuman
KUK 77148	Rombugl	DRYLAND	1542.4	22.5	Gaima
KUK 77152	Mup	DRYLAND	62.7	6.0	Dom
KUK 77153	Mup	DRYLAND	156.9	9.0	Ganz
KUK 77156	Rombugl	DRYLAND	597.1	16.0	*Tuman
KUK 77157	Kenta	DRYLAND	97.8	7.5	*Tuman
KUK 77158	Kuk	SWAMP	134.3	11.5	D
KUK 77159	Kurumdi	SWAMP	217.1	10.5	*Tuman
KUK 77162	Plantation	SWAMP	101.7	7.0	Ganz
KUK 77164	Prkl Rombil	EP RIDGE	233.7	13.5	Ganz
KUK 78002	MNP	DRYLAND	221.7	13.5	*Local
KUK 78006	Prkl Rombil	EP RIDGE	246.7	12.0	*Tuman
KUK 78007	Prkl Rombil	EP RIDGE	133.6	12.0	Local
KUK 78010	Prkl Rombil	EP RIDGE	234.0	9.0	*Tuman
KUK 78013	Prkl Rombil	EP RIDGE	77.3	8.0	*Local
KUK 78046	Prkl Rombil	EP RIDGE	244.5	13.5	Yambina
KUK 78047	Prkl Rombil	EP RIDGE	71.9	7.0	Dom
KUK 78050	Prkl Rombil	EP RIDGE	131.3	9.0	A
KUK 78057	MNP	DRYLAND	134.1	9.5	Ganz

KUK 78062	MNN	DRYLAND	351.9	13.0	Ganz
KUK 78063	MOR	DRYLAND	463.2	15.0	*Local
KUK 78065	Kuning Tip	EP RIDGE	162.6	9.5	*Tuman
KUK 78067	Kuning Tip	EP RIDGE	137.8	8.0	*Tuman
KUK 78068	Kuning Tip	EP RIDGE	193.8	9.0	*Tuman
KUK 78071	Kuning Tip	EP RIDGE	296.0	13.5	B
KUK 78081	Kenta	DRYLAND	337.7	13.0	*Tuman
KUK 78082	Kenta	DRYLAND	225.0	11.5	Tuman
KUK 78083	Kenta	DRYLAND	474.6	16.5	*Tuman
KUK 78084	Mound nr. Guga	SWAMP	80.6	7.5	*Local
KUK 78088	Kuk	SWAMP	104.1	7.5	*Tuman
KUK 78093	MOH	DRYLAND	101.9	10.5	Pukl
KUK 78094	MNP	DRYLAND	116.8	8.5	*Tuman
KUK 78098	Prkl Rombil	EP RIDGE	185.6	13.5	Pukl
KUK 78107	Block M	SWAMP	320.3	13.5	*Tuman
KUK 78110	Prkl Rombil	EP RIDGE	109.4	7.5	*Tuman
KUK 78111	Prkl Rombil	EP RIDGE	81.7	7.5	*Dom
KUK 78117	Block D7	SWAMP	186.0	11.5	*Tuman
KUK 78126	Prkl Rakarong	EP RIDGE	110.6	10.0	Tuman
KUK 78129	Block D6	SWAMP	102.5	8.0	C
KUK 78141	Prkl Emdel	EP RIDGE	219.8	16.5	Ganz
KUK 78144	Plantation	SWAMP	877.6	20.5	Pukl
KUK 78147	Kukrumdi	DRYLAND	104.6	8.0	*Local
KUK 78158	W of Guga R.	SWAMP	265.0	11.5	*Tuman
KUK 78161	Kum	DRYLAND	185.7	10.5	*Tuman
KUK 78180	MOL	DRYLAND	174.4	10.5	Ganz
KUK 78224	Prkl Rombil	EP RIDGE	134.5	8.0	Yambina
KUK 78229	Prkl Rombil	EP RIDGE	191.4	9.5	*Tuman
KUK 78234	Prkl Rombil	EP RIDGE	74.8	6.0	*Gaima
KUK 78236	Baisu	SWAMP	175.6	14.0	Repeng
KUK 78237	Baisu	SWAMP	105.0	9.0	D
KUK 78252	Kuning	EP RIDGE	116.8	7.5	C
KUK 80-1	Kuk (Burton)	SWAMP	136.4	10.0	*Tuman
KUK 80-7	Kuk (Burton)	SWAMP	160.9	11.5	*Tuman
KUK 80-8	Kuk (Burton)	SWAMP	101.2	9.5	*Tuman
KUK 80-20	Kuk (Burton)	SWAMP	70.9	7.5	*Tuman
KUK 81-35	Kuk (Burton)	SWAMP	499.4	16.5	Tuman
EP 80-2	Ep (Burton)	EP RIDGE	74.5	6.0	*Tuman
EP 80-6	Ep (Burton)	EP RIDGE	171.3	9.0	*Tuman
EP 80-9	Ep (Burton)	EP RIDGE	180.5	11.0	*Tuman
EP 80-10	Ep (Burton)	EP RIDGE	375.1	15.5	*Local
EP 81-2	Ep (Burton)	EP RIDGE	338.2	13.5	*Tuman
EP 81-3	Ep (Burton)	EP RIDGE	289.6	15.0	Ganz
EP 81-6	Ep (Burton)	EP RIDGE	113.5	10.0	Ganz
EP 81-12	Ep (Burton)	EP RIDGE	173.6	8.0	*Tuman
EP 81-13	Ep (Burton)	EP RIDGE	128.2	9.5	Tuman
EP 81-16	Ep (Burton)	EP RIDGE	72.8	7.0	*Tuman
EP 81-18	Ep (Burton)	EP RIDGE	361.4	16.5	*Tuman
EP 81-19	Ep (Burton)	EP RIDGE	142.6	11.0	*Tuman
EP 81-23	Ep (Burton)	EP RIDGE	111.7	9.5	Tuman

RECENT PREHISTORIC FINDS OF AXES FROM STRATIFIED CONTEXTS AT KUK

This small collection of finds consists mainly of small fragments of axes, unlike the surface and ethnographic collections from Kuk and Wurup, which consisted mainly of whole axes. The fragments listed were all those large enough to allow a 5 mm plug to be drilled from them (with a drill bit of 7 mm external diameter). This was irrespective of whether the fragment was actually drilled or whether identified by eye alone, marked thus '*'. The labels 'young', 'very young', etc. refer to the general sequence at Kuk. All the finds date to the last few hundred years (Phase 6).

*
indicates hand identification only

Catalogue no.	Findspot	Stratigraphic age	Weight (g)	Most likely source
K/72/S38	KUK	'very young'	97.1	*Tuman
K/72/S52	KUK	'young'	164.3	C
K/72/S94	KUK	'young'	104.9	*Tuman
K/72/S98	KUK	'?very young'	78.9	*Tuman
K/72/S102A	KUK	'young'	42.7	A
K/72/S109	KUK	'young'	40.7	D
K/72/S111	KUK	'young'	54.1	C
K/72/S119	KUK	'young'	42.1	*Tuman
K/72/S120	KUK	'young'	50.5	C
K/72/S121	KUK	'young'	74.0	*Tuman
K/72/S123	KUK	'young'	37.1	*Tuman
K/73/S60	KUK	'very young'	67.4	C
K/73/S66	KUK	'young'	95.9	C
K/73/S114	KUK	'young'	67.1	Mbukl
K/75/S13	KUK	'?young'	609.2	Tuman
K/75/S20	KUK	'?young'	110.3	Dom
K/75/S50	KUK	'young'	46.5	Local
K/75/S64	KUK	'young'	432.0	*Tuman
K/75/S78	KUK	'young'	54.9	Dom
K/77/S38	HED MOUND	Layer I	62.5	C
K/77/S45	HED MOUND	Layer I	54.5	Tuman
K/77/S47	HED MOUND	Layer I	32.2	C
K/77/S51	HED MOUND	Layer I	87.4	*Tuman
K/77/S62	HED MOUND	Layer I	78.5	*Tuman
K/77/S63	HED MOUND	Layer II	35.9	Ganz
K/77/S64	HED MOUND	Layer II	76.9	*Tuman
K/77/S66A	HED MOUND	Layer II	109.3	*Tuman
K/77/S66B	HED MOUND	Layer II	56.4	Ganz
K/77/S72	HED MOUND	Layer II	80.9	Ganz
K/77/S81	HED MOUND	Layer II	108.6	Ganz
K/77/S82	HED MOUND	Layer II	64.9	A

Appendix H
INFRARED SPECTRA OF QUARRIES IN THE STUDY AREA

Reference spectra for the silicates mentioned in Chapter 10 are shown in Figs H.1-H.6 (for a complete description see Garsden 1975). Only a portion of the measured spectrum is illustrated in each case, between the wavelengths of 7.1 and 25.0 microns. Wavelength is indicated by the upper scale in each diagram and wavenumber/cm by the lower scale (wv./cm).

The percentage of energy transmitted by the sample is represented by the vertical scale in terms of a percentage value; absorption peaks show up as spikes pointing downwards (transmission troughs). For some minerals absorption peaks are found at shorter wavelengths (1400-4000 wv./cm) than represented here, but this is not the case with the silicates investigated. In addition, some spectra from axes have minor peaks in this range, but they do not appear with consistency and I have decided to ignore them.

Each mineral species has its own family of absorption peaks, some of which are quite distinctive. The remainder tend to occur in the same locations in other minerals and cannot be used diagnostically. Quartz (Fig. H.1) has six main peaks, labelled A-F, in addition to the generalised absorption band in the 1000-1200 wv./cm range - the general band is present in all the charts examined. The doublet at A (795 wv./cm) and B (775 wv./cm) is characteristic of the quartz spectrum. Other minerals that are likely to crop up in metamorphic rocks used in the highlands for axe manufacture do not possess this feature and in practice many of the rocks used are either rich in quartz or rich in amphiboles.

Reference spectra for the amphibole silicates, hornblende and actinolite, are shown in Fig. H.2. Amphibole-rich samples have a major absorption peak at A (755 wv./cm). The peak which appears in quartz at C is also present in the amphiboles, at 690 wv./cm, but it is not so marked as in quartz. Both quartz and amphiboles share peak D, at (exactly) 600 wv./cm; this spike can be used to check that the chart paper has been correctly aligned. Both appear to share the peaks E and F, but in quartz F lies at 455 wv./cm and in the amphiboles it is broader and lies at 465 wv./cm.

The spectrum of another silicate mineral of contact metamorphism, cordierite, is shown in Figure H.5 for comparison with the amphibole silicates. Many of the absorption bands and peaks are in

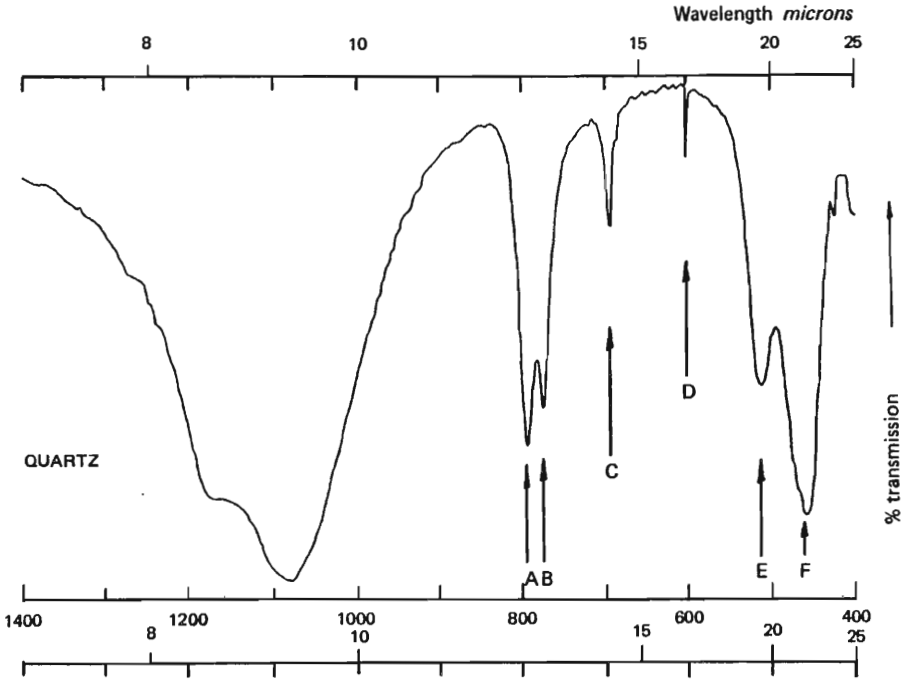


Figure H.1

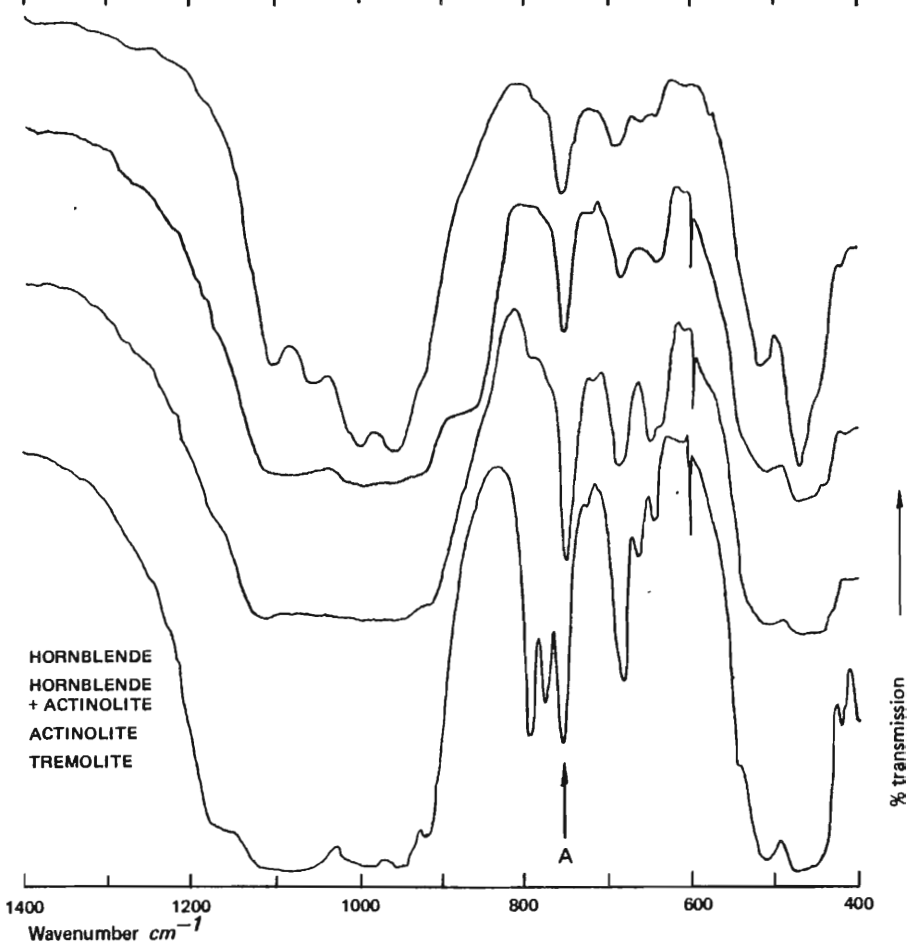


Figure H.2

REFERENCE SPECTRA quartz (upper) and amphiboles (lower)

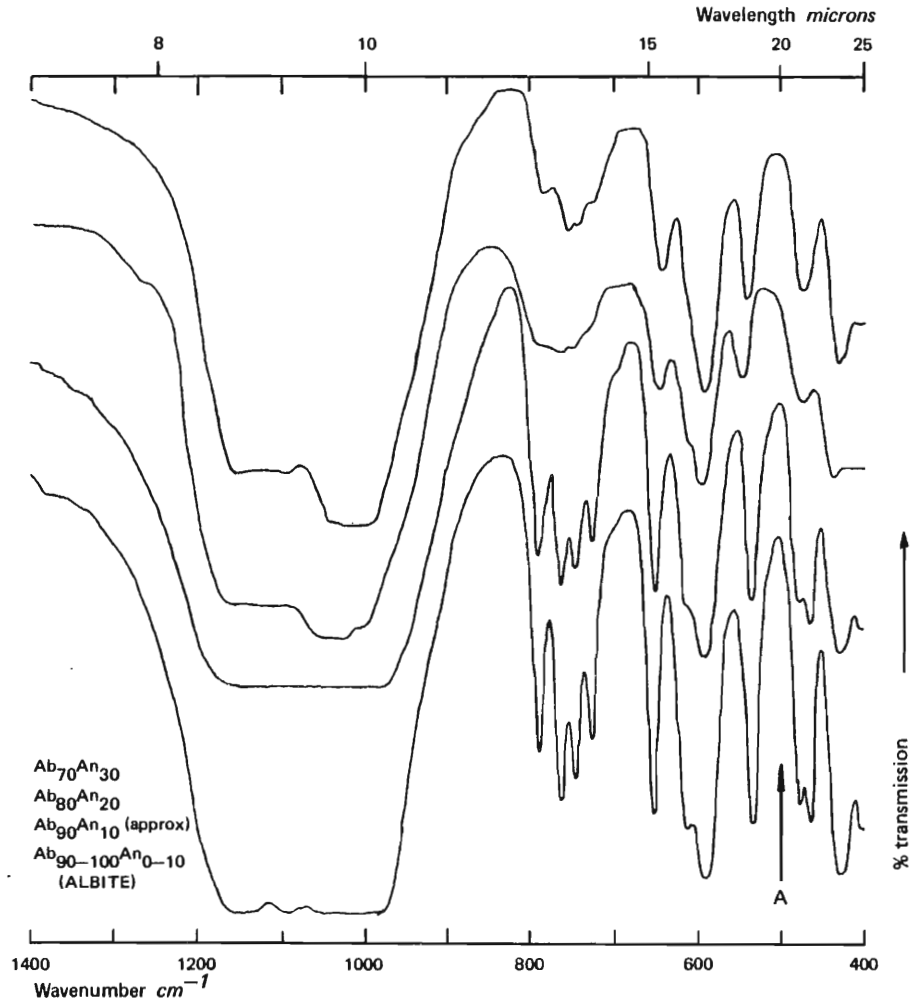


Figure H.3

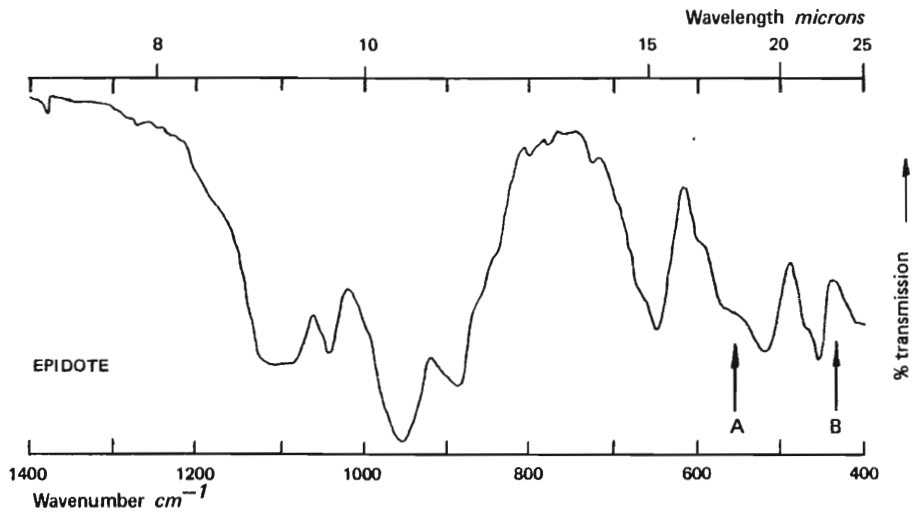


Figure H.4

REFERENCE SPECTRA plagioclases (upper) and epidote (lower)

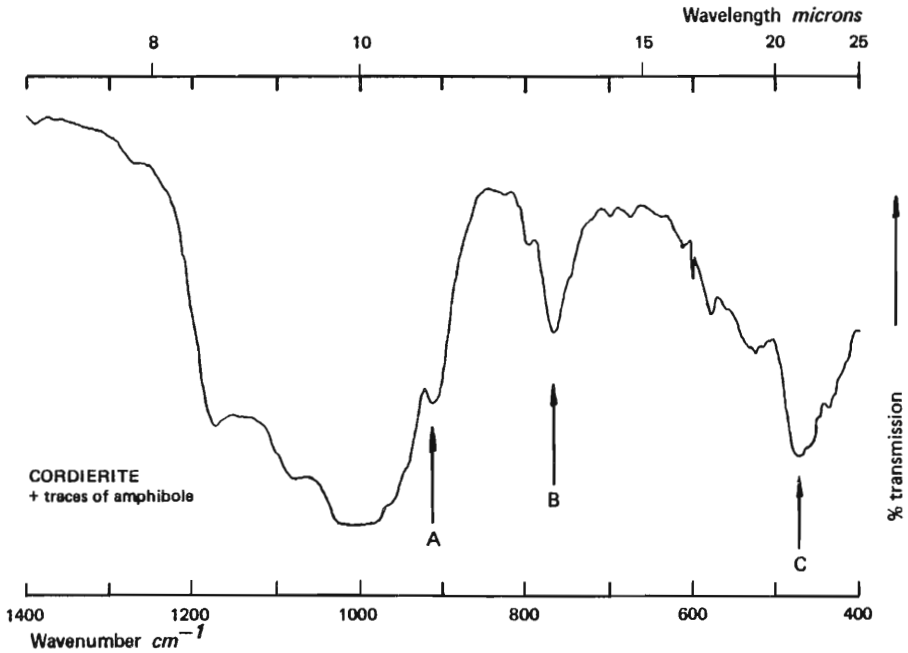


Figure H.5

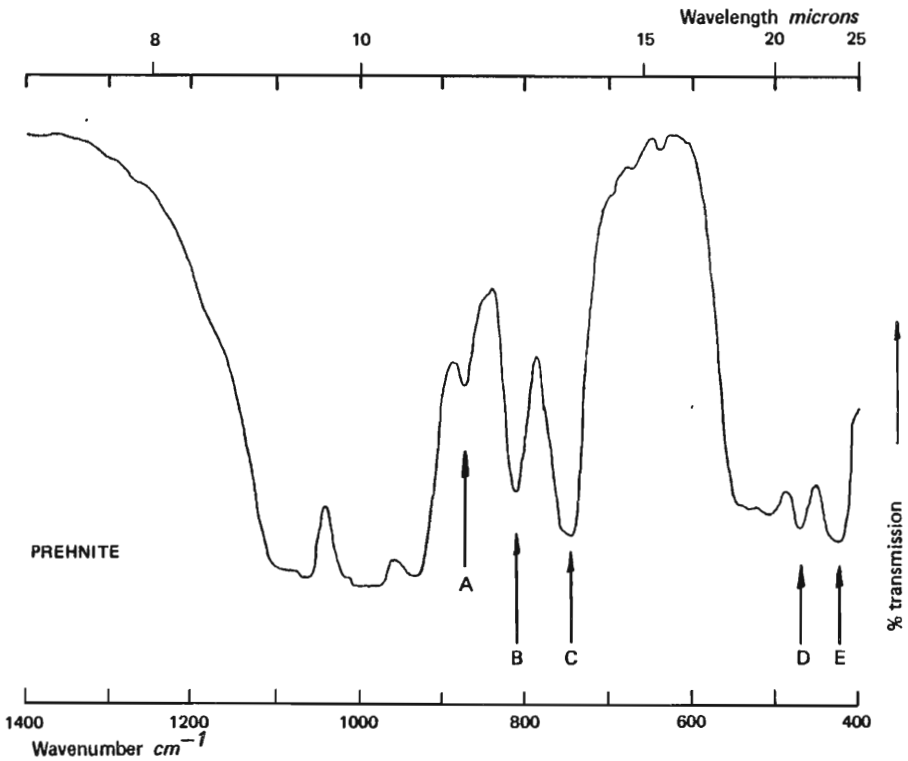


Figure H.6

REFERENCE SPECTRA cordierite (upper) and prehnite (lower)

similar positions, for example at B and C. However, the amphiboles have no peak at A in the cordierite spectrum (around 920 wv./cm) and no spectrum from the outcrop samples or artefacts had one either.

The compositionally similar tremolite and actinolite have a different peak structure at 750-800 wv./cm (Fig. H.2). Tremolite has a triplet of peaks where actinolite has only one. This could be confused with the quartz doublet if, say, quartz and actinolite were found together and the sum of their peaks, a doublet and a singleton, formed a row of three.

An important assumption must be made when samples consist of two or more minerals. A composite spectrum must at least be unique, but my discussion also makes the assumption that the spectrum of a multi-mineral rock sums the peaks of the individuals minerals analysed separately. In Figure H.2 the spectrum of a mixture of hornblende and actinolite seems to confirm this principle, but with more complex compositional mixes peak formation may not be so simple. The descriptions of the spectra of each quarry investigated are given below, starting with the most easily recognised types.

Pukl

I did not visit Pukl myself, but P. Gorecki kindly provided a number of hand specimens of Pukl stone, and two roughouts, collected in a shelter very near to the quarry. Ten samples were analysed, including two from the same hand specimen.

All the samples produced extremely similar pen-traces (Fig. H.7), indicating a high degree of homogeneity at the outcrop (which was not visited by Gorecki until after this program was complete). The two traces from the same piece of rock were not noticeably more similar to each other than to the remainder. The quadruplet of peaks, A-D, is highly distinctive, as is the doublet F-G. These and other features show that the dominant constituent of Pukl is plagioclase felspar. A range of plagioclase compositions is illustrated in Figure H.3. The spectra comparable to Pukl are those of oligoclase and albite; at the anorthite end of the solution series, the peaks are amorphous and not like those seen in Pukl. The main difference between the spectra of Pukl and albite occurs at 480-520 wv./cm. In albite, this band (A in Fig. H.3) is absorption free, while in Pukl there is generalised absorption resulting in a characteristically flattened trace between peaks E and F. Sometimes the effect is strong enough to produce a minor peak in this region (best seen in Wurup 7).

Chappell (1966:109) describes Pukl as similar to Maegmul, a

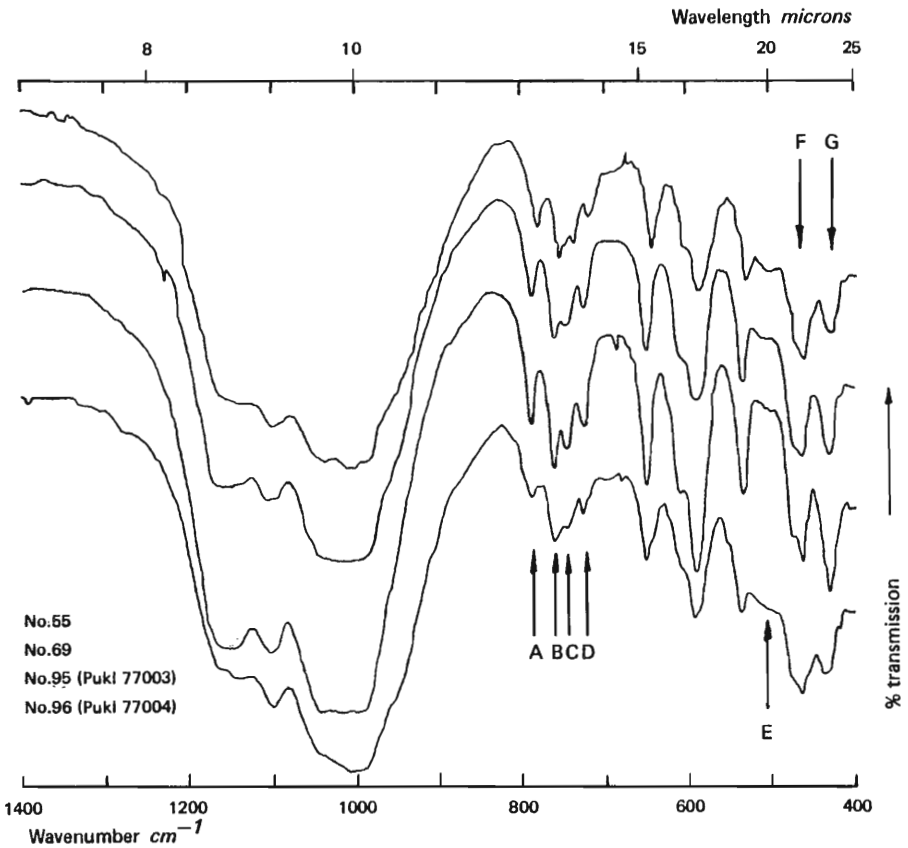


Figure H.7

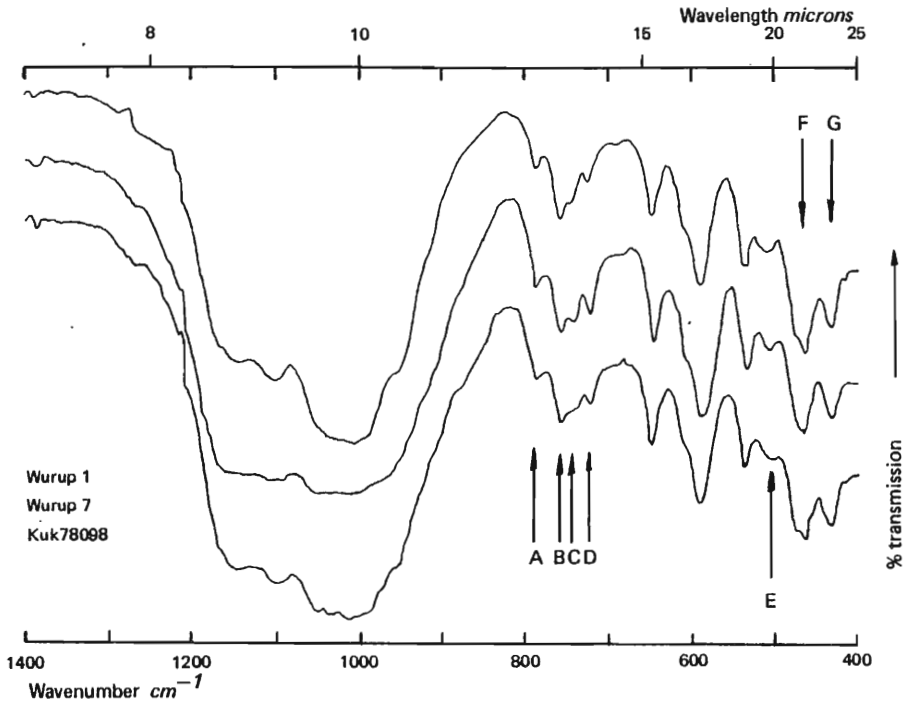


Figure H.8

PUKL infrared spectra of outcrop samples (upper) and axes from collections (lower)

weakly metamorphosed, fine-grained siltstone which (1966:108) 'contains tiny epidote crystals floating in very small laths of albite...detrital felspars are not altered'. The reference trace for epidote (Fig. H.4) has peaks in the region A-B, which could account for the difference between Pukl and albite, but the other epidote peaks would also be expected to be present in Pukl (which they are not).

A small number of unambiguously Pukl pen-traces were found in the collections: five from Kuk and three from Wurup. The axes are typical of the 'Hagen' style, that is to say comparatively thin and a grey or black colour. One feature which may mark out Pukl axes is the presence of spidery veins which show up on a clean, polished surface. One roughout from Kuk with an unmistakably Pukl trace is, however, dull green. I have classed it as Pukl, but this may be in error.

Pukl traces could possibly be confused with some extreme variants from the Ganz River, particularly among examples of the sub-type known as 'PX' (see below). Otherwise Pukl is an excellent example of a minor quarry: a source of axes which might contribute 1-2% of the axes in circulation in the Mt Hagen area. Pukl axes were probably made on a casual basis by members of the owning group as a means of competing in a prestigious trading arena. The axe name was not widely known (it was probably unknown at Wurup), but Pukl blades were passed in small quantities beyond the social horizons of their makers. Gorecki's report (Appendix F) provides more details of the quarry.

Dabiri

Three axes in the Wurup collection produced very similar, but unidentifiable spectra. In White's catalogue of this collection (White et al. 1977a), all three were thought by Chappell to be from the southern Kubor source of Dabiri. This was informed guesswork, none of the axes was sectioned and all were heavily patinated. Informant testimony was suggestive but equivocal; for example, five Wurup men thought No.84 was from the Tuman quarries, two thought it was from Dabiri, one thought it was from elsewhere and one man did not know (White et al. 1977a:Table 6).

Hughes (1977a:135), who went with Christensen to locate the Dabiri quarry site in 1973, was able to supply hand specimens of quarry material. Three samples were analysed and proved to have virtually identical traces to those of the unknown Wurup axes (Figs H.9 and H.10), identifying Dabiri products for the first time. The

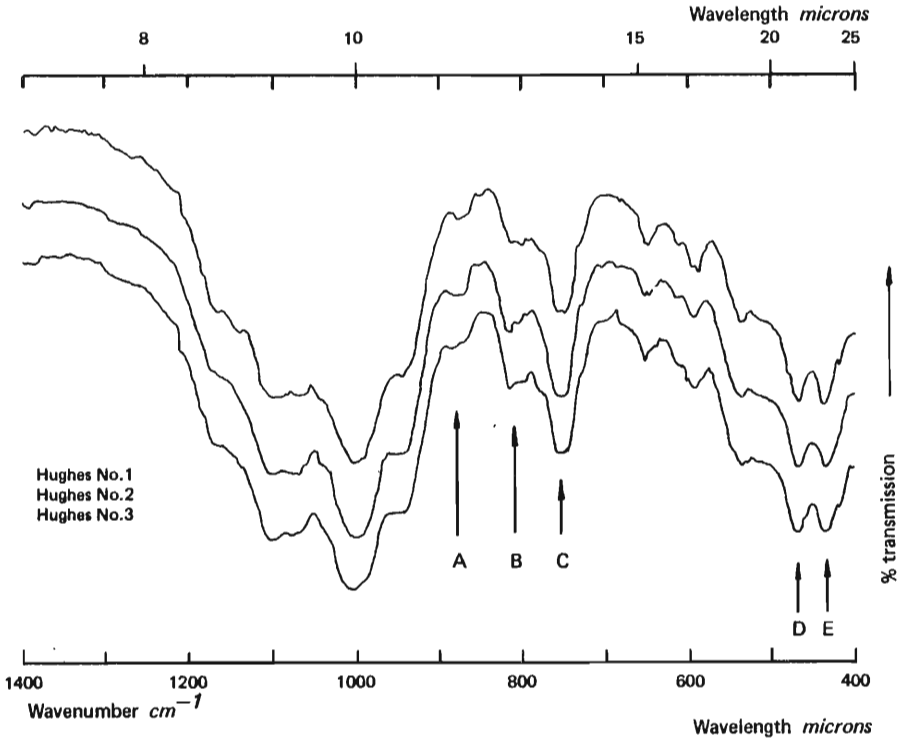


Figure H.9

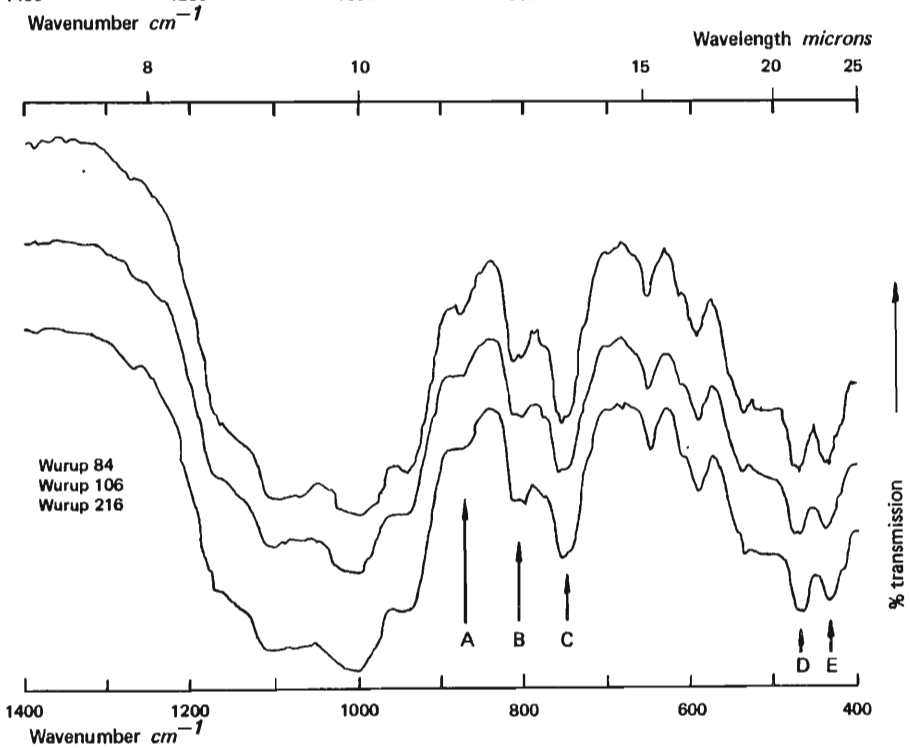


Figure H.10

DABIRI infrared spectra of outcrop samples (upper) and axes from Wurup (lower)

notable peaks are those marked A-E, but the minerals present in the Dabiri spectrum cannot be identified.

Dom Gaima

Dom **gaima** axes are almost always recognisable in hand specimen. Fresh, polished surfaces are greeny-grey and the surface texture looks 'honey-like'. White bands or streaks, if present, run along the length of the blade, parallel to the original bedding of the tabular rock. However, few of these features are preserved after weathering; small Dom blades could then be mistaken for locally made axes. Three quarry samples were initially analysed, showing that at least Dom spectra lay outside the range of variation of other quarries, but that there might be several spectral facies (Fig. H.11).

In fact, spectra from a number of archaeological samples visually recognised as Dom **gaima** show that there are at least two spectral types. A pair of analyses from the same axe fragment - a broken axe found at Kuk numbered K/80/S5 - are quite different (Fig. H.11). The reference spectrum for prehnite (Fig. H.6) shows that the K/80/S5 'B' sample is rich in this mineral; the axe fragment has light bands and the two drill plugs probably sampled them differentially. Unfortunately it is not possible to tell whether the darker or lighter band are prehnite-rich without further work. Prehnite's major peaks, A-C, are all present in Dom axes of the 'B' type, particularly Kuk 77152 and K/75/S20. The Nombe samples show only the A peak as an inflection at 870 wv./cm and the C peak at 755 wv./cm. The B peak, normally at 815 wv./cm, is absent.

In spite of the great variability of Dom infrared spectra, this quarry remains one of the most identifiable. Most Dom axes can be recognised by eye; those that must be sourced spectroscopically can only be visually confused with the similarly light-coloured Tsenga **gaima** and, possibly, with locally made axes which have weathered to a light surface colour. In no case did such an axe in any of the collections have a pen-trace which could have been confused with a Tsenga **gaima** spectrum.

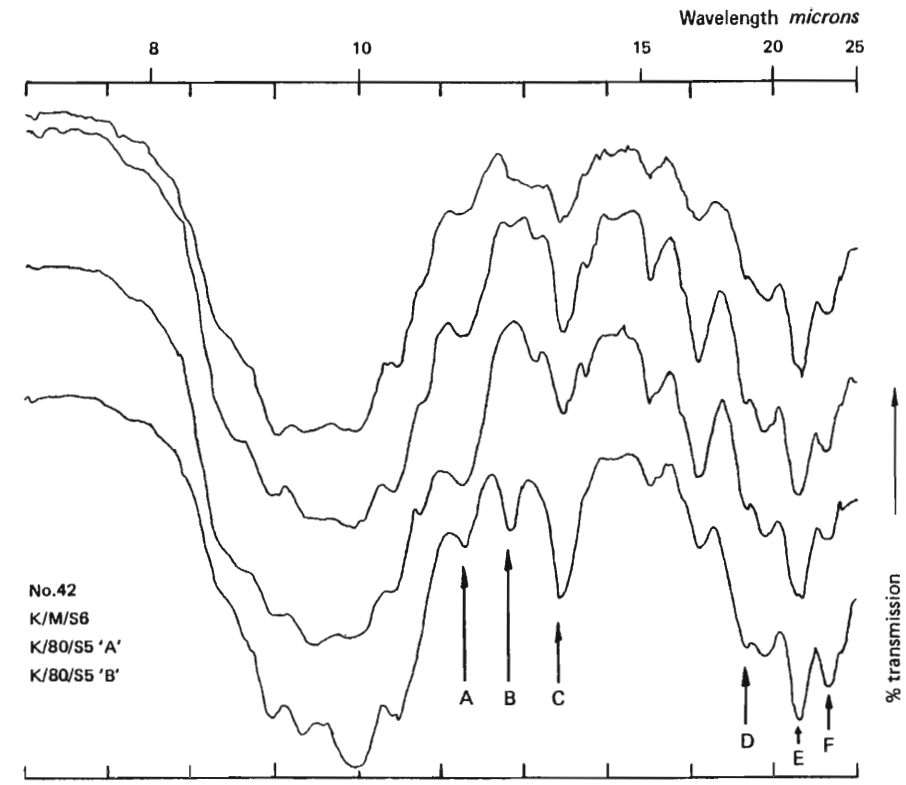


Figure H.11

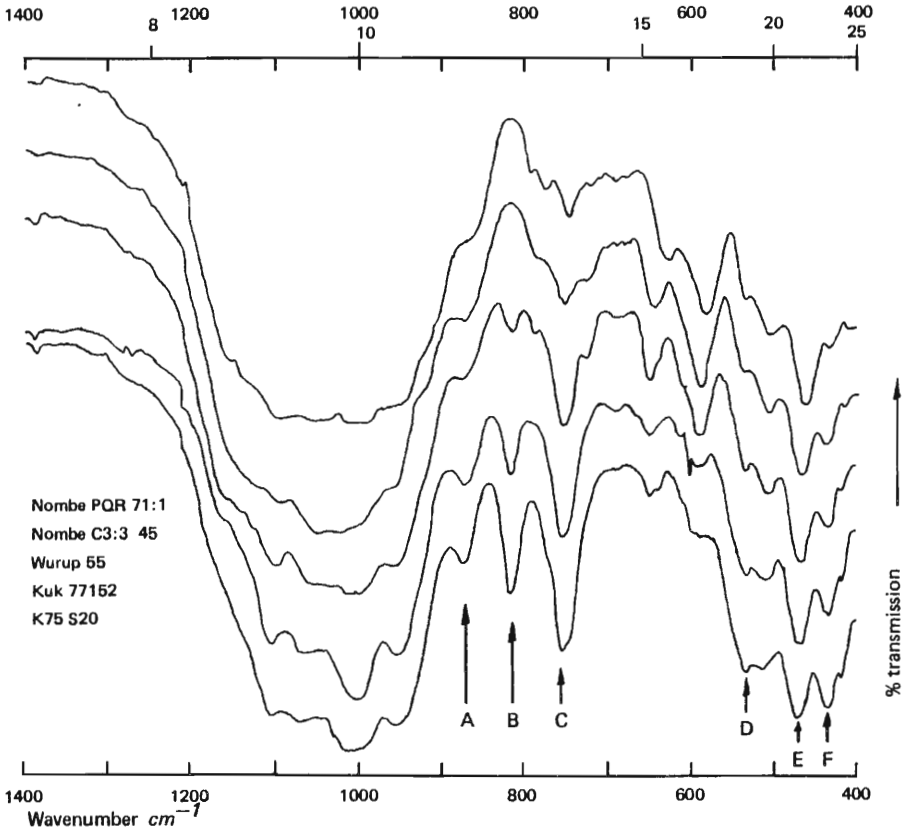


Figure H.12

DOM samples identified as *gaima* (upper) and axes from collections (lower)

Tuman quarries

Most Tuman axes can be identified by eye; they are dark green, have distinctive patches of mottling and graininess and have a thicker section than other axe types. Weathering and resharpening are two of the factors which can make it hard to recognise some or all of these attributes and infrared analysis is useful to confirm suspected identifications. Twenty-one outcrop samples were analysed from among the Tuman sources, Mela and Mis included.

Figure H.13 shows the characteristically quartz-rich spectra of Tuman outcrop samples. The most significant feature is the quartz doublet A/B. Other peaks are well expressed, especially the deep quartz peak at D, 460-465 wv./cm. An accessory peak may appear at C, 750 wv./cm. It is possible that actinolite is responsible for this, as Chappell (1966:107) indicates that the rock is an epidote-albite-actinolite hornfels. Judging from the infrared spectra, albite is not important (compare with Pukl). The other components mentioned by Chappell - basaltic andesite tuff fragments, palagonite and carbonate - are not thought to have peaks in the region. Mbukl spectra (see below) also have a peak near or at C and confusion between Mbukl and Tuman is possible. The Mbukl peak appears to be at 755 wv./cm rather than at 750 wv./cm (see dashed lines in Figs H.13 and H.16).

Spectra from four axes which are definitely from the Tuman quarries, to judge by hand specimen appearance, are shown in Figure H.14. They confirm the variability in the A-C region. Figure H.15 shows the spectra of six axe fragments from the Manim rockshelters (details in Table 10.7). All the fragments are green in colour and, at a distance of only 20 km, are a priori most likely to be from the Tuman quarries. The Manim, Etpiti and Tugeri spectra are all within the range of modern variation. Two of the three Kamapuk samples have strong peaks at C, but I am confident that they are also one or other of the Tuman sources. Each of the finds from Kamapuk is a small flake; all are from the same stratigraphic provenance of Square C, Level 8, and there are about 20 other flakes from the same place. It seems to have been a localised cluster of debitage. All the flakes have Tuman attributes of colour and markings. The Manim fragment, from a level below a date of 3580 ± 80 BP, is nominally the most ancient, but it is an isolated find and further securely dated examples are needed to confirm its significance. Its spectrum (Fig. H.15) is very typical of the Tuman quarries and there is no doubt that it does originate there.

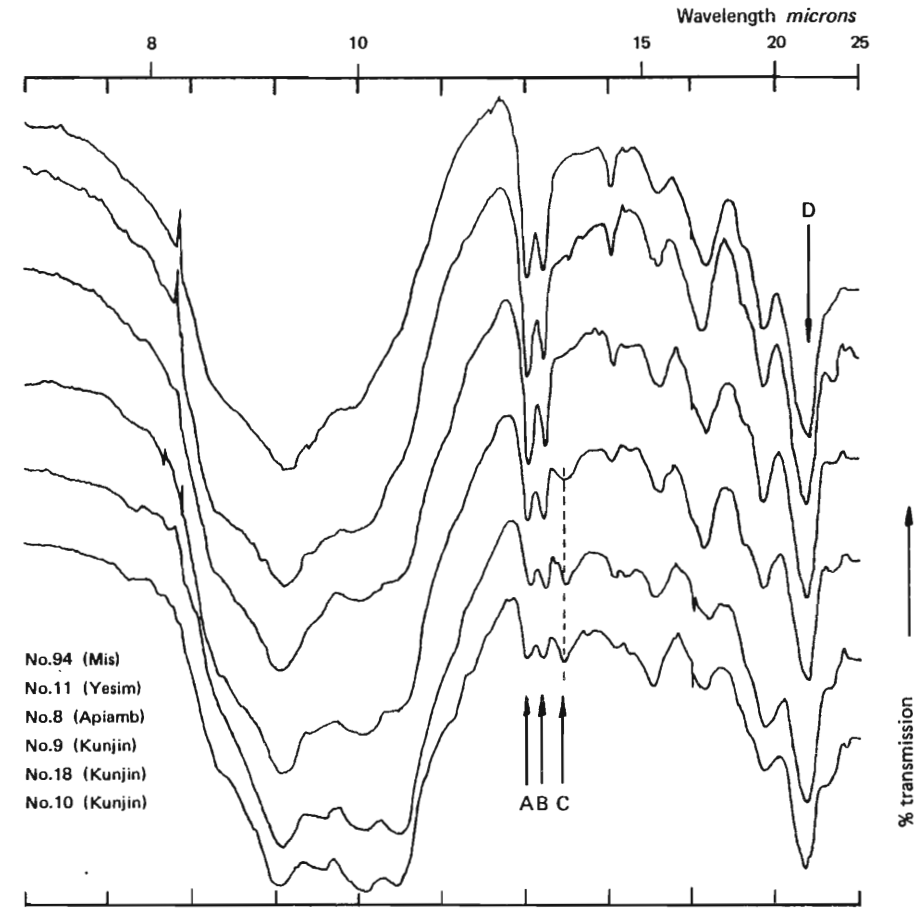


Figure H.13

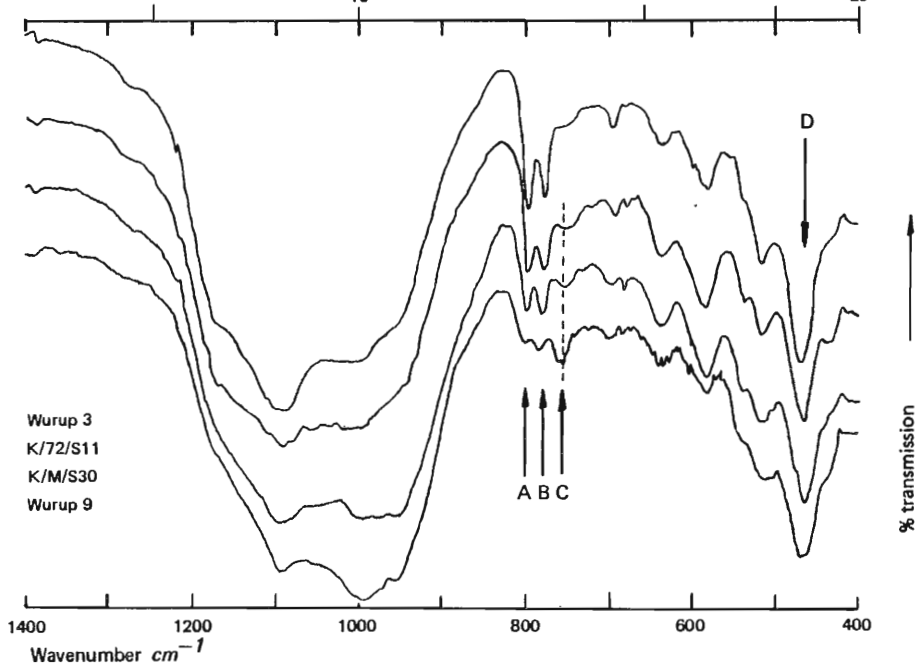
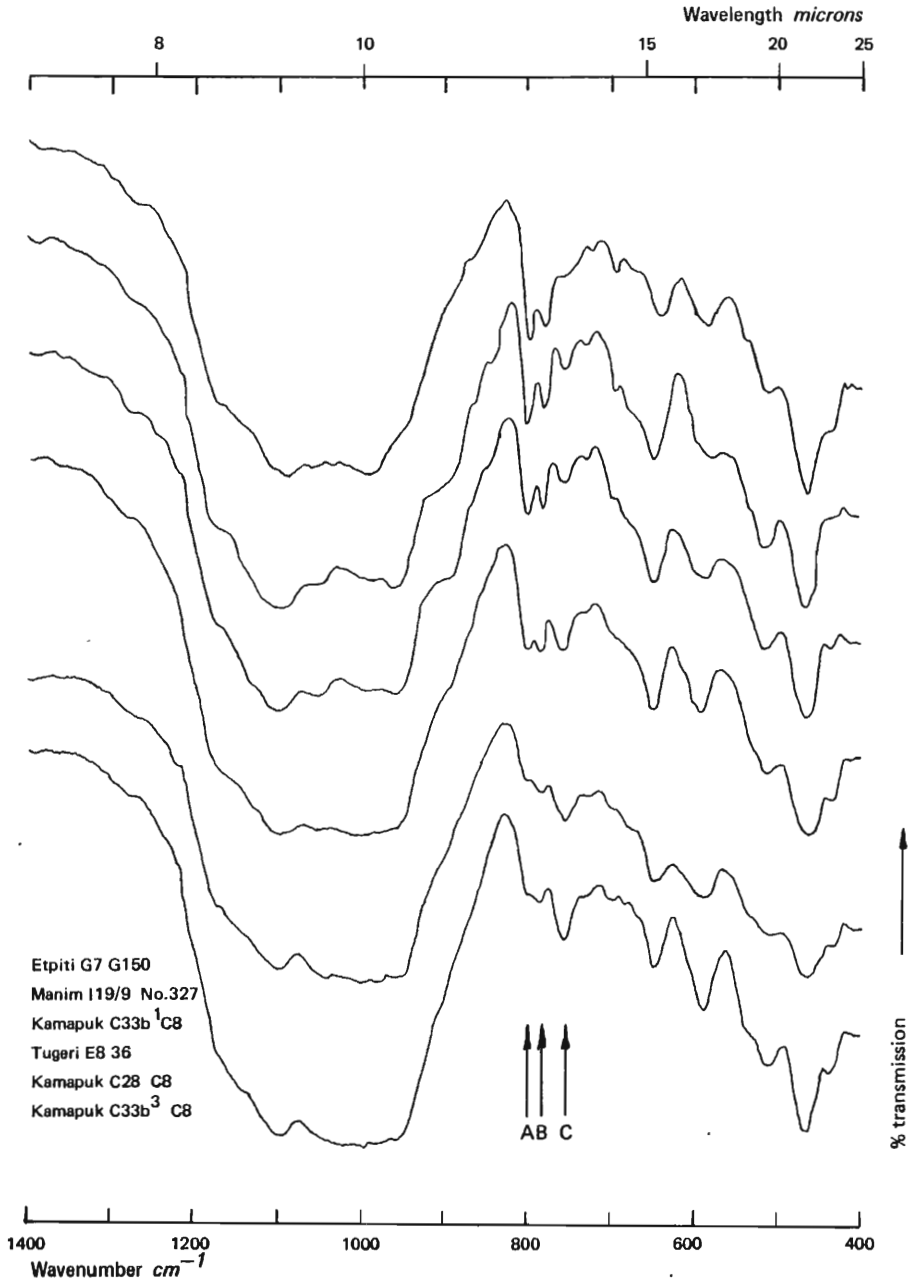


Figure H.14

TUMAN QUARRIES outcrop samples (upper) and axes from collections (lower)



MANIM VALLEY samples identified with the Tuman quarries from stratified contexts

Figure H.15

Mbukl

Typical Mbukl spectra (Fig. H.16) are similar to quartz-poor Tuman spectra. Twelve samples were analysed; they were collected by R. Lampert in 1975 and by myself in 1980. The C peak appears to lie off the 750 wv./cm line (dashed) at 755 wv./cm. One stratified axe fragment from Kuk and seven axes from the Kuk surface collections were tentatively identified as being from Mbukl. Two of their spectra are shown in Figure H.17. All the axes have surface discolourations or patinas to greater or lesser extents; if they were not from Mbukl, the axes would be classed at being from the Tuman quarries. Axe K/M/S17 from Kuk is a roughout with the same deep blue colour that fresh Mbukl specimens possess, but even so a Tuman origin cannot be ruled out. In conclusion, Mbukl and Tuman axes have similar spectra that are unlikely to be confused with those of other sources, and this indicates that the sources have a similar mineralogy. The few X-ray fluorescence analyses that I obtained (Chapter 10) show that Mbukl axes are richer in strontium than Tuman axes and this method of elemental analysis would appear to hold great promise for resolving the differences between the two.

Repeng

Repeng spectra (Fig. H.18) are dominated by quartz and in this respect resemble Tuman and Mbukl. Five spectra were obtained from a sample collected at the quarry. Only one axe in a total of 340 at Kuk and Wurup is possibly from Repeng; its spectrum, which is aberrant in some respects, is quartz-rich with an additional peak, B, at 875 wv./cm (Fig. H.19). It also has a broad absorption band at A, but this may not be important. Well-identified spectra sometimes have aberrant peaks outside the 400-1200 wv./cm range. In the outcrop spectra the 875 wv./cm peak (marked at A in Fig. H.18) is weakly expressed, but still visible.

Repeng axes are very unlikely to be found in the Wahgi Valley; in the collection made nearest to the quarry, the Rappaports' Tsembaga collection, only about 8% of the blades were probably from Repeng (A. Rappaport n.d.; Chappell 1966:Table 2).

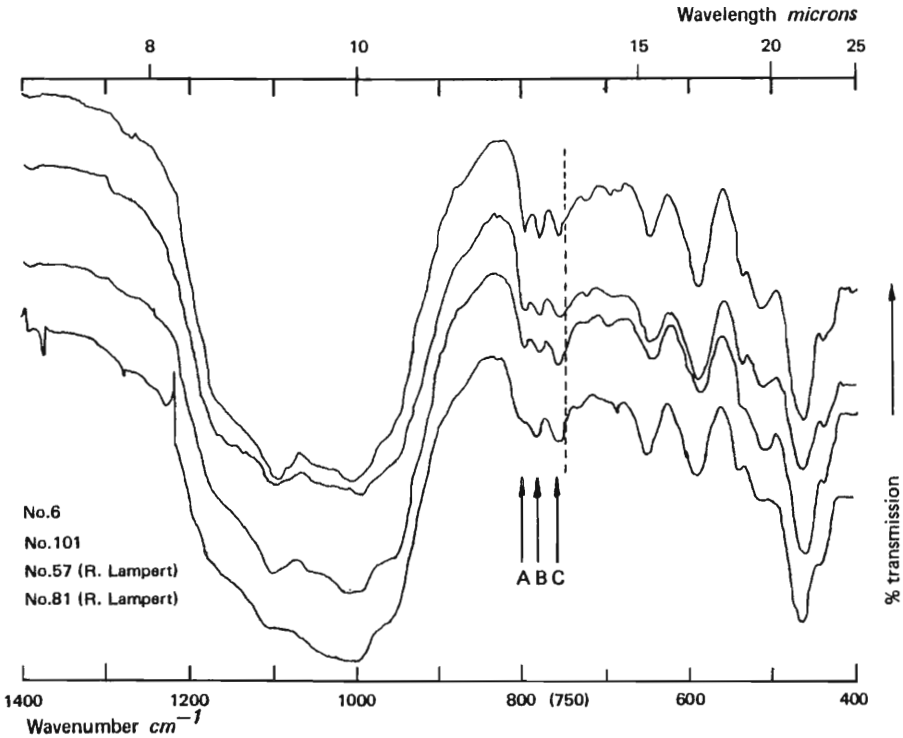


Figure H.16

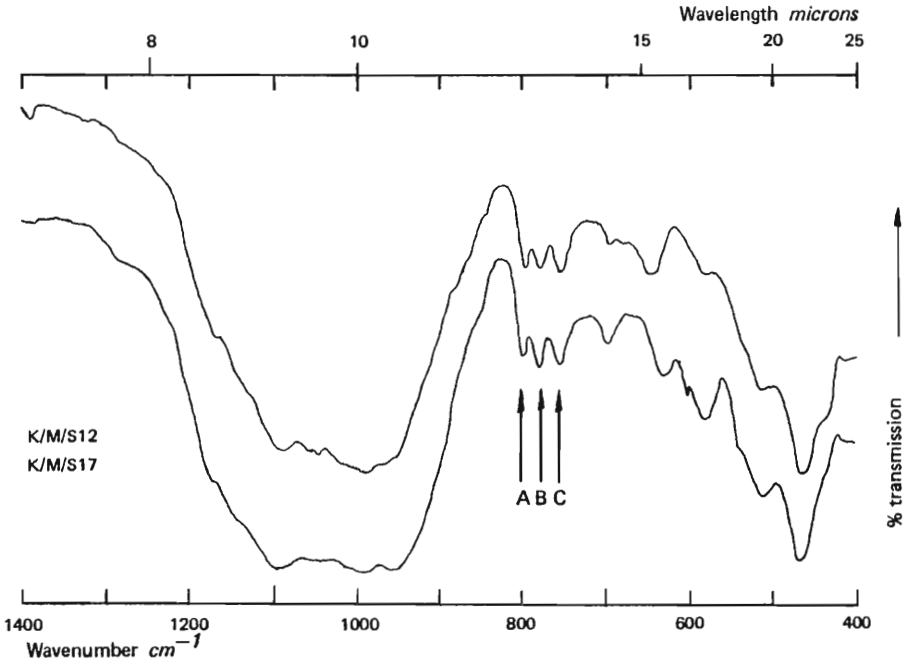


Figure H.17

MBUKL infrared spectra of outcrop samples (upper) and Kuk axes (lower)

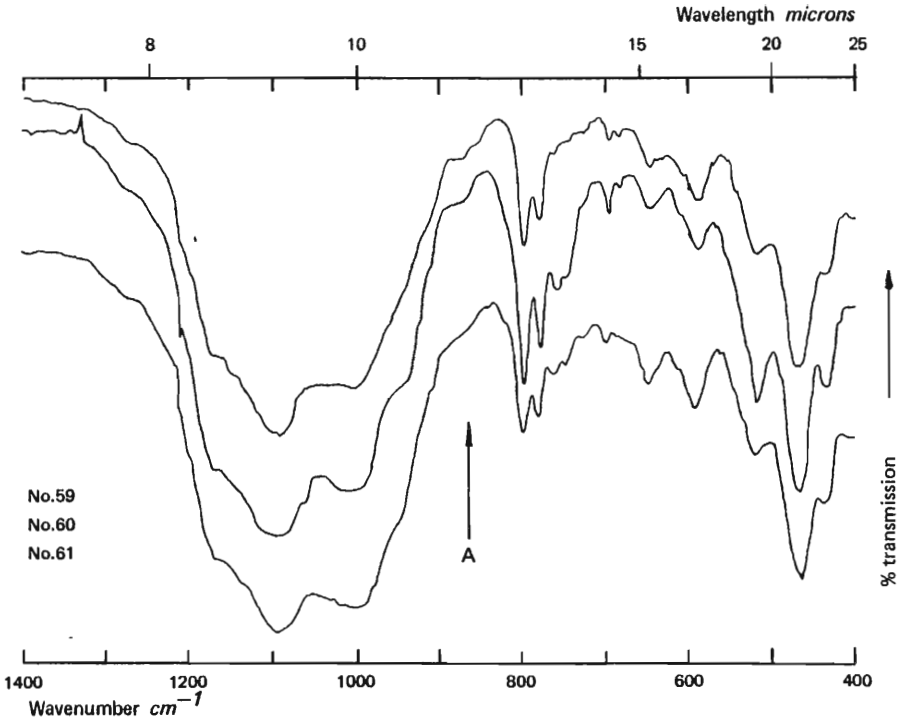


Figure H.18

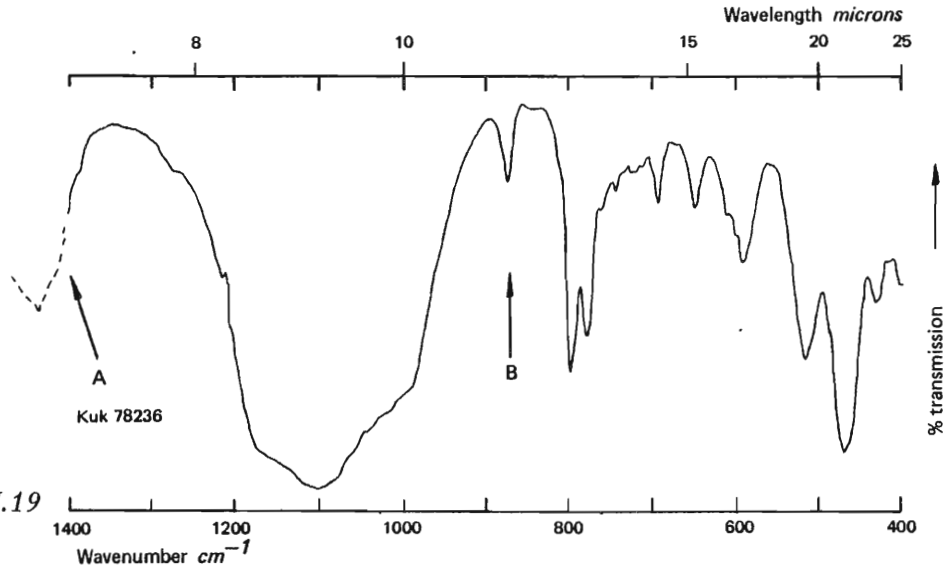


Figure H.19

REPENG infrared spectra of outcrop samples (upper) and suspected axe (lower)

Ganz River

Two facies are present in the 15 samples from the quarry that were analysed: what I have called the 'Ganz PX' facies and the 'generalised Jimi facies' (Chapter 10). The PX spectrum has two distinguishing regions. Between the points marked A and B in Figure H.20 lies a band of peaklets rising like a flight of steps from left to right. Between C and D the spectrum has a characteristic shape culminating in a well-defined peak at D. The shape is either that of a descending flight of steps (e.g. Wurup 13) or it begins with a strong peak at C. In either case the only possible confusion is with Pukl; Pukl, however, has a strong peak midway between the PX peaks C and D (F in Figs H.7 and H.8).

A greater range of spectral types is seen among the artefact collections than the outcrop samples. Only two of the latter, plus Enk Ru's **ketepukla** axe, are of PX facies. Note that some of the axes (e.g. Wurup 302 and Kuk 77153) have the albite quadruplet at A (Fig. H.21) that is most clearly seen in Pukl spectra.

I have identified the fragment from Nombe numbered A1:2(16), a black axe chip from Stratum A, as Ganz PX. It is not absolutely typical of PX, but it exhibits more of the attributes of PX than of any other likely candidate and it is certain to be from one of the Jimi quarries. A number of the axes from the surface collection have similar spectra and they can definitely be sourced to the Jimi Valley quarries, judging by colour, shape and size in hand specimen.

The generalised Jimi facies is illustrated by spectra in Figure H.22. Most of the Ganz outcrop samples that I collected fall into this category, which appears to be rich in amphiboles, having a strong peak at B, 755 wv./cm. Unfortunately the same attributes are seen in spectra from Tsenga **tingri**, Apin and Yambina. I classified axes with comparable spectra into the unknown categories 'A' and 'C' - it was not possible to identify Ganz axes with this kind of infrared spectrum.

Tsenga tingri, Apin and Yambina

The infrared spectra of these quarries cannot be separated. The axe rocks are rich in amphiboles and may be classed with the 'generalised Jimi facies'. Fifteen samples of **tingri** were analysed; the spectra of three outcrop samples and Hughes axe No.29 are illustrated in Figure H.23. On either side of A, in the band 950-1150 wv./cm, there is a set of four amphibole peaks; there is a strong peak at B, 755 wv./cm, and a distinctive set of peaks and inflections between C and D.

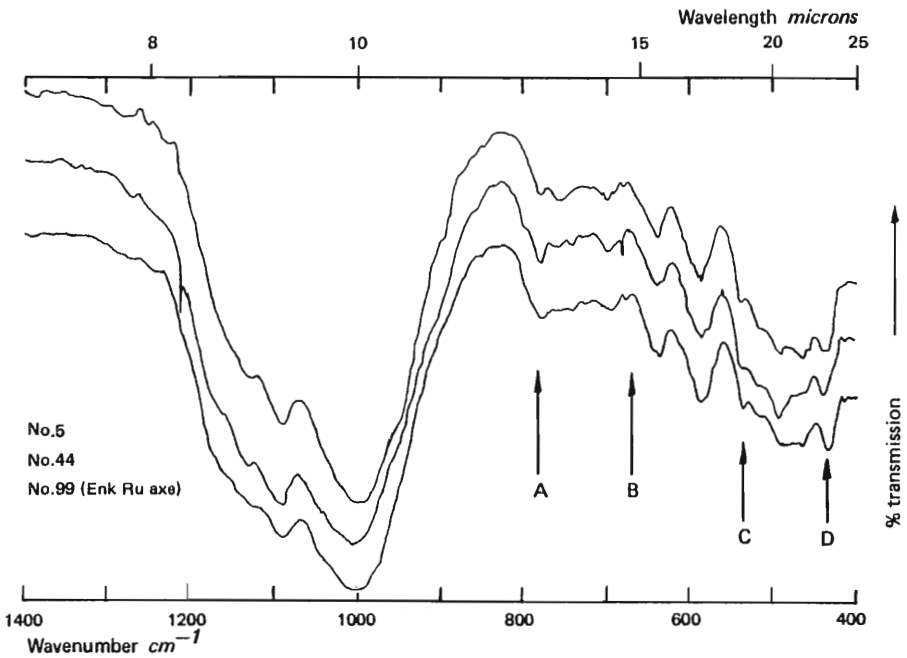


Figure H.20

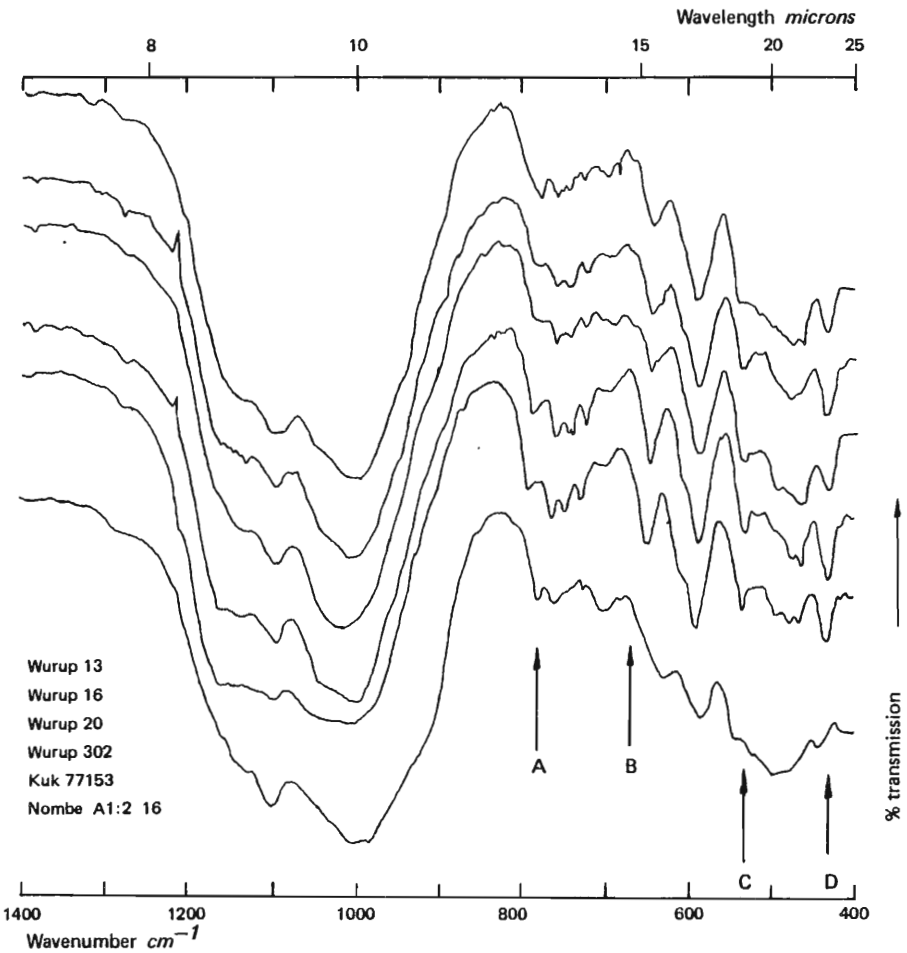


Figure H.21

GANZ ('PX' facies) samples identified with quarry (upper), and collected axes (lower)

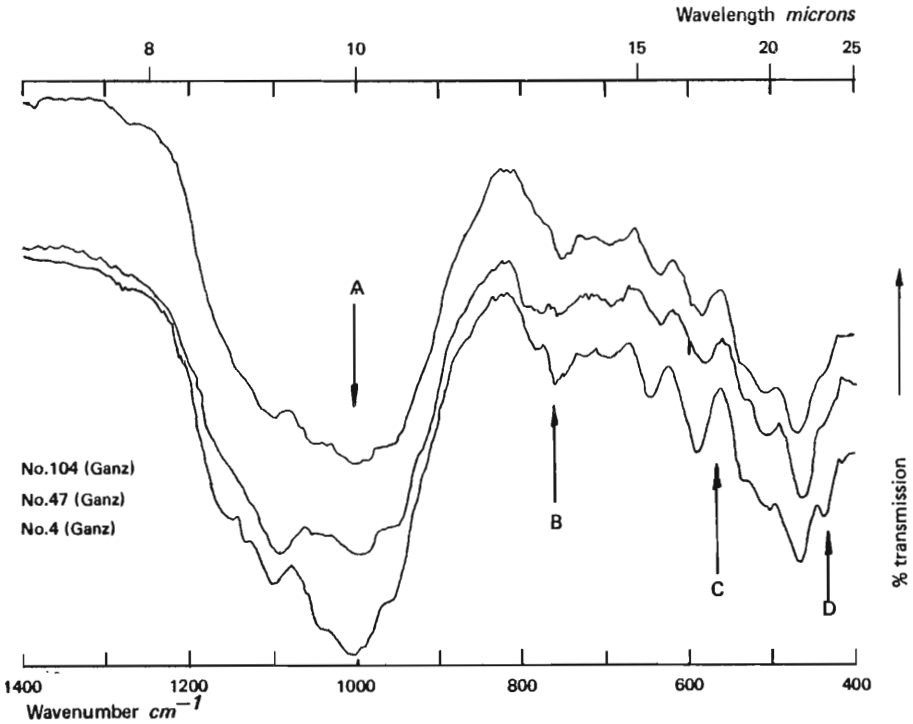


Figure H.22

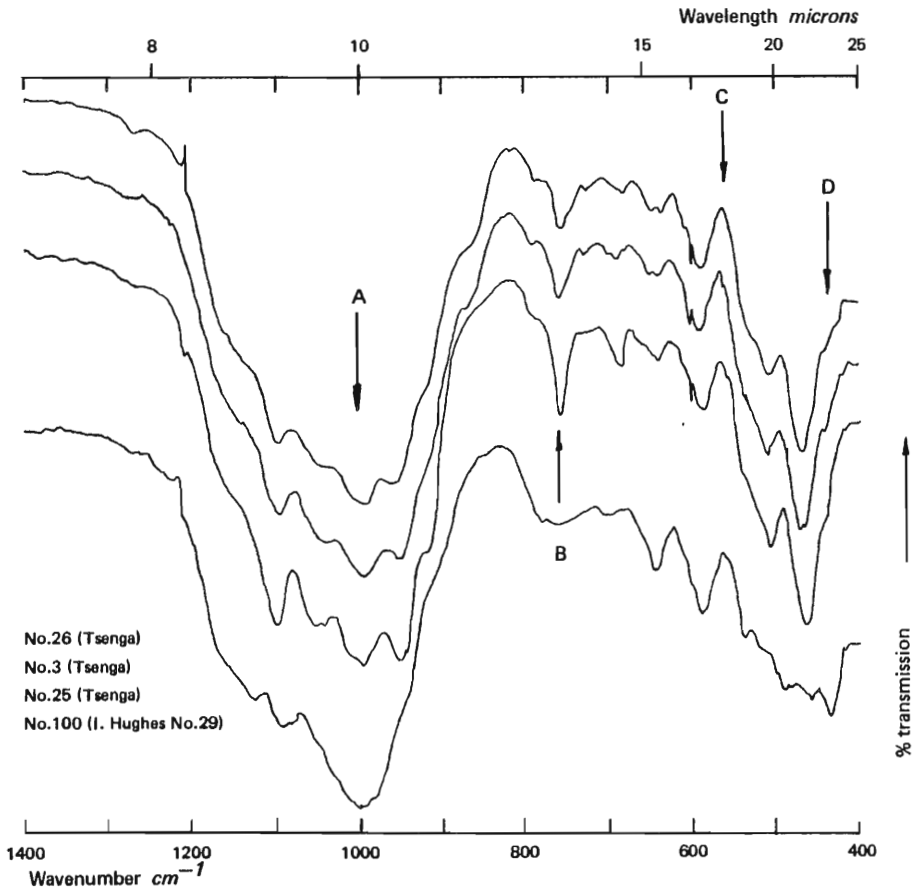


Figure H.23

GANZ/TSENGA samples identified as *ketepukla* (upper) and *tingri* (lower)

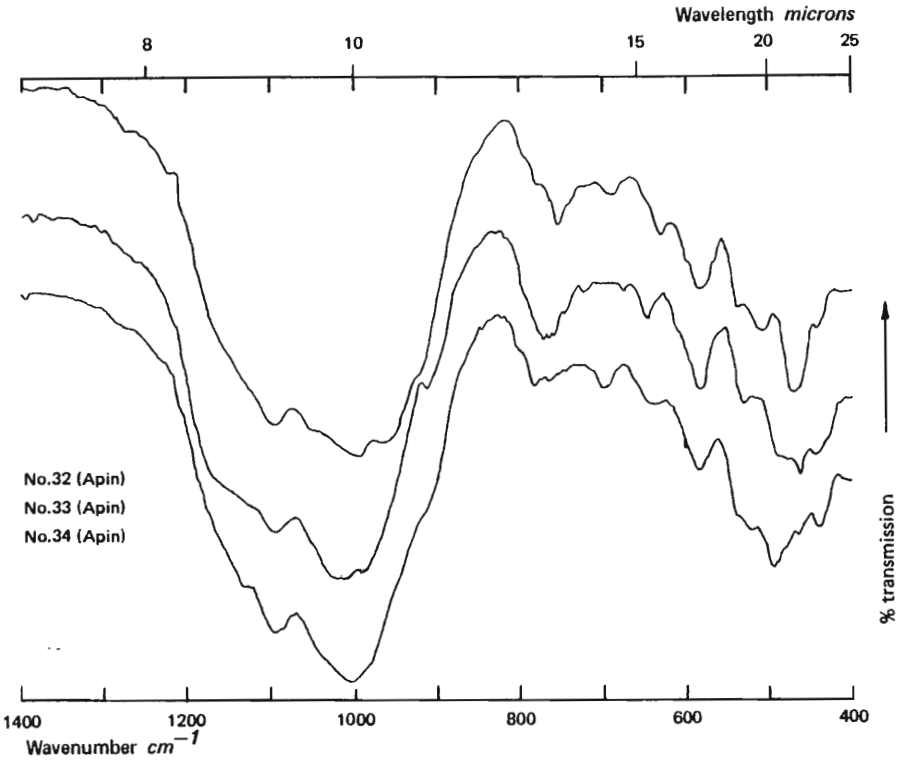


Figure H.24

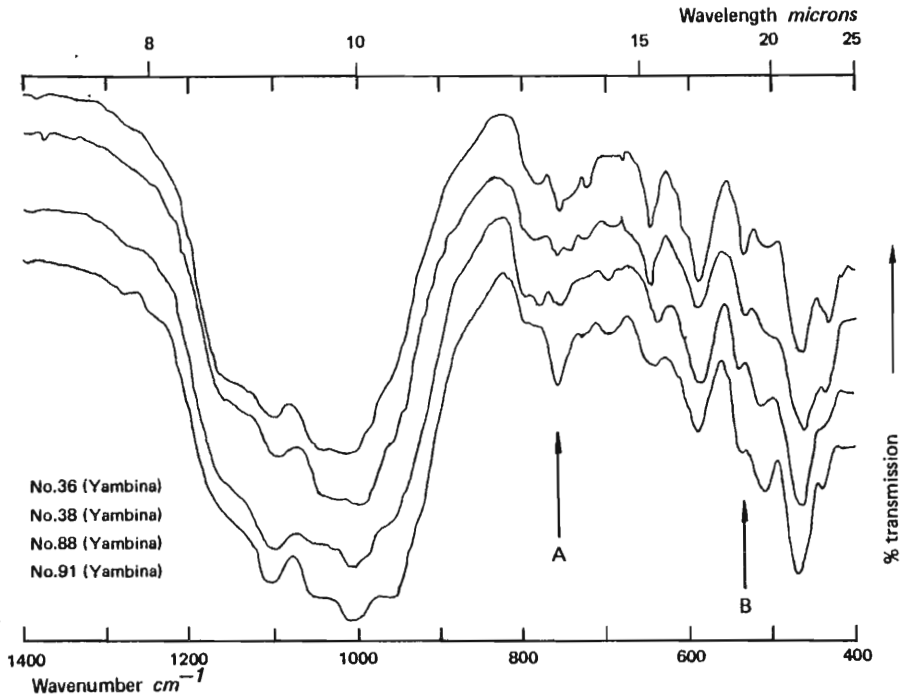


Figure H.25

APIN and YAMBINA infrared spectra of outcrop samples (upper and lower respectively)

Apin spectra are illustrated in Figure H.24 and Yambina spectra in Figure H.25. With only three samples to work from - I visited the site on only one occasion - it is difficult to say much about Apin. The spectra vary from being PX-like to being **tingri**-like. The nine available Yambina spectra range from being Pukl-like to being **tingri**-like. One Yambina sample, No.36, in fact falls within the range of variation of Pukl spectra - this is the only such case among the Jimi outcrop samples.

Chappell (1966:107) stated that both black axe types from Ganz and Tsenga are felspars recrystallised to a mesh of tremolite-actinolite laths with subsiduary albite and quartz. As can be seen from their reference spectra (Fig. H.2), actinolite must predominate in these axe types: tremolite has extra peaks which are not seen in the 'generalised Jimi facies'. In addition, the presence of albite is a feature distinguishing Ganz PX spectra from Tsenga, Apin or Yambina spectra.

Hughes found his axe No.29 at the side of a path at Tsenga (1971:293) and informants identified it as **tingri**. Its spectrum is in fact closer to Ganz PX than to the spectra of the **tingri** outcrop samples I collected; it is closest of all to the spectrum of Enk Ru's **ketepukla** axe (Fig. H.20). It could be that there are also two facies at Tsenga, but if so I failed to pick this up in outcrop samples collected in either 1980 or 1981. None resembled Hughes No.29, which must be seen for the time being as an anomaly.

Tsenga Gaima

I collected a number of light-coloured outcrop samples at Tsenga, both at the Tingri site and from nearby rock faces at Kugla Kugli and Yambina (no relation to the quarry site of Yambina). I also found a light-coloured hammerstone at Ketepukla on the Ganz River. Their spectra were distinctive and similar to each other, as seen in Figure H.26. The peak at A, 865 wv./cm, is not seen in the spectra of other sources; together with the quartz doublet at B and the 'flight of steps' peaklets between B and C, it helps to distinguish **gaima** from other axe types.

Tsenga **gaima** axes are generally easy to recognise in hand specimen. The surfaces of **gaima** axes are light green when fresh and unpatinated; however, most archaeological examples have a skin of weathering about 1 mm thick and are chalky-white in appearance. In either case they could only be confused with Dom **gaima** axes, which are superficially similar when weathered, or local axes. A large roughout from the Kuk surface collection, Kuk 77148, is made from

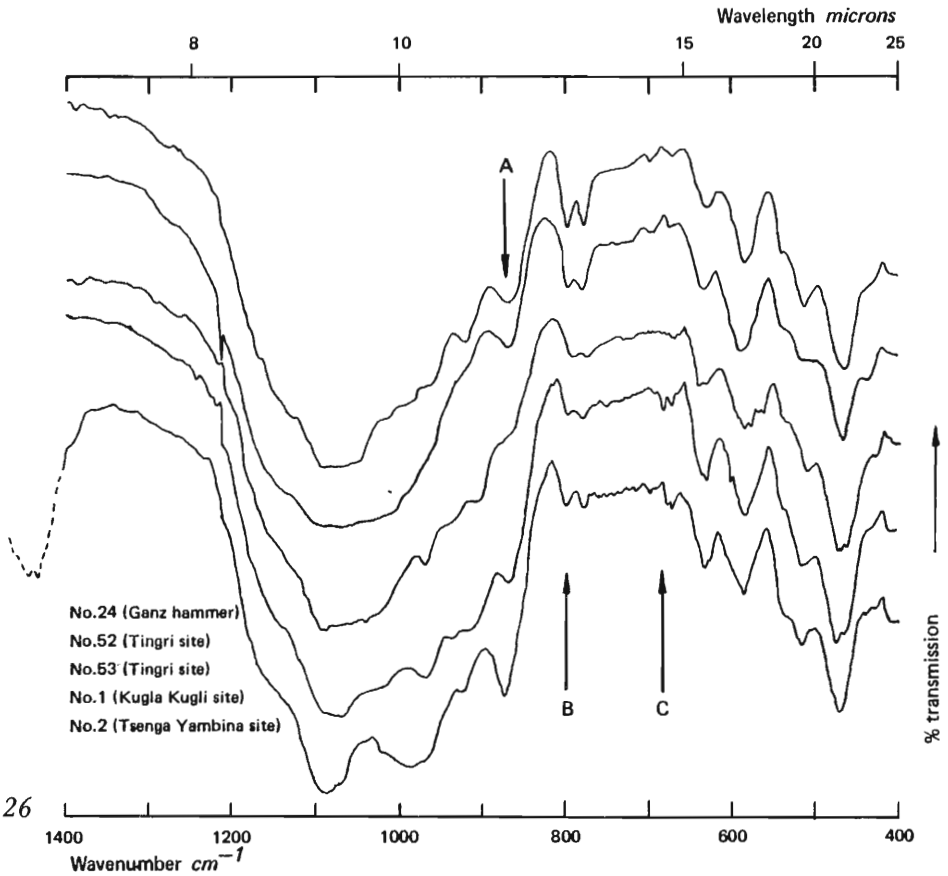


Figure H.26

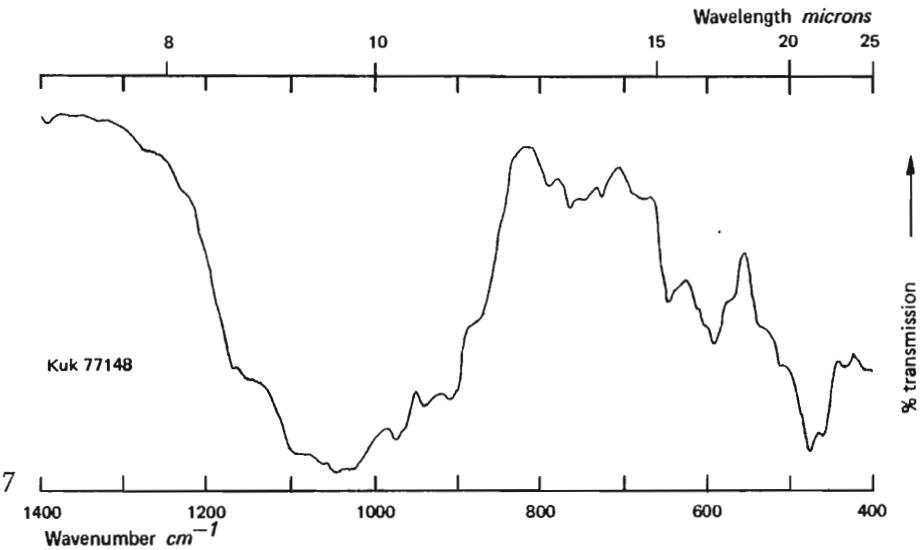


Figure H.27

GANZ/TSENGA samples identified as *gaima* and similar light coloured stone

Tsenga **gaima**, to judge by its colour and surface texture, but its spectrum does not match the outcrop samples. It appears to have a albite quadruplet at 700-800 wv./cm and there are other features not seen elsewhere.

It is curious that the Ganz hammer so closely resembles the Tsenga samples. Men on the Ganz River confidently said that **gaima** was a Tsenga product, when I made specific inquiries. Chappell (1966:100) found that **gaima** was a Ganz material mainly used for hammers, but Hughes (1971:296) was told at both Menjim (Ganz River) and Tsenga that **gaima** was made into axes at both places. Perhaps **gaima** does exist at the Ganz site, but in small quantities or in a phase unsuitable for axe manufacture. At any rate I saw no light-cloured flakes there, in contrast to many dark **ketepukla** flakes. At Tingri, lumps of both light and dark rock were scattered about, indicating that the two type may have occurred in similar quantities.

Unidentified Groups A-D

Amphibole-rich spectra are common in both the Wurup and Kuk collections. They cannot, as already explained, be sorted into groups corresponding with Tsenga, Apin or Yambina spectra. Some examples that I classed with the types 'A' and 'C' are shown in Figure H.28 and, as I stated above, the two groups did not prove to be distinct in the final analysis. The main amphibole peak is shown at A, 755 wv./cm. Axes classed as 'A/C' are black in colour and are stylistically of Jimi Valley design.

Three axes had a distinct spectrum which I labelled 'B'. Their spectra, shown in Figure H.29, are dominated by quartz peaks at A, B and E, but they have a unique 'flat step' between C and D. This a result of additional absorption at approximately 470 wv./cm and 530-540 wv./cm. There is also a minor, unidentified absorption band at 830 wv./cm. Three axes had a spectrum that I labelled 'D'. Quartz is also present, as seen at A and B in Figure H.30. However, there are additional peaks between B and C and a characteristic inflection at D. Both 'B' and 'D' axes are black in colour and typologically similar to axes from known Jimi quarries.

'B' and 'D' axes have no known source as yet and either represent subsidiary facies at one of the major sites or minor sources somewhere in the swathe of hilly country between the Muklpin and Sau rivers. There are a number of candidates among the lists of names collected by A.M. Strathern (1965), A. Rappaport (n.d.) and Gorecki (n.d.). Those not yet satisfactorily linked with axe sources include Nyambi or Nembi (possibly a source at Tsenga); Kraep, Rumna

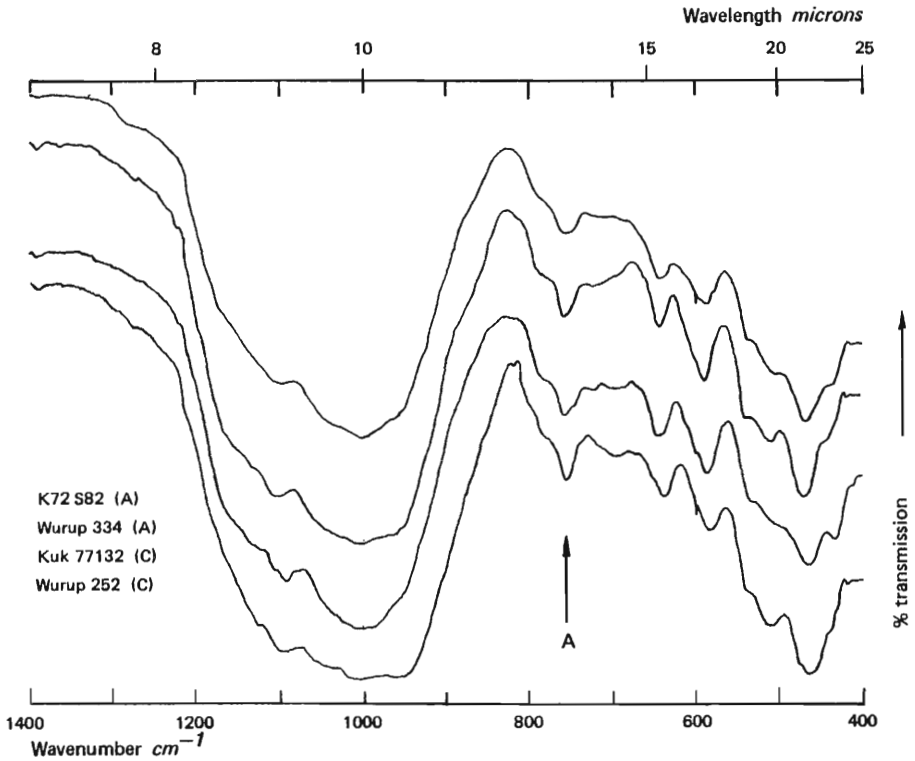


Figure H.28

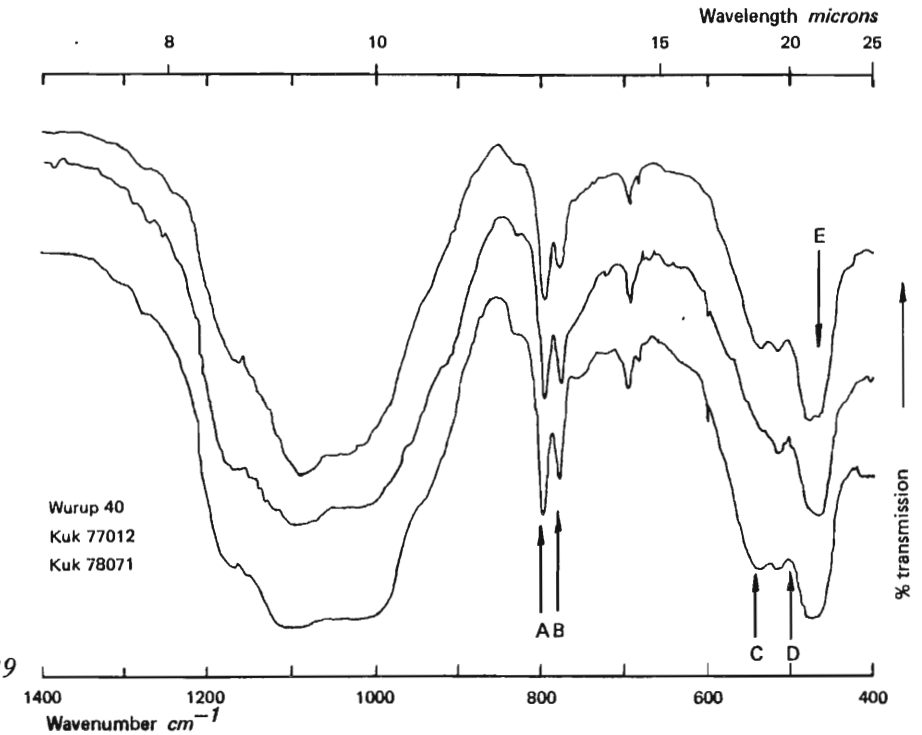


Figure H.29

AXES FROM UNKNOWN SOURCES 'A' and 'C' (upper) and 'B' (lower)

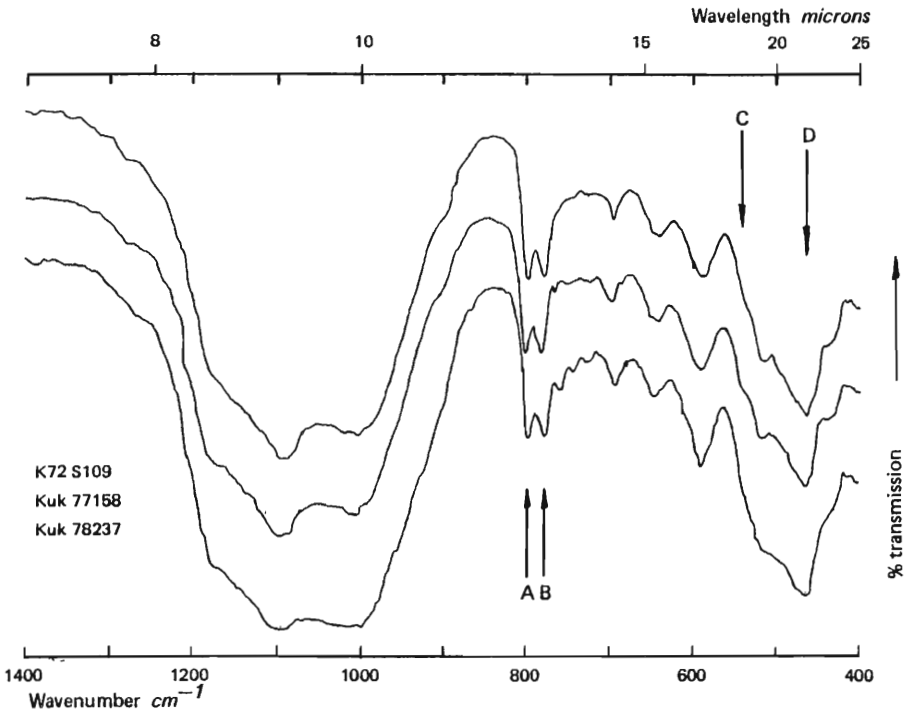


Figure H.30

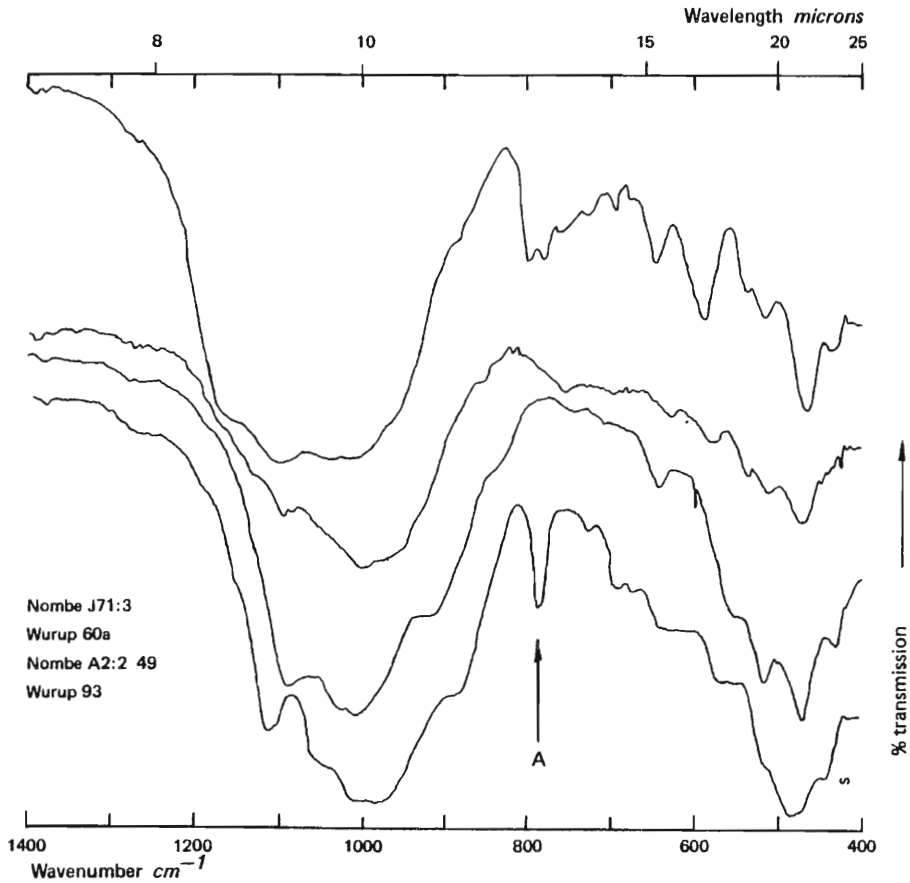


Figure H.31

AXES FROM UNKNOWN SOURCES 'D' (upper) and miscellaneous (lower)

and Roklemana (probably all on Palke ground); and Nøpilye (possibly on Tumalke land).

Other Unidentified Spectra

A few axes produced spectra outside the range of any of the groups I have described; others produced spectra within the ranges of variation of particular groups, but which, for some reason, cannot easily be fitted into them (Fig. H.31). Nombe J71:3 is an axe fragment with a spectrum that could be classified as Tuman, but it is too black in colour and I have left it unsourced. Nombe A2:2 (49), on the other hand, has a spectrum unlike that of any modern source or recently made axe.

Wurup 60a is almost a 'A/C' axe, but its spectrum is too non-descript for sourcing; it is black and it does have a fine-grained texture, but it is not completely typical of a Jimi blade and I have not identified its source. Wurup 93 has a very unusual spectrum with a strong peak, A, at 790 wv./cm. It is a very small axe, only 5.5 cm long, and it has a surface texture unlike other axes from Western Highlands Province. I cannot be certain, but it suspect that it from one of the Eastern Highlands sources on the grounds that there are similar materials among the fragments found at Nombe rock-shelter, which is situated at the extreme estern end of the study area. No infrared analyses were obtained from these fragments, however.

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