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Form and Decoration of Arrows from the Highlands of Papua New Guinea

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ABSTRACT. This study concerns the form and decoration of arrows from the highlands of Papua New Guinea. The morphology of a sample of 834 arrows is described. The decorative carvings on fore-shafts and heads are analysed in terms of 13 elements and variants of these. The combinations of elements into design patterns is described and their geographic distribution analysed. Variations in both morphology and design are found to correlate with language family boundaries for the most part, but the most clearly marked boundary lies between Central and West Central language family areas.

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KEYWORDS: arrows, form, decoration, Papua New Guinea, language boundaries, physiographic boundaries.

The use of bows and arrows for fighting, hunting and display is almost universal in Pacific islands' cultures, and is certainly so throughout the highlands of Papua New Guinea. Being among the most common artefacts and being, to many European eyes unusual and decorative, arrows have been frequently collected. Museums in many parts of the world hold large collections of arrows, which have, however, rarely been the subject of detailed study. This work is a contribution both to the systematic description of these artefacts and to an understanding of the relationship between the distribution of arrow forms and designs, and geographic and linguistic entities.

This study was begun originally as an M.A. thesis (Bush, 1976). The present publication has been extensively amended and re-written, especially in the light of new interpretations of the linguistic data. There has, however, been little modification of the analyses of arrows.

STUDY AREA

Geography. The highlands of Papua New Guinea cover an extensive area of the cordillera that stretches for 960 km and forms the 'backbone' of Papua New Guinea and extends into Irian Jaya. It is a complex system of broken ranges, forming mountain barriers which frequently separate broad upland valleys, and is the watershed for many river systems flowing north, south and east. The ranges that form the cordillera rise to great heights — the highest, Mt Wilhelm at 4,438 m, being part of the Bismarch Range, an arm of which forms the Sepik-Wahgi Divide. Mt Kubor, 4,290 m, is the highest mountain on the southern side of the cordillera that partly encloses the Wahgi and Chimbu River systems.

The eastern boundary of the highlands is relatively well defined by the steep scarp known as the Ramu-Markham Fall. In strict geographic terms the western end lies in Irian Jaya at about 135°E. This study is, however, concerned with that part of the cordillera which lies east of the Papua New Guinea - Irian Jaya border, and particularly with that lying east of the Strickland Gorge.

Within these geographic limits is an important physiographic division, the Chimbu-Asaro Divide. This mountain chain runs roughly north-south, separating the Asaro River valley to the east, from the Chimbu River system to the west. This divide is considered a significant boundary in cultural terms.

Linguistics. Between the Asaro and Chimbu valleys there is a "linguistic break' (Read, 1954:7). This break

between East Central and Central language families closely follows, in part, the Chimbu-Asaro Divide (McKaughan, 1972; Würm, 1975: 563, Fig. 1). The Chimbu languages on the western side of the Divide are different in phonetics and vocabulary to those on the eastern side, and indicate a relationship to languages of the Hagen area and westwards. These western languages (i.e. the Hagen-Wahgi-Jimi-Chimbu group) are cognate but not mutually intelligible.

Settlement pattern. Both Read (1954:12) and Brookfield & Hart (1971:222-4) record that settlement patterns differ on each side of the Chimbu-Asaro Divide. To the east are found nucleated villages, whilst in the Chimbu area and further west, residence is in the form of dispersed settlements.

Stone-axe quarries and axe blades. Eleven stone-axe quarries investigated by Chappell (1966:97, 111-2) and two by M. Strathern 1966:118) constitute the main quarries in the central highlands. Chappell (1966:97) places twelve of these on the western side of the Chimbu-Asaro Divide, with the remaining one at Kafetu on the Divide. There are no quarries east of Kafetu, and stone axes are not made from quarried material east of the Divide.

According to Strathern (ibid.) the types of axe-blades produced are also different. Polished axe-blades, planilateral in section, come from the twelve quarries west of the Chimbu-Asaro Divide, whilst the quarry at Kafetu 'seems only to have produced blades of a lenticular section.' Planilateral axes are not manufactured in the east.

Archaeology. Among 6 archaeological sites (R. S.Bulmer, 1964, 1966,1976; White, 1965, 1967a, 1972), Yuku, Kiowa, and Nombe (Niobe) to the west of the Divide contained flaked waisted blades, whilst Kafiavana, Aibura and Batari to the east did not. The meaning of this dichotomy is at present unknown. There are also minor differences in the flaked stone artefacts.

Languages. According to Würm (1975), highland's languages are all non-Austronesian (Papuan), and are members of two stocks:

1. East New Highlands stock comprising Eastern, East Central, Central, West Central and Kalam families, and Wiru and Kenati family-level isolates;
2. Central and South New Guinea stock, which includes Duna and Ok families.

The distribution of these languages is given in Figure 1. The Central and South New Guinea stock is found in the western part of my study area (Duna family) but extends further west into Irian Jaya, and south into the Fly River Lowlands.

Lexicostatistically, Duna is considered a link between the two stocks with heavy borrowing from Huli of West Central family, yet structurally shows similarities to three families of Central and South New Guinea stock (Würm, 1975: 395).

The relationship of Oksapmin family to other families is unclear; Würm regards it as a sub-phyulum level isolate. Healey (pers. comm.) feels that almost all of the similarities with Ok are due to borrowings in both directions between Oksapmin and Bimin, a family of the Mountain Ok sub-family.

Recent theories on language movements in Papua New Guinea (Würm, 1975) indicate an early movement, through much of mainland New Guinea from west to east, of daughter languages of the trans New Guinea phylum proto-language. Then, during the last 5,000 years, movements from east to west seem to have been responsible for similarities in many highlands languages. These include a migration from the Finisterre area (Huon family) to Telefomin area (Ok family); the relationship is based mainly on typological similarities (e.g. in verb structure and usage). Healey suggests this relationship is probably genetic, though remote.

In this study I have made use of material from all the above-mentioned families and isolates (except the Kalam family and the Kenati family-level isolate). I have also used material from the area of the Daribi language family (Karimui), because arrows and ethnographic data were available from this family which is distantly related to east New Guinea highlands stock. I also used, as a comparison, arrows of the Aiome people (Aian language family) who live on the middle Ramu River. Details of arrows within each family area are given in my thesis (Bush, 1976: 171-216).

Geography and Language

The relationship between physiographic and language boundaries in the highlands makes an interesting study, but only the main boundaries that occur within the study area are summarized here. Physiographic and language boundaries that show close correspondence are:

1. Chimbu-Asaro Divide and boundary between East Central and Central language families.
2. Yuat-Mt Hagen-Kaugel River and boundary between Central and West Central language families.
3. Ramu-Markham Fall and the eastern boundary for families of East New Guinea Highlands stock.

The Strickland Gorge appears to be simply a major physiographic boundary within the highlands proper. It shows no correspondence with boundaries of language families that make up the northern group of Central and South New Guinea stock, although it forms part of the boundary of the Oksapmin sub-phylum level isolate.

To summarize the language situation in the highlands as it appears at present, there seem to be two roughly north-south physiographic boundaries, the Chimbu-Asaro Divide and the Yuat-Mt Hagen-Kaugel River complex, which divide highlands languages into Eastern, Central and West Central groups. A further group extending westwards from West Central family boundary includes Duna and Ok families of Central and South New Guinea stock.

Role of Arrows in Highlands Cultures

Arrows (and bows) are carried by a highlands man almost as part of himself, wherever he moves outside

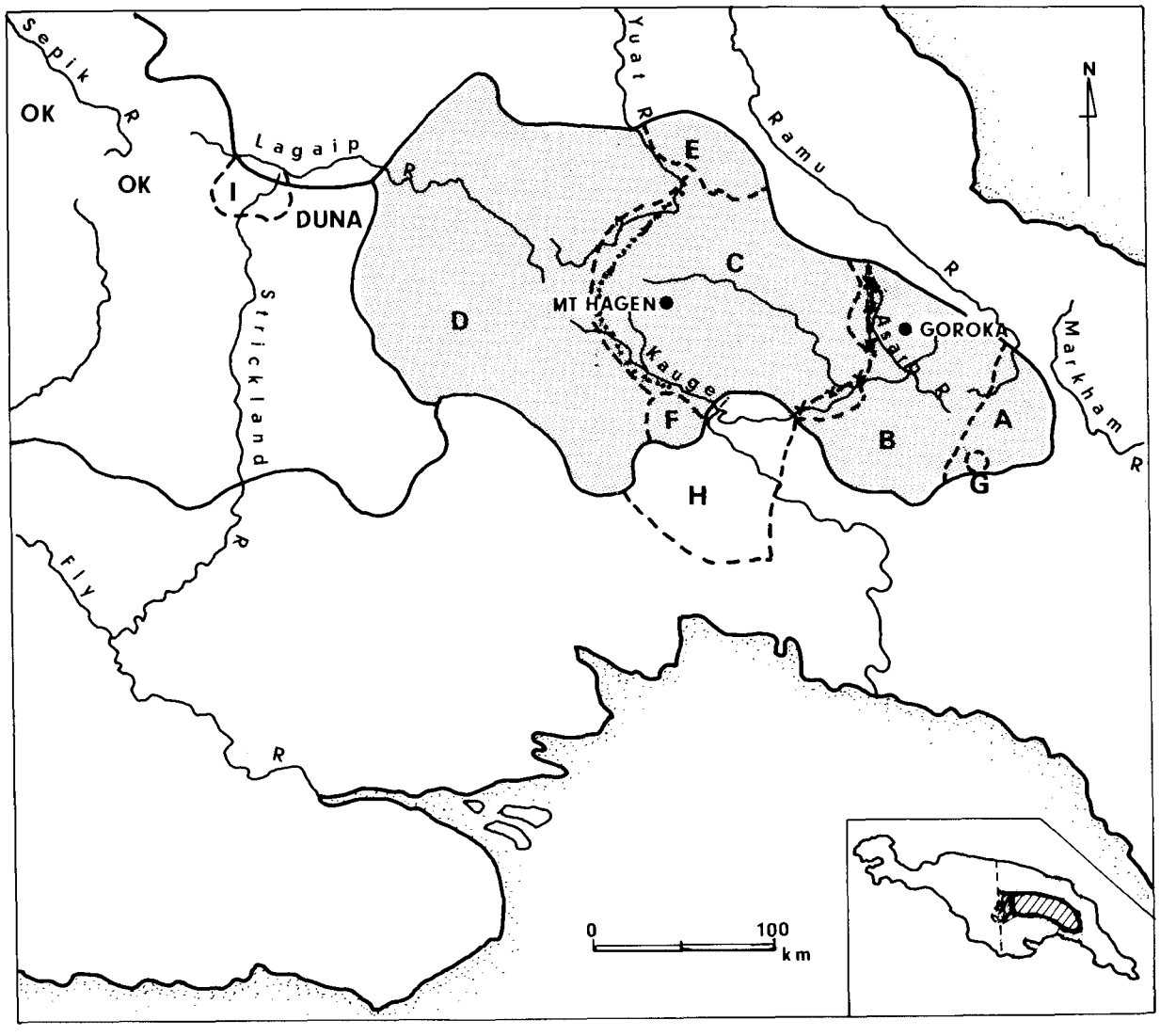

Fig. 1. New Guinea highlands language groups. **Inset:** study area, including East New Guinea Highlands stock and Central and South New Guinea stock areas. **A**: Eastern; **B**: East Central; **C**: Central; **D**: West Central; **E**: Kalam; **F**: Wiru family-level isolate; **G**: Kenati family-level isolate; **H**: Teberan-Daribi (Karimui); **I**: Oksapmin sub-phylum-level isolate;

————	Stock boundary	-x-x-x-x-x-	Chimbu-Asaro Divide
Shaded area	East New Guinea highlands stock	.....	Suggested major boundary between Central and West Central arrow designs

his village. It would seem this behavioural norm gives him a sense of security, and indicates to others his manhood status, while the arrow types he carries could point to the purpose of his sojourn away from his village — hunting, fighting or to attend ceremonies elsewhere. At ceremonies such as marriage or pig feasts, men usually carry their most ornate arrows to display at the gathering and gain prestige. At such ceremonies, the relationship between clans is enhanced by presentations and gifts of elaborately carved arrows.

From personal observation at Isale village, Ialibu, and Yagusa village, Henganofi, the manufacture of an arrow by a specialist arrow-maker becomes a male social gathering where clan gossip is exchanged, with the arrow-maker joining in as he continues working. It should, however, be noted that all highlanders know how to manufacture arrows, and traditionally most did so.

In 1974 I visited several highlands villages and, where possible, met specialist arrow-makers, all of whom were older men. From an interpreter to whom I posed questions about these men, I learned that an arrow-maker's position within the village community was no different from any other member of his clan. However, his superior ability and technical skill in carving designs on arrows is recognized, and gains him prestige. He is an expert whose work is identifiable from that of other arrow-carvers, even though others may copy the designs he uses. He is the person to whom other clansmen come when they require an arrow for a special purpose — a marriage ceremony, *Moka,* pig feast or, in the not-so-distant-past, to kill a specific person.

Arrows emphasise the difference between the roles of male and female within the clan. The making and use of arrows is the exclusive right of males, but in some highlands areas the treatment of raw material to make colour pigments used in arrow designs is done by clan females expert in this work.

Arrows play an important part in social organisation. Special arrows are manufactured by the kin of a murdered person, to use against the person who committed the crime and his kin in 'pay-back' killings. These arrows are made whilst sitting in groups, and 'magic talk' is intoned over each arrow when completed. It is then sheathed and put aside for its later use (Bush, 1976). This 'special purpose' arrow manufacture emphasises clan solidarity.

In pre-contact times, arrows were sometimes used as items of exchange, within and outside clan boundaries. I was told by specialist arrow-maker, Manda Pumuye of Isale village, that in the pre-contact era he traded his arrows to the Mendi people for salt and Kina shell.

In hostilities, arrows are the main weapons used by highlanders to defend their territorial rights, in 'pay-back' killings, in fights resulting from the stealing of pigs and women, failure to pay compensation, or any other infringement of clan rights. As yet, no European-introduced implement has been adopted into highlander's material culture to such a degree as to 'oust' the arrow from its traditional usage as a hunting — fighting weapon. Even in the present (1985), in spite of government bans, tribal fights still occur in the highlands, with arrows the main weapon used.

ARROWS

Sources of data. For the purpose of this study I have examined, measured component parts, tabulated data and made accurate drawings of designs on 834 arrows from as many different physiographic and linguistic areas of the New Guinea highlands as was possible. The populations of arrows studied are listed in Table 1.

The listings in Table 1 are somewhat different from those in the original thesis. Some changes were necessary when more recent data on Papua New Guinea languages became available. Wiru, formerly included in West Central family, is now treated as a family-level isolate. On the advice of B. Craig (Curator of Anthropology, Papua New Guinea Museum) for Ok language family, and Dr K. Franklin (Director, Summer institute of Linguistics, Ukarumpa, Papua New Guinea), for Central and West Central language families, I have re-located various members of the above families. Franklin (pers. comm.) considers that "the Kyaka area near Baiyer could well be a transitional area."

Detailed descriptions of arrows from the New Guinea mainland are rare. The only data in this context is provided by Moyne & Haddon, 1936 (Aiome people), Vicedom & Tischner, 1943–8 (Melpa speakers to the south and east of Mt Hagen), Blackwood, 1950 (Kukukuku), Van de Leeden, 1962 (Sarmi), Van Eechoud, 1962 (Kaowerawedj), Kooijman, 1962 (Star Mountains), White, 1967a (Legaiyu, Asaro), Von Wittinsburg, 1968 (Basle collection), Heider, 1970 (Dugum Dani), Clarke, 1971 (Bomagai-Angoiang), Abramson & Holst, 1973 (Hewa) and Watanabe, 1975 (West Papuan Lowland). It is not a long list and, of these, only the well-illustrated works of Vicedom & Tischner, White, Von Wittinsburg and Clarke deal with areas covered by this study. Further, these published studies have limited use for my purpose as their data do not provide the kinds of information necessary for my analyses.

I have made a distinction between primary attribution and secondary attribution to an area. I have assigned to the primary attribution category those arrows personally collected by anthropologists, patrol officers and others, who themselves have identified and documented in writing, or orally to me, the location of the arrows concerned, as well as those traditional arrows I personally collected from villages in the highlands in 1974. However, such arrows may not have been made in these villages for there exists various avenues for arrow exchange. Nonetheless, I believe that most of the arrows collected from a village, originated in or near to it.

Arrows given secondary attribution to an area are those purchased by or donated to museums as authentic New Guinea highlands arrows, and which may or may not be correctly identified and documented.

The arrows selected for study were collected before, or soon after, restricted areas were declared unresticted, and before European contact became extensive. Pangia sub-district was declared unrestricted in 1960, and I examined H. Kerr's private collection of arrows from Borona village, in this sub-district, collected before this date. These I consider valid traditional arrows in the category of primary attribution. Another well-documented collection of arrows were those collected by D. Hoban in 1966. These are from Um sub-clan, Iore clan, Undiri census division, Mendi sub-district, Southern Highlands Divison. This sub-clan occupies land in the Mendi valley, 10 km south of Mendi township, on the south-west slopes of Mt Giluwe, at an altitude of about 1,650 m above sea-level. Such a comprehensive documentation as this is rare in ethnographic data.

Other arrows I placed in the primary attribution category were: those from the collection of S. Moriarty which contains well-documented material from many Highlands areas, including Tambul, Porgera, Keltiga, Laiagam and Tobua; and J.P. White's arrows from Lake Kopiago (Duna people). I made use of all documented arrows available at the Australian Museum (Sydney), the Macleay Museum (University of Sydney), the Institute of Anatomy (Canberra), the Papua New Guinea National Museum and Art Gallery (Port Moresby) and J.K. McCarthy Museum (Goroka). At Goroka, in 1974, the Assistant District Commissioner, N. Wilson, allowed me to examine the arrows he had

Table 1. Arrow populations studied — general summary

Language Family	No.	Documented location	Language	Owned loaned by:
Eastern	4	Upper Ramu	Gadsup	IA Can.
	8	Kambira, Gadsup Census Div.	Gadsup	IA Can.
	12	Upper Ramu	Gadsup	Aust. Mus.
	2	Gogome village	Gadsup	PNGM
	8	Yabwiara village, Aziana Census Div.	Kenata	PNGM
	3	Nire village	Gadsup	PNGM
	2	Pinata village, Upper Lamari river, Piora Census Div.	Tairora	PNGM
Total	39			
East Central	10	Legaiyu Asaro	Asaro	Aust. Mus.
	19	Otomonarche village, Unggai Census Div.	Bena Bena	Aust. Mus.
	10	Bena Bena, Bena Bena Census Div.	Bena Bena	Aust. Mus.
	3	Henganofi, Kafe Census Div.	Kamano	McCarthy Mus.
	3	Yagusa village, Kafe Census Div.	Kafe	T. Bush
	4	Lufa, Yagaria Census Div.	Yagaria	McCarthy Mus.
	5	Ya'grofa, Kamano Census Div.	Kamano	McCarthy Mus.
	1	Legaiyu, Asaro	Asaro	McCarthy Mus.
	5	Kaiyufa, Bena Bena Census Div.	Bena Bena	IA Can.
Total	60			
Central	3	Mul Council Area, Mt Hagen	Melpa	Aust. Mus
	14	Buka Pena village, Mul Council area, Mt Hagen	Melpa	Aust. Mus
	12	Yamaga village, Mt Hagen	Melpa	Aust. Mus.
	4	Mt Hagen	Melpa	Aust. Mus.
	25	Wahgi valley	Melpa	Aust. Mus.
	13	Chuave, Chimbu	Chuave	Aust. Mus.
	13	Kamul, Chimbu sub-district	Chuave	Aust. Mus.
	10	Nomane, Chimbu sub-district	Nomane	McCarthy Mus.
	6	Koge, Chimbu sub-district	Sinasina	McCarthy Mus.
	9	Koim, Mt Hagen	Melpa	McCarthy Mus.
	12	Wahgi valley	Melpa	McCarthy Mus.
	5	Nebilyer, Mt Hagen sub-district	Melpa	McCarthy Mus.
	2	Yamaga village, Mt Hagen	Melpa	McCarthy Mus.
	14	Kwip, Mt Hagen sub-district	Melpa	McCarthy Mus.
	14	Wahgi valley	Melpa	PNGM
	9	Malgi village, Mt Hagen	Melpa	PNGM
	11	Mul Council area, Mt Hagen	Melpa	PNGM
	7	Buka Pena village, Mt Hagen	Melpa	PNGM
	11	Mt Hagen	Melpa	PNGM
	11	Eltai Village, Mt Hagen	Melpa	N. Wilson, P.C.
	9	Kaip, Mt Hagen	Melpa	N. Forrest, P.C.
	9	Gumine, Chimbu	Gumine (Golin)	M. Geiua, P.C.
	7	Pari village, Kundiawa, Chimbu	Kuman	R. Simmonds, P.C.
	8	Mai village, Kundiawa, Chimbu	Kuman	R. Simmonds, P.C.
	14	Keta village, Mt Hagen	Melpa	R. Simmonds, P.C.
	7	Kenjibi village, Wahgi valley	Melpa	R. Simmonds, P.C.
	3	Kalige village, Mt hagen	Melpa	R. Simmonds, P.C.
	3	Mt Hagen	Melpa	S. Moriarty, P.C.
	11	Tambul	Gawigl (Melpa)	S. Moriarty, P.C.
Total	276			
Wiru F-L Isolate	14	Borona village, Pogoro area, Pangia sub-district Southern Highlands	Wiru	H. Kerr, P.C.
West Central	27	Iore clan, Undiri census Div. Mendi sub-district	West Kewa	Macleay Mus.
	22	Undiri Census Div. Mendi sib-district	and Mbongu	D. Hoban, P.C.
	56	Lagaip river	Enga	Aust. Mus.
	11	Wabag	Enga	Aust. Mus
	3	Kyaka area, near Baiyer	Kyaka	Aust. Mus.
	6	Mendi	S. Mendi	S. Moriarty, P.C.
	4	Tobua	W. Mendi	S. Moriarty, P.C.
	16	Gadio people	Enga	S, Moriarty, P.C.
	8	Porgera	E. Ipili	S. Moriarty, P.C.
	5	Keltiga	N. Mendi	S. Moriarty, P.C.
	3	Laiagam	Enga	S. Moriarty, P.C.
	2	Iore, Mendi sub-district	W. Kewa	S. Moriarty, P.C.
	5	Mendi	S. Mendi	PNGM
	5	Kagua	E. Kewa	PNGM
	7	Tombada village, Ialibu sub-district	E. Kewa	PNGM
	10	Tari	Huli	PNGM
	6	Laiagam	Enga	PNGM
	2	Piangwanda village, Ialibu	E. Kewa	PNGM
	9	Margarima	Huli	T. Bush, P.C.

(continued on next page)

Table 1. Arrow populations studied — general summary (continued).

Language Family	No.	Documented location	Language	Owned or loaned by:
West Central	10	Sirunki	Enga	McCarthy Mus.
	5	Kwinga village, Baiyer river	Melpa	McCarthy Mus.
	7	Isale village, Ialibu sub-district	E. Kewa	N. Forrest, P.C.
	6	Rugli village, Baiyer river	Melpa	N. Forrest, P.C.
	18	Yaramanta village, Baiyer river	Melp poss. Kyaka	N. Forrest, P.C.
	5	Tobandi	Huli	N. Forrest, P.C.
	2	Gadio people	Enga	J.P. White, P.C.
Total	260			
Duna	10	Lake Kopiago	Duna	J.P. White, P.C.
	29	Lake Kopiago, Baranda Parish	Duna	Aust. Mus.
	7	Lake Kopiago, Aluni Parish	Duna	Aust. Mus.
	8	Supei clan, Giwobi village	Duna	PNGM
	8	Tumbudu river	Duna	McCarthy Mus.
	11	Kena river	Duna	McCarthy Mus.
	17	Lake Kopiago	Duna	S. Moriarty, P.C.
Total	90			
Ok	29	Telefomin	Telefol	Aust. Mus.
	21	Upper Fly river	Awin	Aust. Mus.
	14	Tifalmin	Tifal	Aust. Mus.
	8	Atbalmin	Tifal	Aust. Mus.
	1	Fegolmin	Faiwol	Aust. Mus.
	2	Woksapmin	Awin	Aust. Mus.
	14	Upper May river	Mianmin	Aust. Mus.
	6	Sogamin village	Telefol	PNGM
Total	95			
Grand Total	834			

Abbreviations.

Aust. Mus.	Australian Museum, Sydney, NSW
IA Can.	Institute of Anatomy, Canberra, Australian Capital Territory
Macleay Mus.	Macleay Museum, University of Sydney, NSW
McCarthy Mus.	J.K. McCarthy Museum, Goroka, Papua New Guinea
PNGM	National Museum & Art Gallery, Port Moresby, Papua New Guinea
P.C.	Private Collection

collected in the early 1960s from areas he had visited whilst they were still 'restricted'. Beside these, throughout the highlands I was granted many opportunities to examine smaller private collections at Mt Hagen, Kundiawa, Yagusa, Gumine, Nipa, Isale village (Ialibu) and Eltai village near Koim, south-east of Mt. Hagen.

Dates for the 'opening-up" of areas vary considerably throughout the highlands, and before de-restriction some persons such as miners, explorers, patrol officers and linguists (usually associated with missionary work) were permitted into restricted areas. Not long after an area was declared unrestricted, European influx accelerated. Some indigenes soon realised that Europeans would trade European goods or pay cash for their artefacts, which included arrows. These consequently became a marketable asset and were manufactured for their selling potential, with makers using steel tools in place of traditional tools. Such differences as the use of 'store-paint', for filling-in or painting designs on arrows instead of traditional natural clays and ochres, and the use of newspaper, instead of bamboo or banana leaves as a padding under shaft bindings, are two of the commonest substitutions in 'modern' arrows. Whilst I was working on a collection of traditional arrows at Goroka Museum in August, 1974, a Chimbu arrow-maker approached a Museum Trustee offering to him arrows he had manufactured to sell. Technically they were expertly made, beautifully carved and coloured, but a closer examination revealed that both the above-mentioned 'innovations' had been incorporated into the manufacture of these arrows. I have avoided using such arrows in this work.

I should point out here that opportunities for innovation, and the distribution of new arrow types and designs, existed in traditional highlands societies. I. Hughes (1971) describes a network of intersecting routes, old and new, throughout the highlands (cf. Ross, 1936). Wherever trade routes existed, there was the possibility of exchange of artistic designs, either through trade or gift of the arrow itself, by picking up arrows shot by the enemy during tribal conflicts (Heider, 1970: 282; Campbell, 1937, Australian Museum Register), or by observation of elements and motifs in designs at pig feasts, *Moka* and other ceremonies where people from different clans and different linguistic units came together.

General Description of Arrow Types

Each arrow is composite in structure. It has either: (a) two component parts — a shaft into one end of which a head is socket-hafted and bound (Fig.2a); or (b) three component parts — a shaft, a fore-shaft and

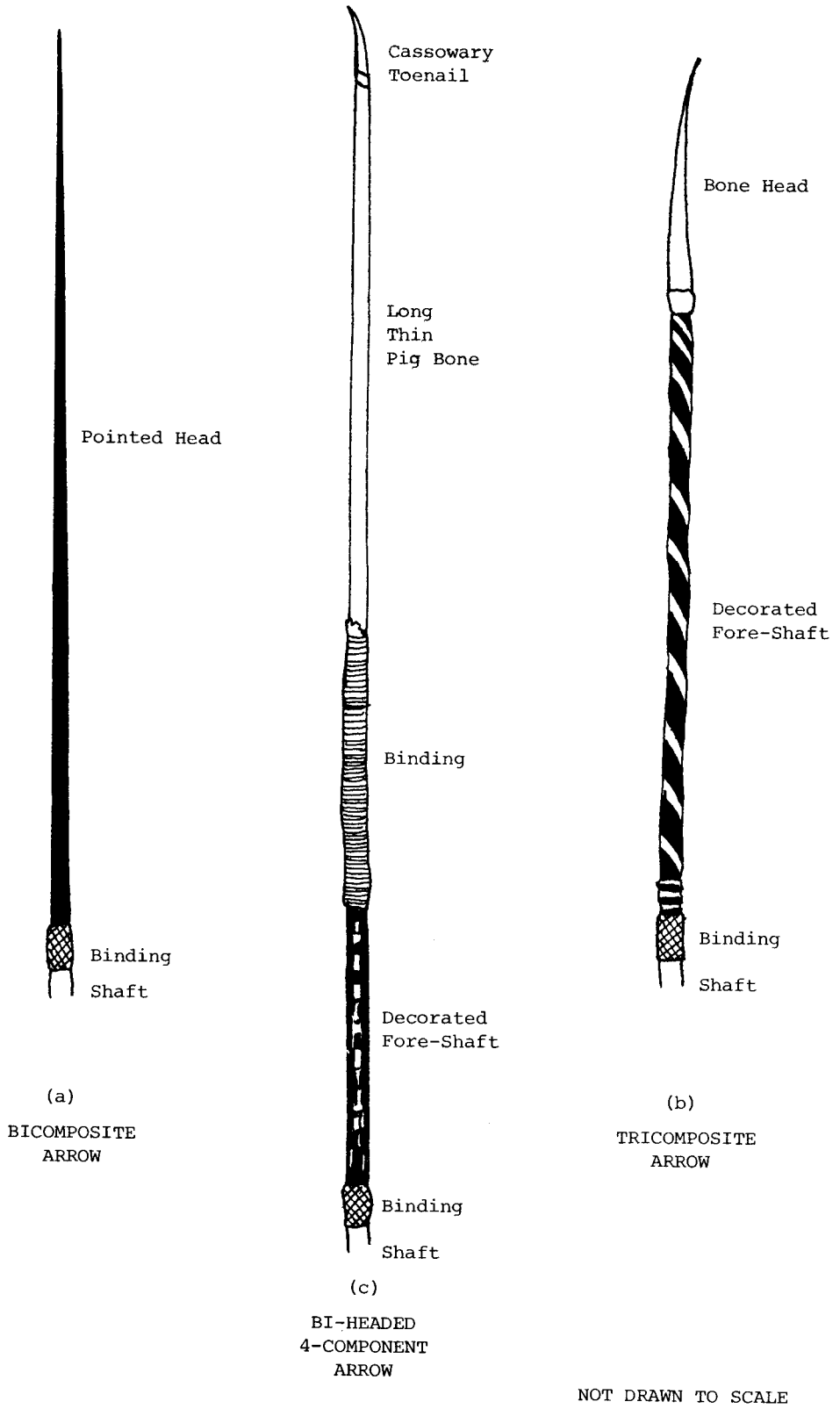

Fig. 2. Arrow types.

head (Fig.2b). The shaft is the longest part of an arrow, made from a slender reed (*Miscanthus floridulus*) a member of the same family as bamboo. The shaft varies in diameter from 0.6 cm to 1.0 cm and into one end the head or fore-shaft is hafted. The head is the distal end of an arrow, and is usually pointed. It is made either of bone, bamboo, palmwood or a hardwood. Fore-shaft is the part of an arrow that lies between the shaft and head, and is hafted to both: it is made from palmwood or hardwood.

I observed only one arrow that did not fit into the above two categories. This consisted of four parts — a normal shaft, a fore-shaft of black palmwood carved and heavily coated with red ochre, and a two-part head. The lower part was a long, thin pig-bone hafted into the fore-shaft, and on the distal end of this was hafted the pointed toe-nail of a cassowary (Fig.2c). This arrow was an extremely old, traditional type: it was part of H. Kerr's collection from Borona village (Wiru speakers).

New Guinea highlands arrow shafts have neither fletches nor nocks; they may be decorated with incised designs. Wooden heads may be decorated, but bone heads are never decorated with a carved design. Fore-shafts are sometimes undecorated, but more frequently are decorated with designs infilled and/or coloured with natural clays and ochres. These clays and ochres are sometimes treated to obtain the colour needed: pig grease mixed with charcoal (soot) to give a black pigment is common to all areas. In two regions, Pangia and Chimbu, a very rare blue subtance (vivianite) is found as nodules in river clays. This is a much desired trade item and because of its rarity is used mainly to colour designs on special arrows and ceremonial objects.

In all language family areas arrows are named according to the type of material used to manufacture their heads. Ethnographic data support the oral evidence of this trait provided to me by members of various highlands clans. As an example, I give the names used by Kewa speakers of Isale and Topopul villages in the southern part of the West Central family area:

kone kane — an arrow with a pointed bamboo head.

mera — an ordinary arrow with a pointed palmwood head.

walapi — an arrow with a pointed hardwood head, often the root of a certain tree (unidentified).

Kuli — means bone in Kewa, and placed in front of this word is a qualifier that indicates the type of bone used as the arrow head.

kimbu (fibula)*kuli* (bone) — human fibula arrow head.

ali (humerus) *kuli* (bone) — human humerus arrow head.

yana (dog) *kuli* (bone) — dog bone arrow head.

mena (pig) *kuli* (bone) — pig bone arrow head.

yari (cassowary) *kuli* (bone) — cassowary bone head.

yari (cassowary) *kinbipa* (claw) — cassowary claw arrow head.

yapa kuli — is the general name for arrows when the bones of larger animals, such as the cuscus and wallaby, are used for arrow heads.

Sapula or *Walawia* — are common referral names for all famous, special arrows that have human bones for heads; for example, the bones of a leading warrior killed in battle are used for the head.

In the area covered by Iore, Ialibu and Pangia sub-districts, some arrows are carved as a series of leaves along the vertical axis of the head or fore-shaft. In Kewa language such arrows are named after the plant whose leaves are this shape (e.g. the mote plant [unidentified]) and whose wood is used for the head or fore-shafts, e.g. *mera mote* (palmwood) — palmwood head carved as mote leaves.

My chief informant, Hilary Manda Pumuye, is the son of Manda Pumuye, a specialist arrow-maker in the Pekai-Alue clan of Isale village, Ialibu sub-district. He has provided me with data regarding the use of various arrow types in his village, and a cross-check with informants from the villages of Eltai, (Hagen sub-district) and of Yagusa (Henganofi sub-district), shows all are basically in agreement, although not every arrow type was used by members of each group. Thus, arrows can be placed in generally recognized categories based on formal variations in head types which relate to differences in function.

Arrows can be classified, according to type of head, into the following categories:

1. Basic. Arrow types common to all highlands areas.

(i) Plain palmwood or hardwood head with a sharp point — common fighting arrow.

(ii) Wide, lanceolate bamboo head, with a sharp point — pig killing.

(iii) Multi-pronged head up to 14 cm long, pointed, bamboo or wood, sometimes barbed — bird or fish arrow.

2. Specific. Arrow types not present in all highlands areas.

(i) Thick, short (6–8 cm) head, blunt, for killing specific types of birds, especially birds of paradise, whose plumage and heads are used for ceremonial head-dress and as trade items.

(ii) Pointed wooden head decorated with carved design, frequently infilled or painted with natural clays and ochres and used for display at weddings, pig feasts and other ceremonies.

(iii) Tri-composite arrows: those with bones of animals or birds as heads and with carved design on fore-shafts are used for display, or for fighting special warriors, whilst those with human bones are for use against a specific person (e.g. a clan leader) or for use in a pay-back killing for a clan warrior killed in battle.

Arrow Making

In traditional New Guinea highlands societies, every man possesses his own armoury which may be self-made or purchased from arrow-makers. Among Duna men of Lake Kopiago region, about half their number make their own arrows whilst the remainder do not make any, purchasing all they require from arrow-makers (J.P. White, pers. comm.). It was indicated to me in many

highlands villages that any man requiring a special, decorated arrow for a specific purpose will have such an arrow made for him by a village arrow-maker. The carving of designs on such an arrow is the work of a specialist and technically beyond the capacity of the ordinary clansman. Though each individual is free to decorate his own collection of arrows, and some do so, the decorative art on such arrows usually demonstrates inferior technical skill.

A carved design on an arrow, using traditional stone or tooth tools, usually takes a skilled arrow-artist-decorator 4–8 hours to complete, depending on the complexity of the elements or motifs used in the design. If European steel tools are used, less time is required for carving the same design.

Descriptions of arrow manufacture in New Guinea are recorded by Blackwood (1950:42–5) and Heider (1970:282–5), but the most specific and detailed account of manufacture in the New Guinea highlands is that given by White of arrow making at Legaiyu and Batari (1967a:109–13) and by the Duna people of Lake Kopiago (1977).

Observation of Design Carving

The observations that follow were made at Isale village, Ialibu sub-district, in 1974. There I interviewed and observed the work of Manda Pumuye.

A black palm, *mera*, is usually used for arrow-heads, fore-shafts and bows, but other palms, *wame*, and *yawi*, which also grow locally, are often used. Special bows and arrows are made from *pate* or *rokopa* palmwoods which are traded from Erave or Pangia and are expensive to buy. The names of the palms are in Kewa language; I was unable to identify botanically the different species.

Arrow-head or fore-shaft manufacture at Isale begins with the felling of the chosen palm and cutting it into required lengths which are carried back to the village. Arrow-makers cut the head or fore-shaft lengths from billets of palm, shape them, and carve the designs or cut the barbs whilst the wood is still fresh.

Manda Pumuye is a specialist arrow-maker, and demonstrated to me the carving of a design on an arrow fore-shaft. The whole process took place in a sitting position on the ground outside Pumuye's house. when making an arrow he worked only 2–3 hours each day, so its manufacturing period was spread over several days. Manda Pumuye used hand-held, traditional flake tools of stone to carve his designs. These tools he called *are* as distinct from stone flakes used for general purposes which he referred to as *kana karepa*; the latter were never used for carving arrow designs as they were considered too soft ('not strong'). *Are* were obtained locally, not at a quarry site, but picked up anywhere when walking beyond the environs of his village. If they were too small to use hand-held, he hafted them into a small wooden handle.

The preparation of the surface of the fore-shaft, including its final shaping and smoothing with *nii yo* (yo = tree; the *nii* tree is a species of *Ficus*, most likely *Ficus trachypison*) leaves, took about one hour before carving of the design. The apical end was held with his left hand, the opposite end firmly fixed between his feet, and with the *are* tool in his right hand he commenced carving the design about 7.0 cms from the top. As he continued carving he slowly rotated the fore-shaft with his left hand. He seemed to work to some sort of pre-conceived design pattern, but when I asked about this, his son said he used elements and motifs as they 'come in his head'. He used some design elements (chevrons, inverted cones, concentric diamonds, zigzags) more frequently than others and, when asked why, the reason given was because his father's father and his father had used them in arrow designs.

The actual carving of the design was completed in eight working hours, and then the fore-shaft was left to dry out. Later, a bone head was to be affixed, then the fore-shaft socket-hafted to a shaft. Finally, the design was to be infilled with natural red ochre and white clay painted on with a feather. I was shown arrows with these final stages completed.

Minor differences are evidenced in some processes of manufacture; e.g. arrow-makers at Legaiyu and Lake Kopiago use *Miscanthus* for shafts as soon as it is cut and cleaned down (White, pers. comm.). In Isale village, *kapa kambe*, a species of reed cultivated for shafts of special arrows, is dried for 2–3 months before use, whereas the common reed *kambe* is used within a few days of cutting.

When the reed is dry, its outer surface is cleaned down with a hand-held stone knife, and adhering leaf-bases removed; the shaft is then smoothed with the abrasive leaves of *nii yo*.

ANALYSES

Method

I made two analyses of Highlands arrows:

1. A morphological analysis of arrow component parts — shaft, head, fore-shaft, haftings, binding types — to distinguish morphological similarities and differences so that any significant correlations can be observed and noted.

2. An iconic analysis of carved designs on arrow heads and fore-shafts, to isolate the motifs and their component elements, and determine any specific or significant combinations of these into similar designs exhibiting the same variations. This can be used to detect any patterning in relation to linguistic affinities and geographic position.

The analytic processes in this work follow, in general, those used by S.M. Mead (1968, 1971). Data relating to aspects of decoration, carving and wood used are given in Table 2.

I have concentrated on carved designs on heads and fore-shafts, but have also examined shafts of these arrows for presence or absence of decoration on them (Table 2). Time would not permit an analysis of shaft

Table 2. Comparison of decoration and arrow components by language families.

Arrows	Eastern		E. Central		Central		W. Central		Duna		Ok		Wiru	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Decorated component														
Head	25	64	54	90	196	71	84	32	48	42	39	41	—	—
Fore-shaft	14	36	6	10	80	29	176	68	52	58	56	59	14	100
Area Decorated head/fore-shaft														
Complete	11	28	11	18	80	30	103	40	60	67	48	50	12	86
Part	16	41	34	57	127	45	99	38	29	32	30	32		
2 or more than 2 separate areas	12	31	15	25	69	25	58	22	1	1	17	18	2	14
Motif numbers used														
1 motif	27	69	51	85	177	64	162	62	63	70	67	70	4	28
>1 motifs	12	31	9	15	99	36	98	38	27	30	28	30	10	72
Type of Carving														
Deep	8	21	14	23	137	50	158	61	60	67	70	74	13	93
Medium	13	33	36	60	125	45	92	35	26	29	21	22	1	7
Light	18	46	10	17	14	5	10	4	4	4	4	4		
Wood type Used														
Palm	30	77	40	67	193	70	160	62	66	73	71	75	10	72
Hardwood	9	23	20	33	83	30	100	38	24	27	24	25	4	28
Shaft														
Decorated	11	29	32	54	113	41	71	27	20	22	64	67		
Undecorated	28	71	28	46	163	59	189	73	70	78	31	33	14	100
Total Number Examined for each Family	39		60		276		260		90		95		14	

decorations, so I made a selection of basic types of shaft designs which provide sufficient data to give some idea of the pattern of their distribution.

The shaft diameters of all arrows examined were measured, but variation was so minimal that I suggest it is the result of environmental factors affecting the growth of the plant used (*Miscanthus floridulus*) within a particular region, and not a specific choice made by the arrow-maker himself.

I have not attempted to analyse the multiplicity of barbing styles, but where an arrow head exhibits a carved design in addition to barbs, the design pattern has been included (Figs 32, 33).

I have made three assumptions:

1. That a design carved on any single arrow is the work of one man only. This assumption is based on data supplied by J.P. White (1967a), oral evidence from arrow-makers, and personal observations of arrow manufacture in Yagusa village (Henganofi sub-district, Kafe dialect speakers) and Isale village (Ialibu sub-district, Kewa speakers).

2. That arrows documented from a location were in fact manufactured in the specific location indicated — a named village, or from within a local district.

3. That the change in technology, from the use of stone and/or tooth to steel, has not caused any change in design elements, motifs or patterns that are observable as decorative art on New Guinea highlands arrows.

Morphological Analysis

Shaft decoration. Arrow shafts can be categorized into two groups: (I) decorated and (II) undecorated. The presence or absence of shaft decoration throughout the highlands is a regional characteristic; e.g. in the southern part of West Central family area (Mendi, Ialibu, Nipa etc.) shaft decoration is completely absent, whilst in the northern part (Wabag, Porgera) shafts are decorated.

If we include as decoration the removal from the shaft of axial strips of epidermis, then we can indicate two decorative types (A) and (B), with (B) having one variable in technique (Figs 3 & 4).

Type I (A): where the epidermis is removed as noted above, seen on shafts from East Central (Bena Bena), Central (Wahgi valley), and the northern part of West Central (Porgera) family areas. The strips removed are approximately 2 mm wide and may be long or short, commencing at a node and sometimes extending the full length of the internode. This form of decorative art is rarely used on any other artefact.

Type I (B): lightly incised designs, almost scratches, made with a very fine tool. Circles, zigzags, triangles, crossed lines and ellipses are elements used on some shafts in most highlands areas.

Type I (B)i: this variation in shaft decoration uses an additive technique: the designs are made more positive by rubbing over them with blackened wax (e.g at Bena Bena and Karimui).

Types (A) and (B) are sometimes both present on the same shaft in the East Central, Central and Duna family areas.

Many Bena Bena arrows exhibit a shaft decoration (Fig. 3 a, b), referred to as the 'running s', that I did not find used on arrow shafts from other areas of the highlands. It is present elsewehere in New Guinea, in designs on other artefacts: painted on shields of the Asmat (Rockefeller, 1961), etched on bamboo in north-east New Guinea (Bodrogi, 1961) and on sago spathes of the Awai (Newton, 1967). Within the New Guinea highlands its use is seemingly confined to arrow shafts in one area within East Central family boundary.

Hafting. In this context 'hafting' refers to the manner in which component parts are fixed together to make a complete arrow. Hafting techniques employed by New Guinea highlanders vary directly with the different manufacturing materials used, and position of parts needing to be hafted.

Three types of hafting techniques were observed:

1. Socket hafting. In all arrows where hafting was

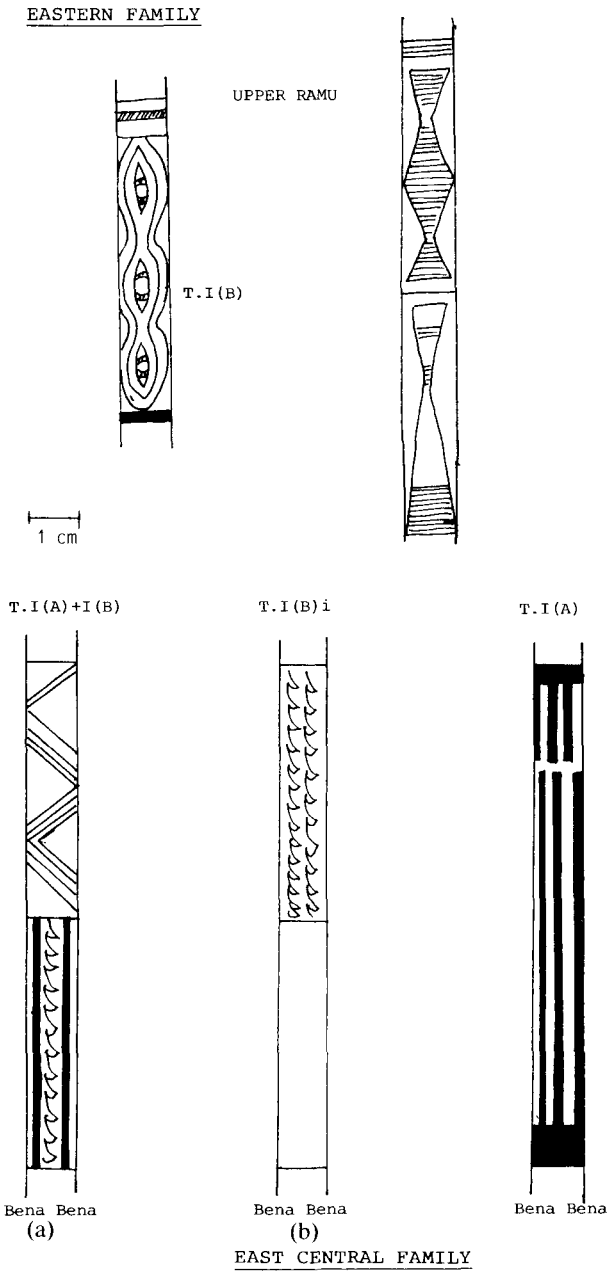

Fig. 3. Shaft decoration.

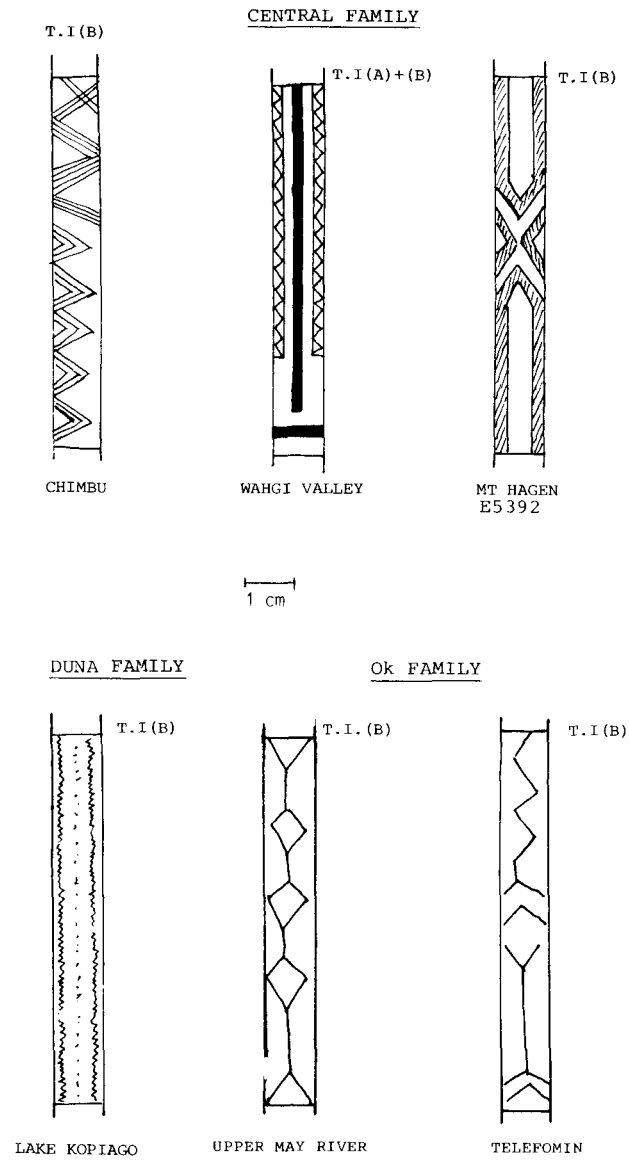

Fig. 4. Shaft decoration.

discernible, the head or fore-shaft is tapered and socket-hafted into the central hollow of the shaft. This is the only method described by Blackwood (1950), Heider (1970), Moyne & Haddon (1936), White (1967a), and is what I saw at Yagusa village. Two types exist: (i) fore-saft or head into hollow of shaft (Fig. 5.1a); (ii) fore-shaft into head. When the head is hollow animal bone, the wooden fore-shaft is thinned and socket-hafted into the bone cavity (Fig. 5.1b).

2. Surface laid to surface. When head is a long bird bone or talon, thin pig bone or lanceolate, flat bamboo, the proximal end is laid flat against the free end of the fore-shaft, overlapping a certain distance, then bound in this position (Fig. 5.2).

3. Hafting into split fore-shaft. an alternative method for hafting the same head types as (2) above. The fore-shaft free end is longitudinally split a suitable distance and sometimes enlarged, and the head is inserted into this split, and bound (Fig. 5.3).

These three types are present in all areas and there was no evidence of variation in their distribution.

Additives used in hafting. All types of bindings, insect wax, tree resins and natural clays I consider additives to haftings. In all arrows the shaft hafting area was bound with one of the three types of bindings described below, and in some, wax or resin was used as a fixative, and sometimes rubbed into the binding. Insect wax mixed with soot is the most commonly used; it sets hard and can be mistaken for pitch. This wax comes from a type of bee (not the honey-bee) called *enko* in Wiru language, while resin is from the *pangeo* tree (H. Kerr, pers. comm.).

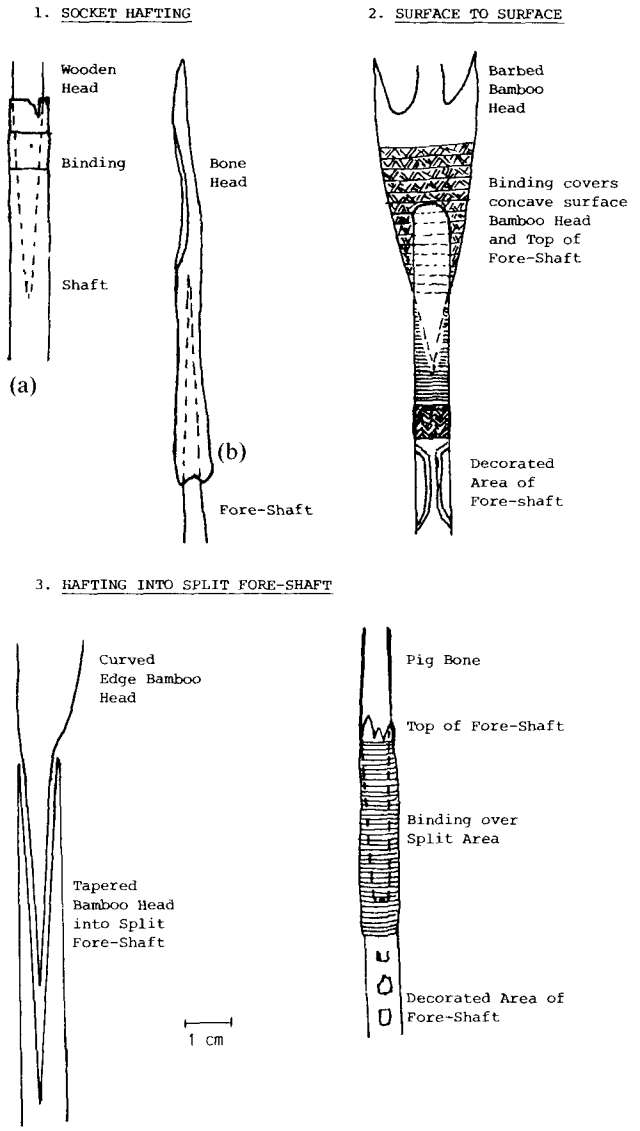

Fig. 5. Hafting types

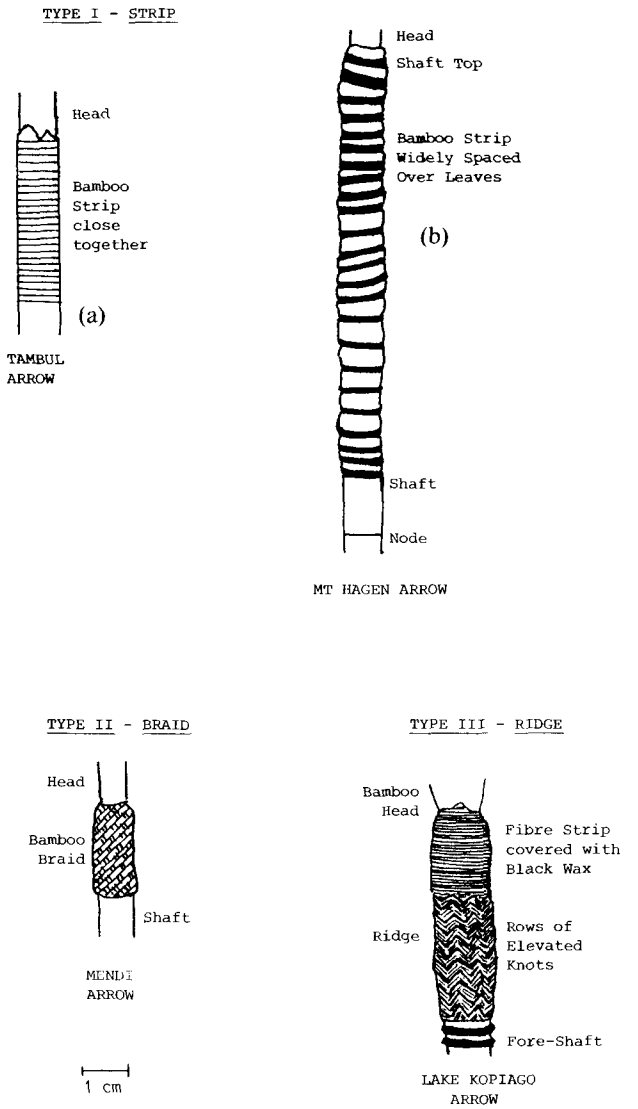

Fig. 6. Binding types.

Binding types. Three types of binding material were used: (i) long, narrow (1.0–1.5 mm in width), flat strips of the epidermis of a bamboo with extremely long internodes; (ii) epidermis of orchid petiole in similar strips; (iii) fibres made from the inner bark of various trees growing in specific areas: *Gnetum gnemon, Maoutia* sp., *Broussonetia papyrifera* (paper mulberry). After treatment, usually by rolling with the palm of the hand against the bare thigh, the bark looks like fine twine which is used for binding and other purposes.

The choice of material for binding is probably simply a reflection of what suitable material is available, which is determined by climate and other physical factors, and also trade. For instance, the species of *Dendrobium* orchid whose epidermis is used for coloured strip and braid binding grows in high altitude forest but is traded to other areas.

I observed only three types of binding techniques used for securing hafted arrow parts. For one, I have adopted the term used by Heider (1970), braid binding. Ethnographic records describe, but do not provide names for, the other two, so I used my own terminology, based on their appearance. The distribution of binding types and materials by language family is given in Table 3.

1. Strip binding. The binding material is wound in a spiral mode around an arrow part so that each circumferential turn very closely approaches the one adjacent to it (Fig. 6a). When a padding of leaves of reed, banana or bamboo is used underneath, the turns are spaced further apart (Fig. 6b). This is, in fact, a double binding type, for underneath the padding the area has already been bound with close strip binding. Its use seems confined to East Central and Central family arrows. Bamboo strip is always used on such doubly-bound arrows. Coloured orchid petiole is also commonly used to bind arrows from East Central and Central family areas.

Table 3. Distribution of binding types and materials by language family.

Language Family	Bamboo Strip	Strip over Leaves	Coloured Orchid Strip	Orchid Fibre Strip	Woven Braid Fibre Strip	Bamboo Braid	Coloured Orchid Braid	Ridge
Eastern	★		★	★	★	★	★	
East Central	★	★	★			★	★	★
Central	★	★	★	★		★		★
West Central	★			★		★		★
Wiru	★			★		★		
Duna				★		★		★
Ok	★		★	★	★	★		★

Bark fibres, too, may be used for simple strip binding, mainly on arrows where a bamboo head is hafted to the fore-shaft. The binding is often covered with blackened wax or clay. This is seen on arrows from Central family area and all areas to the west.

The use of plaited fibre for strip binding to haft bamboo heads to fore-shafts was found in only two areas: Upper Ramu, Eastern family, (one arrow); and Ok family (nine arrows). Sometimes this binding was cross-lashed over ordinary fibre strip to give added security to the hafted parts.

Strip binding in its various forms is in common use throughout the Highlands.

2. Braid binding. This consists of closely plaited strips of either bamboo or orchid epidermis. It is universally used throughout the highlands except on Duna family arrows (Fig. 6).

3. Ridge binding. This is closely woven. It is similar to braid binding but at intervals the braid is knotted when woven, producing regular ridges of 'elevated knots' vertically disposed in close linear succession throughout the binding area. This results in a symmetrical (uniform) succession of vertical ridges (elevated knots) and depressions (flat braid) in the binding pattern (Fig. 6).

This binding method is not used in many areas but is widely used in some, especially on Duna and Ok family arrows; it is used in the northern part (Porgera) of West Central family area but is totally absent in the south. The people of Legaiyu, Asaro, (East Central family) frequently use this binding type, and it was seen on a few arrows from Tambul and Mia river, (Central family area).

Technologically these three binding types might be placed along a continuum from simple to complex, with strip binding at the simple end, ridge binding at the complex end and braid binding half-way between, but whether highlanders regard them in this perspective was difficult to ascertain. At Isale village, where ridge binding is never used, I was told that it was 'very difficult'. In general, however, binding on arrows seems to be a mechanical process, the binding type used being the one at which the craftsman is most adept.

Length of arrows. The overall length of all arrows from each language area was measured to investigate the apparently significant differences in length. This analysis was carried out under the guidance of Professor R.V.S. Wright, Department of Anthropology, University of Sydney. The findings are summarized in Table 4.

Table 4. Length of arrows from different language family areas. Lengths are in cm. $\bar{X}$ = mean; s = standard deviation; N = number of samples. Newman-Keuls results are explained in the text.

Name of Family	Newman-Keuls	N	$\bar{X}$	s
West Central	c	260	115.61	7.88
Duna	c	90	115.85	8.50
Central	c	276	120.75	11.68
Wiru	bc	14	122.20	5.01
Eastern	bc	39	123.83	15.75
East Central	bc	60	123.83	11.76
Aiome	bc	10	124.35	2.39
Karimui	b	14	129.47	3.21
Ok	a	95	142.95	12.08

These results were tested and further analysed by Professor Wright, who has provided the following discussion of his results:

"A one-way analysis of variance confirms what is obvious from inspection of the means, namely that there are some significant differences between them. I have applied, as a more penetrating analysis, the Newman-Keuls test for sequential testing of means (Snedecor & Cochran, 1967:273). This test allows one to examine each group and decide from which of the rest it is significantly different. The results of the Newman-Keuls test are presented by means of the letters in Table 4. A group is significantly different from another group if the two do not share at least one common letter. Thus we see that at the 0.05 level of probability Ok is significantly different from all the other groups and that Karimui is significantly different from West Central, Duna and Central, as well as from Ok."

Within each language family area, I found that the lengths of arrows were normally distributed about the mean (Table 4). It might be expected that, where arrows were made by specialists, there would be greater uniformity in lengths compared to situations in which each person made his own. Some hint that this might be so is given by the low range of lengths of arrows from Duna and Wiru families, but data on makers of individual arrows in my samples are insufficient for proper assessment.

Heads and fore-shafts. With regard to fore-shaft function the only conclusion I could reach is that arrows with decorated fore-shafts are more highly prized than those with decorated heads, for purely aesthetic reasons and they give added prestige to their owner. It seems

that, as projectile weapons, arrows with fore-shafts are no more deadly or accurate in flight than those without. This was demonstrated to me at Yagusa village so I would say fore-shafts are unimportant structurally but important as design fields on which highlanders can display their artistic talents. Fore-shafts thus have a role in the culture of the clan.

In all areas under study arrows with fore-shafts were present (Table 2) and display certain traits:

1. When heads are of bone this attached to a fore-shaft;
2. When heads are of bamboo and attached to a fore-shaft, this fore-shaft is much shorter in length than when the head is bone;
3. Certain arrow types always have fore-shafts and are always well-decorated.
   (a) special arrows for display at ceremonies such as *Moka* and pig feasts;
   (b) arrows used by famous clan warriors in fights;
   (c) arrows used by kin in pay-back killings: this is probably because all such arrows have bone heads, usually those of the slain person whose death is being avenged.

Fore-shafts of arrows with bone heads are always decorated with carved designs in the West Central family area, whilst those with bamboo heads are rarely decorated. In other family areas to the west, particularly Duna and Ok, fore-shafts are elaborately decorated whether heads are bone or bamboo. In these two areas, fore-shafts are much shorter and thicker than those of family areas eastwards, especially when bone heads are used. West Central family arrows have long, slender fore-shafts.

With the exception of Eastern family area, all barbed arrows from the study area exhibit a short design on the head next to the shaft. Simplicity in design is achieved by the use of one element only — circles in Eastern and East Central family areas, occupying only part, never the complete area, of head or fore-shaft; and spirals in West Central area (especially the southern part), covering the whole head or fore-shaft.

Discussion. Figure 7 shows the ratio of all decorated fore-shafts to all decorated heads in each of the language family areas. A change is noted between eastern areas and those to the west. The area of change appears to be between Central and West Central family areas; in the east, arrow heads are more frequently decorated than fore-shafts, whilst in the west the opposite occurs.

The data in Table 2 concerining area of heads and of fore-shafts decorated also show a geographic trend. If the various possibilities are listed according to frequency (Table 5), then it becomes apparent that there is a difference between east and west areas, the transition zone being Central family area. This was confirmed by a chi-square test, which showed a significant difference between east and west areas.

The data in Table 2 (use of more than one motif to form a design pattern) indicate that the use of one motif is preferred in all areas except Wiru.

Table 2 also examines depth of carving. Definitions used are: deep, design cut 1.5–2.5 mm deep into surface area; medium, design cut into surface to a depth of 1.0 mm; light, design lightly incised or scratched on surface — depth not measurable. The depth of carving designs could be placed along a continuum starting with lightly incised in Eastern family area, mostly medium deep in East Central, medium and deep used almost exclusively in Central, with deep carving the major type in families to the west (Table 6).

Table 5. Area of head or fore-shaft decorated — summary. a = completely decorated; b = partly decorated; c = 2 or more areas of decoration.

	East			West		
	Eastern	Central	Central	Central	Duna	Ok
Most common	b	b	b	a	a	a
Next common	c	c	a	b	b	b
Least common	a	a	c	c	c	c

Table 6. Depth of carving — summary. a = deep, b = medium, c = light.

	East			West		
	Eastern	Central	Central	Central	Duna	Ok
Most common	c	b	a	a	a	a
Next common	b	a	b	b	b	b
Least common	a	c	c	c	c	c

The frequency tabulation suggests a division between East and West with Central as the transition zone. This was confirmed by a chi-square test.

Type of wood used (Table 2) is not a useful indicator for differences, because this depends on wood types available locally or whether a person is sufficiently wealthy to buy or exchange goods for the more prestigous palmwood.

The data in Table 2, concerning shaft decoration, do not furnish evidence for a transition zone between east and west.

Table 3, distribution of binding types and materials, indicates arrows of West Central, Wiru and Duna families use fewer — 3 or 4 out of 8 — of the possible combinations than arrows of language families to the east, where 6 or 7 of the 8 combinations are used.

It is evident from the morphological analysis that:

(a) the tradition of carving designs on arrow heads and fore-shafts is universal throughout the Highlands;

(b) the Chimbu-Asaro Divide is less of a barrier to arrow form and design than was expected;

(c) there is evidence for an east–west dichotomy, the boundary of which seems to correspond for the most part to the Central–West Central language boundary, from the Yuat river in the north through Mt Hagen area to the Kaugel river in the south. Central, East Central and Eastern language areas lie to the east of this; West Central, Duna and Ok to the west;

(d) the data point to Central language family area as a transition zone between east and west. I checked to see if the changes could be clinal due to differences in settlement time-depth (as derived from archaeological data), but the results proved negative.

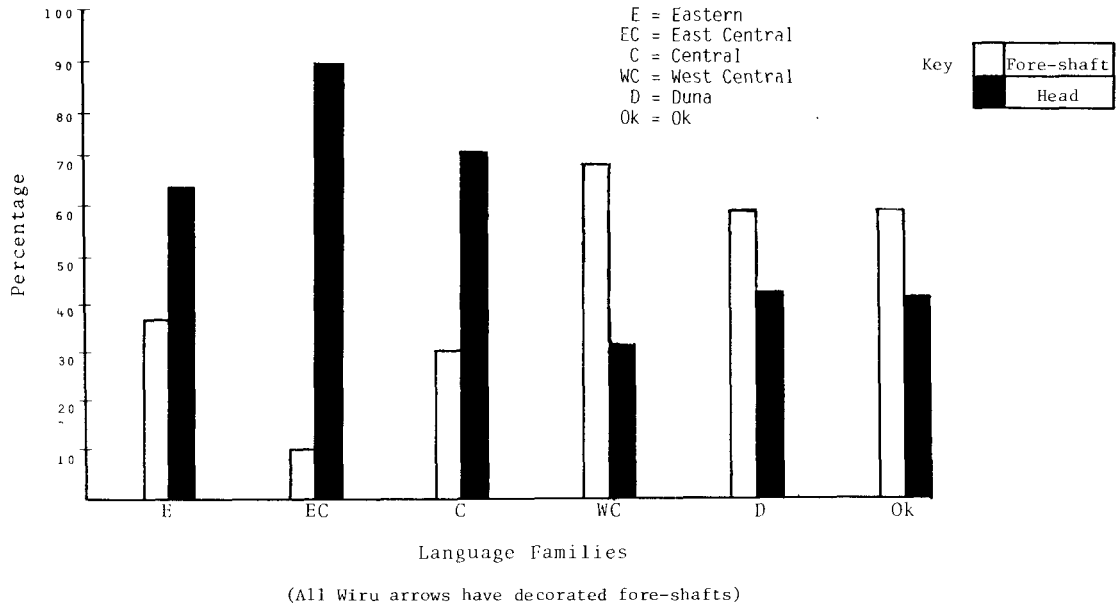

Fig. 7. Ratio of decorated head to decorated fore-shafts, by language family (all Wiru arrows have decorated fore-shafts).

Iconic Analysis

Before proceeding to an iconic analysis of elements and motifs in design patterns, it is necessary to clarify the meaning of terms used.

A design element is the fundamental unit of design. An element may be used by itself in a design, or it may be used in combination with other elements to form motifs in design patterns.

A motif can be formed from one element repeated, or from a combination of two or more elements. The only design elements on arrows considered in this investigation are those carved or incised on arrow heads or fore-shafts. They may or may not be infilled or painted with coloured clays and/or ochres.

The design field is that area of the head or fore-shaft used by the artist to display a carved design.

A boundary marker is usually a simple element, such as a circle, that marks the upper and lower limits of a complete design.

In comparison to other material objects (such as shields, masks, and house-boards) on which the New Guinea Highlanders display their artistic talents, the design field available to the arrow-carver is very limited. Its extent depends entirely on the length of arrow heads and fore-shafts, and the shape of their surfaces. Although the majority are more or less round in cross-section, oval shapes also occur, and these two types provide an elongated and curved surface for the carver. Triangular and rectangular-shaped heads occur in some arrows, especially those where the upper part is barbed above the carved design area, and provide an elongated flat and angular surface. The restricted design fields must place constraints on the types of elements and motifs the arrow artist can use. In addition, the few types of manufacturing material available — wood from various species of palm (*Oriana, Licuala*, black palm indigenous to an area or traded from elsewhere) or hardwood (unidentified) — must place further limits on his artistic representations.

Boundary markers are almost completely absent from arrow designs. Their rare use at the end(s) of designs seems to be simply personal choice.

Element Codification. Within the confines of this study it has not been possible to isolate every element used in arrow designs throughout the highlands. Each element indicated has been selected on one of two criteria: (i) the frequency of its occurrence; (ii) its restriction to certain areas.

Whether an element's position is around or along the vertical axis of arrow heads or of fore-shafts, it is treated in the same body of data, but its position is identified by either drawn lines or notes. All elements are illustrated with the arrow head upwards. Shading indicates intact wood, with unshaded areas indicating carved-out parts.

ELEMENT 1: circle (Fig. 8)

(i) lightly incised around head or fore-shaft

(ii) deeply carved around head or fore-shaft

ELEMENT 2: diamond (Fig. 8)

(i) lightly incised

(ii) centre solid with deep incision surrounding it

(iii) centre deply hollowed-out, an 'empty' 'eye'

(iv) deeply incised with centre left solid

(v) centre a small hollow in a solid diamond shape

[(ii)–(v) are termed 'ocular' or 'eye' variants]

ELEMENT 3: triangle (Fig. 8)

Rarely used in singular form, but is the basis of duplicate forms and single motifs made up of this one element.

(i) lightly incised; often occurs as concentric triangles in either vertical or horizontal postion

(ii) deeply carved, solid; notches along the vertical axis

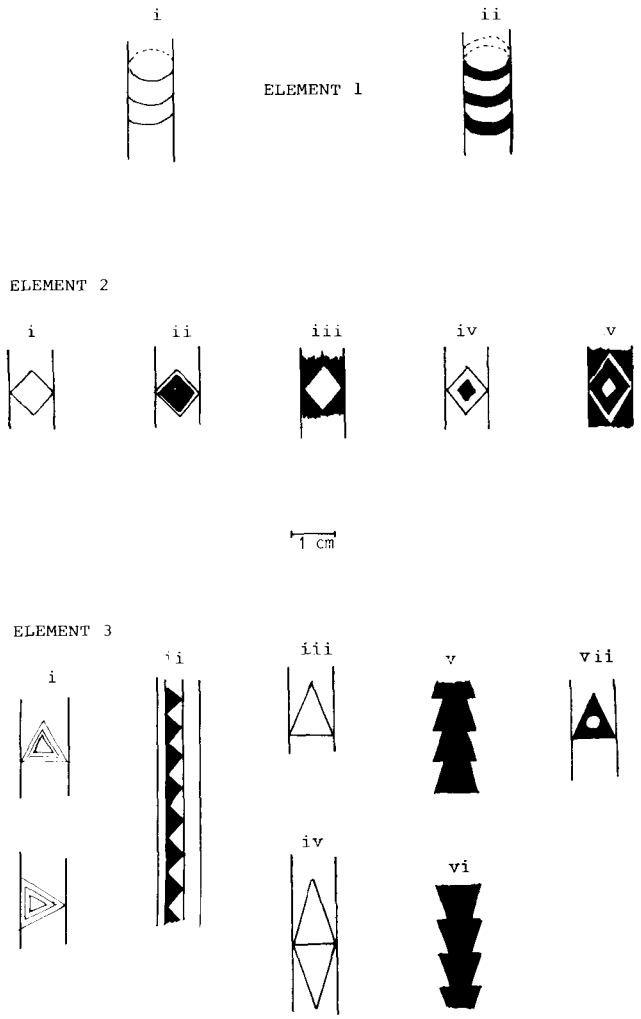

Fig. 8. Variants of elements 1, 2 and 3.

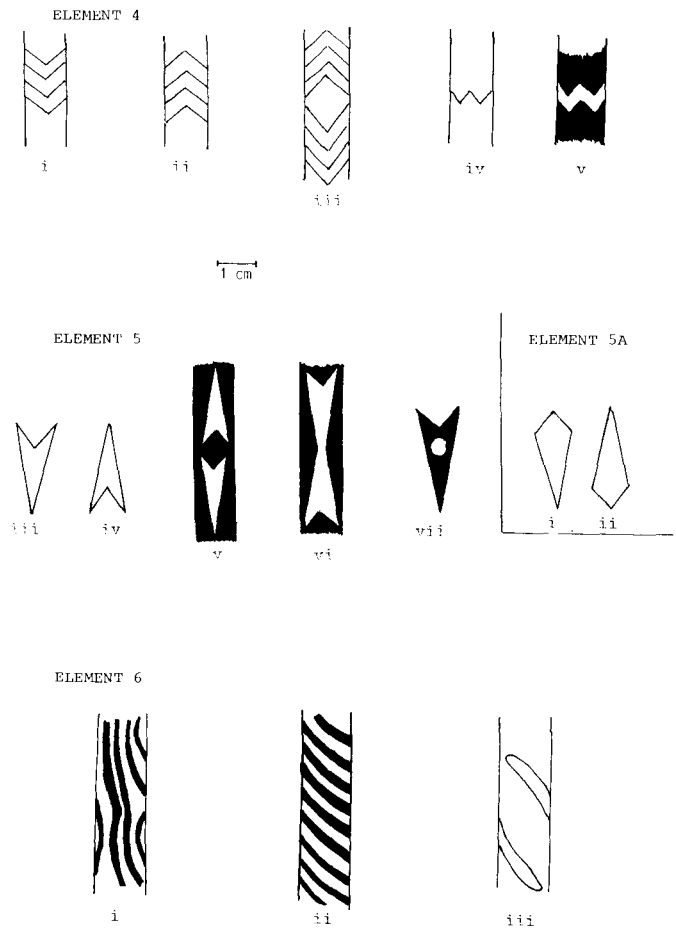

Fig. 9. Variants of elements 4, 5, 5A and 6.

in singular progression

(iii) centre deeply hollowed-out

(iv) two triangles sharing one base-line, deeply hollowed out, in vertical position

(v) carved in vertical linear series with apical angle of each succeeding lower triangle cut off by base-line of adjacent upper one producing an 'inverted cones' effect

(vi) same as (v) but inverted

(vii) solid triangle with hollowed-out circle in centre

ELEMENT 4: chevron or zigzag (Fig. 9)

As chevron it is rarely used in singular form. Variants (i)-(iii) are usually lightly incised.

(i) chevrons in vertical linear succession

(ii) chevrons inverted in linear succession

(iii) chevrons in opposition

(iv) zigzag lightly incised around vertical axis

(v) zigzag deeply carved around vertical axis

ELEMENT 5: four-sided figure (Fig. 9)

Two long sides meet in acute angle, 2 short sides re-entrant.

(iii) short sides re-entrant, lightly or deeply carved

(iv) as (iii) but inverted

(v) = (iii) + (iv) in opposition, deeply incised

(vi) = (iii) + (iv) joined at tapered end with no interruption, deeply carved

(vii) a solid form of (iii) with deeply hollowed-out circle at its wide end

ELEMENT 5A: similar figure with 2 short sides everted (Fig. 9)

(i) short sides everted, lightly or deeply incised

(ii) as (i) but inverted

ELEMENT 6: spiral (Fig. 9)

All deeply carved.

(i) loose vertical spiral that does not completely encircle the head or fore-shaft with each turn

(ii) spiral making complete turns around the vertical axis

(iii) an S-shaped spiral that makes only one complete turn around vertical axis.

ELEMENT 7: shield (Fig. 10)

(i) centre hollowed-out

(ii) deeply hollowed-out except for cigar-shaped centre which is grooved horizontally

(iii) whole centre left solid except for horizontal grooves

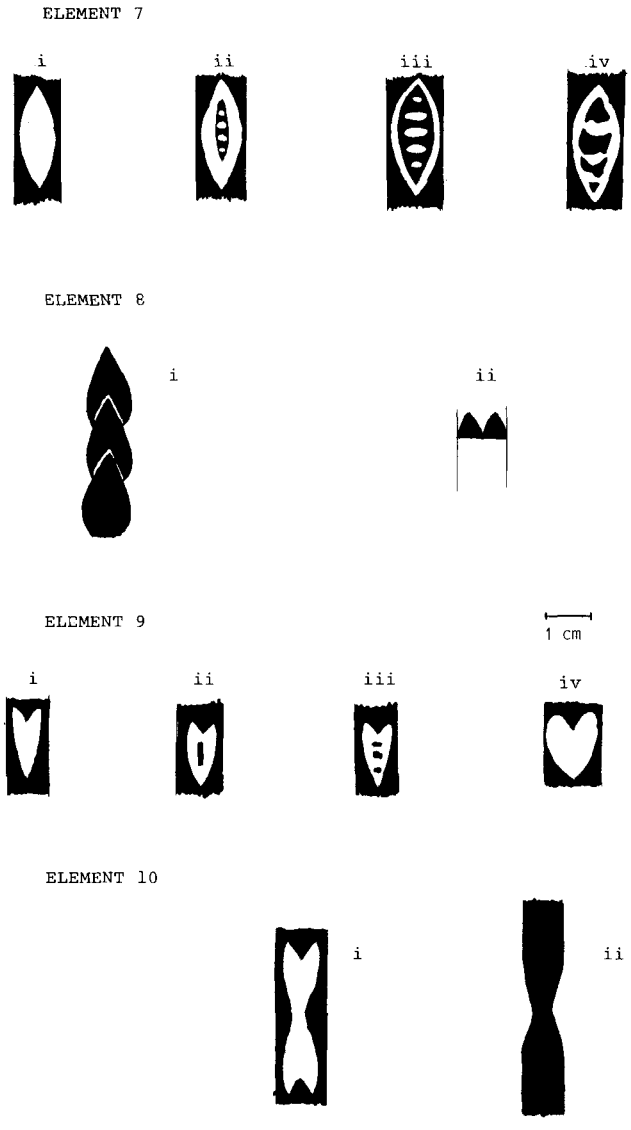

Fig. 10. Variants of elements 7, 8, 9 and 10.

(iv) broader in outline, deeply carved, with solid areas left in a vertical line in the centre

ELEMENT 8: lanceolate, leaf-like shape (Fig. 10)

(i) in vertical linear succession

(ii) smaller, double leaf-shape around the vertical axis

ELEMENT 9: shape similar to element 5 (iii) but with long sides curved (Fig. 10)

(i) centre deeply hollowed-out

(ii) centre hollowed-out except for an elongated solid area

(iii) same as (ii) but a row of separated solid areas in centre

(iv) heart-shaped with centre deeply carved out

ELEMENT 10: hourglass shape (Fig. 10)

(i) curved ends indented to form V-shape

(ii) part of head or fore-shaft carved into this shape

ELEMENT 11: six-sided rectilinear figure (Fig. 11)

Two long sides are parallel and 4 short sides everted.

(iii) short sides everted, parallel sides elongated.

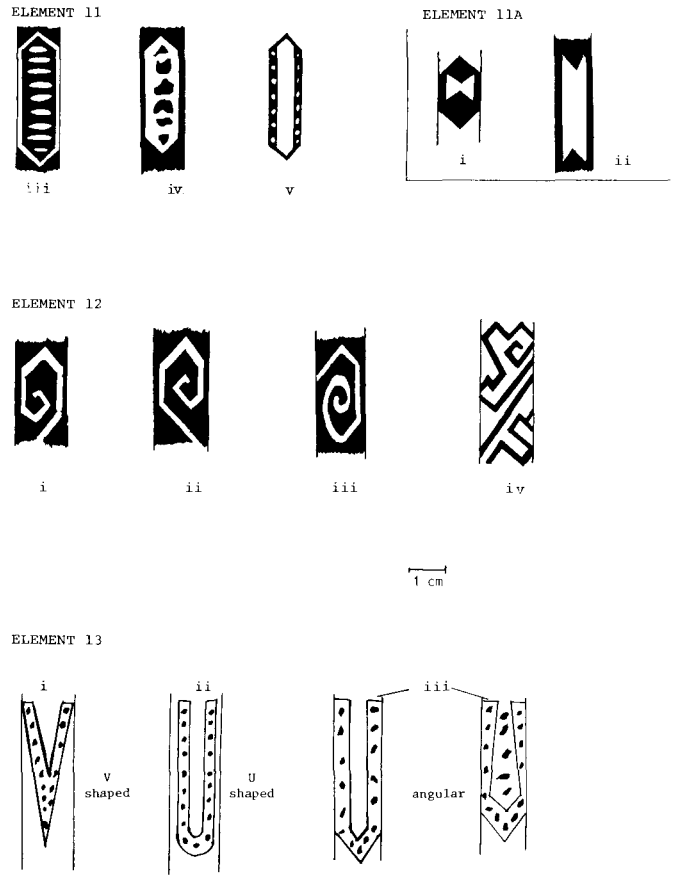

Fig. 11. Variants of elements 11, 11A, 12 and 13.

Centre solid, cut by several grooves

(iv) same as (iii) but centre is carved out except for a row of solid areas down the middle

(v) same as (iii) but centre is carved out and outer rim is cut by small grooves

ELEMENT 11A: similar 6-sided figure with each pair of short sides re-entrant (Fig. 11)

(i) centre deeply carved, parallel sides short

(ii) same as (i) except parallel sides are elongated

ELEMENT 12: geometric figure (Fig. 11)

Deeply carved, often continues around head or fore-shaft, but frequently used as part of a vertically placed motif.

(i) geometric, angular, spiral, vertical position

(ii) mirror image of (i)

(iii) elongated, geometric spiral whose internal sides tend to be somewhat curved

(iv) complicated geometric angular form that continues around head or fore-shaft, deeply carved

ELEMENT 13: grooved element (Fig. 11)

(i) groove with pointed end — V-shaped

(ii) groove with straight sides and rounded end — U-shaped

(iii) groove with sides straight or angled, with an angular pointed end

Grooves sometimes contain a line of solid dots carved within or around the groove. Where this occurs I shall

indicate their occurrences by writing '(dots inside)' for the former, and '(dots outside)' for the latter.

Analytical Procedure. I took each of the 13 elements in turn and using all 834 arrows, but keeping them in their respective language family groups, investigated the way these elements were combined and positioned in design patterns. A summary of my findings and selected arrows to illustrate points in this summary are presented. In my use of the terms 'upper' and 'lower', I am referring respectively to those parts of the arrow head or fore-shaft furthest away from, and nearest to, the shaft; 'at the shaft' means the design commenced where the head or fore-shaft is hafted to the shaft, whilst 'near the shaft' indicates the design commences about 1-4 cm above this hafting area. Within the design area, 'upper' refers to that part of a motif or design nearest the distal end, 'lower' to that part nearest the shaft.

On the accompanying tables I have indicated the positioning of elements and the position of each variant, as being:

(a) in the centre of design;

(b) as part of upper motif, or (bi) part of lower motif;

(c) at upper end, or (ci) lower end of design — boundary markers;

(d) as the complete upper motif, or (di) complete lower motif;

(e) as the only element used in the design.

I have indicated the number of occurrences of each variant of each element in design patterns on Table 7, positions of element variants and the number of arrows on which they occurred in each position on Table 8, the distribution of design elements by language family in Table 9, and the positioning of each element in design patterns on Table 10.

In Figs 12–33 (element variants in design patterns), elements other than the one referred to in the figure caption are identified in full, for example, $(E.4)_v$ means Element 4 variant (v).

ELEMENT 1: circles

Eastern and East Central family areas. Here circles most frequently occur in several groups along the arrow head or fore-shaft with lightly incised diagonal lines between them (Fig. 12a). Circle groups are separated by undecorated areas and never begin at the shaft. Often one or two medium-deeply carved circles are found at the lower end of these groups (Fig. 12a,d). Colour is not widely used on designs in these two family areas, but some Eastern area arrows have red ochre rubbed along the head length or over incised circles, whilst some Bena Bena (East Central) arrows have red ochre on undecorated areas between circles.

Central family area. On arrows from this area, circles are never used singly, always in pairs or as a series of circles repeated as the other motif is repeated along the design area (Fig. 13a). Usually a white clay infill is used.

West Central family area. In the northern part of this area, circles are infilled alternately with red and white ochre/clay, and are never used singly. Most favoured are groups of three, four or five, separated by short

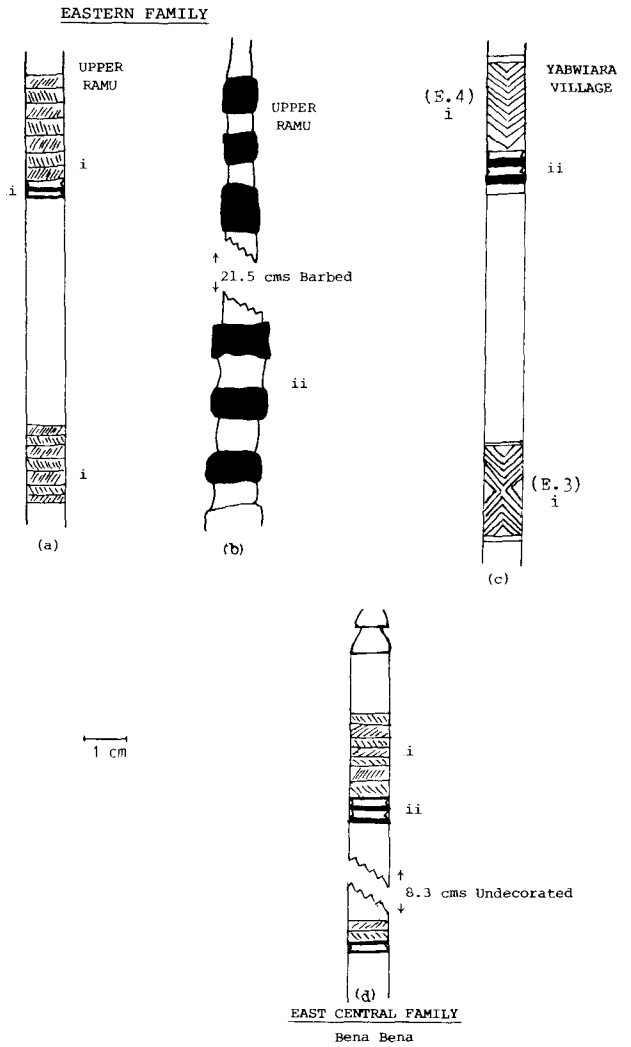

Fig. 12. Element 1 variants in design patterns.

undecorated areas. In the southern part, where approximately 75% of arrow designs use circles, they are used mostly in threes or fours as an integral part of the complete design. On some Mendi arrows (Fig. 13b) circles only are used as the upper half of a two-motif design carved above an area of small barbs at the shaft. Red, white, orange and yellow ochres and clays are used to colour designs.

Wiru family-level isolate area. In this area circles area sometimes used as boundary markers to enclose the design.

Duna family area. The use of circles in a design pattern on arrows from this area may depend on the width of the head or fore-shaft. The only arrows I examined from this area that had several circles in the design were ones with long thin heads, where circles were used in twos or threes, often to separate motifs in the design. All were deeply carved with red or white infill. On lavishly decorated fore-shafts of Lake Kopiago arrows (Fig. 13d) very deeply carved circles are used with alternating red and white infill.

Ok family area. In this area when barbing occurs on

Table 7. Frequency of occurence of variants of elements, by language family.

No. of arrows	Language Family	El.1 Var.		Element 2 Variants					Element 3 Variants							Element 4 Variants					Element 5 & 5A Variants							El.6 Var.		
		i	ii	i	ii	iii	iv	v	i	ii	iii	iv	v	vi	vii	i	ii	iii	iv	v	i	ii	iii	iv	v	vi	vii	i	ii	iii
39	E	225	56	8	8				4								20	28	23										7	
60	EC	293	73		8				5								17	24	33	14									10	
276	C	357	331	108			245		82		70					40	41	72	84	154							6		4	
260	WC	218	248	15		63	199	68	12	27	120	117	45	31	22	27	27	74	56	116	66	69			36	35		8	58	
90	D		280		28	76	42		27	67			22			6						25		31						7
95	Ok		167	10	8	61	16		36				10	7				10		94	30	36	13	25	4	37				
14	W		9			6		21	14		32	6	7		14					36										

No. of arrows	Language Family	Element 7 Variants				El.8 Var.		Element 9 Variants				El.10 Var.		Elements 11 & 11A Variants					Elements 12 Variants				Element 13 Variants		
		i	ii	iii	iv	i	ii	i	ii	iii	iv	i	ii	i	ii	iii	iv	v	i	ii	iii	iv	i	ii	iii
39	E	4																							4
60	EC																								
276	C																								
260	WC		38	12	54	10		40	28	19	183	10	9			75	96	30	12	13				9	34
90	D		7					5									39						38	15	
95	Ok				9	3		25	9	5	70			21	10		2		4	20	6	7	17	15	8
14	W	2	4		12	43	18					32					12	8							

heads, circles seem to be used as a way of separating the design from the barbed area. Some Telefomin designs use circles this way, but in others, circles are absent. No circles are used in designs on Tifalmin arrows, whilst on Upper Fly and Atbalmin arrows they are used only as boundary markers. When present almost all are coloured red and white (Fig. 20c, d).

Comments on use of Element 1. Five arrows were anomalous in their use of Element 1. Two arrows from Upper Ramu (Eastern family) used variant (ii), elongated and so deeply carved as to be almost notched (Fig. 12b). This feature is otherwise unknown in arrows from Eastern family areas, but is seen on arrows from Lagaip River (West Central family) and Duna. Three arrows from Laiagam (West Central family) using variant (i) lightly incised (Fig. 13c) were likewise far removed from the norm of their area, but resembled arrows from Eastern and East Central family areas. I suggest that these five arrows may be 'introduced' items.

ELEMENT 2: diamond

This element is rarely used singly in designs; its commonest forms are 'eye' variants (usually in opposite pairs), solid diamonds in series, or several concentric diamonds.

Eastern and East Central family areas. In both these areas the concentric form is used in designs; the whole is smeared with red-brown ochre.

Central family area. More use is made of this element in the western half of this area. In the eastern part, Chimbu arrows show some use of variant (i) in concentric form. On Wahgi valley arrows, but more frequently in the Hagen area, it is mainly used in 'eye' variant forms. Tambul arrows show use of variant (v) elongated and deeply carved, often in the centre of a two-element, one-motif design (Fig. 15b), with white infill. Yamaga, Mt Hagen, arrows use variants extensively. Variant (iv) as an opposite pair, in the centre of a similar upper and lower motif separated by a central motif not using this element; deeply carved with red and white infill. Variant (i) in upper and centre motifs of a tri-motif design with variant (iv) as well in upper and in lower motif; carving medium deep, red and white infill (Fig. 14a). Variant (v) in opposite and alternate pairs as part of lower motif (Fig. 18c).

Western Central family area. Designs show extensive use of this element throughout the area, deeply carved, with red and white infill. In the northern part 'eye' variants are the most used, especially in Lagaip river area:

1. As the centre of the motif in short designs, variant (iii) or (iv) as one opposite pair, or two pairs opposite and alternate (Fig. 14b).
2. As the centre of a short motif at the shaft when the remainder is barbed, variant (iii) (Fig. 14c).
3. Next to shaft, an opposite pair of variant (iv) (Fig. 14d).
4. As part of upper and lower motifs variant (iii), in a two-motif design separated by an undecorated area (Fig. 29d).
5. Opposite and/or alternate pairs of variant (iv) or (v) at ends of design (Fig. 29e).

Porgera arrow designs use variant (iii) or (iv) at the lower ends at the shaft (Fig. 29c). Variant (iv) in two pairs, opposite and alternate near the shaft, as the only decoration is seen at Arafundi River (Fig. 15d).

In the southern part of this area, designs frequently show a combination of two diamond variants to form a pattern, variant (ii) in series plus an 'eye' variant — (iii) in (Fig. 15a). Iore (Mt. Giluwe) designs, using an 'eye' variant — with only one other element to form the complete pattern are common (Fig. 30d).

Wiru family-level isolate. Designs use mostly 'eye'

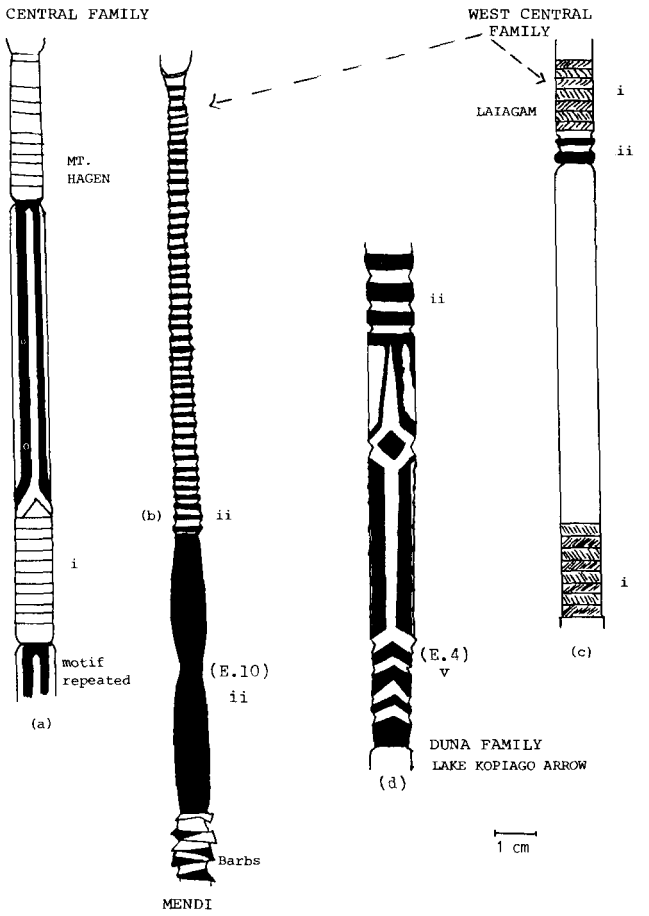

Fig. 13. Element 1 variants in design pattern.

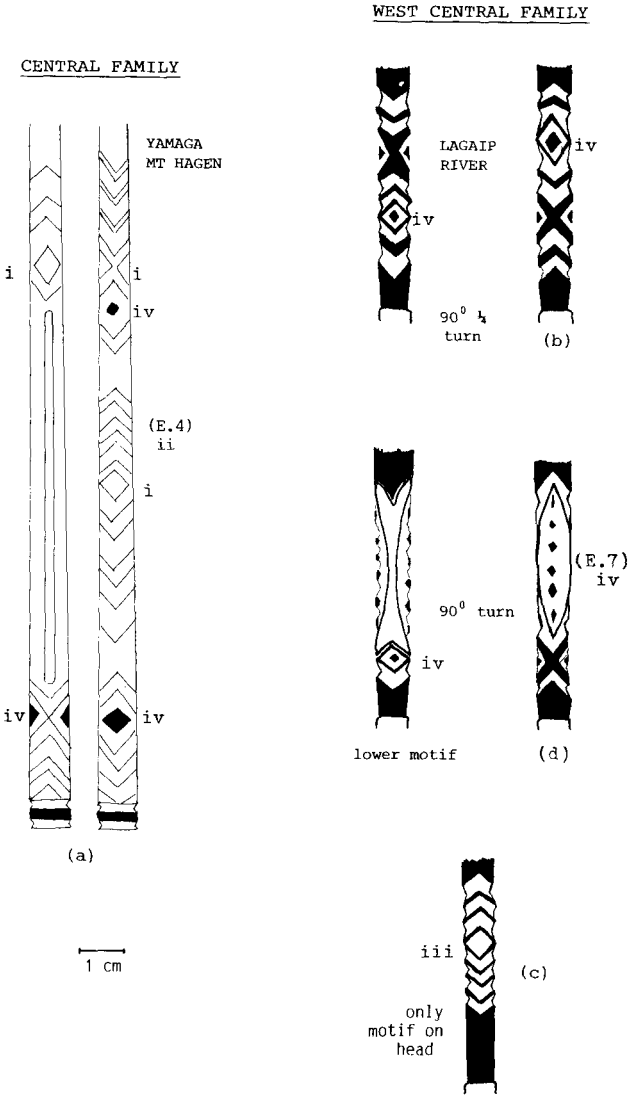

Fig. 14. Element 2 variants in design pattern.

variant (v) with red infill on few arrows.

1. In the centre, three variant (v) around fore-shaft, one (v) with two centres below these (Borona village).

2. As part of upper motif, 12 variant (v), (Borona village).

3. Variant (v) an opposite pair, at upper end of main motif, (Borona village, Fig. 23a).

Duna family area. More use is made of diamonds in series together with frequent use of 'eye' variants, with red and/or white infill.

1. Variants (ii) or (iii) in series as either the upper or lower half of a two-motif design. The lower position seems more favoured on Lake Kopiago arrows (Fig. 16e).

2. 'Eye' variants in the centre of a design to separate two different motifs that occupy all the fore-shaft. The type of variant used seems to relate to the design pattern. Variant (iv) is always the upper element in the lower motif, or the 'centre-piece' of the complete design when upper and lower motifs are the same. When variant (iii) is used, it seems to be in the design solely to separate the upper and lower motifs, with no relationship to either one (Lake Kopiago arrows, Fig. 31).

3. Variant (iii) at lower end of design (Lake Kopiago, Fig. 31b).

4. Variant (iv) as lower motif around head (Lake Kopiago, Fig. 15c).

5. Variant (iv) in centre and (v) at lower end of design covering fore-shaft (opposite pairs) Lake Kopiago, Fig. 31a).

Ok family area. 'Eye' variants infilled with white clay are used most.

1. Variant (iii) or (v) as the topmost element in the design pattern or at the upper end of a short design before barbing starts (Telefomin, Fig. 29a).

2. Variant (iv), an opposite pair, in lower motif near shaft (Tifalmin, Fig. 29b).

3. Variant (ii), surrounded by deeply carved, interlocking and concentric (i), around the head as the only motif before barbing starts (Upper Fly and Telefomin, Fig. 33).

Comments on use of Element 2. Designs on arrows from West Central and Duna family areas indicate a similar use of variant (ii) in series, plus variant (v). Although less use is made of this element in Ok designs,

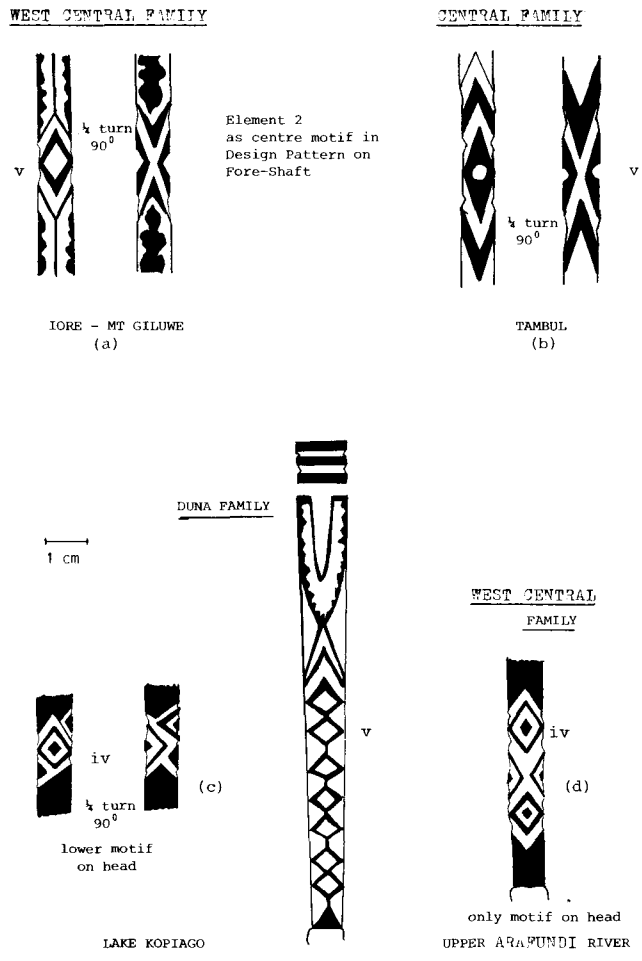

Fig. 15. Element 2 variants in design patterns.

it does occur in some designs on arrows from all parts of the area. In the northern part of West Central, Duna and Ok family areas, 'eye' variants are often used in designs with element 9 variant (iv). This combination will be discussed later.

ELEMENT 3: triangle

Eastern family area. The most commonly used variant is (i) in concentric form (Fig. 12c). East Central designs variants (i) or (v) occur as the main motif (Bena Bena, Fig. 16a). Central area arrow designs use these same two variants similarly positioned, and as well, variant (iii) on heads, at the shaft before barbing starts.

West Central area. More use is made of variants in the southern part, where one or two only are used to form the complete pattern. In Mendi-Iore (Mt Giluwe) region, variants are used extensively; variant (ii) in two alternate rows, linear series (Iore, Fig. 16d); variant (v), inverted cones with medium-deeply carved triangles on each one forming the upper motif in a two-motif design (Mendi, Fig. 16c).

Wiru family-level isolate area. Designs show frequent use of variants sometimes combined to form the complete design (Borona village, Fig. 16b).

Duna family area. Variants are often used as a short motif at the shaft, the only design on the head before barbing starts. Sometimes concentric triangles are used, or variant (iii) deeply carved, alternately inverted and separated by deep grooves. Triangles in series occur as the lower motif in two-motif design patterns which seem to be confined to the Lake Kopiago region (Fig. 16e).

Ok family area. Deeply carved, with red and white infill, variant (i) as the only motif, at the shaft before barbing begins. This variant is also used in two sets on the concave surface of a bamboo head, in concentric form on Upper Fly arrows (Fig. 17b). Variant (iii) alternately inverted as part of a short, geometric pattern on the concave surface of a bamboo head (Telefomin, Fig. 17a). When used thus on the head, this variant is absent from the fore-shaft design.

Comments on use of Element 3. The frequent use of variants in West Central area designs is obvious from Table 8, but designs in the northern part indicate little use is made of this element. Arrows from the southern part and from Wiru area show variety in the use of variants in design patterns. There is also variety in the use of colour infilling designs, especially in Wiru arrows, where yellow and the rare blue pigment, vivianite, are used as well as red and white. In Duna area designs, short motifs are the norm; this is opposite to their length on arrows from the southern part of West Central, where motifs occupy an extensive area of long fore-shafts. In the Ok family area the use of this element in designs seem to indicate individuals 'play around' with ideas on how to use a variant in a different way to the accepted norm, and come up with surprising results. As well as these designs appearing to show individualism in the use of variants, bamboo heads are decorated here more than in any other area, with triangle variants used often in such decoration (Fig. 17a,b).

ELEMENT 4: chevrons and zigzags

Variants of this element are used in arrow designs throughout the highlands and further west. Variants (i), (ii) and (iii) — chevrons — never occur singly. They are used in sets or in opposition, frequently enclosing another element, often to form the complete design. Zigzags, variants (iv) and (v), occur rarely in singular form as boundary marker(s) but usually are used in designs in the same way as chevrons.

East and East Central family arrows show a similar use of variants as part of a design.

Eastern family area. Chevrons, lightly incised, most favoured.

1. Variant (ii) as two sets of chevrons, one in both upper and lower part of a single motif design (Heganofi, Fig. 18a).
2. Variant (iv) zigzags in a group, form the largest and top part of the upper motif, in a two-motif separated design.
3. Variant (i) as upper part of upper motif (Yabwiara, Fig. 12c).
4. Variant (v) as upper part of the design on a short, thick fore-shaft with one (v) at lower end (Upper Ramu, Fig. 18b).

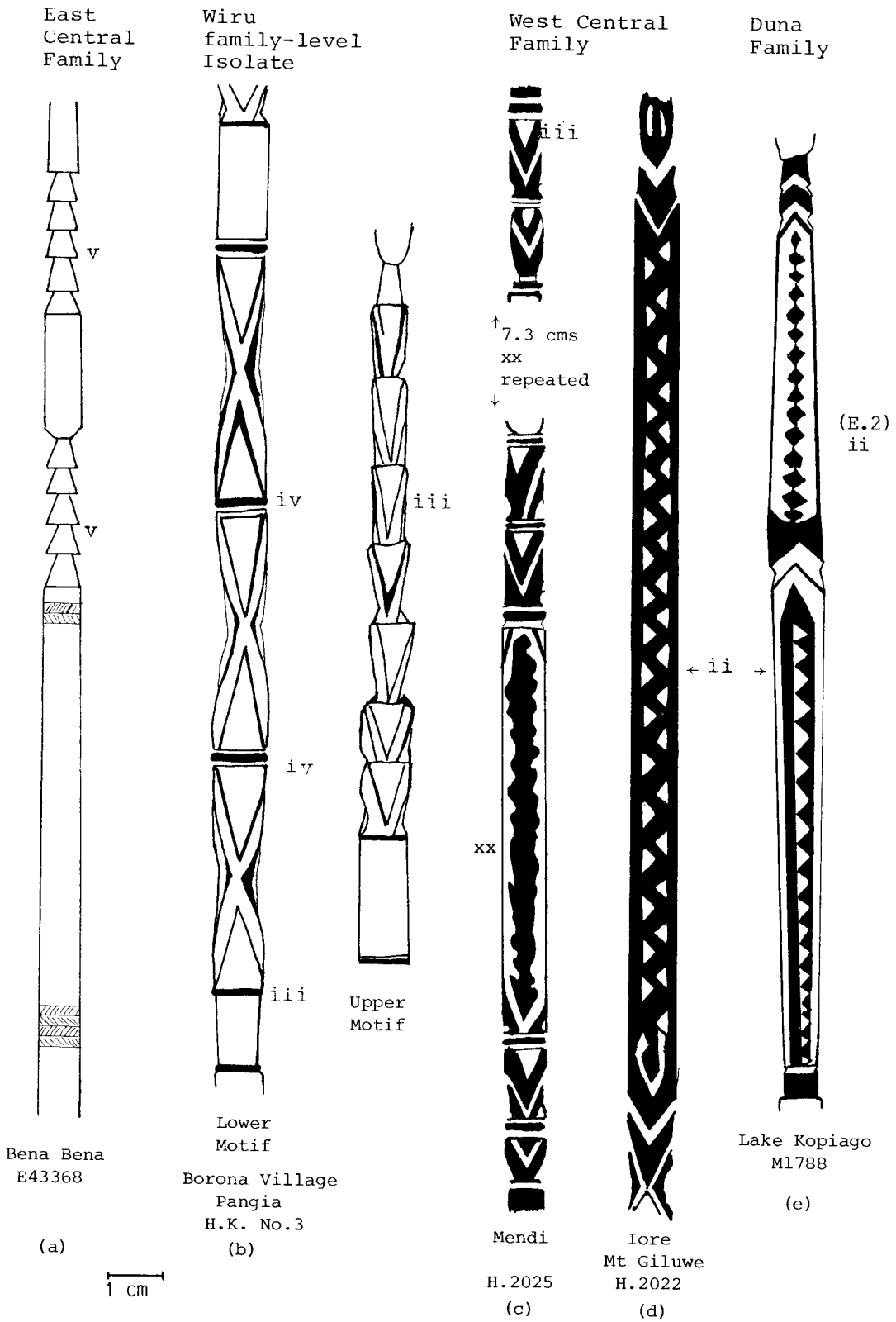

Fig. 16. Element 3 variants in design patterns.

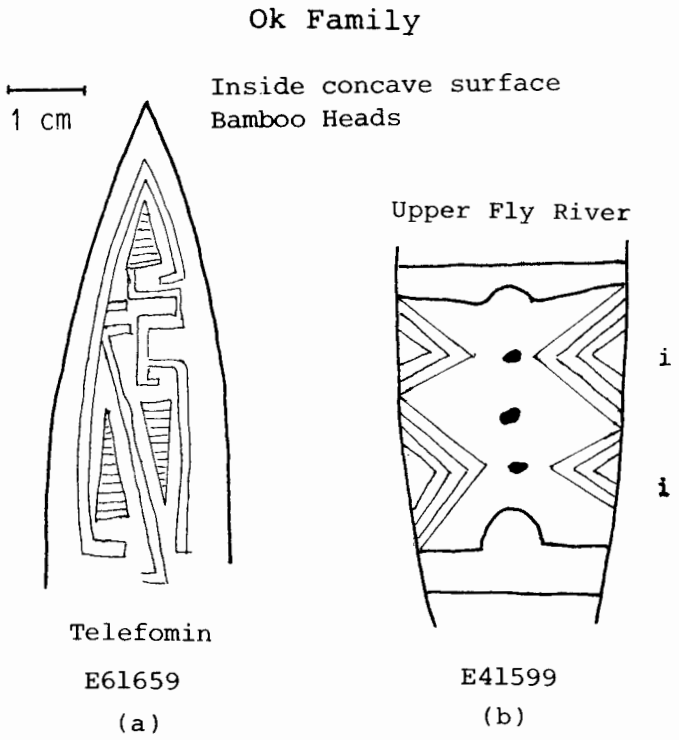

Fig. 17. Element 3 variants in design patterns.

East Central family area. Zigzag variants most used. Variants (iv) or (v) as rows of vertically positioned zigzags on the wider-shaped lower end of the head, as the only decoration on barbed arrows; on Bena Bena arrows carving is medium deep with red ochre infill (Fig. 32a).

Central family area. The Chimbu region and Mt Hagen–Tambul area make most use of variants. Variation in depth of carving designs is very evident, ranging from light (Mai village, Chimbu) to medium (Mt Hagen, Fig. 18c), to very deep in Tambul arrows (Fig. 18e)). Where carving is deep, red and/or white infill is used.

1. Variants (i) and (ii) lightly incised, at both ends of design (Mai village, Chimbu).
2. Variant (iii) medium-deeply carved, forms the main central design motif on one side of the fore-shaft (Yamaga, Mt Hagen, Fig. 14a).
3. Variant (v) very deeply carved, enclosing two sets of opposite pairs of elements 2, variant (v), occupies the complete fore-shaft (Tambul, Fig. 18e).
4. Variant (iii) light to medium deeply carved, occupies the long central area of the design, with variant (i) at the lower end and variant (v) at the upper end (Yamaga, Mt Hagen, Fig. 18c).

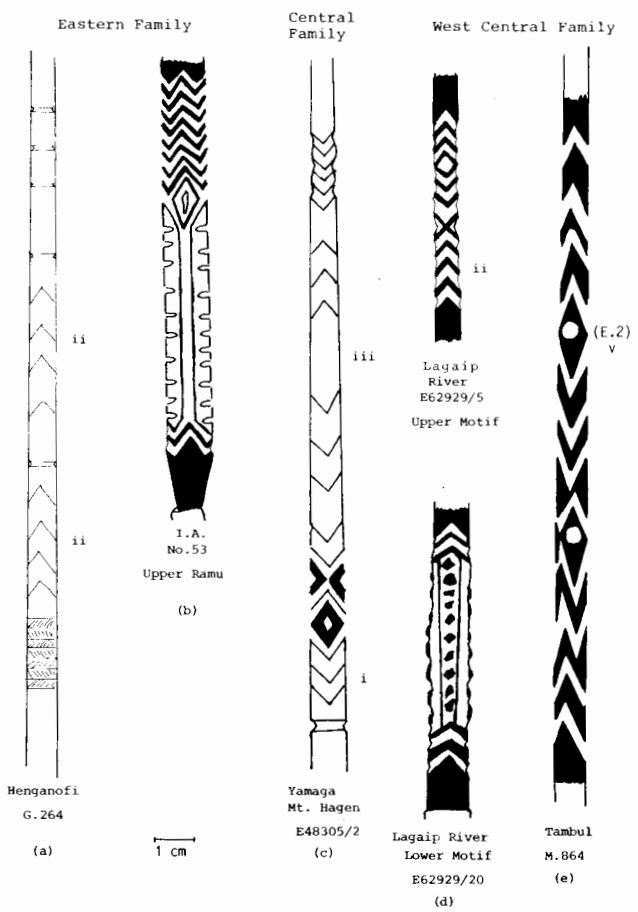

Fig. 18. Element 4 variants in design patterns.

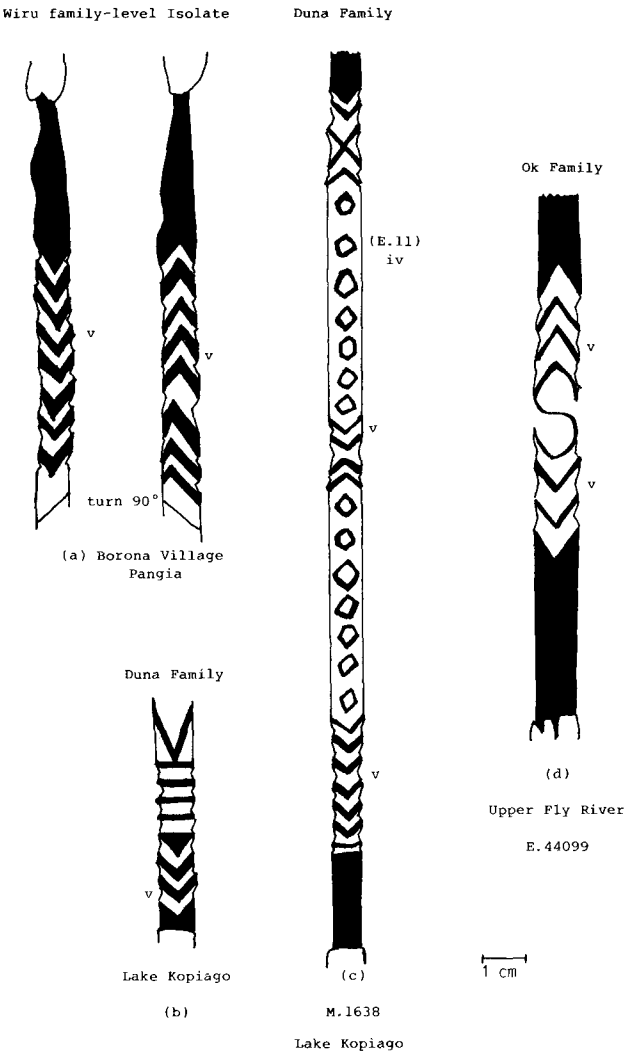

Fig. 19. Element 4 variant (v) in design patterns.

West Central family area. This element is used more in the northern part especially in the Lagaip–Porgera area.

(a) Northern region. 1. Variant (v) deeply carved zigzags, in short lengths of design, separate the other element in a two-element motif that forms the complete design pattern (Lagaip river, Fig. 18d).

2. Variant (v) in a group, near the tip of the head, as the topmost element in a single motif design (Porgera).

3. Variant (iii) as upper motif, deeply carved, enclosing two pairs of 'eye' variants, element 2, opposite and alternate to each other, (Lagaip river, Fig. 18f).

4. Variant (iv) on Keltiga arrows is used around the head, near the shaft, before barbs commence (Fig. 33).

5. Variant (iii) opposing chevrons deeply carved, as the complete design, enclosing 'eye' variant of element 2 (Porgera, Fig. 14c).

6. Variant (v) at shaft (Tabua village, Fig. 20a).

(b) Southern region. Around Ialibu-Mt Giluwe-Mendi, variation in the use of this element's variants provides diversity in designs, and some unusual use of variant (iii) is made. Sets of chevrons occupy the whole design area, enclosing in upper and lower parts a pair of 'eye' variants of element 2. the angles of the chevrons may be connected by a very narrow uncarved area left between them, as at Mt Giluwe (Fig. 30e).

Wiru family-level isolate area. On a few arrows variant (v) is used rather extensively, in designs deeply carved with blue, red and white infill (Borona village, Pangia Fig. 19a).

Duna family area. Designs show the rare use of variant (i), much use of variant (v) deeply carved, infilled with red or white (Fig. 19b,c).

Ok family area. Especially in the Telefomin and Upper Fly areas, deeply carved variant (v) is used to enclose another element (Telefomin, Fig. 29b; Upper Fly, Fig. 19d).

Comments on use of Element 4. A common use for variants (iv) and (v) is as zigzags in unconnected rows, either along the vertical axis of the head or around the head commencing at, or near, the shaft and continuing to where barbs begin. When used this way they are the only added decoration to barbed arrow heads. Either variant is used, apparently at random, except that on arrows from Duna and Ok family areas, variant (v) is used exclusively on barbed heads. Another difference noted is that, whereas on West Central arrows (Gadio people) only one row of zigzags occur vertically along each side of the head, on arrows from other language areas to the east, two or more rows are carved on each side. On Keltiga (West Central) and Mt Hagen (Central) arrows, variant (iv) is used around the head below the barbed area. Another variation occurs on some Baiyer River (West Central) arrows where two rows of zigzags, vertically disposed, cross-over each other forming a pattern below the barbs. On West Central, Duna and Ok barbed arrows, similar short designs seem to favour more the use of variants of elements 2 and 3 (Figs 32, 33).

ELEMENT 5: four-sided figure with short sides inverted, long sides meet in acute angle.

ELEMENT 5A: the same except short sides everted

These elements are absent in designs on arrows from Eastern, East Central and Central family areas and Wiru family-level isolate.

West Central family area. Elements absent on arrows from the southern part of this area, except for one documented from Tabua village where variant (vii) is the only one used in the design pattern along 29.5 cms of fore-shaft (Fig. 20a). In the northern part, frequent use is made of variants of these elements which often have a line of solid dots or rectangles in the hollowed-out centre. Where this occurs I shall write '(dots)' after the variant.

Element 5. 1. Variant (v) in its centre encloses another element to form a short, one-motif design near the shaft (Lagaip river, Fig. 20b).

2. Variant (iv) '(dots)' as upper element in the lower motif of a two-motif design (Porgera).

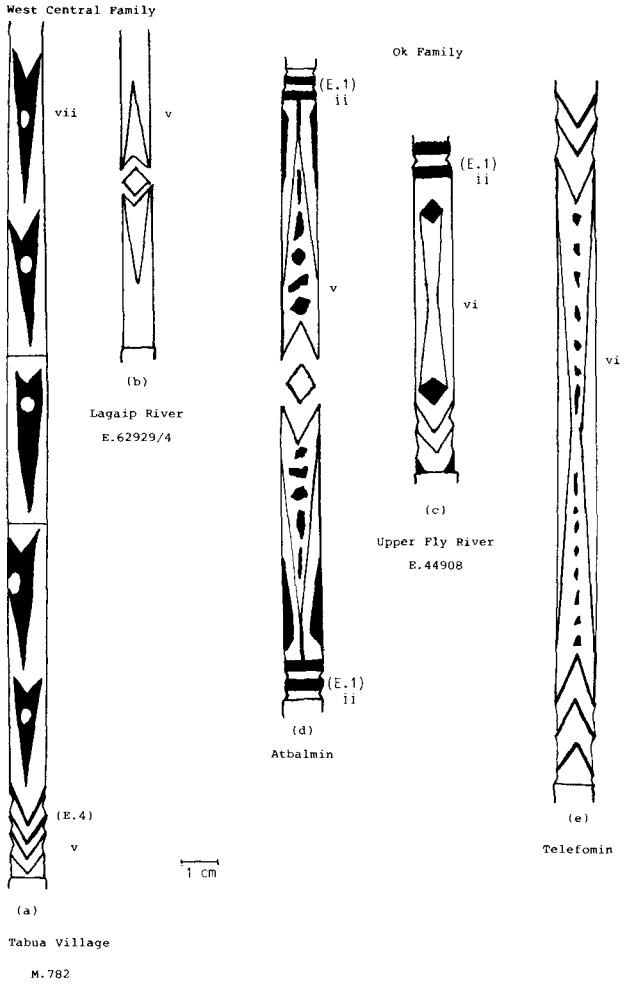

Fig. 20. Element 5 variants in design patterns.

Element 5A. 1. Variant (i) '(dots)', in centre of a one-motif design near shaft (Lagaip river).

2. Variant (ii) '(dots)' as part of upper motif, with variant (iv) '(dots)' as part of lower motif in the same design pattern.

3. Variants (i) and (ii) '(dots)' form upper part of lower motif.

4. Variant (ii) '(dots)' in upper part of geometric design (Porgera, Fig. 27a).

Duna family area. Variants of element 5 only are used.

1. Variant (iii) as part of both upper and lower repeated motif in a separated two-motif design.

2. Variant (v) as part of upper and lower motif. Here it encloses another element and forms the same design on both sides of the arrow head.

Ok family area. Both 5 and 5A are used in designs.

1. Variant (vi) occupies almost all the area in a short design at the shaft (Upper Fly River, Fig. 20c).

2. Variants (iii) and (iv), as opposite and alternate pairs, occupy the complete head (Upper May River).

3. Variant (v) '(dots)' enclosing another element occupies all the fore-shaft on one side, with variant (vi) '(dots)' occupying the reverse side (Atbalmin, Fig. 20d).

4. Variant (ii) '(dots)' as the lower and centre motif in a tri-motif design, with variant (iv) occupying the same position on the reverse side of the fore-shaft (Tifalmin).

5. Variant (vi) '(dots)' occupies all the fore-shaft with element 4 variant (v) as boundary markers (Telefomin, Fig. 20e).

Comments on use of Elements 5 and 5A. The variants of elements 5 and 5A have a limited use in designs on highlands arrows, and a combination of two variants to form part of, or the complete design pattern, is common. Sometimes different variants are used on opposite sides of the same arrow head or fore-shaft to form two different patterns.

In all areas where they are used in designs, these variants are deeply carved, but differ in the use of colour infill. White only is used in West Central and Duna family areas, but in Ok, while red and white are sometimes used as alternate infills, frequently red only is used.

ELEMENT 6: spiral

Spirals are absent from arrow designs of Ok family and Wiru family-level isolate. They are rare in other family areas except West Central, where they occur more in the southern part; in the northern part variants are mainly used as short spirals next to the shaft, often as the only design pattern.

Eastern and East Central family areas. 1. Variant (ii) occurs as a short spiral 5.0 cm long with incised diagonal lines between spiral turns around the head near the shaft, as the only element in the design (Kambira, Fig. 21a).

2. Variant (ii) starting 11 cm from the shaft, a short spiral, 4.3 cm long, separated by circles from a second spiral, 3.2 cm long, which has incised diagonal lines between spiral turns.

Central family area. Deeply carved variant (ii) is the only decoration on a long fore-shaft, 26.2 cm, infilled with white clay (Yamaga, Mt Hagen, Fig. 21b).

West Central family area.

(a) Southern region. 1. Variant (i) almost just curved lines that do not completely encircle the fore-shaft along its whole length (Iore, Mt Giluwe, Fig. 21d).

2. Variant (ii) spirals enclose one other element alternately between their curves, covering the complete fore-shaft in a one-motif design pattern (Ialibu, Fig. 30b).

3. Variant (ii) deep, wide spirals cover the whole fore-shaft, with two circles, one red, one white, as boundary markers at either end (Iore, Mt Giluwe).

4. Variant (ii) forms the lower half of a two-element design motif covering the whole fore-shaft (Iore, Mt Giluwe, Fig. 21c).

(b) Northern region. 5. Variant (ii), in lower half coloured red, in upper half coloured white, separated from each other by circles in this one-motif design (Porgera).

6. Variant (ii) only design on head near shaft (Lagaip River, Fig. 21f).

	EASTERN ..(39)								EAST CENTRAL ..(60)								CENTRAL ..(276)							
	C	PU	PL	UE	LE	All U	All L	All D	C	PU	PL	UE	LE	All U	All L	All D	C	PU	PL	UE	LE	All U	All L	All L
No.arrows El.1 Var.	4 i	8 i	7 i	4 i ii	4 i ii			12 i ii	4 i	5 i	6 i	10 ii	12 ii			15 i	20 i	8 i	9 i	17 ii	15 ii			
No.arrows El.2 Var.			4 i ii										5 ii				28 i	33 i iv	36 i iv					
No.arrows El.3 Var.			6 i ii.		2 i					3 i v	3 i v							3 i v	4 iii v					
No.arrows El.4 Var.	6 iii	18 i ii iv	11 ii		1 v	1 v			19 iii iv v	7 ii	7 ii					23 iv v	41 iii	23 i	25 i	27 i ii v	31 i ii iv v			18 iv v
No.arrows El.5 Var. El.5A																								
No.arrows El.6 Var.								3 ii								10 ii								19 ii
No.arrows El.7 Var.							2 i																	
No.arrows El.8 Var																								
No.arrows El.9 Var.																								
No.arrows El.10 Var.																								
No.arrows El.11 Var. El.11A "																								
No.arrows El.12 Var.																								
No.arrows El.13 Var.								1 iii																

Table 8. Element variants and the number of arrows on which they occurred in each position.

Positions:
C: centre of design;
PU: upper part of motif;
PL: lower part of motif;
U: upper; L: lower;
D: design; E: end.

Duna family area. Variant (iii) short spirals separate occurrences of the other element in a two-element motif at the shaft before barbing starts (Lake Kopiago, Fig. 21e).

Comments on use of Element 6. Variants of this element mostly occur as the complete design in all areas where they are used. The limited positioning of the element could possibly relate to its form, which could discourage its use as part of a motif. An almost exclusive use of variant (ii) is evident in all areas. In Eastern and East Central, notable aspects of the use of variant (ii) are its short length (5.0 cm maximum), light incision and no use of pigments; in other family areas it occupies the complete length (measured maximum 30.5 cm), or most of the head or fore-shaft, is deeply carved and infilled with red and/or white ochres and clays. Many spirals are wide (maximum 4.0 mm) particularly in the southern part of West Central family area. Even in this area, where designs are often infilled with other pigments, only red and white are used to colour spirals.

This element's use appears to have regional significance within West Central language family boundary. In the north it occurs in designs on arrows from the Lagaip–Porgera region, and in the south from Mt Giluwe–Ialibu area where arrow designs show prolific use of spirals.

Arrow designs from comparison area Karimui show a similar use of spiral variant (ii) to designs on Iore and Mendi arrows from the southern part of West Central language family area.

WEST CENTRAL ..(260)								DUNA ..(90)								Ok .. (95)								Wiru ..(14)							
C	PU	PL	UE	LE	All U	All L	All D	C	PU	PL	UE	LE	All U	All L	All D	C	PU	PL	UE	LE	All U	All L	All D	C	PU	PL	UE	LE	All U	All L	All D
13 ii	10 ii	10 ii	19 ii	24 ii	13 i	3 i	2 ii	5 ii	3 ii	3 ii	4 ii	4 ii				6 ii			14 ii	10 ii							3 ii	3 ii			
27 iii iv	15 ii iii	19 ii iii	7 v	20 iii iv v	5 ii v	4 ii v	3 ii	14 iv v	9 ii	16 iii	7 iii		7 ii iii	10 ii iii	3 iv	6 iii	11 iii iv	19 ii iv	5 ii iii						1 v	1 v	1 iii	1 v	1 v			
30 i ii v	13 v vii	12 ii v	7 i iii	9 i iii	11 iv v	9 v vii	14 iii iv			13 ii					9 i ii iii	4 v vi	7 v	13 v vi			14 v	2 v	3 i ii		1 vii		2 iii iv	2 iii vii	2 i iii	1 iv	2 iii + iv
27 iii v	10 v	10 v	25 i ii iv v	36 v	7 i v		16 iii iv v	4 v		3 v	25 v	31 v	6 i v		12 v	4 v	3 v	9 iii v	5 v	10 v			5 v		2 v	2 v	1 i		1 v		
17 i	22 iv + ii v	34 i + ii iv v			2 iv		12 i ii vii		11 iii v	13 iii v						1 ii iv v vi	9 i ii iii	12 ii iii iv v			5 vi	9 ii iv vi	6 iii iv vi								
		8 ii			10 ii	10 ii	48 i ii			7 iii																					
	20 ii iv	19 ii iv				18 iii	25 iii + iv ii iv			2 ii								5 iv	4 iv	4 iv			7 iv	1 iv	1 iv	2 ii iii					4 ii ii + iv iii + iv
2 i	5 i	4 i	3 i	3 i	11 i ii	10 i										3 i					3 i	3 i		1 i	1 i	2 i	3 i ii	2 i	1 iv		
35 i ii iv	6 i	29 iii i			3 i			3 i								7 iv	8 i	8 i			11 i iv	4 iv	1 i iv								
19 ii	7 ii	9 i ii																							3 ii	2 ii					
18 i i	19 i	16 iii iv v	2 iv	2 iv		16 iii iv	17 iii iv			9 iv			7 iv	7 iv	16 iv	7 i	10 i iv	8 i	8 i	6 i			8 i ii	2 iv v	1 iv	2 iv v		1 v		1 iv	2 iii iv
10 ii						9 i										6 ii	13 ii iii	13 ii iii				6 ii	17 iv								
	13 iii	13 iii				5 iii	9 ii		14 i	14 i iii			15 i ii			7 i	12 ii	12 ii	4 iii												

Table 9. Design elements distribution. ☆ = elements used on two arrows either wrongly documented or trade/gifts from a language family much further westward.

Language Family	Elements												
	1	2	3	4	5/5A	6	7	8	9	10	11/11A	12	13
Eastern	★	★	★	★		★	☆			☆			☆
East Central	★	★	★	★		★							
Central	★	★	★	★		★							
West Central	★	★	★	★	★	★	★	★	★	★	★	★	★
Wiru	★	★	★	★			★	★		★	★		
Duna	★	★	★	●	★	★	★		★		★		★
Ok	★	★	★	★	★		★	★	★		★	★	★

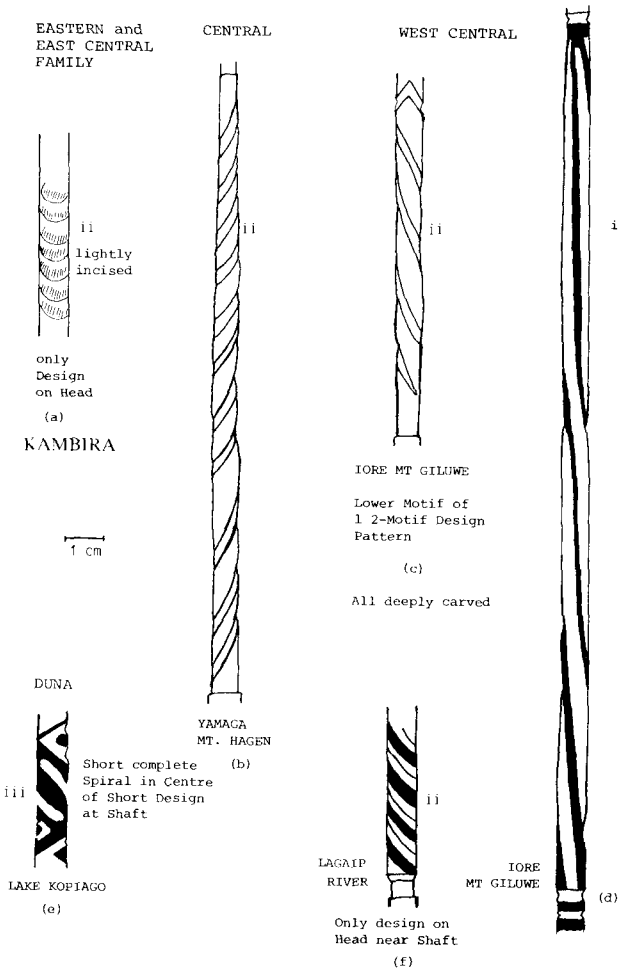

Fig. 21. Element 6 variants in design patterns.

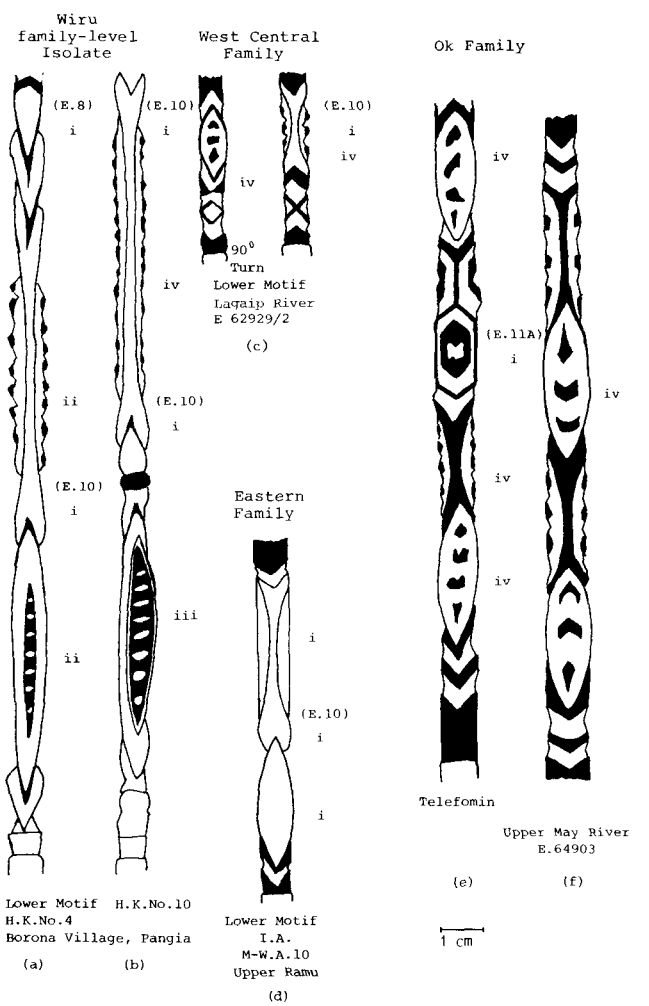

Fig. 22. Element 7 variants in design patterns.

ELEMENT 7: lenticular shield

This element is one of the least used in arrow designs in the highlands except for two family areas, West Central (especially around Ialibu and Mendi in the south) and Wiru family-level isolate. It is rarely present on Duna and Ok arrows, and is absent from East Central and Eastern family areas except for two arrows documented from Upper Ramu.

Eastern family area. As variant (i) medium-deeply carved, two opposite and alternate pairs around fore-shaft as lower motif of a two-motif design (Upper Ramu, Fig. 22d).

West Central family area.

(a) Northern region. 1. Variant (iv) opposite pair, positioned as upper half of a two-element lower motif next to shaft, separated by undecorated area from upper motif using different elements (Lagaip River, Fig. 22c).

2. Variant (iv) as in 1. but here occupying the greater part of both upper and lower motifs, and with one other element ('eye' element 2) forming the whole design pattern (Lagaip River).

(b) Southern region. Ialibu arrow designs frequently show use of variants in elongated form, or combine variants (iii) + (iv).

3. Variant (iv) separated by spiral grooves along complete length of fore-shaft (Ialibu, Fig. 30b).

4. Variant (ii) elongated; two opposite and alternate pairs, enclosed and separated by a different element, form the complete design pattern (Mendi, Fig. 23b).

5. Variants (iii) + (iv) combined to cover the complete fore-shaft. Three of variant (iv) are arranged in a spiral around the lower part. Directly above is an opposite pair of variant (iv) and at the upper end of the design is an opposite pair of variant (iii) alternate to the pair of variant (iv) below (Ialibu, Fig. 30a).

Wiru family-level isolate area. Used most in this area where arrow designs exhibit frequent use of variants elongated and sometimes combined, or individually as opposite pairs to form the whole design.

1. Variant (ii) elongated, two opposite and alternate pairs, occupying most of the lower motif in a two-motif design pattern (Borona village, Fig. 22a). Red, orange and white pigments used to infill design.

2. Variant (iv) elongated, four opposite and alternate pairs, forming a one-motif design, with boundary markers, that occupies the whole fore-shaft (Borona village).

3. Variant (iii), an opposite pair lower motif, plus (iv),

an opposite pair upper motif, with element 10 variant (i), all elongated, covering the whole fore-shaft (Borona village, Fig. 22b).

Duna family area. Variant (iv) occurs as an opposite and alternate pair, as the main element in the lower motif of a two-motif design pattern.

Ok family area. 1. Variant (iv), three elongated, opposite and alternate pairs occupy all the fore-shaft except for another element at both ends of the design (Telefomin, Fig. 26c).

2. Variant (iv), one opposite pair in lower motif of a tri-motif design pattern (Tifalmin).

3. Variant (iv) as three opposite and alternate pairs, two positioned near shaft, one pair at upper end of design, before barbs begin (Telefomin, Fig. 22e).

Comments on use of Elements 7. This element's use in arrow designs documented from Upper Ramu (Eastern family), and its absence from both East Central and Central arrow designs, leads me to suspect these arrows were introduced from an area further to the west.

In the northern part of West Central family area where use of this element is rare, motifs are mostly short and separated by an undecorated area. The variant is reduced in overall size to fit into the long, thin design field provided by the long, slender heads and fore-shafts. In the southern part the opposite happens; variants more frequently occur in elongated form, that is, the curved sides are extended, together with any internal solid areas, to adapt to the long, narrow design area. As well, two different variants are often used in the one design. Some Wiru arrow designs show great similarity, in the use of this element, to those of Ialibu and Mendi, particularly when two variants are combined. However, in Wiru area it is never used with spiral element 6 variant (ii), with which it occurs frequently on arrow designs from the southern part of West Central family area. In Ok arrow designs it occurs in its normal form, as the fore-shafts of these arrows are much shorter and thicker, providing a wider design field for use. In Tifalmin–Telefomin area designs there appear to be an association between the use of variant (iv) of this element and variant (i) of element 11A. This seems to be a regional phenomenon within the Ok family language boundary.

Comparison area Karimui arrow designs show use of variant (i) as the complete lower motif, and as a short, complete design with only variant (i) in two opposite and alternate pairs. All are infilled with greyish clay.

ELEMENT 8: lanceolate, leaf-like shape

Occurs frequently in the southern part of West Central family area, Mendi region, and Wiru family-level isolate area, but in no others except on three arrows from Ok family area. It has two variant forms, both deeply carved; one is carved in linear series along the length of head or fore-shaft, the other is a smaller double-leaf variant in pairs, around the head or fore-shaft.

Wiru family-level isolate. 1. Variant (i) above and below a central element, then variant (ii) as the upper

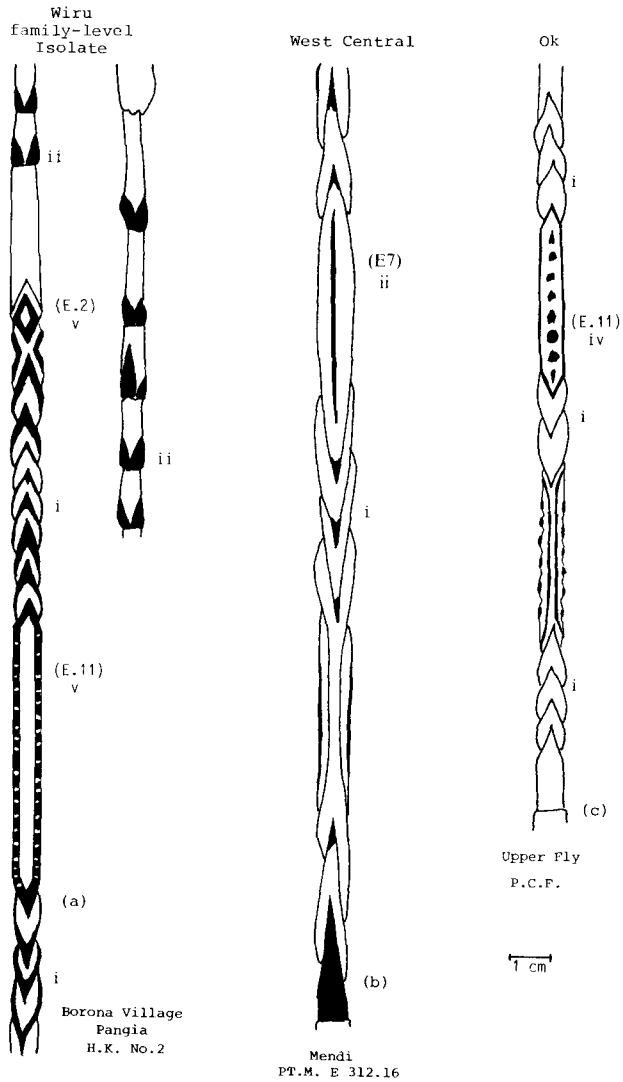

Fig. 23. Element 8 variants in design patterns.

motif in this two-motif design. These are separated by an undecorated area. Red, white and yellow pigments used to infill design (Borona village, Fig. 23a).

2. Variant (i) inverted at upper and lower end of design (Borona village, Fig. 22a).

3. Variant (i) at shaft and in centre, variant (ii) at upper end of a one-motif repeated design (Borona village).

West Central family area. 1. Variant (i) as the main element in a two-element motif covering all the fore-shaft (Iore, Mt Giluwe, Fig. 30d).

2. Variant (i) at both ends and centre of a two-element, one-motif design (Mendi, Fig. 23b).

Ok family area. Variant (i) positioned as upper, centre and lower element, with one other element separating them, in a two-element, one-motif design pattern (Upper Fly River, Fig. 23c).

Comments on use of Element 8. The use of this element is almost confined to the Mendi region in the southern part of West Central family area, and Wiru

family-level isolate area. Variant (ii) is much less used, and then always with variant (i) which lends itself most effectively to use on the long, slender fore-shafts of West Central and Wiru area arrows. Variant (i) is used on Wiru arrows to enclose variants of element 11, whilst Mendi designs use a variant of element 7 in this same way. Upper Fly (Ok family) designs exhibit the use of variant (i) in a similar way to Wiru and Mendi. All are deeply carved with much use of coloured infill. Arrows from Ok family area using this element are almost replicas of those from Wiru, and I suggest these, documented to the Upper Fly, are trade items from Wiru area.

ELEMENT 9: figure with two long sides curved and short sides inverted

In design patterns, variants, especially variant (iv) the 'heart' variant, are frequently associated with 'eye' variants of element 2.

West Central family. 1. Variant (ii), three opposite and alternate pairs, as the centre element in a tri-motif design. Lower motif contains 'eye' variant (v) of element 2 (Porgera, Fig. 24a).

2. Variant (i), two opposite and alternate pairs, in centre as in 1.

3. Variant (iv) centre motif in a tri-motif design. Lower motif contains 'eye' variant (iv) of element 2 (Porgera, Fig. 29c).

4. Variant (iii) in reverse position, an opposite pair, in the lower motif; variant (iv) as central motif, with 'eye' variant (v) of element 2 as the upper motif, in a design covering all the head except for pointed tip. 'Eye' variants (iii) + (iv) of element 2 are associated in lower motif (Lagaip River, Fig. 29e).

5. Variant (iii), two opposite and reversed pairs in lower motif. Opposite and alternate pairs of variant (iv) occupy the remainder of the design area of the head (Lagaip River, Fig. 24b).

Duna family area. 1. Variant (i), very deeply carved, two pairs opposite and alternate at upper end of design (Lake Kopiago).

2. Variant (i) as central motif in a tri-motif design (Lake Kopiago).

Ok family area. 1. Variant (i) as an opposite pair in the lowest motif of a tri-motif design (Telefomin, Fig. 24c).

2. Variant (i) as an opposite pair near shaft with reversed pair above, enclosing a variant of element 12. An opposite and alternate pair at the upper end complete the design (Tifalmin, Fig. 24d).

3. Variant (i) in two pairs deeply carved, opposite and alternate, forming the upper motif in a two-motif design (Telefomin, Fig. 24e).

4. Variant (iv) in seven pairs, deeply carved, opposite and alternate, in centre position of a tri-motif design, with 'eye' variant of element 2 in upper motif (Telefomin, Fig. 29a).

5. Variant (iv) occupying 24.5 cm of head, eleven down one face of head (unpaired), as the main motif in the design which has an 'eye' motif at the shaft (Tifalmin, Fig. 29b).

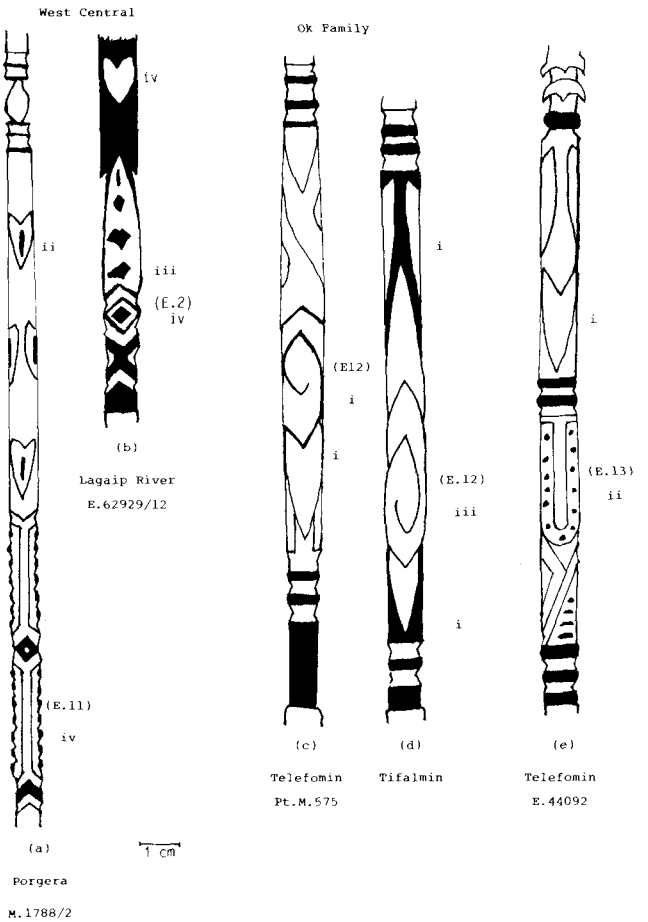

Fig. 24. Element 9 variants in design patterns.

Comments on use of Element 9. This element's distribution appears confined to specific areas within the language family boundaries: Lagaip–Porgera in West Central, Lake Kopiago in Duna, and Tifalmin–Telefomin in Ok. This could point to its diffusion from west to east or east to west (most probably the former), for there is great similarity in its use in Ok and West Central arrow designs. Both show that when variant (iv) is used, either alone or with variant (iii), it is always associated with one of the 'eye' variants of element 2. Here there could be some biological inference in this association, as variant (iv) is heart-shaped, giving a 'hearts' and 'eyes' combination (Fig. 29).

Some bamboo heads on Ok family arrows exhibit the use of variant (i), either carved as on fore-shafts or completely carved-out leaving a hollowed-out outline. When this variant is used on bamboo heads, a different element is used in designs on the fore-shafts. For this element, white infill is usually used, and red is rare.

An unusual method of using variant (iv) is seen on some Tifalmin and Telefomin arrows, which deviate from the norm in two respects. Here the element is not used in pairs, nor is it carved around the head. Instead it is presented in linear series and on one face only of the head, for about 20.0 cm of its length. Positioned directly above an 'eye' enclosed in chevrons at the shaft, is the smallest of a series of variant (iv), 'heart'; above

this they gradually increase in size to two large central 'hearts', then decrease in size towards the tip of the head. In series these numbers are 4–2–4 (Fig. 29b). On other arrows the series are 4–1 (large)–3(small) repeated up to the tip. I think these arrow designs are the work of one artist-decorator, perhaps trying out a different way to use a familiar element in an arrow design.

ELEMENT 10: hourglass

This element has a limited distribution, occurring in West Central family area, Wiru family-level isolate, comparison areas Karimui and Aiome, and on one arrow from Eastern family area.

West Central family area and Wiru family-level isolate. 1. Variant (i) elongated, enclosing in the V-shaped ends another element, in a repeated design motif (Borona village, Fig. 22b).

2. Variant (i) alternate and opposite as part of a motif that covers the whole fore-shaft, repeated four times (Mendi and Borona village, Fig. 22a).

3. Variant (i) as part of lower motif in a separated two-motif design pattern (Lagaip River, Fig. 22c).

4. Variant (ii) in the centre, separating two other motifs (Mendi, Figs 25b, 13b).

Comments on use of Element 10. Even in the language family areas in which it is used in arrow designs, this element is used sparingly. Perhaps the simplicity in shape and few variations that can be given to its form, puts limits on its use in designs and makes it a disfavoured element. The use of variant (i) in West Central family area and more frequently in Wiru family-level isolate area, could be related to the use of Element 7 as the other element in these design patterns, because the two shapes conveniently fit together to form a motif. The arrow documented from Upper Ramu, I strongly suspect of being a gift or trade item from Wiru or West Cenral family area.

In comparison areas Karimui and Aiome (Fig. 25c, d), element 10 is used in the central position where part of the head or fore-shaft is carved to this shape, as in Mendi arrow designs.

ELEMENT 11: rectilinear, six-sided figure, four short sides everted

ELEMENT 11A: a similar figure with four short sides inverted

Both elements are absent in Eastern, East Central and Central language family areas. Element 11A is found in the Ok family area only.

Element 11 West Central family area.

(a) Northern region. 1. Variant (iv) as complete lower motif near shaft, in a two-motif design separated by an undecorated area (Lagaip River).

2. Variant (iv) as two opposite pairs separated by an element 2 'eye' variant, form the lowest motif in a tri-motif design (Porgera, Fig. 24a).

(b) Southern region. 1. Variant (iii) two opposite pairs in centre of design (Mt Giluwe).

2. Variant (iv) elongated, as two opposite pairs occupying the whole fore-shaft, separated from each other by circles or 'eyes' at the centre of design,

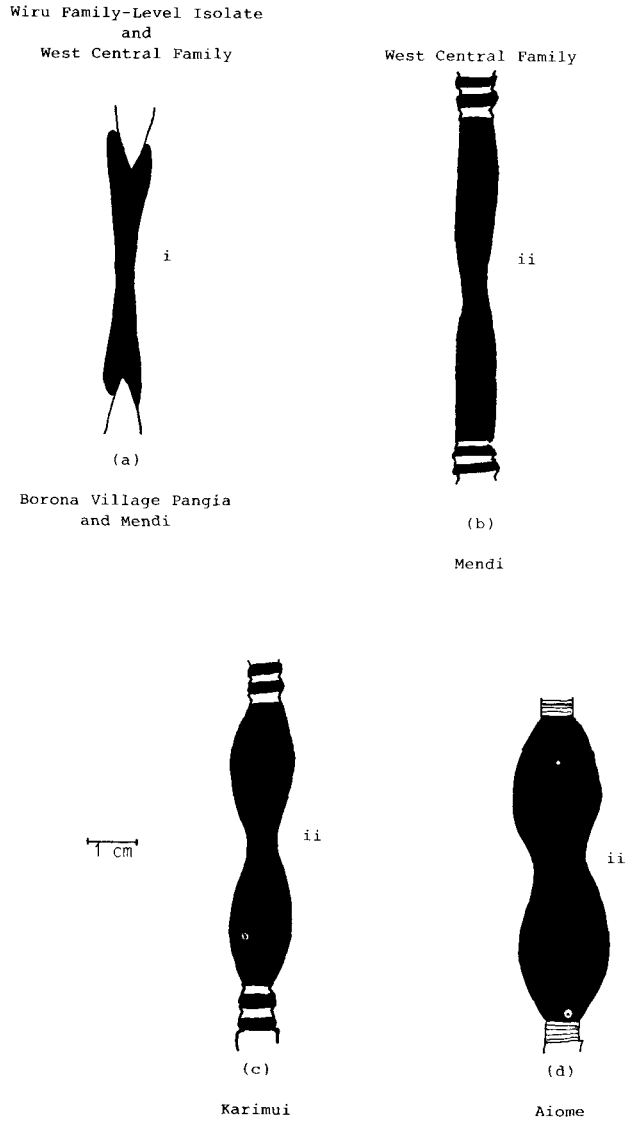

Fig. 25. Element 10 variants in design patterns.

boundary marker circles at both ends. Variant (iii) is also used in this same manner.

3. Variant (iii) as an opposite pair; variant (iv) as an opposite and alternate pair above, forming the lower two-thirds of a tri-motif design on a long, slender fore-shaft. Both variants are elongated (Mendi, Fig. 30c).

4. Variant (iv) as two opposite pairs at upper end of lower motif at shaft, and reversed on repeated upper motif, separated by a different motif at centre (Mendi).

5. Variant (iv) elongated, as two opposite pairs separated by an undecorated area, with a very short variant (iv) completing the fore-shaft design (Tabua).

Wiru family-level isolate area. 1. Variant (iv) elongated, two opposite pairs occupying the whole fore-shaft, separated from each other by circles or 'eyes' at the centre of design; boundary marker circles at both ends. Variant (iii) is also used in this same manner (Borona village).

2. Variant (iv) elongated, as two opposite and

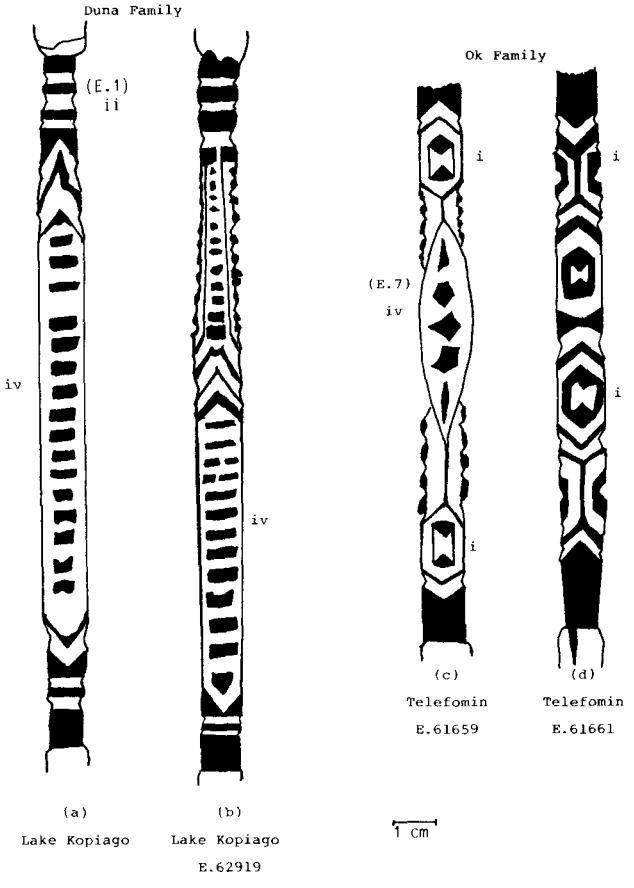

Fig. 26. Element 11 and 11A variants in design patterns.

alternate pairs occupying the lower two-thirds of the design, with a different element in the upper one-third completing the pattern (Borona village).

3. Variant (v) as one opposite pair at lower end of design near shaft, and in centre position in the same pattern; yellow infill (Borona village).

4. Variant (v) as one opposite pair forming the centre element in the lower design, in a separated two-motif pattern; yellow infill (Borona village, Fig. 23a).

Duna family area. 1. Variant (iv) as two opposite pairs occupying the whole fore-shaft, except for zigzags or 'eyes' separating them at the centre, and zigzags enclosing them at both ends (Lake Kopiago, Fig. 19c).

2. Variant (iv) as two opposite and alternate pairs forming the complete design, separated in the centre by zigzags with circles as boundary markers at both ends. Very deeply carved; white infill (Lake Kopiago, Fig. 26b).

3. Variant (iv) elongated to form the complete one-element, one-motif design with circle boundary markers at both ends (Lake Kopiago, Fig. 26a).

4. Variant (iv) as an opposite pair forming the lower motif (Lake Kopiago, Fig. 31a).

Ok family area. 1. Variant (iv), upper element in a two-element motif next to shaft. Different elements complete the design. Deeply carved; coloured red and white (Telefomin).

2. Variant (iv) as two opposite and alternate pairs, together with one other element forming the complete design pattern (Upper Fly, Fig. 23c).

Element 11A. Ok family area. 1. Variant (i) at both ends of a design pattern, in opposite pairs (Telefomin, Fig. 26c).

2. Variant (i) in upper motif of a complicated geometric design (Telefomin, Fig. 27b).

3. Variant (i), four opposite and alternate pairs each separated by a zigzag make the complete design pattern (Tifalmin, Fig. 26d).

Comments on use of Elements 11 and 11A. Although variants of elements 11 and 11A are used in arrow designs in only three of the language family areas and Wiru family-level isolate, variants of 11 are widely distributed throughout Wiru and West Central, as are variants of 11A in Ok area. In Duna arrow design, variant (iv) of element 11 is used exclusively and appears confined to the Lake Kopiago region. In Wiru and West Central area, variants are sometimes elongated to fit the design field on a long, slender head or fore-shaft, and this also occurs in Duna family language area because often only one or two variants are used to occupy the complete design field. Variants are deeply carved in all areas, but coloured clays and ochres used as infills to emphasize them, differ in different areas; in the northern part of West Central area white is used for all variants, but in the southern part, red and/or white is used. In Wiru area, variant (iv) is always infilled with yellow clay, whilst in other variants either red or white is used. In Duna designs, white infill is used exclusively; in Ok arrow designs red and/or white are used.

ELEMENT 12: geometric

Deeply carved, often continues around head or fore-shaft, but frequently used as part of a vertically-placed motif. It was impossible to analyse all geometric variants, so the ones below are selected because they are the four most commonly used in design patterns. They are found in only two family areas: the northern region of West Central, where they are rare, and the Telefomin–Tifalmin region of Ok family area, where they are used extensively.

West Central family area. 1. Variant (ii) as centre element in the central motif of a tri-motif design covering all the fore-shaft (Porgera, Fig. 27a).

2. Variant (i) as the lower motif separated by an undecorated area from the upper motif, in a two-motif design pattern (Lagaip River, Fig. 27d).

Ok family area. 1. Variant (i) in centre position in lower motif, and as mirror image in upper motif on reverse side of fore-shaft, in a two-motif design (Telefomin, Fig. 24c).

2. Variant (ii) as an opposite pair in lower part of design enclosed by a variant of element 9 (Tifalmin, Fig. 24d).

3. Two of variant (ii), one a mirror image of the other, joined as centre motif, and variant (ii) as lower motif next to shaft, in a tri-motif, and variant (ii) as lower motif next to shaft, in a tri-motif design on fore-shaft

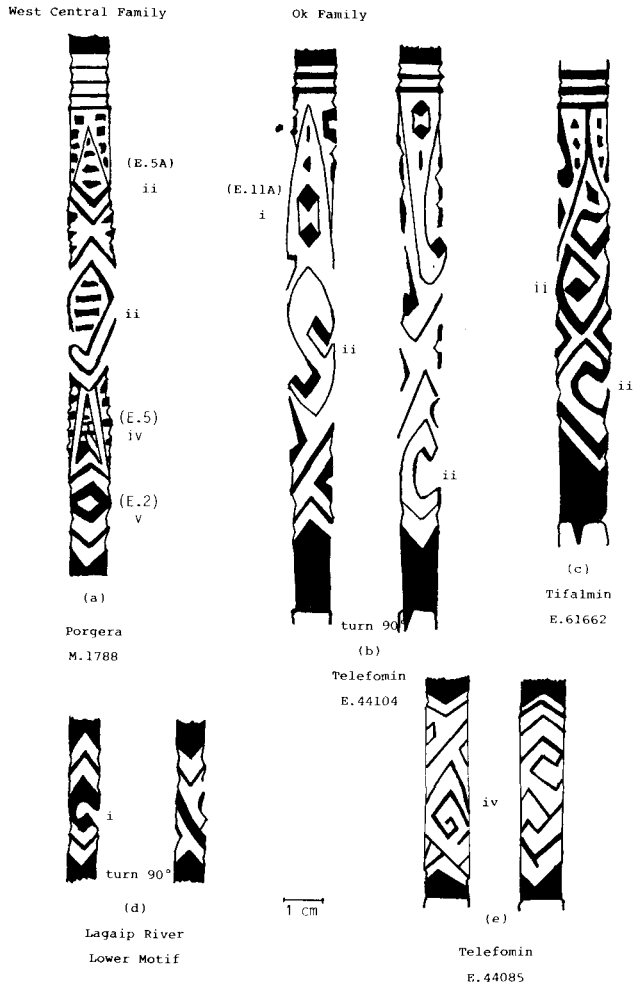

Fig. 27. Element 12 geometric variants in design patterns.

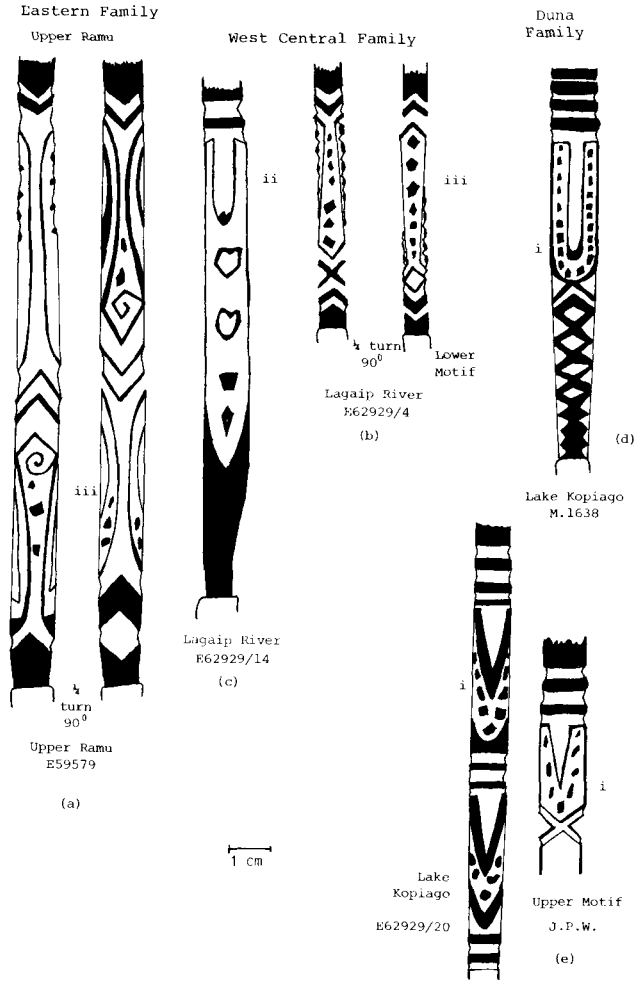

Fig. 28. Element 13 variants in design patterns.

(Telefomin, Fig. 27b).

4. Variant (iv) in a complex angular design, for 5.0 cm on head next to shaft; there is no other decoration (Telefomin, Fig. 27e).

5. Variants (ii) + (iv) in a complex angular design occupying all the fore-shaft (Tifalmin, Fig. 27c).

Comments on use of Element 12. Variants of this element are rarely seen on highlands arrow designs. When used they often occur either reversed or as mirror images in two areas of the design. Variant (iv) is the only one used as the complete design. Sometimes red ochre and/or white clay are used to infill designs, but often no colour is used.

The frequent use of this element in an area of Ok family to the west of Strickland Gorge, and its rare use in the northern part of West Central family area, might indicate its diffusion from west to east, i.e. from Telefomin–Tifalmin area to the Lagaip River–Porgera region.

ELEMENT 13: grooved elements

Very rare in Eastern family area, absent in East Central, Wiru and Central; present in all other areas. Grooves sometimes contain a line of solidly carved dots inside or outside in their surrounding area. Where these occur I shall indicate these occurrences by writing '(dots inside)' for the former, and '(dots outside)' for the latter, after naming the variant concerned.

Eastern family area. 1. Variant (iii) '(dots inside)' occurs twice, one upright at base of lower of two motifs, the other time inverted at the top of the upper motif which is itself an inverted example of the lower motif (Upper Ramu, Fig. 28a).

West Central family area 1. Variant (ii) '(dots outside)' surrounds elongated to fill length of whole fore-shaft on both sides, (Lagaip River, Fig. 28c)

2. Variant (iii) '(dots inside and outside)' occupies the greater part of upper motif, and in reversed position in lower motif on opposite side of fore-shaft (Lagaip River).

3. Variant (iii) '(dots inside)' two opposite and alternate pairs, plus 'eye' variant of element 2, form the whole lower motif in a separated two-motif design (Lagaip River, Fig. 28b).

Duna family area. 1. Variant (i) '(dots outside)' as part of upper and lower motifs in a two-motif design (Lake Kopiago, fig. 28e).

2. Variant (i) as in 1. above but inverted in upper motif.

Table 10. Positioning of elements in design patterns.

Element		C	PU	PL	UE	LE	All U	All L	All D
1	E	*	*	*	*	*			*
	EC	*	*	*	*	*			*
	C	*	*	*	*	*			
	WC	*	*	*	*	*	*	*	*
	D	*	*	*	*	*			
	Ok	*			*	*			
	W				*	*			
2	E			*					
	EC					*			
	C	*	*	*					
	WC	*	*	*	*	*	*	*	*
	D	*	*	*	*		*	*	*
	Ok	*	*	*	*				
	W	*	*		*	*			
3	E			*		*			
	EC		*	*					
	C		*	*					
	WC	*	*	*	*	*	*	*	*
	D			*				*	
	Ok	*	*	*			*		*
	W		*		*	*	*	*	
4	E	*	*	*					
	EC	*	*	*					*
	C	*	*	*	*	*			*
	WC	*	*	*	*	*	*		*
	D	*		*	*	*	*		*
	Ok	*	*	*	*	*			*
	W		*	*	*	*	*		
5 & 5A	E								
5	EC								
5 & 5A	C								
5	WC	*	*	*					*
	D		*	*					
	Ok	*	*	*			*	*	*
	W								
6	E								*
	EC								*
	C								*
	WC			*			*	*	*
	D			*					
	Ok								
	W								
7	E							*	
	EC								
	C								
	WC		*	*			*	*	*
	D			*					
	Ok			*	*	*			*
	W	*	*	*		*			

Language Families
E = Eastern
C = Central
W = Wiru
Ok = Ok
D = Duna
WC = West Central
EC = East Central

Positions
C = Centre of design
PU = Part of upper motif
PL = Part of lower motif
U = Upper
L = Lower
D = Design

Element		C	PU	PL	UE	LE	All U	All L	All D
8	E								
	EC								
	C								
	WC	*	*	*	*	*	*	*	
	D								
	Ok	*					*	*	
	W		*	*	*	*	*		
9	E								
	EC								
	C								
	WC	*	*	*			*		
	D	*		*	*				
	Ok	*	*	*		*	*	*	*
	W								
10	E								
	EC								
	C								
	WC	*	*	*					
	D								
	Ok								
	W		*	*					
11	E								
	EC								
	C								
	WC	*	*	*	*	*		*	*
	D			*			*	*	*
11A	Ok	*	*	*	*	*			*
11	W	*	*	*		*		*	*
12	E								
	EC								
	C								
	WC	*						*	
	D								
	Ok	*	*	*				*	*
	W								
13	E								*
	EC								
	C								
	WC		*	*				*	*
	D		*	*			*		
	Ok	*	*	*	*				
	W								

3. Variant (i) '(dots outside)' as an opposite pair in upper motif of a two-motif design (Lake Kopiago, Fig. 31c).

4. Variant (ii) '(dots inside)' one pair, upper motif, plus variant (iii) '(dots inside)' inverted, one only as part of lower motif (Lake Kopiago, Fig. 31a).

5. Variant (iii) '(dots inside)' an opposite pair, forming the upper motif in a two-motif design pattern, (Lake Kopiago, Fig. 31b).

6. Variant (ii) '(dots outside)' in an opposite pair as

the upper half of a one-motif design pattern (Lake Kopiago, Fig. 28d).

Ok family area. 1. Variant (i) '(dots inside)' one inverted, forms an opposing pair with another in centre position of design (Telefomin).

2. Variant (ii) as opposite pairs '(dots outside)' forming part of upper and lower motifs in a two-motif design (Upper Fly).

3. Variant (iii) as an opposite pair at upper end of design (Telefomin).

4. Variant (ii) '(dots inside)' as an opposite pair in upper part of a complex lower motif (Telefomin, Fig. 24e).

Comments on use of Element 13. Apart from a single arrow from the Eastern language family area using variant (iii) as its whole design, variants of element 13 are completely absent from designs on Eastern, East Central and Central family arrows. The anomalous Eastern family arrow is therefore assumed to have been introduced much further westwards.

Only in the northern part of West Central area do designs on arrows exhibit the use of variants of this element, and one can say its distribution covers a geographic region from Lagaip River through Lake Kopiago area westwards to the border with Irian Jaya. This distribution pattern points to a linkage between West Central and Duna family areas in the highlands, and Ok family area across the Strickland Gorge.

DISCUSSION OF ELEMENT USE

In this discussion I am excluding two arrows (E59579 Aust. Mus.) documented Upper Ramu, Eastern family area, and three from Laiagam (PNGM) West Central family, because they show no correspondence at all in element use and design patterning to other arrows within their documented areas. These arrows, I am convinced, have come from other language family areas as trade items or gifts.

Data from Tables 7, 8 and 9 show that seven elements (7–13 inclusive) occur only in designs from western areas, which also use twice as many design elements as eastern areas. The numbers of elements used are:

Eastern	East Cental	Central	West Central	Duna	Ok	Wiru
5	5	5	13	10	11	8

From these data, although there appears to be a boundary or break between Central and West Central areas, when tested against a theoretical distribution generated by means of a random numbers table, it was found not to be significant even at P = .05, using a chi-square test. A further similar test gave the result 'probably significant'. However, the use of the 13 elements considered does seem to confirm the idea that there are basic distinctions between design patterns on arrows from the language family areas to the east and west of the suggested physiographic boundary. Designs on arrows from Eastern, East Central and Central family areas are simple and stylistically homogeneous.

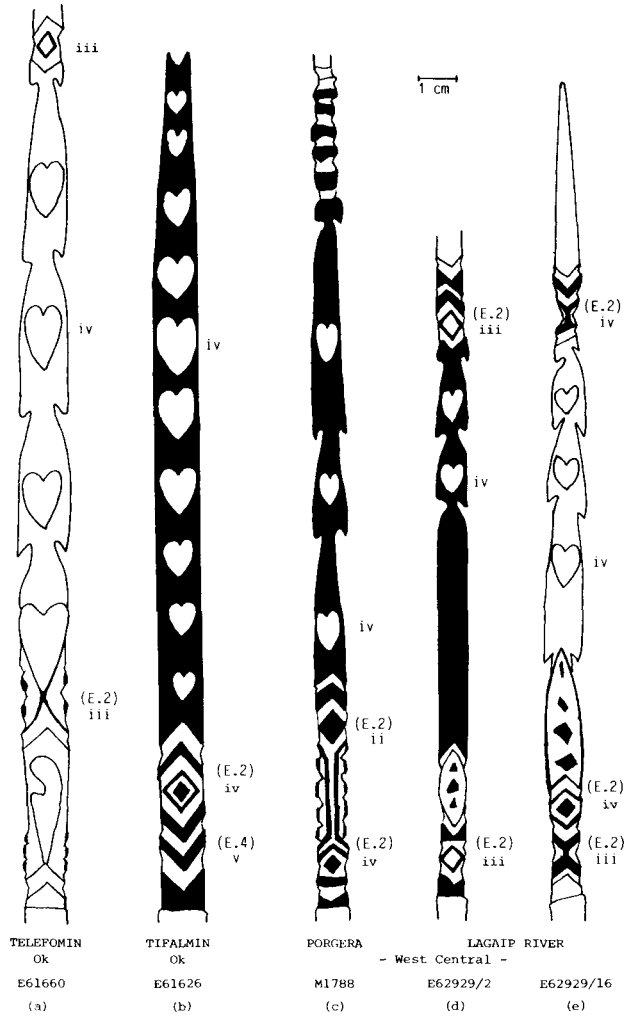

Fig. 29. Design patterns — 'eye-heart' combination. Element 2 variants with element 9 variant (iv).

The small number of elements used limits the similarities possible within their own family groups and also puts constraints on their possible similarity to arrows from those language groups — West Central, Duna and Ok — which exhibit the use of many design elements. The larger the number of elements used in design patterns, the greater the variation possible within and between family groups. This is evident in West Central family area where the use of some variants of every element in designs, and the physiographic diversity within an extensive language boundary, results, as could be expected, in the greatest within-group variation. The variation is not in arrow form, but in the elements used in design patterns. Some elements are used only in the northern region, others only in the south; elements 5, 9, 12 and 13 appear confined to Lagaip and Porgera areas in the north, whilst elements 8 and 10 are found only in designs on arrows in the southern region around Mendi, except for the use of element 10 variant (ii) on a few Lagaip arrows. Element 11 is used rarely in the north but frequently in the south; the opposite occurs with the use of elements 3 and 4, which are rare in the

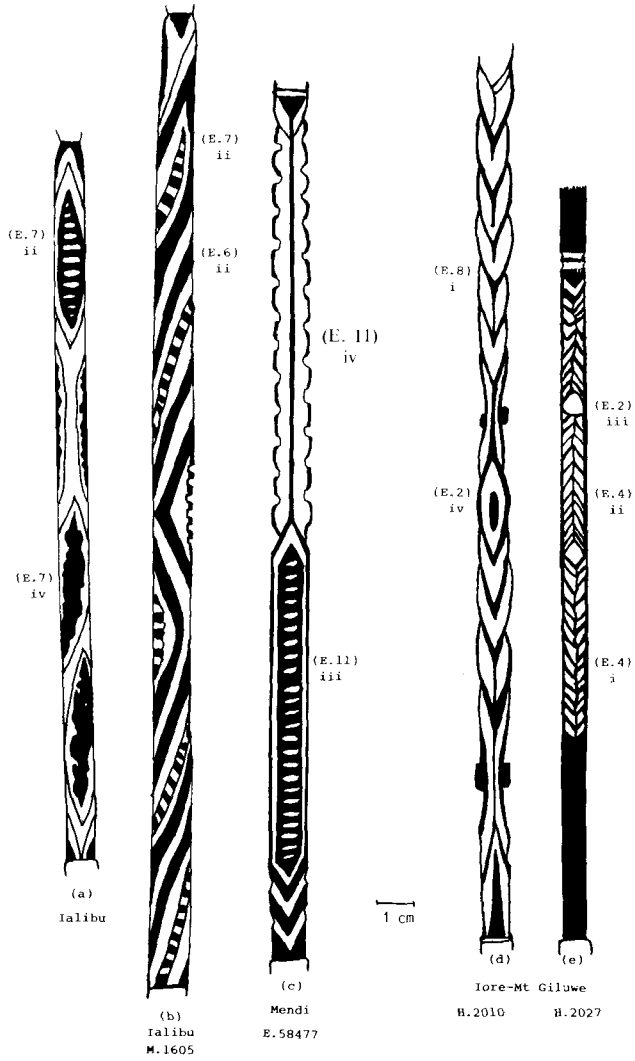

Fig. 30. Design patterns from southern region of West Central.

south. Moreover, in the south, element 3 is never used with element 9 variant (iv), with which it occurs most often in the northern part of this language area. As well, the positioning of motifs to form the design differs: repetition of a motif in unbroken sequence to form a single design pattern on long fore-shafts is confined to the southern region of West Central family area. In the northern region the usual design pattern is a small motif at the shaft separated from an upper motif formed of different elements. Thus there seems to be a division bordering on a dichotomy in element use and patterning within the West Central family area. The boundary of this division in arrow design patterns correlates with the linguistic boundaries of sub-families Enga (in the north) and Angal-Kewa (in the south), within West Central language family area. In the north, element use shows similarities to designs on Duna and Ok arrows, whilst in the south, affinities to Wiru family-level isolate are apparent, as well as to some extent, those of Karimui comparison area.

Ialibu arrow-artists show in their design patterns a distinctive way of using variants of element 7. Their mode of spiralling this element's variants around a fore-shaft to form the complete pattern demonstrates ingenuity and expertise in design giving a uniqueness in style that can only be the work of specialist arrow-decorators. This style is of regional significance within the southern part of West Central family area, for it is not found elsewhere in the highlands (Fig. 30a, b).

Within the Duna family area, the designs seen only on fore-shafts of Lake Kopiago arrows with bamboo heads show a high degree of similarity in elements used, and the positions these occupy within design patterns. These fore-shafts are all comparatively short, with elaborate, deeply carved, two-motif designs, coloured red and white, occupying the complete design field. These traits, and particularly the element-position factor, are so distinctive that they are easily distinguishable from morphologically similar arrows from other areas.

In the use of variants of element 1 (circles), Central family area seems to be a transition zone: Eastern and East Central use only variant (i) in designs, Central uses both variants whilst areas to the west use variant (ii) almost exclusively. In the use of element 2 (diamond), Central area arrow designs show similarities to those of East Central in the eastern half, whilst in the western half, especially in the north, strong affinities with West Central are seen. Element 3 (triangle) in Central is similar to East Central in positioning, using mainly the same variants (i/v), but is medium-deeply carved in Central as against lightly carved in East Central.

In depth of carving there is a very noticeable transition across Central area from light carving in the eastern border area to deep at its border with West Central family area, with medium-deep carving being used for most Central family designs. In general, the border affinities indicated above hold for other elements used in Central family area arrow designs. In the use of colour pigments there is a change from designs without colour or a smearing of red ochre in Eastern family area, through some use of red ochre in East Central, white with some red in Central, to a profuse use of red and white in the northern part of West Central, along with yellow as well in the southern region. Duna and Ok arrow designs exhibit a lavish use of red and white. These correlated patterns in elements used, depth of carving and colours used provide strong evidence to support my contention that Central family area is a transition zone in arrow decoration.

Looking further west, all variants (except (v)) of elements 5 and 5A occur in Ok designs which also show extensive use of elements 4, 9 and 12, while 11A variants are found only in Ok designs. This within-family use of certain elements produces design patterns easily distinguishable from those of other language family areas. There is some indication of a west-to-east diffusion of element 12, from frequent use in Ok designs to rare use in the northern part of West Central, and its absence further east. This, together with restriction

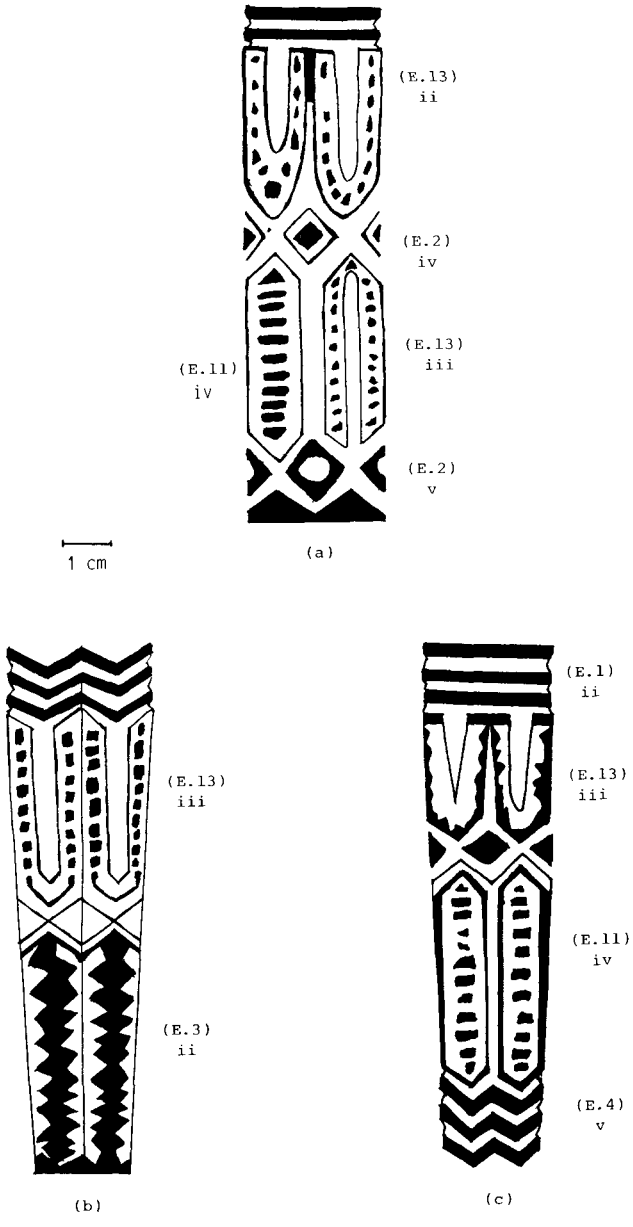

Fig. 31. Lake Kopiago fore-shaft design patterns.

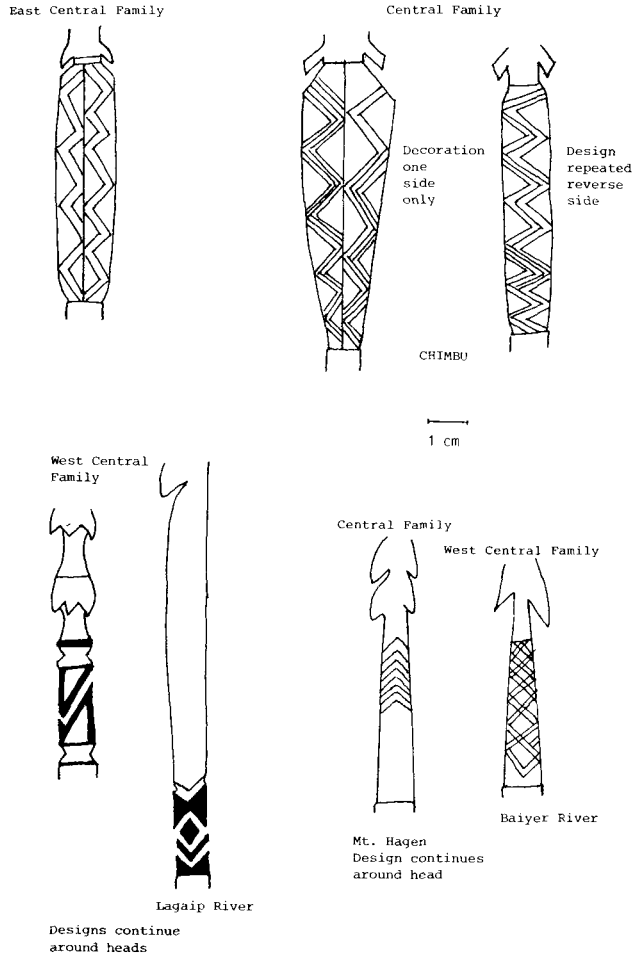

Fig. 32. Designs on heads before barbs commence.

of the combination of 'eye' variants of element 2 with 'heart' variant of element 9 to these two family areas, suggest the Strickland Gorge is not a barrier to design pattern distribution. The fact that variants of elements 5 and 5A, 9 and 13 occur only in designs on arrows from West Central, Duna and Ok family areas, points to the absence of physiographic restrictions on design pattern distribution between these three language family areas.

The Duna people of Lake Kopiago area make much greater use of element 13 variants in arrow designs than occurs in West Central family to the east and Ok family to the west. This use-factor raises questions. Did this element have its origins in the Lake Kopiago area and from there spread to the east and west, or was it an element adopted by the Duna from West Central or Ok and incorporated so successfully in their designs that it became a favoured element of arrow artist-decorators? Early language movements and settlement patterning did not give any positive indication. On the basis of use it would appear that element 13 had its origins in the Lake Kopiago area, even though the distribution patterning of other elements found only in these three family areas seems to point to a movement from west to east.

The similar use of the same variants of some elements in designs on arrows from Eastern, East Central and Central language family areas, indicates the Chimbu-Asaro Divide is not a barrier to design pattern distribution.

Except for the use of element 10 (variant ii) shaped as part of the fore-shaft as it is on some Mendi arrows, I found no correspondence between designs on Aiome (middle Ramu) arrows and those from any language family under study. However, in Karimui comparison area (Daribi speakers), designs on arrow heads and fore-shafts show a close affinity to those on arrows from the southern part of West Central area. Spirals, lenticular shields in various forms, circles and inverted cones seem to dominate design patterns. All are deeply carved, coloured with red ochre and white or grey clay infill.

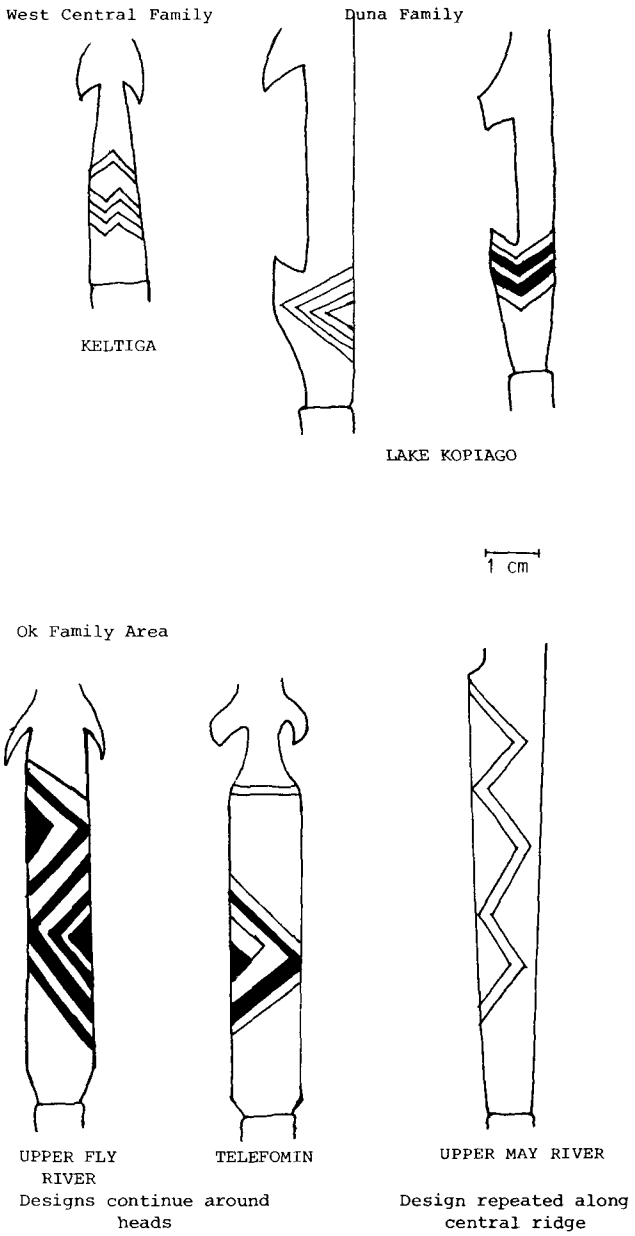

Fig. 33. Designs on heads before barbs commence.

Hourglass (element 10, variant [ii]) is used as on Mendi arrows. From two sources (Wagner, 1967; Hughes, 1971), Karimui trade and conflict appear to be oriented in a south-westerly direction — fighting with the Baria, Wiru speakers of Pangia sub-district; trading with the Kewa speakers of Ialibu sub-district, and north with the Chimbu and sout-east Wahgi peoples. thus, the similarities in design patterns on arrows of the Karimui people and the Kewa of the southern part of West Central family area are most probably the result of contact through trade.

Any interpretation of the meaning of elements and motifs in design patterns on traditional highlands' arrows must be speculation, as its significance to the person who made it and the person examining it will be different (cf. White, 1967a). With an iconic analysis, one is dealing with the results of the artist's thought processes manifested in the designs he carved. On only two occasions was I told the meaning of a design and, since this information did not come from the artist, it must be suspect.

However, the occurrence of the ocular or 'eye' element (element 2) on so many traditional arrows seems to indicate that it is intended a realistic element. Variants are recognised by New Guineans as eyes — 'him (arrow) see to fly' — and are commonly found in designs on fighting arrows to ensure they hit their target.

CONCLUSION

My study of Papua New Guinea highlands arrows shows that morphological attributes of arrows can be formally described, and carved designs on heads and fore-shafts can be analysed into elements which in turn may be further analysed into variant forms. The arrows manifest uniformity in component parts with diversity in carved designs, and the main factor responsible for the distribution of arrow design elements, motifs and patterns is the highlander himself.

Highlands arrow design patterns demonstrate regional variations within linguistic boundaries and between linguistic groups, but the within family differentiation is not so great as that between language families. In the distribution of design elements, patterns of association emerge within arrow populations, and some combinations only occur in particular areas. Thus, the geographic distribution of the combination of element 2 'eye' variants with element 9 'heart' variant, points to some link between the northern part of West Central family area and Ok family area across the Strickland Gorge (Fig. 29).

As a result of this study, I suggest that the Chimbu–Asaro physiographic boundary is not a barrier to the interchange of cultural traits, but that there does exist a boundary further westward, running roughly north to south, from the Yuat River to Mt Hagen and the Kaugel River. It is on either side of this boundary that variation of arrow forms and decoration is most clearly visible. I base this statement not on one aspect of the arrows, but several. These are: length, where noticeable differences in the mean occur to the east and west of this line (Table 4); the ratio of carved heads to carved fore-shafts, which shows a distinct reversal at this boundary (Fig. 7); design element distribution, which indicates the use of few to the east and many to the west (Table 9); design patterns, which are more complex and show distinctly different use of elements with deep carving the norm to the west, as opposed to simple designs, light to medium carved to the east; binding type distribution, which shows numerically fewer types west of this line (Table 3).

Linguists have already recognised a language boundary (the western border of Central family) that almost corresponds to the physiographic and cultural

one I postulate, but has it a deeper significance than already indicated by Würm (1975)?

With regard to the Chimbu–Asaro divide, I would like other researchers, whose work involves studies within the highlands of Papua New Guinea, to look again at their results to see if there is any correspondence between my findings and their conclusions.

ACKNOWLEDGEMENTS. The work reported here is part of my M.A. thesis 'Form and Decoration of New Guinea Highlands Arrows' data for which I collected in the field at various locations in the Highlands in 1974, and from museum and private collections in Australia and Papua New Guinea 1974–75. This publication differs from the original thesis in some respects as a thorough re-checking of data indicated adjustments should be made to some results and conclusions.

In my thesis I have acknowledged my indebtedness to all those people who so readily gave me assistance during my fieldwork and later research. For further assistance in this present work I must re-affirm my grateful thanks to Jim Specht, Peter White and Richard Wright for their encouragement, advice, valuable comments and helpful suggestions.

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