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FOUNDATIONS OF KINSHIP MATHEMATICS

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Preface

In the spring of 1965, while the author was engaged in a structural analysis of a Yami genealogy recorded on Botel Tobago, he had the opportunity of making the acquaintance of the linguist John H. T. Harvey. A joint exploration of genealogical space was thus launched, the initial result being the construction of a numerical kinship notation system amenable to mathematical operations and yielding algebraic multi-value groups (Harvey and Liu 1967). With this, a new approach to the mathematical analysis of kinship structure was fortuitously inaugurated. For the past twenty years, it has been the author's self-appointed task to further explore this new territory. He hopes that publication of this book will open up this new area of anthropological inquiry and stimulate others to explore paths he has neglected.

Just as new building materials require new tools, so new research programs require new methods. In developing his method, the author first expanded a genderless notation system to include gender, then developed a numerical notation for coding segmentary space (Liu 1969; 1972). Applying these tools to the analysis of such systems as Murngin, Kokata, and Crow-Omaha, he then discovered what he now prefers to call "box theory", which involves in essence the use of patri- and matri-generators to depict the kin diagrams employed in this book and later known as Cayley diagram to the mathematician (Liu 1967; 1968b; 1969; 1970; 1973a, b, c; 1976; 1977; 1978; 1979). In all this he has come to realize the fruitfulness of studying kinship space, the feasibility of using mathematical language for analyzing kinship structures and the predicability of structural transformations.

In 1973 the author had the good fortune of meeting the mathematician Sydney H. Gould who was then living in Nankang, Taipei. This meeting opened a new chapter in his research program. From 1973 to 1982, when

Mr. Gould left Nankang for his home country, we cooperated closely in re-examining previously proposed notation systems and their mathematical properties (Gould and Liu 1976; Gould 1978). At this stage of our work we discovered that the mathematical concept "equivalence rules" developed by the Yale school of kinship semantics (Lounsbury 1956; 1964a, b; Scheffler and Lounsbury 1971; Scheffler 1978) was compatible with box theory and helped determine the number of boxes and their relationship. Consequently, with a new (X, Y)-notation system, we attempted an amalgamation of equivalence rules with the theory of group relations developed in our previous papers. (The results was a paper drafted in 1978 and published in 1984.) The results of this work are applied in this volume, enabling us to depict kinship structure in algebraic and geometric forms. Our goal throughout has been to bring to kinship studies more rigorous mathematical formulation and thus refinement of its theoretical basis.

1985 marked the 30th anniversary of the founding of the Institute of Ethnology and also happened to be the year when the Institute moved to its new building. For this occasion it was proposed that a special commemorative publication be issued, and the author chose to present as his contribution this monograph, which represents the culmination and synthesis of 20 years of work at the Institute.

If the theoretical structure of this monograph has any merit and its argument any validity, they are in large part the result of an intensive long-term collaboration with Mr. Gould. His contribution to this monograph is inestimable. It must be pointed out, however, that Mr. Gould has delved deeply into the literature on kinship and has developed his own ideas on the subject, which will be presented in a publication to be entitled "Kinship, Marriage and Mathematics." I am not in complete agreement with Mr. Gould's analysis but welcome it nonetheless, confident that our differences will stimulate discussion and thus serve our common interest in promoting development of the field.

The two appended papers are closely related to the argument of the main text. All of them have been previously published but in journals not easily accessible to the reader-at-large. They are reprinted here to help the reader understand the process by which the author gradually developed his theoretical views. The first paper was the outcome of joint research by Mr. Harvey and the author and was first published in the *Bulletin of the Institute of Ethnology*, No. 23 (1967). The second paper was the first publication based upon joint research Mr. Gould and the author and first appeared in the *Bulletin of Visiting Scholars Association*, Harvard-Yenching Institute, Harvard University, China Branch, Vol. 13 (1976). They serve to show the foundation for the author's current mathematical study of kinship.

The author would like to take this opportunity to express his profound gratitude to Messrs. Harvey and Gould for their assistance over the years. I am confident that thieir contribution to kinship mathematics will be hailed by anthropologists. The ninety some diagrams contained in this monograph are indispensable to the articulation of arguments, presented therein and the author gratefully thanks Miss J. C. Tai for her excellent work in this regard.

P. H. L.

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CHAPTER I

Preliminary Mathematical Concepts

> Relation: an aspect ... of two or more things taken together
> Aspect: position in relation to
>
> — Webster

> Another topic that needs fuller treatment...has to do with fundamental postulates, the ultimate primitives, and the logical structure of kinship reckoning as a mathematical system.
>
> — Lounsbury

1. 1 Kinship study as a science. Science consists of concise descriptions, called general laws, of the recurrences of phenomena. In kinship study the phenomena are kinterms like *father*, *brother*, *uncle* in English or *bapa*, *gawel*, *gatu*, *waku* in the Murngin language in northwestern Australia, and the recurrences take the following form. In English the kinterm *uncle* for father's brother recurs for mother's brother, but in Murngin *bapa* for father's brother recurs for father and not for mother's brother (*gawel*). In English the term *son* applied to a male child by his father recurs as the term applied to the same child by his mother, but in Murngin *gatu* (father's child) recurs for brother's child (English *nephew*), and not for mother's child (*waku*). Then the general laws take the form of "equivalence rules" (see e. g. 4. 6), by which the recurrences are concisely described.

1. 2 Social importance of kinterms. In his children's eyes a Murngin father, F=*bapa*, is on much the same social footing as the father's brothers, FB also=*bapa*, since all of them live together around the same water-hole, but his mother's brothers (*gawel*) are on a different footing, since they live around a distant water-hole, the pre-marriage residence of his mother; and in general the multifarious variety of kinterm recurrences around the world reflects differences of social behavior. An American male does not apply the same kinterm to his sons as to his brother's sons and does not treat them in the same way, but a Murngin male calls them all *gatu* and treats them pretty much alike. Kinship systems determine legal and moral obligations; they are the earliest form of organized human grouping, the prototype of all social and political organizations.

Establishment of proper kinterms is often a matter of extreme social importance. If two unacquainted aboriginal males encounter each other, they begin at once to discuss their various relatives in order to establish between themselves a linking chain that will determine the kinterm by which each is to address the other, and if no such chain can be found, it becomes the duty of each to kill the other. As Radcliffe-Brown [1913: 151] writes, in an essay describing the Kariera tribe on the west coast of Australia:

> ... when a stranger comes to a camp ... he remains at some distance. A few of the older men, after a while, approach him ... and ask "Who is your *maeli*?" (father's father). The discussion proceeds on genealogical lines until all parties are satisfied of the exact relation of the stranger to each of the natives present in the camp. ... In one case, after a long discussion, they were still unable to discover any traceable relationship between my servant and the men of the camp. That night my "boy" refused to sleep in the native camp, as was his usual custom, and on talking to him I found that he was frightened. These men were not his relatives, and they were therefore his enemies. This represents the real feelings of the natives on the matter. If I am a blackfellow and meet another blackfellow, that other must be either my relative or my enemy. If he is my enemy I shall take the first opportunity of killing him, for fear he will kill me. This, before the white man came, was the aboriginal view of one's duty towards one's neighbour.

1.3 The formalist approach. Recurrences in kinship terminology are the subject-matter of "kinship in the narrower sense", i. e. "formalist" kinship theory, and their correlation with social behavior and organization, or with ecology, history and the like, is "kinship in the wider sense", functionalist, historical, etc., an intricate and exceedingly difficult subject that has engaged the attention of anthropologists for a hundred years. Although for various reasons we make an occasional foray into this wider terrain, in the present book our attention is concentrated on the purely formal task of describing kinterm recurrences; so that in particular, our discussion of marriage will be motivated almost entirely by its influence on terminology. We feel confident that advances in this simpler field will prove helpful for subsequent anthropological studies of many kinds.

1.4 Morgan's "Systems of Consanguinity and Affinity . . . ". Since we are interested throughout, not in the kinterms themselves, but only in their patterns of recurrence, two kinship systems with the same pattern but in different native languages are regarded as being the same system. The fact that two systems, one say in eastern Peru (Piro, see 11.8) and the other in southern India (Tamil, see 10.1), can be the same system in spite of wide geographical separation and mutually unintelligible languages is one of the most fascinating aspects of our subject, a fascination deeply felt by the originator of modern kinship theory, Lewis Henry Morgan, a railroad lawyer in New York State, whose epoch-making work "*Systems of Consanguinity and Affinity of the Human Family*" [Morgan 1870] begins as follows:

> As far back as the year 1846, . . . I found among them [the Seneca-Iroquois in northeastern USA], in daily use, a system of relationship for the designation and classification of kindred, both unique and extraordinary in its character, and wholly unlike any with which we are familiar. . . . In the . . . summer [of 1858], while on the south shore of Lake Superior, I ascertained the system of the Ojibwa Indians; and . . . with some degree of surprise . . . found among them the same elaborate and complicated system which then existed among the Iroquois. Every term of relationship was radically different from the corresponding term in the Iroquois; but the classification of kindred was the same. It was manifest that the two systems were identical . . . I determined to follow up the subject . . . among the American aborigines, . . . upon the Eastern Continent, and among the islands of the Pacific.

1.5 Relations as structures. Although Morgan was not a mathematician, his decision to investigate what was common to two superficially different systems is characteristic of all mathematical activity. In the process of abstracting for further study those qualities of a given set of systems that are common to all of them, the mathematician must often neglect specific features of great interest to anthropologists, e. g. warfare, political organization, or methods of obtaining food. So the complaint is sometimes made that mathematics is too abstract to be helpful.

Certainly, if we wish to retain the advantages of mathematics, we must state some definitions, e. g. of the fundamental concept of a "relation", in a mathematical way. Circular definitions of the kind quoted above from Webster are useful in daily life because of the high probability that somewhere in the circle the reader will find a familiar idea, but in mathematics they are avoided, or at least an attempt is made to avoid them, by leaving one concept altogether undefined, namely a "set of elements", and defining all others in terms of that one concept alone.

With Webster's definition of "relation" compare the following mathematical definition: "A relation on a given set U of elements $a, b, c, \ldots$ is a set of pairs $(a, b), (c, d), \ldots$ of the elements of U." In mathematics the relation **is** that set of pairs which in everyday language would be said to exemplify it. In particular, the relation indicated by a kinterm like *father* or *mother*, or like *bʉpa* or *arndi* is a certain set of pairs of persons in the aggregate U of persons that use the kinterm. The first member of the pair is usually called **ego** or the **speaker**, and the second member is **alter** or the **referent**; e. g. in the *father* relation alter is the father of ego.

More generally, if U is a set of elements of any kind, any set of sets —e. g. any set of pairs—or any set of sets of sets etc. of elements of U is called a **structure** on U, and U is called the **underlying set**, or the set of **ultimate primitives**, for the structure. Every mathematical system or concept, in particular every relation, is a structure on some underlying set.

1. 6 Kinship systems as partitions. Of equal importance with relations in kinship study is the concept of "partition", defined as follows. A **partition** of U is the structure consisting of a set of subsets of U such that every element of U belongs to exactly one of the subsets; i. e. a partition is a set of exhaustive, mutually exclusive subsets. In this case the subsets are usually called **classes** or **equivalence classes**, since any two elements in the same class are regarded as being "equivalent" to each other in some sense determined by the nature of the partition. For example, if the set of all integers is partitioned into two classes, one containing the even integers and the other the odd, we say that any two even integers, or any two odd, are equivalent to each other but an even integer is inequivalent to an odd; in symbols, $2\sim4$, $3\sim5$, $2\nsim3$ etc., where the symbol $\sim$ means "is equivalent to", and as customary a slash through a symbol negates its meaning.

As another example, every kinship terminology partitions the set of personal relations in its own particular way by assigning two relations to the same class if the given terminology uses the same kinterm for both or else has no kinterm for either. Thus in English FB$\sim$MB since they are both in the *uncle* class but FB$\nsim$F since F=*father* goes by a different kinterm from FB; and WBW (wife's brother's wife)$\sim$HZH (husband's sister's husband) since English has no kinterm for either of them. In Murngin, on the other hand, FB (*bapa*)$\nsim$MB (*gawel*), but FB$\sim$F since both are in the *bapa* class; and WBW (*mari*)$\nsim$HZH (*kutara*).

1.7 Genealogical space. A structure, call it Σ, consisting of the underlying set U itself and one or more structures on U, is called a **space**, in generalization of the three-dimensional space of everyday experience, which may be regarded as a set of "undefined elements" or "ultimate primitives" called "points", together with two structures called "lines" and "planes"; i. e. a line is a set of points and a plane is a set of lines. Then a **genealogical space** is a space $\Sigma=(U; A, S, P)$ having three (non-empty) structures A=**age-distinction**, S=**sex-distinction**, and P=**parenthood** with the following properties, i. e. satisfying the following axioms or postulates.

Axiom 0: The set U has finitely many elements, called **persons**.

Axiom 1: The age-distinction A is a relation on U, i. e. a set of pairs of persons, with the property that the entire set of persons in U can be arranged in a sequence $a_0, a_1, \cdots, a_{n-1}$ in such a way that if (a_i, a_j) is in the relation A, then a_i precedes a_j in the sequence and conversely. If the pair (a_i, a_j) is in A, we say that a_i is **younger** than a_j and a_j is **older** than a_i.

Axiom 2: The sex-distinction S is a partition of U into two classes, one called **male** and denoted by μ, the other called **female** and denoted by ϕ.

Axiom 3: The parenthood relation P is a subset of the age-distinction A. If (a_i, a_j) is in P, we say that a_j is a **parent** of a_i, and a_i is a **child** of a_j. Thus every child is younger than its parent.

Axiom 4: There exist two persons, called **ultimate ancestors**, one male denoted by μ_p, the other female denoted by ϕ_p, who have no parent in U. All other persons have one male parent, called **father**, and one female parent, called **mother**.

In a more complete treatment of kinship terminology it would be necessary to add another axiom, distinguishing dead persons from living, just as Axiom 2 distinguishes male from female, since in some kinship systems the term applied by ego to alter changes after the death of a connecting relative; e. g. in the Karok tribe in California grandfather (=FF) is *atic* if ego's father is still alive and otherwise *aticvaci*. But for brevity we have omitted all reference to kinterms dependent on "decedence", since they usually appear to be "excrescences which have grown on the various terminologies rather than integral parts of each" [Gifford 1922: 258].

1.8 Style of the book. In a formal mathematical text we would now proceed with definitions, theorems and proofs in strict military tempo; e. g.

Definition 1. A genealogical space is also called a **race**.

Theorem 1. A race contains at least three persons.

Proof. If U contained only μ_p and ϕ_p, the parent-relation P would be empty.

Theorem 2. A race may consist of only three persons.

Proof. A set U consisting of μ_p, ϕ_p and one common child satisfies all the axioms.

But in fact we follow a more relaxed, conversational style, inserting non-mathematical remarks wherever they seem helpful. Here, for example, we might point out that in everyday speech the concept of a race is so vague as to have been one of the causes of the Second World War, so that in sharpening up concepts of this sort for precise mathematical use it is often convenient to admit cases that at first sight may seem absurd. For example, the "Aryan" race, or the Anglo-Saxon race, includes many more than three persons and no practicing anthropologist will encounter a race that consists of only three. Nevertheless our inclusion of such a possibility is harmless and convenient, and similar statements hold for many other mathematical concepts.

As another informal remark, let us point out that our model of a genealogical space, or race, includes the assumption, common in primitive and nonprimitive societies, that the entire race is descended from exactly two ultimate parents, who may be eponymous, like Hellen for the Greeks (Hellenes) or may represent the abstract concept of man and woman, like Adam (man) and Eve (life), or the abstract concept of fertility, like a tree or a seed. As we shall see in 2. 12, a race can be divided into its mythical part, which may be empty, and its non-mythical part, called a tribe.

Throughout the book we proceed in the same manner, keeping the motto constantly in mind: "no mathematical statement without an anthropological example."

CHAPTER II

Basic Anthropological Concepts

2. 1 The traditional notation. Our use of the traditional notation, with some additions, is as follows:

F = father, M = mother, P = parent,
S = son, D = daughter, C = child,
B = brother, Z = sister, J = sibling (half or full)
cf. Jack and Jill,
H = husband, W = wife, V = spouse
cf. the Latin VIR = husband,
VXOR = wife,
μ = male, ϕ = female, $\alpha = \mu$ or ϕ,
e. g. μZ = male speaker's sister,
ϕFB = female speaker's father's brother,
e = elder, y = younger, $a = e$ or y,
g = "greats", the first one being changed to "grand" before F, M, S, D;
e. g. g^2F = greatgrandfather,
Bg^2S = greatgreatnephew (i. e. brother's greatgrandson),
$\hat{J}$ = same-sex sibling: ego is of the same sex as ego's sibling,
$\check{J}$ = opposite-sex sibling: ego is of opposite sex from ego's sibling,
$\hat{P}\hat{J}$C = parallel cousin (abbreviated to *prco*): ego's parent is a same-sex sibling of alter's parent,
$\hat{P}\check{J}$C = cross cousin (abbreviated to *crco*): ego's parent is an opposite-sex sibling of alter's parent,
$\hat{J}$C = parallel nephew or niece: ego is a same-sex sibling of alter's parent,
$\check{J}$C = cross nephew or niece: ego is an opposite-sex sibling of alter's parent.

A repeated diacritical mark ^ or ´ indicates "same sex", whereas a pair of contrasting marks indicates opposite sex; thus *á*P̂J̌Ć=cross cousin of same sex as ego; and the mark ^ used alone, i. e. without ˇ or another ^ , indicates "of the same sex" as ego; e. g. Ĵ and J̌ above. A vertical slash separates male referent on the left from female referent on the right; e. g., we write B | Z for "*brother* and *sister*". Also we use the lower-case letters *f*, *m*, *p*, *b*, *z*, *j*, *s*, *d*, *c*, *h*, *w*, *v* to denote the kinterms associated with the relatives denoted by the corresponding upper-case letters. Thus FB denotes an actual relative, independently of any native language, but *fb* denotes the kinterm for FB in a particular language; e. g. $fb=mb$ (*uncle*) in English, but $fb \neq mb$ in Seneca (*hanih*≠*haksoneh*; 9. 1).

2. 2 The "actual" and "classificatory" convention. In a book about non-English kinterms written in the English language it is usually impossible to find one English word that will exactly express the meaning of any one foreign word, e. g. the Murngin kinterm *bapa*. Since a Murngin speaker applies this kinterm to an unlimited number of relatives F, FB, FFBS, FFFBSS etc., it cannot be completely translated into English except by an infinitely long phrase like "father and father's brother and father's father's brother's son and . . . ". But the single word *father* can serve as a translation if we introduce a suitable convention.

We first note that any terminological distinction expressible in English can be expressed in any other language. In particular, the English distinctions between F (*father*), FB (*uncle*), FFBS (*first-cousin-once-removed*) etc. are expressed in Murngin by phrases which a native with a fair command of English will translate as "my close father" (F), "my little bit faraway father" (FB), "my faraway father" (FFBS) etc. For our purposes it will be sufficient to distinguish between the "close" and "non-close" fathers as follows.

Among those relatives to whom ego applies a given kinterm, say *bapa*, the ones to whom ego is connected by the shortest sequence of letters, in this case the one letter F, are ego's "actual" or "own" or "primary" or "true" relatives and the others are "derivative" or "extended" or "secondary" or "classificatory". Although all these adjectives, and still others, occur in the literature, we shall usually choose "actual" and "classificatory" and may then translate the Murngin term *bapa* by *father*, with the understanding that any non-English kinterm without the modifier "actual" or "classificatory" refers to both kinds of relatives. For example, a statement like "the Murngin prescribe MBD-marriage" does not mean that a Murngin male is necessarily expected to marry an actual MBD, although in fact he often does, but only that he should marry an MBD, actual or classificatory.

For the Murngin kinterm *bapa* there is only one shortest sequence of letters, namely F, but consider the Seneca kinterm *akyase* applied to the unlimitedly many relatives

FZC, MBC, FFBDC, FMZDC, MFBSC, MMZSC, ...

Here there are two shortest sequences FZC, MBC, representing ego's cross-cousins *p̂ǰc*. So we say that these two closest *akyase* are ego's "actual cross-cousins", and the others are "classificatory cross-cousins". If we agree, as is common in computer science and elsewhere, to let any sequence of letters be called a **word**, then the "words" *f*, *mbd*, *p̂ǰc* become reasonably satisfactory translations of *bapa*, *galle* and *akyase* respectively.

2. 3 Glosses. More generally, we adopt the following method of "glossing" native kinterms, i. e. of translating the chief part of their meaning into an artificial language that approximates English. Let us illustrate with the kinterm *saplo*, which is applied by the Piro tribe in eastern Peru (cf. 11. 8) not only to FZ but to FFBD, FMZD, FFBSD etc. Since FZ is the only shortest sequence among them, our English gloss for the Piro term *saplo* is just *fz*. But *fz* will not serve as a gloss for the English kinterm *aunt*, since ego's MZ is just as close as ego's FZ, so that the gloss for the English *aunt* is *pz* (parent's sister). For a kinterm in any native language, including English, the gloss will consist of a sequence of lower-case letters formed from the initial letters of the English words representing the closest relatives.

Since our whole purpose is to preserve exactly those recurrences that are found in the native language, every native kinterm must be glossed in exactly the same way wherever it occurs and distinct kinterms must receive distinct glosses. For example, in Seneca the term *akyase* includes all four cross-cousins FZS, FZD, MBS, MBD, so that we must gloss *akyase* by $\hat{p}\check{J}c=$ parent's cross-sibling's child. But the Piro terms *anuru* | *meknaxiro* distinguish the sex of these cousins and must therefore be glossed by $\hat{p}\check{J}s$ | $\hat{p}\check{J}d$ (male cross-cousin | female cross-cousin).

2.4 Social parenthood; society. When we speak of ego's father, we do not necessarily mean ego's biological father, who may be unknown, but rather his "social" or "jural" father, namely the one whom ego calls *father*, and who is recognized as ego's father in the social and jural conduct of the tribe. Thus ego's father is usually that male person, whether biological father or not, who has nurtured ego during ego's early life. An ego, male or female, may possibly have several adoptive fathers in succession. For example, in tribes with prescribed marriage, if no suitable female is available for some young man, an older relative may conventionally "adopt" a daughter in order to bring her into the right relationship with her suitor. But in all such cases we recognize only one father. A mathematicization of kinship without Axiom 4 (1.7) would be undesirably complex.

We make the same convention regarding mothers and define a society S as a finite set of persons, living or dead, that includes at least one father-mother-child triad and includes either both the parents or else neither parent of every person in S.

2.5 Paternity among the Nayars. In the preceding section we have excluded the possibility that ego has more than one actual father. On the other hand (again see Axiom 4) we do not wish everyone to be without a father at all, as is sometimes stated to be the case with the Nayars on the Malabar Coast in southern India. For example, Leach [1955] writes:

> The notion of fatherhood is lacking. The child uses a term of address meaning "lord" or "leader" towards all its mother's lovers, but the use of this term does not carry with it any connotation of paternity, either legal or biological.

On the other hand, Gough [1959] writes as follows about the state of affairs before the British assumed government in 1792:

> There is some uncertainty as to the number of visiting husbands a woman might have... since Nayar women vied with each other. ... A husband visited his wife after supper at night and left before breakfast next morning. He placed his weapons at the door of his wife's room and if others came later they were free to sleep on the verandah of the woman's house. Either party to a union might terminate it at any time without formality. A passing guest recompensed a woman with a small cash gift at each visit. But a more regular husband... had certain customary obligations. ... Most important, however, when a woman became pregnant it was essential for one or more men of appropriate sub-caste to acknowledge probable paternity. This they did by providing a fee of a cloth and some vegetables to the low caste midwife who attended the woman in childbirth. If no man of suitable caste would consent to make this gift, it was assumed that the woman had had relations with a man of lower caste or with a Christian or a Muslim. She must then be either expelled... or killed by her matrilineal kinsmen. ... the fate of the child in such a case, ... I do not know whether he was killed or become a slave; almost certainly, he must have shared the fate of his mother.

As a result, Gough concludes (p. 31) that the concept of legally established paternity was of fundamental significance in establishing a child as a member of his lineage and caste, so that the Nayars become a society in our sense.

2. 6 Consanguineal and affinal relations; prescriptive terminologies. A sequence formed from the eight **primary** relations F, M, B, Z, S, D, H, W is said to be **consanguineal** (having common ancestors) if it contains no H or W, and otherwise it is **affinal** (related by marriage). A consanguineal sequence is **lineal ascending** if it consists of F's and M's alone, it is **lineal descending** if of S's and D's alone, and **collateral** (alongside of lineal) if it contains a B or a Z possibly preceded by the ascending letters F and M and possibly followed by the descending letters S and D. Collateral sequences beginning or ending with their B or Z are **collineal** (close to lineal) and otherwise **ablineal.** Thus *parents, children, grandparents, grandchildren, greatgrandparents* etc. are lineal; *uncles, aunts, nephews* and *nieces* with any number of prefixed *greats* are collineal, *cousins* of every kind are ablineal, and *in-laws* are affinal.

So to decide whether a given sequence of the eight letters is consanguineal or affinal we need only look for the presence or absence of H and W, but when we come to consider the corresponding kinterms the situation is more complicated. In English, for example, some kinterms (e. g. *nephew*) are strictly consanguineal, some are strictly affinal (e. g. *father-in-law*), and two kinterms are both consanguineal and affinal; namely, *uncle* for FB, MB, FZH and MZH, and *aunt* for FZ, MZ, FBW, MBW. Similarly, in Seneca (9. 1 and 9. 2) all kinterms are strictly consanguineal or strictly affinal except two; namely, *hocsote* for FF, MF, WFF, WMF and *ocsote* for FM, MM, WFM, WMM. Thus in English and Seneca the "overlap" between consanguineal and affinal kinterms consists of just two terms.

But in many other languages the overlap is much greater. In Tamil (Table 10. 5) it includes all kinterms except the two "special" affinal terms *kanavan=husband* and *mainaivi=wife*, and in Murngin it is total in the sense that every one of the 24 kinterms is both consanguineal and affinal; e. g. *due* is not only *husband* but also FZS (and FFZSS etc., i. e. *first cousin, second cousin,* ... see 2. 7) and *galle* is not only *wife* but also MBD (and MMBDD etc.)

This overlap will naturally be more extensive for tribes with prescribed marriage, i. e. tribes in which a male is expected to marry a collateral kinswoman, call her ego's *K*-relative; e. g. first cousin or second cousin etc.; for then every affinal relative is also consanguineal. Thus the overlap is small in English, with free marriage, and large in Murngin, with *galle*-marriage, i. e. marriage to a kinswoman to whom ego applies the same kinterm as to his MBD. So if the overlap is large we may look for evidence of prescribed marriage.

The evidence for or against prescribed marriage will usually be provided by the consanguineal terminology alone, for the following reason. If ego's father, i. e. any married male in the tribe, has married his (the father's) *K*-relative, then we will expect to find that ego applies the same kinterm to ego's mother (i. e. ego's father's wife) as to ego's father's *K*-relative. In other words, M and F*K* will go by the same kinterm. Also, since ego's child is ego's wife's child, for a male speaker C and KC will go by the same kinterm. Again, if we let $\bar{K}$ denote the relation reciprocal to K (e. g. if K is MBD, then $\bar{K}$ is FZS), we expect F and M$\bar{K}$, and for a female speaker C and $\bar{K}$C, to go by the same kinterms.

For example, in Murngin, with K=MBD: a male speaker applies the kinterm *arndi* to his mother and to all his FMBD's, whether married to his father or not, and the term *gatu* to his own children and to all the children of any of his MBD's; and similarly a female speaker applies *bapa* to her father and to all her MFZS's, and *waku* to her own child and to the children of all her FZS's. For this reason we say that the Murngin terminology is **prescriptive,** i. e. indicative of prescribed marriage.

On the other hand, the English and Seneca terminologies are non-prescriptive, since e. g. ego does not apply the kinterm *mother* to any of his father's collateral relatives.

2. 7 Cousins, removed and non-removed. Since cousins play a prominent role in kinship terminology, let us examine them more closely.

Ego and alter are first cousins (non-removed) if they are not siblings but have a common grandparent, i. e. if their nearest common ancestor is two generations above them. Thus there are sixteen kinds of first cousins non-removed: namely

FBS, FBD, FZS, FZD, MBS, MBD, MZS, MZD,

with a distinction, important in some languages, between male and female speaker for each of these eight; e. g. for the Tolowa Indians in California μFZD is *ontdesi* and ϕFZD is *seti*. Thus the sixteen kinds can be represented by αPJC with two choices for each of the four ambiguous letters.

Similarly ego and alter are second cousins (non-removed) if their closest common ancestor is a greatgrandparent, so that there are 64 kinds, who can be represented by αP^2JC^2, and in general, ego and alter are nth cousins (non-removed) if the closest common ancestor is $(n+1)$ generations above them, in which case they can then be represented by αP^nJC^n. If the nearest common ancestor is n generations above one of them and $(n+m)$ generations above the other, they are nth-cousins-m-times-removed and can then be represented by $\alpha P^n J C^{n+m}$ if alter is *m* generations below ego, or by $\alpha P^{n+m} J C^n$ if ego is *m* generations below alter. Thus ego's first-cousin-once-removed may be either one generation above ego or one generation below. If the degree of removal is not stated, it is assumed to be zero, i. e. the cousins are non-removed; and *cousin* alone usually means *first cousin.*

An impressive example of the manifold possibilities in cousin terminology is provided by the Southeastern Wintu tribe in the Sacramento valley in California. Six of the sixteen cross-second-cousins of a male speaker are his grandchildren, true or classificatory, in the sense (2. 2) that he applies to them the same kinterm *tai* as to his own children's children (12. 6); three are his grandfathers *ape*, two are his grandmothers *amake*, two are his children *de*; one is his father *dantce*, one is his mother *nake*, and one is his sister *hutuntce*; and for a female speaker the numbers are the same, although she distributes her cousins a little differently into the various categories. Yet this apparently bizarre situation, as well as the entire Wintu terminology can be described by simple and concise equivalence-rules (12. 5).

2. 8 Cross-cousin marriage. If *a* and *b* are cross-cousins such that *a* is MBC to *b*, and therefore *b* is FZC to *a*, then *a* is called a **matrilateral** cross-cousin to *b*, and *b* is a **patrilateral** cross-cousin to *a*. If each of their fathers has married a sister of the other father, each of the two cousins *a* and *b* is both MBC and FZC to the other, in which case they are called **bilateral** cross-cousins. Then cross-marriage is described as follows. If husband and wife are bilateral cross-cousins, actual or classificatory, the marriage is called **bilateral**; if the wife is matrilateral but not bilateral to the husband, so that the husband is patrilateral but not bilateral to the wife, the marriage is called **matrilateral**, and if the wife is patrilateral but not bilateral to the husband the marriage is called **patrilateral**. Here it is to be noted first that the marriage is described from the point of view of the husband, e. g. in a matrilateral marriage it is the husband who marries a matrilateral cousin, and second that the three kinds of cross-cousin marriage are mutually exclusive; i. e. if the cousins are bilateral, the marriage is **not** called either patrilateral or matrilateral, even though each cousin is both MBC and FZC to the other. The extreme importance of the difference between patrilateral and matrilateral cross-cousin marriage is made startlingly clear in Chapter 21.

2.9 The English kinlist. We are now ready to give the English **kinlist** (see Table 2.9), namely a complete list of the English kinterms, consanguineal and affinal, together with their range of application, after the manner of a field-worker's report from an aboriginal tribe.

Table 2.9 The English kinlist

Kinterm	Range
great^{n-2} grandfather | *great^{n-2} grandmother*	P^n
grandfather | *grandmother*	P^2
father | *mother*	P
great^{n-2} greatuncle | *great^{n-2} greataunt*	P^nJ
greatuncle | *greataunt*	P^2J
uncle | *aunt*	PJ, PJV
nth-cousin m-times removed	P^nJC^{n+m}, $P^{n+m}JC^n$
nth cousin	P^nJC^n
cousin	PJC
son | *daughter*	C
grandson | *granddaughter*	C^2
great^{n-2} grandson | *great^{n-2} granddaughter*	C^n
brother | *sister*	J
nephew | *niece*	JC
greatnephew | *greatniece*	JC^2
great^{n-2} greatnephew | *great^{n-2} greatniece*	JC^n
husband | *wife*	V
father-in-law | *mother-in-law*	VP
brother-in-law | *sister-in-law*	JV, VJ
son-in-law | *daughter-in-law*	CV
stepfather | *stepmother*	PV
stepbrother | *stepsister*	JJ (=PVC)
stepson | *stepdaughter*	VC

Here we have given only one form of the kinterm for each relation, although in any language there will usually be several nearly synonymous forms. An American boy may apply many different terms to his younger sister, e. g. *sis*, *sissy*, or *sister*, or to his father, e. g. *pa*, *dad*, *the old man*, or *father*, some of them used only in direct address, e. g. *sissy*, and some of them only in third-person reference, e. g. *the old man*, and it would be impossible to mathematize the vagaries of each individual speaker. So in each case we make a definite choice, usually the one used in formal reference, e. g. *father*, with an occasional remark about possible variants.

2. 10 Consanguineal kinterms in aboriginal languages. The English system has an accepted kinterm for every consanguineal relative but the situation in aboriginal languages is less definite. Under the harsh conditions of primitive life it is unlikely that any tribesman ever had a living great-grandfather, although some are recorded among relatively advanced tribes like the Seneca. Nevertheless the concept is familiar to all aborigines, since they have terms for second cousins, i. e. relatives with a common great-grandfather. When asked for the kinterm for FFF informants in some tribes will say that it is the same as for FF, in others that it is different and in still others that they never use such a term; and similarly for FFFB, FFFZ, FFFF etc. Again, it is unlikely that any aborigine, or for that matter any speaker of English, has ever considered the concept of a 500th cousin, connected to ego by the chains $P^{500}JC^{500}$, although the kinterm for such a cousin exists in English. In the absence of any natural stopping place we assume that like English all kinship systems have a coverset of kinterms for every consanguineal chain, although the field-workers give us varied information, sometimes stating that *grandfather* terms go as high as the third, the fourth or the fifth generation, or that *cousin* terms apply only to first cousins, or to first and second, or first, second and third, etc.

2. 11 Lineage. If a and b are two persons such that $aF^{q}b$ in some society, i. e. such that b is a's father, or paternal grandfather or greatgrand-father etc., we say that a is a **patri-descendant** of b, or an **agnatic descendant**, or a descendant **in the male line**, and b is a **patri-ancestor** of a. The set of all **patridescendants** of b, together with b himself, is the **patrilineage**, call it P_b, **generated** by b, who is its **progenitor**, and for each fixed value of q the set of all persons a with aF^qb is the qth **patrigeneration** G_{-q} below b. See Figure 2.11, where males are represented by μ and females by ϕ and to simplify the drawing we have assumed that each father has exactly two sons and two daughters. The children of a female are in the patrilineage of her husband, which is usually different from hers.

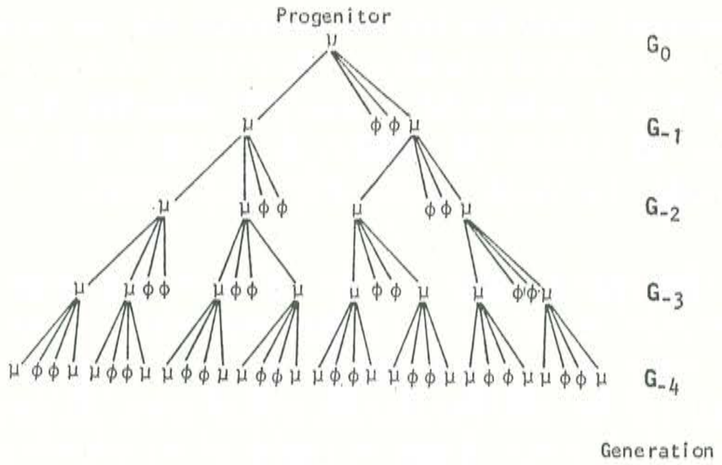


Figure 2.11 Patrilineage.

From the fact that no person has more than one father it follows that any two patrilineages P_a and P_b are either mutually exclusive or else one of them, say P_a, is a **sublineage** of the other; i.e. every person in P_a is also in P_b, which means that the progenitor b of P_b is a patrilineal ancestor of the progenitor a of P_a.

Matrilineages are defined analogously, but when we use words like "lineage", "descendant", "generation" etc., without the patri- or matri- prefix, we refer to the patri-concept, and similarly for "tribe", "clan", "moiety" etc. below.

In practical field work a lineage is often considered to be a set of persons who can actually trace their ancestry back to a certain still-remembered ancestor, whereas a clan is a set of persons who acknowledge common descent from some comparatively recent ancestor but are unable to trace out the details of their connection with him. However, it is hardly rewarding to mathematize such concepts as memory and vague recollection.

2. 12 Tribe. A set T of lineages all of whose progenitors are in the same generation $G_{(0)}$ below the ultimate ancestor μ_p of a race is called a **tribe** provided that the lineages have intermarried sufficiently often to ensure that every two persons in T are related to each other, consanguineally or affinally, through relatives all of whom are also in T. The members of the race in generations above $G_{(0)}$ are called **mythical**, and the progenitors in $G_{(0)}$ are called the **original progenitors** of the tribe, in contrast to their male descendants, each of whom is the (non-original) progenitor of a sublineage in the tribe. In practice, the members of a tribe usually have closely related languages and inhabit a fairly well-defined territory.

2. 13 Clan, subclan, moiety. If the set of original progenitors of a tribe is partitioned in any way, i. e. divided into mutually exclusive subsets, each of the sets of lineages generated by these subsets of progenitors is called a **clan**, and the tribe thus becomes a set of clans. In particular, the entire tribe is itself a clan, defined by putting all the original progenitors into one class, and any single lineage is also a clan.

If a, b, $\cdots$, n is any set of males in the same generation of a given clan, the set of lineages P_a, P_b, $\cdots$, P_n generated by these males is a subclan of the given clan, and this subclan itself may be further divided into subsubclans, and similarly for subsubsubclans etc.

If the tribe is divided into two **exogamous** clans, i. e. such that a male in either of them must marry a female in the other, each of the two clans is called a **moiety**, a Shakespearian word for **half.** Some idea of the importance of moieties may be gained from an impressive passage of Shapiro [1967] on wrong marriage in Murngin.

> The boundaries between other social groups can be broken and genealogical, kin-categorical, clan and section norms of marriage can be defied, but moiety boundaries are absolutely fixed and marriage within the moiety unheard of.

Thus the set of persons in a given clan may be called a tribe, a moiety, a clan, a subclan, a subsubclan etc. depending on whether we are considering the set by itself, or as part of a larger clan, or of a still larger clan etc. For example, the entire Kariera tribe is itself a clan, by definition, though it is seldom so called; each of its two moieties is also a clan, though again seldom so called, and then each of the moieties is divided into ten clans, so that the entire tribe consists of twenty clans, which could also be called subclans of the moiety, or subsubclans of the entire tribe.

Finally, since a clan is simply a collection of patrilineages, nothing prevents a set of subclans, or subsubclans etc., from re-uniting in lower generations to form a new clan (i. e. a subclan of the whole tribe) which in still lower generations may again subdivide and so on.

2. 14 Overt and latent clans. With our definition of patriclan and matriclan every tribe must have clans of both kinds, since they are simply sets of descendants of certain members of the tribe. In the literature, however, it is often stated that certain tribes have only patriclans, e. g. the Fox Indians in Iowa, certain others have only matriclans, e. g. the Seneca-Iroquois in New York, and still others have no clans of any kind, e. g. the Arapaho in Wyoming. What is meant is that the Fox have **named** patriclans, Wolf, Bear etc., the Seneca have named matriclans, Hawk etc., while the Arapaho attach no social significance to any group of persons in the nature of a clan. Modern American society is also clanless in this sense; for although patrilineal descent is recognized through the practice of giving a child the same surname as its father, nevertheless the "Smith" clan, the "Jones" clan etc. have no special political or social significance. Clans in our sense, i. e. sets of descendants of certain forebears, will be called **overt** if they have been given native-language names or other explicit recognition by the tribe, and otherwise they are **latent.**

2. 15 Kuma clans and subclans. As an illustration of clans, subclans etc. consider the situation among the Kuma in New Guinea, described by Reay [1959] as "a flamboyant, extroverted people . . . in whose culture conflict is inherent."

In 1959, there were twenty-seven clans altogether, ten of type A, i. e. divided only into (explicitly recognized) subclans; fourteen of type B with subclans divided into subsubclans, and three of type C, each divided into two subclans called "main segments", with subsubclans (i. e. subclans of the main segments) and subsubsubclans. Each of the subsubsubclans formed "a mutual labor force, whose members claimed to be much more closely related to one another than to anyone else".

The two distinguishing features of Kuma clans are exogamy, i. e. a male should marry outside his own clan, and internecine strife. As Reay writes: "a clan seems to be faced with the alternative of expansion or extinction. Everyone knows of at least two other clans that have died out because of losses in warfare." But if the clan becomes too large, the sets of subsubsubclans in the two main segments become so far separated from each other that they begin to act as separate clans, aiming to destroy each other. Reay continues: "this is a logical implication of the Kuma system. But the people's immediate interest is in perpetuating and developing a group of agnatically related males who are strong and numerous enough to intimidate their present enemies." As a result, the clans, subclans etc. continually split and are reunited in various ways in subsequent generations.

2. 16 Sections and subsections. A **section** of a clan C is defined as a complete set of alternate generations in C. Thus after arbitrary choice of a generation to be called G_0 every clan consists of two sections, one of them, call it S_0, being made up of all the even-numbered generations, and the other S_1 of all the odd-numbered; i. e.

$$S_0 = \cdots + G_4 + G_2 + G_0 + G_{-2} + G_{-4} + \cdots ,$$
$$S_1 = \cdots + G_5 + G_3 + G_1 + G_{-1} + G_{-3} + \cdots ,$$

with the result that ego and ego's grandfather, grandson, greatgreatgrandfather, greatgreatgrandson etc. are in one section, and ego's father, son, greatgrandfather, greatgrandson etc. are in the other.

Here again, as with clans, it is obvious that every tribe has an even section and an odd section in the sense of having persons in even and odd generations. So a statement like "Murngin has sections but English does not" means that in Murngin the sections are **overt**, e. g. they play a role in the prescription of marriage, whereas in English they are **latent**. i. e. they remain unmentioned because they have no social, political or religious significance.

For example, the Murngin tribe has moieties named Dua and Yiritcha, whose even and odd sections are "overt" in the sense that they determine the prescribed or "right" kind of marriage in Murngin. But in spite of being overt in this way they are unnamed, so that we shall provisionally call them the Dua-even, Dua-odd, Yiritcha-even and Yiritcha-odd sections.

Each Murngin moiety consists of 30 named clans; for example, one of the Dua clans is called Djambarpingu (small bird), and one of the Yiritcha is called Daiuror (snake). Consequently, there are 60 clans in all, each with an even and an odd section. Then in the Murngin system each of the two sections is subdivided into two named subsections, as follows:

$$S_0 \text{ into: } \begin{array}{l} S_{00} = \cdots + G_4 + G_0 + G_{-4} + \cdots, \\ S_{01} = \cdots + G_6 + G_2 + G_{-2} + \cdots, \end{array}$$

and

$$S_1 \text{ into: } \begin{array}{l} S_{10} = \cdots + G_5 + G_1 + G_{-3} + \cdots, \\ S_{11} = \cdots + G_7 + G_3 + G_{-1} + \cdots, \end{array}$$

so that ego is in the same subsection as his greatgreatgrandfather and his greatgreatgrandson etc., whereas ego, ego's father, grandfather and great-grandfather are all in distinct subsections. The two subsections in the Dua-even section are called Buralang and Balang, so that we may christen the unnamed Dua-even section with the compound name Buralang-Balang, and similarly for the names of the other three sections:

Dua-odd:	Karmarung-Warmut,
Yiritcha-even:	Bulain-Ngarit,
Yiritcha-odd:	Bangardi-Kaijark.

The significance of these four sections and eight subsections is as follows. In Murngin there are many different kinds of wrong marriage but just two kinds of right marriage, namely "regular" and "alternate" (Webb 1933). Right marriage is defined in terms of the four sections with compound names Buralang-Balang etc., and the two kinds of right marriage, regular and alternate, are distinguished from each other in terms of the eight subsections with the individual names Buralang, Balang, Karmarung etc.

CHAPTER III

Formal Notation

3. 1 Patriline and matriline. From the axioms in 1. 7 it follows that any relation between persons can be expressed in terms of parenthood alone. For example, if the reader will select some close or distant relative of his own, say his "cousin's wife's cousin's husband", he can visualize a sequence of persons, living or dead, who connect him to his relative in such a way that in each of the links, i. e. in each of the successive pairs of linking relatives, one of the two persons is a parent of the other.

Thus we can depict the relationship between ego and alter by a diagram like Figure 3. 1, in which alter is ego's FBSWMZDH, i. e. ego's father's brother's son's wife's mother's sister's daughter's husband. In such a diagram, persons are represented by dots, the parent in each link is placed higher on the page than the child, a father is linked to his child by a heavy solid line, called a **patriline**, and a mother to her child by a dashed line, called a **matriline.**

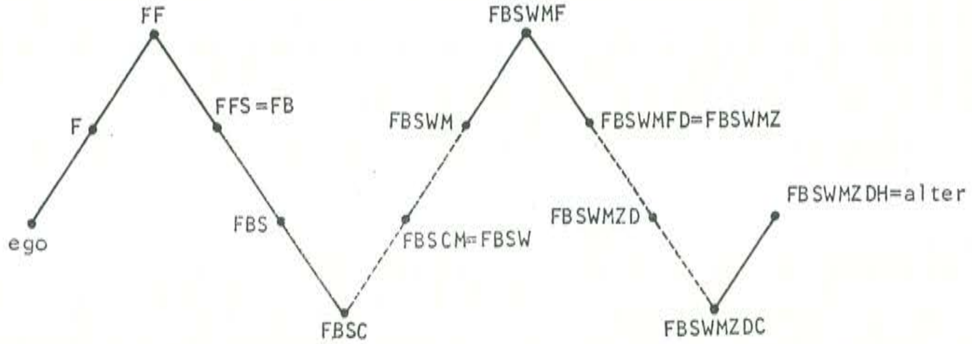


Figure 3. 1. Ego's cousin's wife's cousin's husband.

3.2 Reciprocal relations. The parent-relation P is said to be reciprocal to the child-relation C because the statements "b is parent to a" and "a is child to b" have exactly the same meaning, and similarly for H=husband and W=wife. But the English language has no reciprocal for *father* or *mother*, since e.g. "b is father to a" does not have quite the same meaning as "a is son to b", which allows the possibility that "b is mother to a". Many languages do have such reciprocal terms, e.g. Murngin *bapa* (father etc.) is reciprocal to *gatu* (child etc. of a male speaker), and *arndi* (mother etc.) is reciprocal to *waku* (child etc. of a female speaker), and in English we shall sometimes use the invented terms *fatherling* for "son or daughter of a male speaker" and *motherling* for "son or daughter of *a* female speaker". Thus the statements "b is father to a" and "a is fatherling to b" have exactly the same meaning, which we express by writing $a\mathrm{F}b$ or $b\bar{\mathrm{F}}a$, with an overbar to denote a reciprocal relation.

Ordinarily, reciprocal relations are expressed by distinct kinterms; e.g. *parent* and *child* in English, *bapa* and *gatu* or *arndi* and *waku* in Murngin. But the phenomenon of **kinterm-self-reciprocity**, whereby alter applies the same kinterm to ego as ego to alter, is also common. The only examples in English are provided by the kinterms for *cousin* of all kinds and degrees of removal; e.g. if alter is first-cousin-once-removed to ego, then ego is first-cousin-once-removed to alter. But in other languages throughout the world, and especially among the Indians in California, examples occur for a great variety of relations. Thus for the Shastan Indians we find:

arodsa=*fb* (paternal uncle)=μbc (male speaker's fraternal nephew | niece)
ambaki=*fz* (paternal aunt)=ϕbc (female speaker's fraternal nephew | niece)
apaki=*mb* (maternal uncle)=μzc (male speaker's sororal nephew | niece)
anidi=*mz* (maternal aunt)=ϕzc (female speaker's sororal nephew | niece)

3.3 The formal (X, Y)-notation. In order to have a separate notation for mathematical statements, as distinct from traditional notation for explanatory remarks, we replace F by X, M by Y, $\bar{\mathrm{F}}$ by $\bar{\mathrm{X}}$, and $\bar{\mathrm{M}}$ by $\bar{\mathrm{Y}}$, P by A (i.e. both father and mother, from the Latin *ambo*=both) and C by $\bar{\mathrm{A}}$. Thus $a\mathrm{X}b$ means that a's father is b. $a\bar{\mathrm{X}}b$ means that a's fatherling is b, aYb means that a's mother is b, and aAb means that a's parent is b. Consequently, $X\bar{X}$ means that ego and alter have the same father and are therefore either full siblings, if they also have the same mother, or paternal half siblings, if they have different mothers, and similarly for $Y\bar{Y}$. We write J (cf. Jack and Jill) to mean full sibling, i. e. $X\bar{X}$ and $Y\bar{Y}$, unless it is clear that only half-sibling can be meant, as e. g. in the chain $JY=X\bar{X}Y$ (stepmother=ego's father's child's mother). For if the father's child were ego's full sibling, alter would be ego's mother, linked to ego by the shorter chain Y. We also abbreviate $\bar{X}Y$ to W (wife), $\bar{Y}X$ to H (husband) and $\hat{A}\breve{A}$ to V (spouse), so that the sequence of letters FBSWMZDH in 3. 1 becomes $XJ\bar{X}WYJ\bar{Y}H$ (see Figure 3. 1).

The chief difference between the traditional notation, which we shall call "informal", and our new "formal" notation lies in the fact that the informal notation requires the subsidiary letters μ and ϕ to express the sex of the speaker, while the formal notation requires them to express the sex of any person who is not the father or mother of someone in the sequence linking ego to alter; e. g. $\mu F=\mu X$, $\mu C=\bar{X}$, $B=J\mu$, $BC=J\bar{X}$, $MBD=YJ\bar{X}\phi$, $\mu C=\bar{X}$, $\mu S=\bar{X}\mu$, $\phi MFZS=\phi YXJ\bar{Y}\mu$ (cf. their sketches in Figure 3.). As a quick check on the correctness of any translation from one notation to the other, we may look to see whether alter remains in the same generation; e. g. in ϕMFZS there are two ascending letters F, M and one descending S, so that alter is one generation above ego, and similarly in $\phi YXJ\bar{Y}\mu$ there are two unbarred letters and one barred.

The most obvious advantage of the formal notation is its convenience in dealing with reciprocal relations. Thus if ego is linked to alter by the sequence ϕMFZS we cannot at once read off the reciprocal chain linking alter to ego, but in the formal notation $\phi YXJ\bar{Y}\mu$ we need only reverse the order of the letters, changing barred letters to unbarred and conversely, to obtain $\mu YJ\bar{X}\bar{Y}\phi=\mu MBDD$.

Or again, for the *uncle* | *aunt* and *nephew* | *niece* kinterm self-reciprocity quoted in 3. 2 for the Shastan Indians we have

arodsa: $XJ\mu$ and $\mu J\bar{X}$,
ambaki: $XJ\phi$ and $\phi J\bar{X}$,

apaki: $YJ\mu$ and $\mu J\bar{Y}$,
anidi: $YJ\phi$ and $\phi J\bar{Y}$.

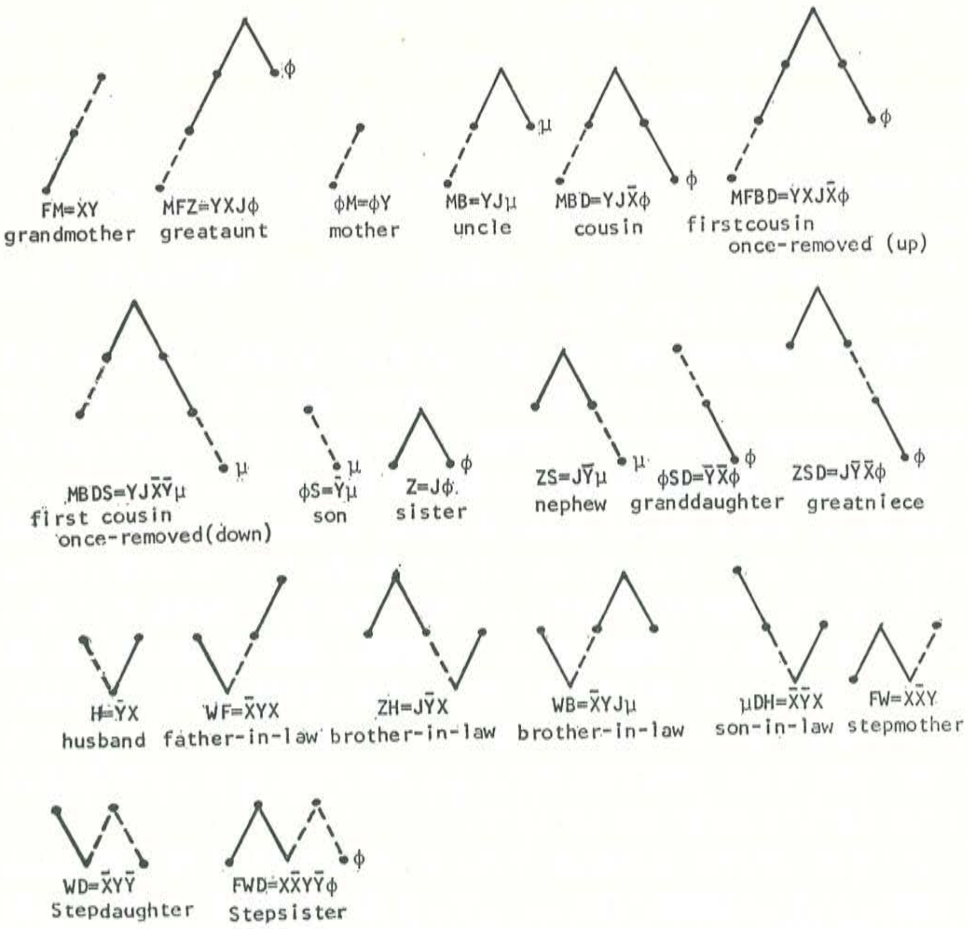


Figure 3. 3 Sketches for English kinterms.

3. 4 Chains and strings. A sequence formed from the four letters X, $\bar{X}$, Y, $\bar{Y}$ is called a **chain**, or **kinchain**, and a sequence containing one or more of the subsidiary letters μ or ϕ (or e=elder, y=younger as in 6. 1), is a **string**, or **kinstring**. In particular, the empty sequence formed by no letters at all is called the **empty chain** and is denoted by I.

Thus chains indicate only the sex of those persons who are parents of some other person in the sequence (cf. 3. 1), whereas strings give information about relative age or about the sex of persons who are childless as far as the given sequence is concerned. Since the sex of childless persons is genealogically unimportant, the main part of the information in a string is already contained in its imbedded chain. So we distinguish **types** of kinship systems by differences in their partitions of the set of chains, and **subtypes** of a given type by differences in their partition of strings. For example, Tamil and Telegu belong to the same type (Dravidian) because they have the same chain-equivalences, but different subtypes because of the difference in their partitioning of cross-cousin strings (see Figure 10. 2). Since the present chapter and the next deal only with chains, in particular with the English system as a type, there will be no further mention of strings until Chapter Six.

3. 5 Alphabet and dictionary; multiplication. The four letters X, $\bar{X}$, Y, $\bar{Y}$ in that order will now constitute our formal **alphabet**. Our other symbols J, H, W, μ, ϕ, e, y, F, M, B, Z, S, D are not regarded as letters, i. e. they do not belong to the alphabet, since J=X$\bar{X}$ or Y$\bar{Y}$, H=$\bar{Y}$X, W=$\bar{X}$Y are abbreviations for pairs of letters, μ, ϕ, e, y are not parts of chains, F, M, B, Z, S, D do not belong to our formal notation at all, and I is merely an abbreviated statement of the absence of letters. Since a chain is thus a sequence of letters, it is also called a **word** (cf. 2. 2) and the entire set of all possible chains, i. e. words, is called the **dictionary** D. A word is said to be formed by concatenating its letters, i. e. by writing them in a sequence one after another; and the word, call it KK', formed by concatenating two given words K and K' is called the **product** of K and K'. For example, if K=YX and K'=$\bar{X}\bar{Y}$X, then KK'=YX$\bar{X}\bar{Y}$X. Concatenation is often called **multiplication**, so that the word KK' is said to be formed by "multiplying" K with K'.

3. 6 Connecting and linking chains, kinterm-coverset. In a given society U, ego=a is said to be **connected** to alter=b by a chain, say K=YX$\bar{X}\bar{X}$ (MBC), if there exist three "connecting" persons p_1, p_2, p_3 such that the five persons a, p_1, p_2, p_3, b are all in U and satisfy the four conditions aYp_1, p_1Xp_2, $p_2\bar{X}p_3$, $p_3\bar{X}b$, which are usually written in the more concise form

$aYp_1Xp_2\bar{X}p_3\bar{X}b$. Thus ego is connected to alter=ego's MBC if U includes ego, ego's mother p_1, her father p_2, her father's fatherling p_3, and p_3's fatherling=alter, with no distinction between dead and living persons.

In any society it may happen that ego is connected to alter≠ego by chains of various lengths. For example, if ego's father has married his (the father's) MBD, ego's mother is ego's FMBD as well, so that ego is connected to her by the two chains Y and $XYX\bar{X}\bar{X}\phi$. In such a case it is only the shortest connecting chains that will determine ego's choice of a kinterm for alter, since ego would not apply the kinterm *first-cousin-once-removed* to his own mother. To take account of this fact we say that the shortest connecting chains not only "connect" but also "link" ego to alter, so that only linking chains determine choice of kinterms. Then the complete set of native kinterms applicable to relatives to whom ego is linked by a given chain K is called the **coverset**, or **kinterm-coverset**, of K in the given terminology. Thus the English coverset for the chain XJ consists of the two kinterms *uncle* | *aunt*, for $XJ\bar{X}$ it is the single term *cousin*, and so on.

Many linking chains have no native kinterm, e. g. WBW=$\bar{X}YX\bar{X}\bar{X}Y$ in English. But we would like every chain to have a coverset of some sort, since we wish to consider a native terminology as a partition of the set of all chains on the basis of their coversets (cf. 1. 6). So to the chain WBW in English we agree to assign *kintermless* as its coverset. Then two chains K and K' with the same coverset are said to be **coverset-equal**; e. g. $XXJ\bar{X}$ and $XYJ\bar{Y}$ are coverset-equal in English because the coverset for each of them is *first-cousin-once-removed*; and WBW and HZH are coverset-equal because each of them has the coverset *kintermless*.

3. 7 Natural and auxiliary chains. The eight pairs of letters $X\bar{X}$ and $Y\bar{Y}$ (*brother* | *sister*), $X\bar{Y}$, $Y\bar{X}$, $\bar{X}X$, $\bar{Y}Y$, $\bar{X}Y$ (*wife*), and $\bar{Y}X$ (*husband*) are called **turns**, since they turn from ascending (unbarred) letters to descending (barred) letters or vice versa. The pairs $X\bar{X}$, $Y\bar{Y}$, $X\bar{Y}$ and $Y\bar{X}$ are **upper** turns, and the pairs $\bar{X}X$, $\bar{Y}Y$, $\bar{X}Y$, $\bar{Y}X$ are **lower** turns. The pairs $X\bar{X}$, $Y\bar{Y}$, $\bar{Y}X$, $\bar{X}Y$ associated with the native kinterms b | z and h | w are **natural** turns, and the others are **auxiliary**. Chains with no turn are **lineal**, with an upper turn but no lower turn they are **collateral**; lineal and collateral chains are **consanguineal**, and chains with a lower turn are **affinal.** Collateral chains starting or ending with their turn are **collineal** and all other chains are **ablineal** (cf. 2.6). The empty chain I and chains with an auxiliary turn are called **auxiliary** chains, and the others are **natural** chains.

Every auxiliary chain has the coverset *kintermless*. For if K contains an upper auxiliary turn $X\bar{Y}$ or $Y\bar{X}$ it cannot connect ego to any alter since the intermediate person p_i in $p_{i-1}Xp_i\bar{Y}p_{i+1}$ would have to be both male and female, i. e. father to p_{i-1} and mother to p_{i+1}, and similarly for $Y\bar{X}$; and on the other hand a chain with a lower auxiliary turn $\bar{X}X$ or $\bar{Y}Y$ cannot be the shortest chain from ego to alter. For if say the chain $K=\bar{X}\bar{X}X$ with the lower auxiliary turn $\bar{X}X$ connects ego$=a$ to ego's son's child's father$=b$ with $a\bar{X}p_1\bar{X}p_2Xb$, then ego's child's father b is necessarily the same person as ego's son p_1, so that ego is connected to $p_1=b$ by the shorter chain $a\bar{X}b$. More generally, a chain connecting ego$=a$ to alter$=b\neq a$ with intermediate relatives $p_1, p_2, \cdots, p_{n-1}$, cannot be a linking chain unless all the $(n+1)$ persons $a, p_1, \cdots, p_{n-1}, b$ are distinct.

Finally, the empty chain I connecting ego to himself has the coverset *kintermless*, since ego never applies the same kinterm to himself as to any of his relatives.

The advantage of admitting auxiliary chains into our dictionary, even though they cannot have native kinterms, lies in the fact that they allow us to form the product of any two chains without exception. With the natural chains alone we could not multiply, say $K=XX$ (grandfather) by $K'=\bar{Y}\bar{X}$ (female speaker's grandchild), since the resulting product $KK'=XX\bar{Y}\bar{X}$ is an auxiliary chain. As we shall see, it is this ability to multiply without restriction that enables us to describe kinship systems as groups and monoids, and thus to compare them more easily with one another. Getting rid of exceptions by introducing new entities is a common practice in all branches of mathematics.

3.8 Foci. The total number of letters in a kinchain, written in unabbreviated form, is called the **length** of the chain, a concept which in some legal systems determines the share received by alter from the estate of an ego who dies intestate; for example, XY, $\bar{X}\bar{Y}$, J, W, H are of length two, and VJ, JV are of length four. The number of unbarred letters minus the number of barred letters is the **height** of the chain, which determines the generation in which alter stands with respect to ego, the five generations G_2, G_1, G_0, G_{-1}, G_{-2} around ego being called the **central generations.** Thus $XYX\bar{X}$ is of height two and therefore belongs to generation G_2, and the empty chain I is of length and height zero and therefore belongs to G_0. We also make use of such readily understood notation as X^3 for XXX, X^{-3} for $\bar{X}^3$, and X^0 for I.

Then the entire set of chains, i. e. the **dictionary** is said to be arranged in **dictionary-order** if shorter chains precede longer and chains of the same length are arranged alphabetically by the order X, $\bar{X}$, Y, $\bar{Y}$. Thus the entire dictionary, unlike Webster's, contains infinitely many words, in the following order:

$$I, X, \bar{X}, Y, \bar{Y}, XX, X\bar{X}, XY, X\bar{Y}, \bar{X}X, \ldots, \bar{Y}\bar{Y}, XXX, \ldots, \bar{Y}\bar{Y}\bar{Y}, XXXX, \ldots.$$

In any set of chains the earliest in dictionary-order is called the **leading** chain, or **leading** focus, and all chains of the same length as the leading focus, i. e. all the shortest chains in the set, are also called **foci.** For example, in the list of chains $XJ\bar{Y}$, $YJ\bar{X}$, $XXJ\bar{X}\bar{Y}$, $XYJ\bar{Y}\bar{Y}$, $YXJ\bar{X}\bar{X}$, ... for the Seneca term *akyase* (*p̂ǰc*, cf. 2. 3), the foci are $XJ\bar{Y}$ and $YJ\bar{X}$, and the leading focus is $XJ\bar{Y}$.

With the definitions and notation of this chapter we are now ready to begin our formal description of the English kinship system.

CHAPTER IV

The English Kinship System

4.1 Traditional listing of kinterms. Since we are interested only in kinterm-recurrences, it might seem that we should describe a kinship system simply by listing its kinterms, each accompanied by its corresponding chains, as is done in standard field-reports on aboriginal terminologies. For the English system a report would contain entries like the following:

father	F	*uncle*	FB, MB
mother	M	*greatuncle*	FFB, FMB, MFB, MMB
grandfather	FF, MF	*nephew*	BS, DS
grandson	SS, DS	*greatnephew*	BSS, BDS, ZSS, ZDS
⋮	⋮	⋮	⋮

But a mere listing of kinterms fails to state any general law about the system and is therefore too long-winded to be suitable for classification of systems. We must search for a more concise description, i. e. for a general law. Since the traditional notation obscures regularities in the system by using too many letters, with no reciprocals for F, M, S and D, we conduct our search in the (X, Y)-notation.

4.2 Partition by coverset-equality. We first assemble the kinterms into rows according to their coversets, as in Table 4.2. In each horizontal row the coverset-equal chains are arranged in dictionary-order and the rows are arranged under one another with their leading foci appearing in dictionary-order.

Table 4. 2 Partition of the set of all chains by coverset-equality in English

Consanguineal kinchains

Coverset	Chains
father $\mid$ *mother*	$X \mid Y$
son $\mid$ *daughter*	$\bar{X}$, $\bar{Y}$
grandfather $\mid$ *grandmother*	$XX, YX \mid XY, YY$
grandson $\mid$ *granddaughter*	$\bar{X}\bar{X}, \bar{X}\bar{Y}, \bar{Y}\bar{X}, \bar{Y}\bar{Y}$
uncle $\mid$ *aunt*	XJ, YJ (and XJV, YJV)
nephew $\mid$ *niece*	$J\bar{X}, J\bar{Y}$
cousin	$XJ\bar{X}, XJ\bar{Y}, YJ\bar{X}, YJ\bar{Y}$
first-cousin-once-removed	$XXJ\bar{X}, XXJ\bar{Y}, \cdots, YYJ\bar{Y}, XJ\bar{X}\bar{X}, XJ\bar{X}\bar{Y}, \cdots, YJ\bar{Y}\bar{Y}$
pth-cousin-q-times-removed	$X^{p+q}J\bar{X}^{p}, \cdots, Y^{p+q}J\bar{Y}^{p}, X^{p}J\bar{X}^{p+q}, \cdots, Y^{p}J\bar{Y}^{p+q}$

Affinal kinchains

Coverset	Chains
husband $\mid$ *wife*	V (i. e. $\bar{Y}X \mid \bar{X}Y$)
father-in-law $\mid$ *mother-in-law*	VA (i. e. $\bar{Y}XX, \bar{X}YX \mid \bar{Y}XY, \bar{X}YY$)
son-in-law $\mid$ *daughter-in-law*	$\bar{A}V$ (i. e. $\bar{X}\bar{Y}X, \bar{Y}\bar{Y}X \mid \bar{X}\bar{X}Y, \bar{Y}\bar{X}Y$)
brother-in-law $\mid$ *sister-in-law*	VJ, JV (i. e. $\bar{X}YJ, J\bar{X}Y, \bar{Y}XJ, J\bar{Y}X$)
stepbrother $\mid$ *stepsister*	$JJ=AV\bar{A}$ (e. g. $X\bar{X}Y\bar{Y}=AV\bar{A}$)
uncle $\mid$ *aunt*	XJV, YJV (and XJ, YJ)
kintermless	all other affinal chains

4. 3 Partition by coverset-equivalence. As the next step toward discovering a general law, we note a fundamental difference between two different kinds of coverset-equality. For example, the three chains $XXJ\bar{X}$, $XXJ\bar{Y}$ and $XJ\bar{X}\bar{X}$ are all coverset-equal (*cousin-once-removed*). But the coverset-equality of $XXJ\bar{X}$ with $XXJ\bar{Y}$ is quite different from its coverset-equality with $XJ\bar{X}\bar{X}$. The two chains $XXJ\bar{X}$ and $XXJ\bar{Y}$ not only have the common coverset *cousin-once-removed* when they are not parts of longer chains, i. e. when they link ego himself to ego's own cousins once-removed, but they also produce coverset-equality when they are parts of longer chains, say as parts of the longer chains $YXXJ\bar{X}$ and $YXXJ\bar{Y}$ with prefixed Y, or as parts of $XXJ\bar{X}\bar{Y}$ and $XXJ\bar{Y}\bar{Y}$ with suffixed $\bar{Y}$. For in the first case both YXXJ$\bar{X}$ and YXXJ$\bar{Y}$ (ego's mother's cousins-once-removed) have the coverset *cousin-twice-removed*, and in the second case both XXJ$\bar{X}\bar{Y}$ and XXJ$\bar{Y}\bar{Y}$ (children of ego's cousins-once-removed) have the coverset *second cousin*, and the situation is the same when any chain, call it K_0, is prefixed in place of Y or suffixed in place of $\bar{Y}$. In other words, if we write K for XXJ$\bar{X}$ and K' for XXJ$\bar{Y}$, we have the result: not only is K coverset-equal to K', but it is also true that the product K_0K is coverset-equal to K_0K' and KK_0 to $K'K_0$, for all choices of the multiplier K_0. This situation is described by saying that the coverset-equality of XXJ$\bar{X}$ and XXJ$\bar{Y}$ is **stable under multiplication**, and the two chains are then said to be **coverset-equivalent.**

But for the two chains XXJ$\bar{X}$ and XJ$\bar{X}\bar{X}$ the situation is quite different. Here again they are themselves coverset-equal to each other with the common coverset *cousin-once-removed*, but now the coverset-equality disappears when they are parts of longer chains. For now, when Y is prefixed, the coverset for YXXJ$\bar{X}$ is *cousin-twice-removed*, but for YXJ$\bar{X}\bar{X}$ it is *second-cousin*, and when $\bar{Y}$ is suffixed, the coverset for XXJ$\bar{X}\bar{Y}$ is *second-cousin* but for XJ$\bar{X}\bar{X}\bar{Y}$ it is *cousin-twice-removed*. In other words, if we write K for XXJ$\bar{X}$ and K'' for XJ$\bar{X}\bar{X}$, we have the result; the two chains K and K'' are themselves coverset-equal, but for some choices of a factor K_0 the two chains K_0K and K_0K'' are no longer coverset-equal, nor are KK_0 and $K''K_0$. This situation is described by saying that the coverset-equality of XXJ$\bar{X}$ and XJ$\bar{X}\bar{X}$ is **unstable under multiplication**, and the two chains are then said to be **coverset-coincident**, in symbols XXJ$\bar{X} \approx$ XJ$\bar{X}\bar{X}$. So when we state that two chains are coverset-equivalent we are stating recurrences of kinterms for many pairs of chains throughout the native terminology and are therefore describing a basic property of the whole kinship system; but when we state that two chains are coverset-coincident we are merely stating a recurrence for those two chains themselves, so that we are no longer dealing with a property of the terminology as a whole but with an accidental feature of the given language, like the uncharacteristic failure of English to distinguish higher and lower generations for removed cousins. Consequently, we may expect to come closer to a general law if we base our partition on coverset-equivalence rather than coverset-equality; i. e. if we refine the partition by coverset-equality in Table 4. 2 into a partition by coverset-equivalence, a step which requires us, for example, to split the single row labeled *cousin-once-removed* into two rows, that might be labeled, say:

cousin-once-removed up:	$XXJ\bar{X}$, $XXJ\bar{Y}$, $XYJ\bar{X}$, …, $YYJ\bar{Y}$
cousin-once-removed down:	$XJ\bar{X}\bar{X}$, $XJ\bar{X}\bar{Y}$, $XJ\bar{Y}\bar{X}$, …, $YJ\bar{Y}\bar{Y}$.

4.4 Stability, product of kinterms. Stability owes its importance to its connection with such questions as: what kinterm does ego apply to ego's *grandmother*'s *grandfather*? Such a kinterm is called the **product** of the two given kinterms because it is found by multiplying any chain for *grandmother* by any chain for *grandfather* and then examining the coverset of the product-chain. Here the two sets of chains are:

for *grandmother*:	XY, YY
for *grandfather*:	XX, YX.

So to obtain the desired kinterm for *grandmother's grandfather*, we multiply any chain in the first row YY, by any chain in the second row, say XX, thereby obtaining the product-chain YYXX with coverset *greatgreatgrandfather*, from which we conclude that in English a *grandmother*'s *grandfather* is called a *greatgreatgrandfather*.

But we can draw this conclusion only if, as in the present case, the result is the same for all four possibilities arising from either of the two choices of a representative chain from the first row and from the second row.

But now consider the question: what does ego call ego's *grandmother*'s *cousin-once-removed*?

Here again we set out the chains, two for *grandmother* and sixteen for *cousin-once-removed*, eight of them coverset-equivalent to $XXJ\bar{X}$ and eight to $XJ\bar{X}\bar{X}$:

grandmother:	XY, YY
cousin-once-removed:	$XXJ\bar{X}$, $XXJ\bar{Y}$, …, $YYJ\bar{Y}$; $XJ\bar{X}\bar{X}$, $XJ\bar{X}\bar{Y}$, …, $YJ\bar{Y}\bar{Y}$.

In this case the answer will differ according to our choices of representatives.

If we take XY from the first row and say $XXJ\bar{X}$ from the second we obtain XYXXJ$\bar{X}$ with the coverset *cousin-three-times-removed*, but if we take say XJ$\bar{X}\bar{X}$ from the second row we obtain XYXJ$\bar{X}\bar{X}$ with the coverset *second-cousin-once-removed.*

So the kinterm applied by ego to ego's *grandmother's grandfather* is uniquely determined, but not the kinterm applied to ego's *grandmother's cousin-once-removed*, for the reason that the coverset-equality of the chains for *cousin-once-removed* is not stable.

4. 5 Abstract kinship system. Any native terminology partitions the set $\mathfrak{D}$ of all chains on the basis of coverset-equality, in other words, the terminology is an array of rows, i. e. classes, as in Table 4. 2, each row being labeled by its coverset with the word *kintermless* supplied as a coverset for those classes that have none in the native language. In many languages, e. g. English, this partition by coverset-equality is unstable, in many others it is stable, at least for consanguineal chains.

But let us now consider an arbitrary partition P of the set $\mathfrak{D}$ of all chains, i. e. any array of the chains arranged in rows. If for every choice of two chains K and K' from the same row, i. e. from the same class in the partition, and for every choice of a multiplier chain K_0 from any class, the product K_0K falls into the same class as K_0K', and KK_0 into the same class as $K'K_0$, the entire partition is said to be **stable.**

Any stable partition P of the set $\mathfrak{D}$ of all chains is called an **abstract kinship system,** abstract because as yet no kinterm-coversets have been assigned to its classes. Nevertheless, in analogy with the product of two kinterms (4. 4) we can still speak of the **product of two classes** in P as being the unique class containing the product KK_0, where K is any representative from the first class and K_0 is any representative from the second (see class-multiplication in 5. 2).

An abstract system becomes **concrete** if a label, called a "coverset" and possibly consisting of the single word *kintermless,* is attached to each of the classes in the partition. Then any statement to the effect that two given chains K and K' have the same coverset, i. e. are in the same class, implies the infinitely many statements that K_0K has the same coverset as K_0K', and KK_0 as $K'K_0$, for all choices of K_0. So we may hope that it will be possible to give a very concise description of coverset recurrences in such a system.

To describe any actual system we therefore adopt the following procedure. We determine an abstract system such that when it is suitably labeled with actual native kinterms the resulting concrete system is close to the actual system and then, if necessary, we provide supplemental statements of the discrepancies between this concrete system and the (possibly unstable) actual system. We shall find that such a description can in fact be very concise.

4. 6 Partition by equivalence-rules. When we examine this new partition, namely by coverset-equivalence rather than coverset-coincidence, we are at once struck by a certain general law, namely the substitutability, almost always without change of coverset-equivalence, of X for Y, Y for X, $\bar{X}$ for $\bar{Y}$ and $\bar{Y}$ for $\bar{X}$. For example, $XXJ\bar{Y}$ can be obtained from the coverset-equivalent chain $XXJ\bar{X}$ by substituting $\bar{Y}$ for $\bar{X}$ in the fourth place, but $XJ\bar{X}\bar{X}$ cannot be obtained from the non-coverset-equivalent chain $XXJ\bar{X}$ by any combination of the four suggested substitutions.

So we now consider a third partition of chains for the English system, namely: two chains K and K' are put into the same class if they can be obtained from each other by the substitutions X for Y, Y for X, $\bar{X}$ for $\bar{Y}$ and $\bar{Y}$ for $\bar{X}$, in which case they are said to be **chain-equivalent** or just **equivalent**, in symbols $K \sim K'$. Any class in this partition, i. e. any complete set of equivalent kinchains, is called a **kinclass**. For example, one of the English kinclasses consists of the four chains $X\bar{X}$, $Y\bar{Y}$, $Y\bar{X}$, $X\bar{Y}$, the first two of which are natural, with the native coverset *brother* | *sister*, while the last two are auxiliary and therefore have the coverset *kintermless*. In such cases we say that the kinclass as a whole has the coverset *brother* | *sister*, namely the coverset common to the natural chains in the class.

Since the two particular equivalences $X \sim Y$ and $\bar{X} \sim \bar{Y}$ imply all the others, they are called the **equivalence-rules** for the English system.

The partition based on these rules will be stable. For if $K \sim K'$, then $KK \sim KK'$ and $KK \sim K'K$, since we can obtain KK' from KK, and KK, from $K'K$, by simply making the substitutions on K necessary to transform K

into K'.

A kinship system with the rules $X \sim Y$, $\bar{X} \sim \bar{Y}$ is said to be **non-bifurcate** because it does not distinguish the father's side of the family, the so-called "sword" side, consisting of the chains XJ, XJ$\bar{X}$, ... that begin with X, from the mother's or "distaff" side, consisting of the chains YJ, YJ$\bar{X}$, ... that begin with Y.

4.7 Supplemental statements. Our description of the English system by the rules $X \sim Y$, and $\bar{X} \sim \bar{Y}$ has the desired conciseness, but we must note four respects in which it does not precisely reflect the actual recurrence of kinterm-coversets in English. First, it makes X equivalent to Y, although *father* is the coverset for X and *mother* for Y, and similarly for other chains ending in X or Y, e. g. J$\bar{Y}$X (sister's husband=*brother-in-law*) and J$\bar{X}$Y (brothers' wife=*sister-in-law*). Second, it fails to register the recurrence of *first-cousin-once-removed* in XXJ$\bar{X}$ and XJ$\bar{X}\bar{X}$ (see just above) or of *brother-in-law* in J$\bar{Y}$X (sister's husband) and $\bar{X}$YJ (wife's brother). Third, it sometimes makes auxiliary chains, e. g. X$\bar{Y}$ and Y$\bar{X}$, with coverset *kintermless*, equivalent to natural chains, e. g. X$\bar{X}$ and Y$\bar{Y}$, with native coverset $b \mid z$. Fourth, the rule fails to state that in English almost all natural affinal chains are coverset-equal with the common coverset *kintermless*, the only exceptions being those of length two or three, the chains JJ and VJ$\approx$JV of length four and the chain PJV ($\approx$PJ) of length five (see Table 4. 2).

The first case, arising from the fact that final X and Y distinguish sex of the referent, is almost universal for kinship systems and will therefore be tacitly assumed, with a special statement only for the very rare systems in which it does not hold. The second case will require a supplemental statement in any complete description of the English system, but the third can be safely ignored, since it will not mislead anyone into thinking that an auxiliary kinchain can have a native coverset, and the fourth can be dealt with by simply listing those affinal chains, as we have just done, that have no native coversets in English.

4.8 Final description of coverset-recurrence in English. We can now give a concise, correct and complete description of the recurrence of coversets in English as follows: like all other systems, the English system is a partition of the set of all chains; in English, the partition is defined by the equivalence-rules $X \sim Y$, $\bar{X} \sim \bar{Y}$. Two supplemental statements are then necessary:

i) the chain-coincidences are

a) $A^{p+q}J\bar{A}^{q} \approx A^{q}J\bar{A}^{p+q}$

i. e. cousins-removed-up are not distinguished from cousins-removed-down.

b) $JV \approx VJ$

i. e. siblings' spouses go by the same kinterm (*b-in-law* | *z-in-law*) as spouses' siblings

c) $PJ \approx PJV$

i. e. spouse of *uncle* | *aunt* is also *uncle* | *aunt*

ii) the special affinal chains with non-empty coverset are:

those of length two or three, the chains JJ, $JV \approx VJ$ of length four, and the chain PJV ($\approx PJ$) of length five.

However, this description refers only to recurrences of coversets as a whole, although recurrences of kinterms within a given coverset are also part of a given kinship system. For example, the kinterm for a male referent recurs for a female referent in the coverset for $XJ\bar{X}$ (*cousin*) but not in the coverset for XJ (*uncle* | *aunt*), and in other languages similar recurrences and non-recurrences may depend on sex of the speaker, relative age of ego and alter and other factors. To this subject we return in Chapter Six. In the meantime let us consider the question of representing coverset-recurrence by means of geometric diagrams called "kingraphs".

4.9 Kingraph. A diagram consisting of points, some or all of which are connected in pairs by directed lines, i. e. lines with arrowheads, is called a (directed) **graph**. If the points represent kinclasses, some of which are connected by patrilines (solid) or matrilines (dashed), the graph is called a **kingraph**. In such a graph it is often convenient to inflate the points into rectangles, or **boxes**, so that glosses or other information can be written inside them. For systems like English with non-prescriptive marriage, it is hardly worthwhile to include the affinal chains in a geometric diagram since only a few of them have native kinterms. As for prescriptive systems, the one diagram serves for both kinds of chains; see e. g. Figure 10. 2.

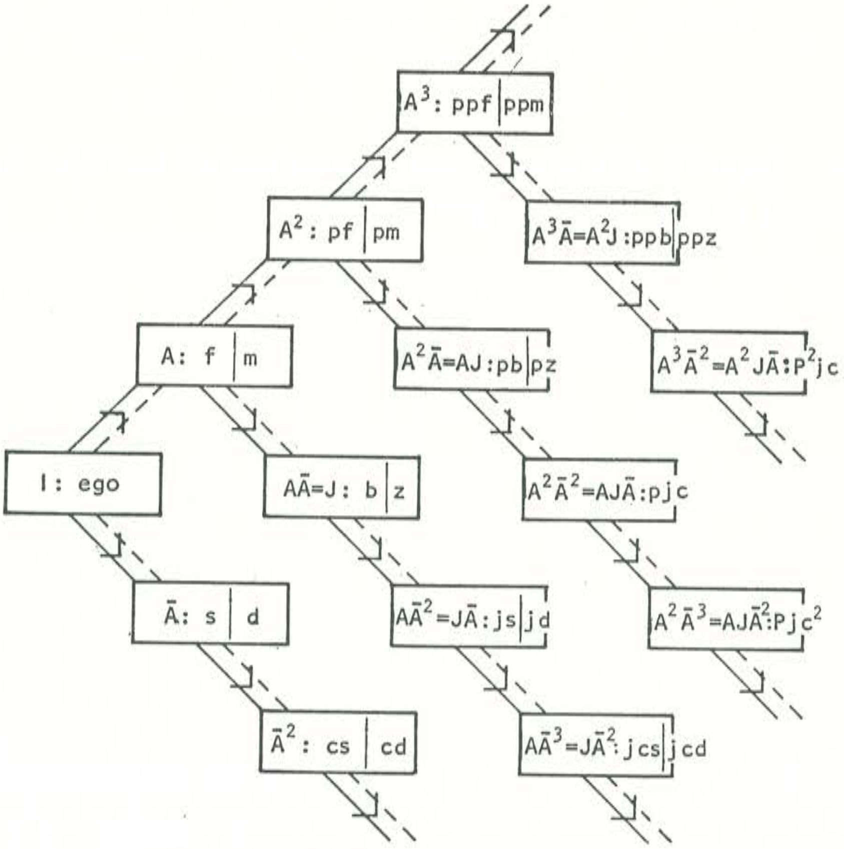


Figure 4. 9 English consanguineal kingraph.

4. 10 Tracing-out. The kingraph in Fig. 4. 9 can be used to give a purely geometric proof of any consanguineal chain-equivalence, say $XYJ\bar{Y}\bar{X} \sim XXJ\bar{X}\bar{Y}$ for second cousins, by a procedure called "tracing-out".

We first replace the J's by $X\bar{X}$ and then trace out $K=XYJ\bar{Y}\bar{X}=XYX\bar{X}\bar{Y}\bar{X}$ by putting an index finger on the I-box in the kingraph and moving the finger up a patriline for the first X, up a matriline for the Y, up a patriline for the next X, down a partiline for the $\bar{X}$, down a matriline for the $\bar{Y}$ and down a patriline for the last $\bar{X}$, finally arriving at the second-cousin box. Then K' will be equivalent to K if and only if tracing-out K' brings us to the same box as K. From a strictly mathematical point of view this geometric procedure adds nothing to the algebraic proof:

$$XYJ\bar{Y}\bar{X}{\sim}XXJ\bar{Y}\bar{X} \text{ by } Y \text{ for } X \text{ in second place,}$$
$$XXJ\bar{X}\bar{X} \text{ by } \bar{X} \text{ for } \bar{Y} \text{ in fourth place,}$$
$$XXJ\bar{X}\bar{Y} \text{ by } \bar{Y} \text{ for } \bar{X} \text{ in fifth place.}$$

However, geometric tracing-out is usually much quicker and often contributes greatly to ease of comprehension.

CHAPTER V

Kinship Systems as Quotient Monoids

5. 1 Definition of a monoid. For more concise application to kinship systems other than English we now wish to state the preceding developments in more mathematical form.

We consider a set, call it $\mathfrak{B}$, of elements a, b, c, $\cdots$ of any kind, i. e. not necessarily of chains as heretofore. Then, as a generalization of the operation of concatenating two chains, we assign to each pair (a, b) of elements of $\mathfrak{B}$ an element c in $\mathfrak{B}$ called the **product** of a and b under an operation of some kind, which we call (generalized) **multiplication**. For example, $\mathfrak{B}$ may be the set of all integers $\cdots, -3, -2, -1, 0, 1, 2, 3, \cdots$ and the operation may be addition, or subtraction or ordinary multiplication etc. Or, as up to now, $\mathfrak{B}$ may be the set $\mathfrak{D}$ of all "words" in the "dictionary", i. e. all chains K, K', K'', $\cdots$ formed from the four letters X, $\bar{\text{X}}$, Y, $\bar{\text{Y}}$ under the operation of concatenation. Or the multiplication may take many other forms, provided only that some operation assigns an element c in $\mathfrak{B}$ to each pair (a, b) of elements in $\mathfrak{B}$. The operation may be denoted by a general symbol, say $\odot$, in which case we write $a \odot b = c$, or by special symbols like $\times$ or $+$ or $-$, when we write $a \times \text{b} = c$, or $a + b = c$, or $a - b = c$, or even by mere juxtaposition, i. e. $ab = c$.

The set $\mathfrak{B}$, together with the structure on $\mathfrak{B}$ consisting of all pairs (a, b) and the associated products c, is then called a **closed binary system**, "closed" because the product of two elements in $\mathfrak{B}$ is also in $\mathfrak{B}$ and "binary" because multiplication is defined for pairs of elements. A closed binary system is also called a **groupoid** and it is customary, though imprecise, to let the same letter, say $\mathfrak{B}$, denote not only the underlying set itself but also the whole groupoid, i. e. the underlying set together with its rule for multiplication.

Then a groupoid may have either, neither or both of the following two properties.

i) the multiplication is **associative**; i. e. $(pq)r=p(qr)$ for all p, q, r in $\mathfrak{B}$.

For example, if $\mathfrak{B}$ is the set of all integers, ordinary multiplication and addition are associative, e. g. $9\times(5\times2)=(9\times5)\times2$ and $9+(5+2)=(9+5)+2$, but subtraction is not associative; $9-(5-2)=6$ but $(9-5)-2=2$. Or if $\mathfrak{B}$ is the set of all words on X, $\bar{\text{X}}$, Y, $\bar{\text{Y}}$, then concatenation is associative, since the final product of any three words K_0, K_1, K_2 is the same whether we first form (K_0K_1) and then adjoin K_2 to it, or first form (K_1K_2) and then adjoin it to K_0. An associative groupoid is called a **semigroup.**

ii) there exists an identity-element, or identity, call it i, such that $pi=ip=p$ for all p in $\mathfrak{B}$.

Thus if $\mathfrak{B}$ is the set of all integers, ordinary multiplication has the identity-element 1, and addition and subtraction have 0, but if $\mathfrak{B}$ is the set of all even integers, ordinary multiplication has no identity-element. If $\mathfrak{B}$ is the set of all chains, the empty chain, linking ego to himself, is the identity. A semigroup with an identity-element is called a **monoid.** For example, the set of all chains under concatenation, i. e. the structure which we have called our dictionary $\mathfrak{D}$, is a monoid.

A monoid cannot have two distinct identity-elements, call them i and $i'\neq i$. For then we would have the contradiction $i=ii'=i'$.

For a third property, which makes a monoid into a "group", see 11. 1. We shall have no need of groups until we arrive at kinship systems with prescribed marriage in Chapter Ten. For we shall discover that prescriptive systems are groups, whereas non-prescriptive systems are only monoids.

For all systems, prescriptive or non-prescriptive, our equivalence-rules will occur in pairs such that either of the pair is formed from the other by taking reciprocal chains; e. g. English has the pair X∼Y, $\bar{\text{X}}$∼$\bar{\text{Y}}$, Fox has X$\bar{\text{Y}}$∼X, Y$\bar{\text{X}}$∼$\bar{\text{X}}$, Tamil has XX∼XY, $\bar{\text{X}}\bar{\text{X}}$∼$\bar{\text{Y}}\bar{\text{X}}$ and YX∼XY, $\bar{\text{X}}\bar{\text{Y}}$∼$\bar{\text{Y}}\bar{\text{X}}$. From an anthropological point of view this situation is quite natural, since it means that if say a male ego applies the same kinterm to two referents, e. g. *grandfather*, to his XX- and YX-referents, (i. e. XX∼YX) then each of them will apply the same kinterm *grandson* to ego (i. e. $\bar{\text{X}}\bar{\text{X}}$∼$\bar{\text{X}}\bar{\text{Y}}$).

5.2 Stable partitions; class multiplication. If P is any partition of the elements of $\mathfrak{B}$ and if we write $a \sim b$ to mean that a and b are in the same class in P, then P is said to be **stable**, i. e. stable under the multiplication for $\mathfrak{B}$, provided that $a \sim b$ implies $ca \sim cb$ and $ac \sim bc$ for all c; that is to say, if two equivalent elements a and b remain equivalent after being multiplied on the left or on the right by any element c (cf. 4.3).

If P is stable with $a \sim b$ and $c \sim d$, then $ac \sim bc$, by multiplication of $a \sim b$ with c on the right, and $bc \sim bd$ by multiplication of $c \sim d$ with b on the left, and therefore $ac \sim bd$. We now let $\{a\}$ denote the entire class containing the element a, so that the two statements $a \sim b$ and $\{a\}=\{b\}$ have exactly the same meaning. Then the above result, namely that $a \sim b$ and $c \sim d$ imply $ac \sim bd$, means that for a stable partition the class $\{ac\}=\{bd\}$ is the same for every choice of representative $a, b, \cdots$ from the class $\{a\}=\{b\}= \cdots$ and of representative $c, d, \cdots$ from the class $\{c\}=\{d\}=\cdots$ This uniquely determined class $\{ac\}=\{bd\}=\cdots$ is called the **product** under **class-multiplication** of the two classes $\{a\}=\{b\}=\cdots$ and $\{c\}=\{d\}=\cdots$ (again cf 4.3).

As a simple example, let $\mathfrak{B}$ be the set of all integers under ordinary addition and let P be the partition of $\mathfrak{B}$ into two classes, namely the even class, call it e,

$$\cdots, -4, -2, 0, 2, 4, \cdots$$

and the odd class, call it o,

$$\cdots, -3, -1, 1, 3, 5, \cdots$$

Then P is stable. For if a and b are both in say the even class, then $c+a$ and $a+c$ will be in the even class as $c+b$ and b regardless of the choice of c.

5.3 Quotient-monoid. The class-multiplication defined in 5.2 for the classes of any stable partition P of a given monoid $\mathfrak{B}$ is associative, as follows at once from the associativity of multiplication of individual chains; and the class $\{I\}$ is an identity-element since for every class $\{K\}$ we have $\{K\}\{I\}=\{KI\}=\{IK\}=K$. Consequently the set of classes under class-multiplication forms a new monoid, denoted by $\mathfrak{B}/P$ and called the **quotient-monoid** of $\mathfrak{B}$ by P.

For example, if $\mathfrak{B}$ is the set of all integers under ordinary addition and P is the even-odd partition (5.2), the quotient-monoid $\mathfrak{B}/P$ has two elements, namely the even class and the odd class, call then e and o, with e for its identity-element and with the following "multiplication-table":

	e	o
e	e	o
o	o	e

since e. g. odd plus odd=even.

5.4 Monoids and generating relations. In 4.5 we defined an abstract kinship system as being any stable partition of the set $\mathfrak{D}$ of all chains, and showed that the English system, as defined by the equivalence-rules $\mathrm{X}\sim\mathrm{Y}$, $\bar{\mathrm{X}}\sim\bar{\mathrm{Y}}$, is a stable partition of this kind. More generally, let us choose any arbitrary set of pairs of chains (K_0, K_0'), (K_1, K_1'), $\cdots$, (K_{n-1}, K_{n-1}'); e. g. for the English system the two pairs (X, Y) and ($\bar{\mathrm{X}}$, $\bar{\mathrm{Y}}$). Let us then form the partition P of $\mathfrak{D}$ which assigns two chains K and K' to the same class if each of them can be obtained from the other by substitutions of K_0 for K_0', $\bar{K}_0$ for $\bar{K}_0'$, $\cdots$, K_{n-1} for K_{n-1}', $\bar{K}_{n-1}$ for $\bar{K}_{n-1}'$ and conversely. This partition will be stable, for if $K\sim K'$, then $K_0K\sim K_0K'$ and $KK_0\sim K'K_0$ for every chain K_0, since e. g. K_0K can be obtained from K_0K' by carrying out the allowable substitutions on K' alone.

In order to avoid the inconvenience of printing many curly brackets, we now denote the class $\{K\}$ containing the chain K by the corresponding lower-case letter k, so that e. g. $\{K\}=\{\mathrm{XY}\bar{\mathrm{Y}}\bar{\mathrm{Y}}\bar{\mathrm{X}}\}$ becomes $k=\mathrm{xy}\bar{\mathrm{y}}\bar{\mathrm{y}}\bar{\mathrm{x}}$, and the statement $K\sim K'$ has exactly the same meaning as $k=k'$. Then the quotient-monoid $\mathfrak{D}/P$ constructed by means of the pairs of chains (K_0, K_0'), $\cdots$, (K_{n-1}, K_{n-1}') as just above, and therefore with classes k, k', $\cdots$ as its elements, is said to have the **equivalence-rules** $K_0\sim K_0'$, $\cdots$, $K_{n-1}\sim K_{n-1}'$ or, synonymously, to have the **generating relations** $K_0=K_0'$, $\cdots$, $K_{n-1}=K_{n-1}'$. For example, the English abstract kinship system has the equivalence-rules $X \sim Y$, $\bar{X} \sim \bar{Y}$ and therefore the generating relations $x = y$, $\bar{x} = \bar{y}$.

The original monoid $\mathfrak{D}$ itself, which is free of generating relations and has the property that every one of its elements, i. e. every chain, can be expressed as a product of the four elements, X, $\bar{X}$, Y, $\bar{Y}$ is called the **free monoid on four generators.**

On the other hand, the system of the Fox Indians in Nebraska, which has the equivalence-rules $X\bar{X} \sim Y\bar{Y} \sim I$, $Y\bar{X} \sim Y$, $X\bar{Y} \sim \bar{Y}$ (12. 2) is called the **monoid on four generators:** x, $\bar{x}$, y, $\bar{y}$ **with the generating relations** $x\bar{x} = y\bar{y} = i$, $y\bar{x} = y$, $x\bar{y} = \bar{y}$. As for the (non-bifurcate) English system, its equivalence-rule $X \sim Y$ (with reciprocal rule $\bar{X} \sim \bar{Y}$) reduces the number of generators from four to two, because Y and $\bar{Y}$ can be replaced by X and $\bar{X}$. Consequently, since the English system has no other equivalence-rule, it is called the **free monoid on two generators,** say x and $\bar{x}$. In the same way the non-bifurcate system of the Yurok Indians in California, which in addition to $X \sim Y$ has the equivalence-rule $X\bar{X} \sim I$ (7. 2) is called the **monoid on two generators with the generating relation** $x\bar{x} = i$.

5. 5 The English system as a monoid. The English system is now formed by adjoining the native English kinterms as in Table 5. 5.

We have begun with the English system because of its greater familiarity but the advantages of the abstract mathematical method will be clearer for the systems in subsequent chapters, in which each class contains many more chains than in English. For example, the English kinterm *father* applies only to the chain X, whereas the Murngin *bapa* applies not only to X but to infinitely many other chains $XXJ\bar{X}$, $XYJ\bar{Y}$, $YXJ\bar{Y}$, etc. In any case the defining of "type" by generating relations is a step toward the ultimate practical goal of cataloguing all kinship systems.

Table 5. 5 The English system as the free monoid on two generators

Kinclasses of chains natural and auxiliary	Coverset of the kinclass
i	*kintermless*
x	*father* | *mother*
$\bar{x}$	*son* | *daughter*
x^2	*grandfather* | *grandmother*
$x\bar{x}$	*brother* | *sister*
$\bar{x}x$	$\bar{Y}X$ for *husband*; $\bar{X}Y$ for *wife*
$\bar{x}^2$	*grandson* | *granddaughter*
x^3	*greatgrandfather* | *greatgrandmother*
$xx\bar{x}$	*uncle* | *aunt*
$x\bar{x}x$	*stepfather* | *stepmother* e. g. $(X\bar{X})Y$ is "half-sibling's mother" and $X(\bar{X}Y)$ "father's second wife"
$x\bar{x}\bar{x}$	*nephew* | *niece*
$\bar{x}xx$	*father-in-law* | *mother-in-law* e. g. $\bar{X}YX$ is "wife's father"
$\bar{x}x\bar{x}$	*stepson* | *stepdaughter* e. g. $\bar{X}(X\bar{X})$ is "child's half-sibling"
$\bar{x}\bar{x}x$	*son-in-law* | *daughter-in-law* e. g. $\bar{X}(\bar{X}Y)$ is "son's wife"
$\bar{x}\bar{x}\bar{x}$	*greatgrandson* | *greatgranddaughter*
x^4	*greatgreatgrandfather* | *greatgreatgrandmother*
$xx\bar{x}x$	*kintermless*
$xx\bar{x}\bar{x}$	*cousin*
$x\bar{x}xx$	*kintermless*
$x\bar{x}x\bar{x}$	*step-brother* | *step-sister* e. g. $(X\bar{X})(X\bar{X})$ is "half-sibling's half-sibling"
$x\bar{x}\bar{x}x$	*brother-in-law* | *sister-in-law* e. g. $(X\bar{X})(\bar{X}Y)$ is "brother's wife"
$x\bar{x}\bar{x}\bar{x}$	*great nephew* | *great niece*
$\bar{x}xxx$	*kintermless*
$\bar{x}xx\bar{x}$	*brother-in-law* | *sister-in-law* e. g. $(\bar{X}Y)(X\bar{X})$ is "wife's sibling"
$\bar{x}x\bar{x}x$	*kintermless* e. g. $(\bar{Y}X)(\bar{X}Y)$ is "husband's other wife"
$xx\bar{x}\bar{x}x$	*uncle* | *aunt* (i. e. spouse of parent's sibling)
⋮	⋮

CHAPTER VI

Generation Patterns for Kinterms

6.1 Formation of strings from chains. Equivalence-rules and coverset-coincidences cannot take into account recurrences of kinterms within a given coverset. These "internal" recurrences can be of many kinds. For example, the English kinterm *brother* applies equally well to elder and younger brother, in contrast to the Murngin *wawa* (elder brother) and *yukiyuko* (younger brother), or again the English kinterms *son* | *daughter* may be used equally well by male and female speakers, in contrast to the Murngin *gatu* (child of a male speaker) and *waku* (child of a female speaker). To take care of all such cases we form strings from chains by adding the subsidiary letters μ, ϕ, *e*, *y*, as follows.

The Greek letters μ and ϕ (mu for male and phi for female) are prefixed to chains beginning with X or Y to indicate sex of the speaker and suffixed to chains ending in $\bar{X}$ or $\bar{Y}$ to indicate sex of the referent. An *e* or *y* inserted before final μ or ϕ, or in final position if there is no final μ or ϕ, indicates that alter is respectively older or younger than ego, and *e* or *y* before J indicates an older or younger sibling, whether of ego or of a linking relative. Thus $\mu YJ\bar{X}y\phi$=male speaker's MBD younger than ego, $YJ\bar{X}y$=matrilateral cousin of either sex, younger than ego, $YeJ\bar{X}\phi$=daughter of ego's mother's elder brother, $\mu eJ\phi$=male speaker's elder sister, ϕyJ= female speaker's younger sibling, etc.

Then α stands for either μ or ϕ, and *a* for either *e* or *y*, and the diacritical marks ˆ, ˇ, ´, ` written over the ambiguous letters A, $\bar{A}$ and α, describe relative sex, in the same way as in the informal notation (2.1), e.g. $\hat{A}J\check{\bar{A}}$ means either $XJ\bar{Y}$ or $YJ\bar{X}$, namely "cross-cousin", $\hat{A}J\hat{\bar{A}}$ means parallel cousin, either $XJ\bar{X}$ or $YJ\bar{Y}$, and $\hat{\alpha}\check{A}J\hat{\bar{A}}\check{\alpha}$ means either "male speaker's

MBD" or "female speaker's FZS", i. e. opposite-sex cross-cousin, matrilateral for male speaker and patrilateral for female, a common type of prescribed marriage partner.

6. 2 String coincidence. A string or chain that can be obtained from a given string S_0 by deleting some or all of the subsidiary letters in S_0 is said to be **imbedded** in S_0. In particular, every string contains exactly one imbedded chain, obtained by deleting all its subsidiary letters. Thus the chain J$\bar{X}$ (BC) is imbedded in the string J$\bar{X}\phi$ (BD) or in μJ$\bar{X}$ (μBC) or in μJ$\bar{X}\phi$ (μBD), etc. A string is called **lineal, collateral**, etc., according as its imbedded chain is lineal, collateral, etc., and is said to be **maximal** if it has subsidiary letters in every possible position. For example, *e*Jϕ (elder sister) and μeJ (male speaker's elder brother | sister) are non-maximal strings, since *e*Jϕ can be imbedded in either of the maximal strings μeJϕ or ϕeJϕ, and μeJ in either μeJμ or μeJϕ. By the principle stated in 2. 9, the coverset of a maximal string cannot consist of more than one kinterm.

Ego is said to be **linked** to alter by the string S if ego and alter are linked (3. 6) by the chain imbedded in S and satisfy the conditions indicated by the subsidiary letters., e. g. a male speaker is linked to his elder brother by the chain μeJμ. The terms "coverset" etc. for chains can be immedately extended to strings; e. g., the **coverset** of a string is the set of kinterms (perhaps consisting of the single term *kintermless* cf. 3.6), applicable to relatives to whom ego is linked by the given string. Thus the English coverset for the string μXJ is *uncle* | *aunt*, but for XJϕ, X*e*Jϕ, X*y*Jϕ, μXJϕ or μX*e*Jϕ it is *aunt* alone, and in general, the coverset of any non-maximal string, or of any chain, consists of the kinterms corresponding to all the maximal chains in which the given string or chain can be imbedded. For example, in Tamil (10. 1), which has the four kinterms *eb*, *ez*, *yb*, *yz* for sibling, the *eb* stands for $\mu eb + \phi eb$, and *e* alone stands for $\mu eb + \phi eb + \mu ez + \phi ez$. When two strings S and S' have the same coverset, they are said to be **coincident,** in symbols $S \approx S'$. The chain-equivalence XXJ$\bar{X}$∼XYJ$\bar{X}$ states that either of these two chains can be substituted for the other in any longer chain, but the chain-coincidence XXJ$\bar{X}$≈XJ$\bar{X}\bar{X}$ or the string-coincidence XXJ$\bar{X}\mu$≈XJ$\bar{X}\bar{X}\mu$ states nothing about substitutability in longer chains or strings. For strings there is no concept corresponding to the equivalence of chains.

6. 3 Final description of the English system. The description of the English system given in 4. 8 can now be completed by listing its string-coincidences, namely:

i) $K\mu \sim K\phi$ for ablineal chains K,
   i. e., cousin terms never distinguish sex of the referent;

ii) $e \sim y$,
   i. e., kinterms are never distinguished by relative age;

iii) $\mu \cdots \sim \phi \cdots$,
   i. e., kinterms are never distinguished by sex of the speaker.

6. 4 Generation patterns. Other languages will have string-coincidences that differ from English, often in rather surprising ways. In this chapter we give a fairly exhaustive account of them largely on the basis of information in Murdock [1970] and Gifford [1922].

Our purpose is as follows. More than 1,000 kinship terminologies are now known in detail. Yet the information about them is scattered throughout many publications in diverse and inconvenient form. What is needed is a concise catalog, distributing the kinship systems into types, subtypes, etc. We have already arranged for distribution into types by means of equivalence-rules for chains. But the diversity of string-coincidences is so great that distributions into subtypes will be an awkward task unless we systematize the string-patterns in some suitable manner. To do this we consider patterns separately in the five central generations G_0, $G_{\pm 1}$, $G_{\pm 2}$, beginning with sibling patterns in G_0 (6. 5 and 23. 1), and continuing with (*father*) *uncle* | *aunt* (*mother*) patterns in G_1 (6. 6), with (*son*) *nephew* | *niece* (*daughter*) patterns in G_{-1} (6. 7), with grandkin patterns in the two generations $G_{\pm 2}$ (6. 8), and ending with cousin-patterns in 6. 9. The patterns in each of the six diagrams (Figures 6. 5d, 6. 6b, 6. 7a, 6. 7d, 6. 8, 6. 9) are numbered for later reference. Then for a complete description of the kinterm-recurrences of a given system, it is only necessary to give the equivalence-rules and the generation-patterns. For example, the English system is described by

$$x=y,\ \bar{x}=\bar{y},\ 3,\ [3],\ 1\ (f,\ m),\ 5\ (s,\ d),\ 2\ (pf,\ pm),\ 2\ (cs,\ cd).$$

Here $x=y$, $\bar{x}=\bar{y}$, are the equivalence-rules.

The first 3 states that the English sibling-pattern $b \mid z$ is the one numbered 3 in Figure 6. 5d, Table 23. 15a. The [3] states that the English cousin-pattern is the one numbered 3 in 6. 9, where the square brackets indicate that for many kinship systems the equivalence-rules themselves will indicate how cousins are to be treated; e. g., in the generational type in Chapter Seven it is already clear from the equivalence-rules that (non-removed) cousins go by the same kinterms as siblings, so that there is no need for a special entry to indicate the cousin-pattern (cf. 6. 9).

Then the 1 indicates the $pb \mid pz$ pattern no. 1 in G_1, while the (f, m) show that in English there are special lineal terms for father and mother; and in the same way the 5 indicates the $js \mid jd$ pattern no. 5 in G_{-1}, again with special lineal terms for son and daughter.

Finally, the 2 (pf, pm) and 2 (cs, cd) show the grandkin patterns in G_2 and G_{-2}, again with special terms.

6. 5 Sibling patterns. In writing the eight maximal strings $\mu e J \mu$, $\mu e J \phi$, $\cdots$, $\phi y J \phi$ it is often convenient to omit the J itself, i. e. to write

$$\mu e \mu,\ \mu e \phi,\ \mu y \mu,\ \mu y \phi,\ \phi e \mu,\ \phi e \phi,\ \phi y \mu,\ \phi y \phi,$$

with corresponding glosses

$$\mu eb,\ \mu ez,\ \mu yb,\ \mu yz,\ \phi eb,\ \phi ez,\ \phi yb,\ \phi yz.$$

These eight strings or their glosses can be arranged as in Figure 6. 5d, where male speaker is separated from female by a double vertical line, elder person from younger by a horizontal (replaced in running text by a diagonal slash), e. g. eb/ yb, and male referent from female by a single vertical line:

J:

$\mu e \mu$	$\mu e \phi$	$\phi e \mu$	$\phi e \phi$
$\mu y \mu$	$\mu y \phi$	$\phi y \mu$	$\phi y \phi$

Figure 6. 5a Strings for the sibling chain J.

When kinterm distinctions depend on the sex of the speaker it is often not the speaker's sex in itself that is important but the relative sex of speaker and referent: e. g. in the Omaha system of the Fox Indians in Iowa two brothers or two sisters call each other *netotam* (same-sex sibling), whereas a male calls his sister *netegwam* (opposite-sex sister) and a female calls her brother *netawam* (opposite-sex brother). Using the Greek letter $\pi = pi$ (parallel) to mean that the speaker is of the same sex as the referent, and similarly $\chi = chi$ (cross) for opposite sex, we may write the eight siblings as follows:

$$\pi e\mu,\ \chi e\mu,\ \pi y\mu,\ \chi y\mu,\ \chi e\phi,\ \pi e\phi,\ \chi y\phi,\ \pi y\phi.$$

These eight strings for siblings or their glosses $\pi eb, \cdots, \pi yz$, may be arranged as in Figure 6. 5b, where same-sex (i. e., of speaker and referent) is separated from opposite sex by a wavy vertical line:

J:

$\pi e\mu$	$\pi e\phi$	$\chi e\mu$	$\chi e\phi$
$\pi y\mu$	$\pi y\phi$	$\chi y\mu$	$\chi y\phi$

Figure 6. 5b J in parallel-cross notation.

The number of distinct kinterms for sibling may vary from one to eight, as illustrated by the examples in Figure 6.5c.

These eight examples have been taken from the approximately complete set of sibling patterns, numbered from 1 to 52 in Figure 6. 5d (cf. Table 23. 15a).

6. 6 Patterns in G_1; kinterm reciprocity. In generation G_1 the minimum number of kinterms is two—e. g., *nama* | *naina* in Taromak-Rukai (11. 10)—since so far as we know *uncle* is always distinguished from *aunt*, even though in some tribes, e. g. the Coast Yuki in California, father and mother are combined into the one term *parent*. On the other hand, the maximum number is ten, since there may be eight *uncle* | *aunt* terms, distinguished by sex of referent, age relative to ego's linking parent, and father's or mother's side, and it may also happen that father is distinguished from paternal

Name	Pattern	Number of Kinterms	Reference numbers in Figure 6. 5d
Mbuti	j	one	1
Fox	$\pi \} \chi$	two	2
Algonkian	$e\mu \mid e\phi$ / y	three	13
Tamil	$eb \mid ez$ / $yb \mid yz$	four	24
Komba	$\mu eb \} \phi eb \mid ez$ / $yb \mid yz$	five	37
Caddoan	$\frac{\mu eb}{\mu yb} \} \chi b \mid \frac{\phi ez}{\phi yz} \} \chi z$	six	43
Assiniboine	$\frac{\pi eb}{\pi yb} \} \chi b \mid \frac{\phi ez}{\phi yz} \} \frac{\mu ez}{\mu yz}$	seven	48
Ogalalla	$\frac{\mu eb}{\mu yb} \} \frac{\phi eb}{\phi yb} \mid \frac{\phi ez}{\phi yz} \} \frac{\mu ez}{\mu yz}$	eight	52

Figure 6. 5c Examples of sibling patterns.

uncle and mother from maternal aunt. For example, the Wappo Indians in California have the G_1-pattern shown in Figure 6. 6a, where as usual the special lineal terms are given in parentheses:

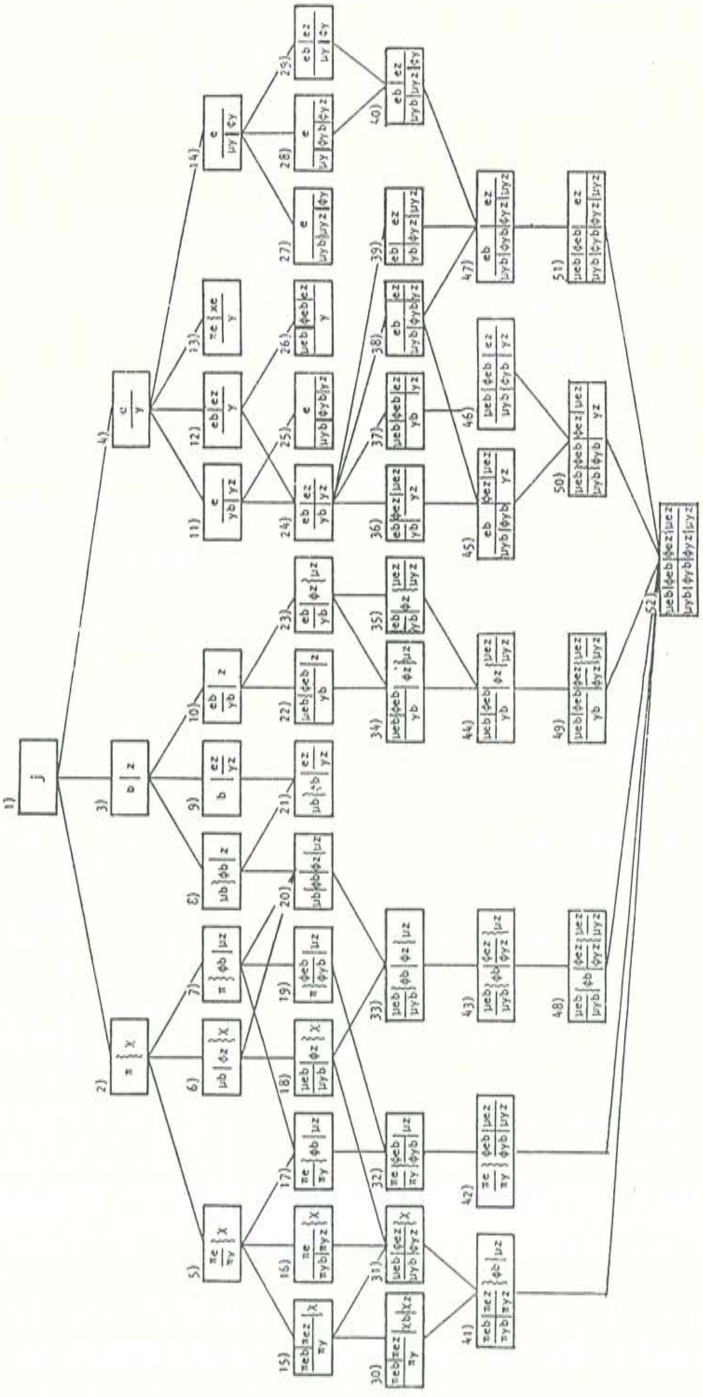


Figure 6.5 d Sibling patterns

<table>
<tr><td></td><td>JX</td><td></td><td>JY</td><td></td></tr>
<tr><td>(f)</td><td>feb | fez
fyb | fyz</td><td></td><td>meb | mez
myb | myz</td><td>(m)</td></tr>
</table>

f=*aiya*	*m*=*naa*
feb=*oca*	*meb*=*awa*
fez=*boa*	*mez*=*paha*
fyb=*olo*	*myb*=*taa*
fyz=*etsa*	*myz*=*newa*

Figure 6. 6a G_1**-pattern for Wappo.**

Uncle-aunt patterns fall into six basic types, as in Table 6. 6.

Table 6. 6 ***Uncle-aunt*** **patterns**

<table>
<tr><th></th><th>Strings</th><th colspan="2">Glosses</th></tr>
<tr><td>α :</td><td>Aμ | Aφ</td><td>pb | pz</td><td></td></tr>
<tr><td>aα :</td><td>Aeμ | Aeφ
Ayμ | Ayφ</td><td>peb | pez
pyb | pyz</td><td></td></tr>
<tr><td>Aα :</td><td>Xμ, Xφ, Yμ, Yφ</td><td>pf | fz</td><td>mb | mz</td></tr>
<tr><td>πa,X :</td><td>Xeμ, Xyμ, Yeφ, Yyφ, Xφ, Yμ</td><td>feb
fyb | fz</td><td>mb | mez
myz</td></tr>
<tr><td>π,αX :</td><td>Xμ, Yφ, Xeφ, Xyφ, Yeμ, Yyμ</td><td>fb | μfz ‖ φfz</td><td>μmb ‖ φmb | mz</td></tr>
<tr><td>Aaα :</td><td>Xeμ, Xeφ, Xyμ, Xyφ
Yeμ, Yeφ, Yyμ, Yyφ</td><td>feb | fez
fyb | fyz</td><td>meb | mez
myb | myz</td></tr>
</table>

There are also two subpatterns for Pattern 6:

6a) father's side and mother's side are distinguished only for parent's siblings younger than the linking parent, so that pattern 6a) has only six kinterms, since *feb* and *meb* are both *peb*, and *fez*, *mez* are both *pez*.

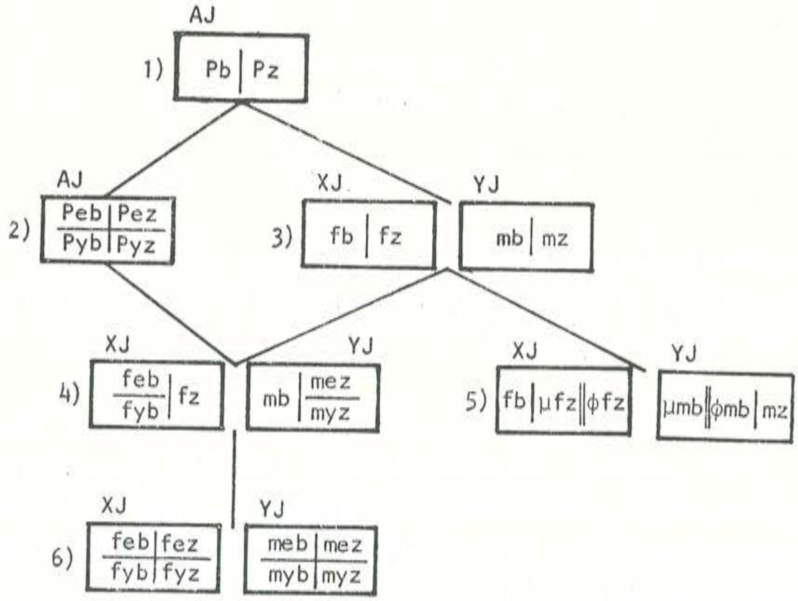


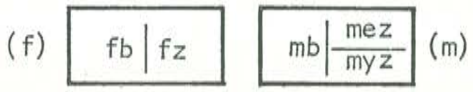
Figure 6. 6b Hierarchy of uncle-aunt patterns.

6b) relative age is not distinguished on the mother's side, so that *mez* and *myz* both become *mz* and pattern 6b) has only seven kinterms.

Further variety is introduced by the fact that uncles may be taken from one pattern and aunts from another, as follows:

Uncles from pattern	Aunts from pattern
1)	3), 4), 5) or 6)
2)	1)
3)	1), 4) or 5)
4)	1), 2), 3) or 6)
5)	1) or 3)
6)	2) or 4)

When the *uncle*-pattern for a given system is different from its *aunt*-pattern we give them both, connected by the word "and". For example, the Plains Miwok tribe has:



with

$$\begin{array}{rcl} f \mid m & = & appa \mid uka \\ fb \mid fz & = & tata \mid ene \\ mb \left| \begin{array}{c} mez \\ myz \end{array} \right. & = & kaka \left| \begin{array}{c} tomu \\ tete \end{array} \right. \end{array}$$

which we describe by writing "3(f) and 4(m)".

In Figure 6. 6b we have arranged the *uncle-aunt* patterns in a hierarchy to suggest their possible evolution.

6. 7 Patterns in G_{-1}. The coversets for the nephew-niece chains J$\bar{X}$ and J$\bar{Y}$ are of particular historical interest because Morgan (8. 1) found them puzzling for the Seneca and Tamil systems. In English they take the simple form (Figure 6. 7a) that all nephews and nieces are terminologically distinguished from sons and daughters.

J$\bar{A}$ (s) [js | jd] (d)

js=nephew, *s=son,*
jd=niece, *d=daughter.*

Figure 6. 7a Glosses for the chains J$\bar{X}$ and J$\bar{Y}$ in English.

In the Seneca system, as in many others, ego's parallel nephews and nieces (μJ$\bar{X}$ and ϕJ$\bar{Y}$) are identified with ego's sons and daughters, but cross nephews and nieces (ϕJ$\bar{X}$ and μJ$\bar{Y}$) are distinguished from them as in Figure 6.7b.

coverset for J$\bar{X}$ coverset for J$\bar{Y}$

[$s \mid d \parallel \phi\check{j}s \mid \phi\check{j}d$] [$\mu\check{j}s \mid \mu\check{j}d \parallel s \mid d$]

$s \mid d$ = *haahwuk | kaahwuk*
$\mu\check{j}s \mid \mu\check{j}d \parallel \phi\check{j}s \mid \phi\check{j}d$ = *hayawanda | kayawanda || hasoneh | kasoneph*

Figure 6. 7b Glosses for J$\bar{X}$ and J$\bar{Y}$ in Seneca.

For the Tamils in South India (Figure 6. 7c) the coversets for $J\bar{X}$ and $J\bar{Y}$ correspond to those for Seneca-Iroquois except that no distinction is made between *μǰs | μǰd* and *φǰs | φǰd.*

coverset for $J\bar{X}$	coverset for $J\bar{Y}$
s | d ‖ ǰs | ǰd	ǰs | ǰd ‖ s | d

s | d =makan | makal
ǰs | ǰd=marumakan | marumakal

Figure 6. 7c Glosses for $J\bar{X}$ and $J\bar{Y}$ in Tamil.

Here it is to be noted that two kinchains are not said to have the same coverset unless the same kinterms appear in the same order. Thus $J\bar{X}$ and $J\bar{Y}$ are coverset-equal in English because they have the same set of two kinterms *nephew | niece* arranged in the same order; but $J\bar{X}$ and $J\bar{Y}$ are not coverset-equal in Tamil, even though they have the same set of kinterms *s, d, ǰs, ǰd*. For when these terms are arranged in standard order, i. e., first by sex of speaker, then by relative age, and then by sex of referent, with *μ* before *φ* and *e* before *y*, they appear in the order *s, d, ǰs, ǰd* for $J\bar{X}$ and in the order *ǰs, ǰd, s, d* for $J\bar{Y}$.

Unfortunately, the field-worker's information for *nephew | niece* patterns is often presented to us only from the point of view of a male speaker, as in our Figure 6. 7d, so that we are sometimes left in doubt as to just how the G_{-1} pattern runs for a given system. In the case of kinterm-reciprocity with G_1 we simply write the letter "r" for G_{-1}.

6. 8 Grandkin patterns. Here again there may be special lineal kinterms, e. g. *ff* may differ from *ffb*, as in English or in the Lower Burma system (7. 7) and reciprocally *cc* may differ from *bcc*, but this situation is less common in $G_{\pm 2}$ than in $G_{\pm 1}$.

In $G_{\pm 2}$ self-reciprocal patterns are almost as in $G_{\pm 1}$. Thus *gf* (AX) is often distinguished from *gfb* (AXJμ) or *gm* (AY) from *gmz* (AYJϕ), and therefore by reciprocity *μcc* ($\bar{X}\bar{A}$) from μBCC ($\mu J\bar{X}\bar{A}$) and *φcc* ($\bar{Y}\bar{A}$) from *φzcc* ($\phi J\bar{Y}\bar{A}$). For example, the Serrano Indians have the five $G_{\pm 2}$-kinterms:

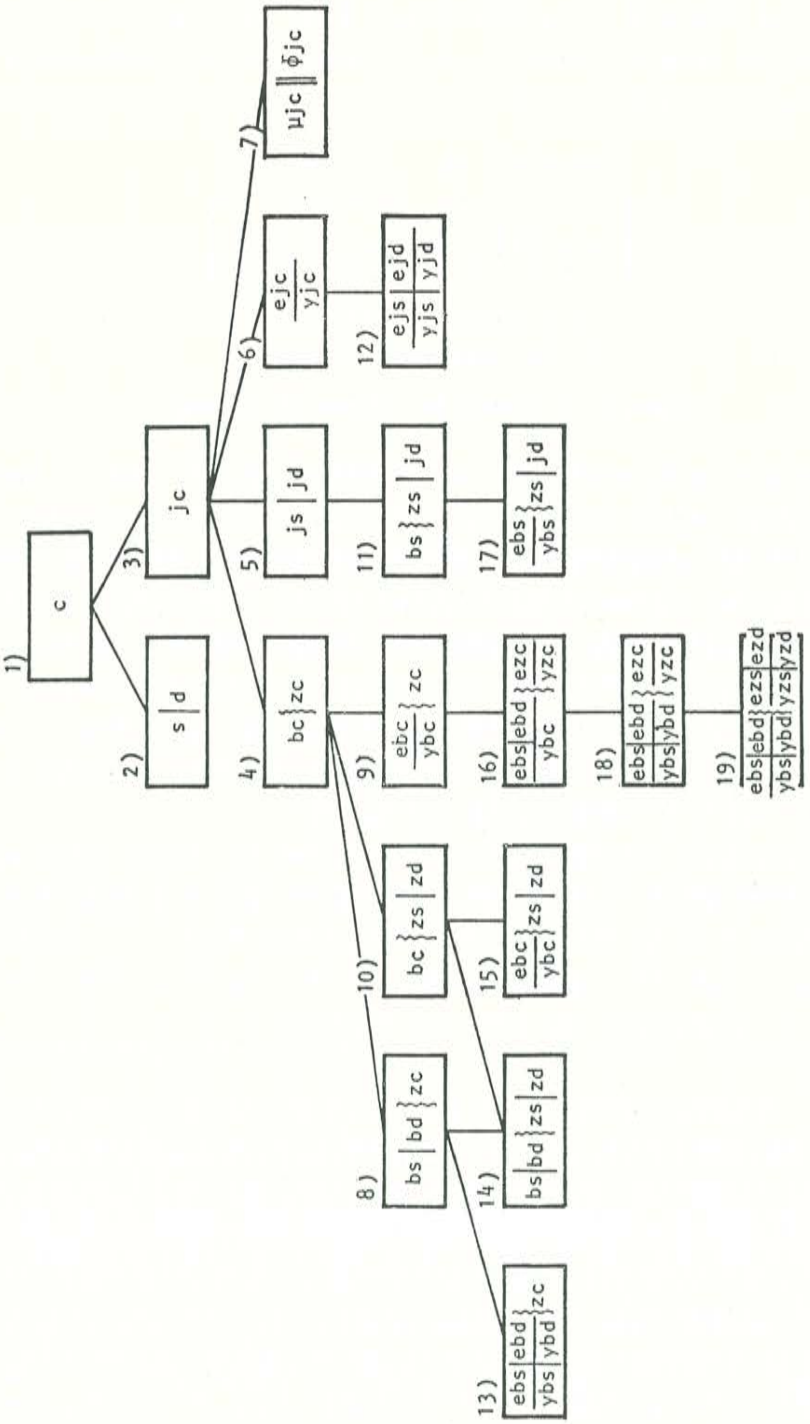
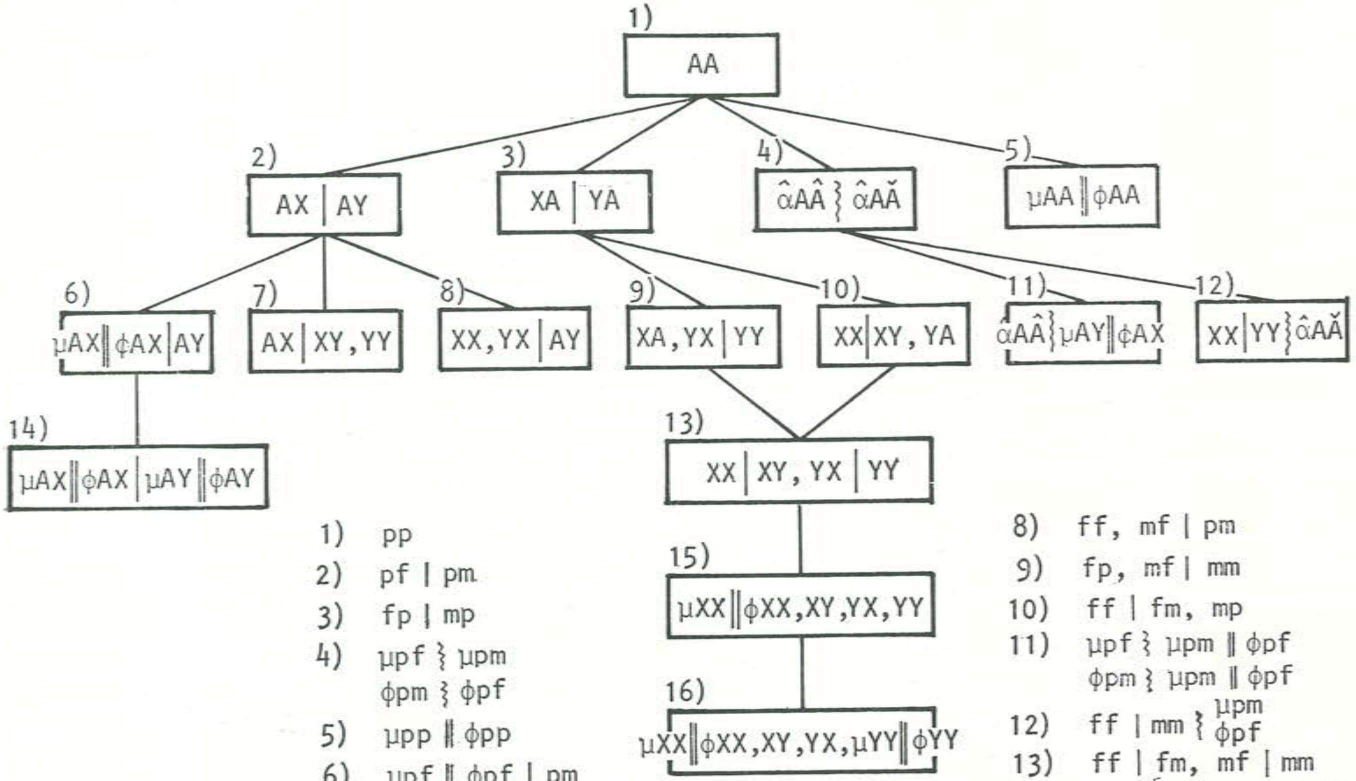


Figure 6. 7d Nephew-niece patterns



1) pp
2) pf | pm
3) fp | mp
4) μpf } μpm
ϕpm } ϕpf
5) μpp ‖ ϕpp
6) μpf ‖ ϕpf | pm
7) pf | fm, mm
8) ff, mf | pm
9) fp, mf | mm
10) ff | fm, mp
11) μpf } μpm ‖ ϕpf
ϕpm } μpm ‖ ϕpf
12) ff | mm } μpm ϕpf
13) ff | fm, mf | mm
14) μpf ‖ ϕpf | μpm ‖ ϕpm
15) μff ‖ ϕff, fm, mf, mm
16) μff ‖ ϕff, fm, mf, μmm ‖ ϕmm

Figure 6. 8a Grandparent patterns.

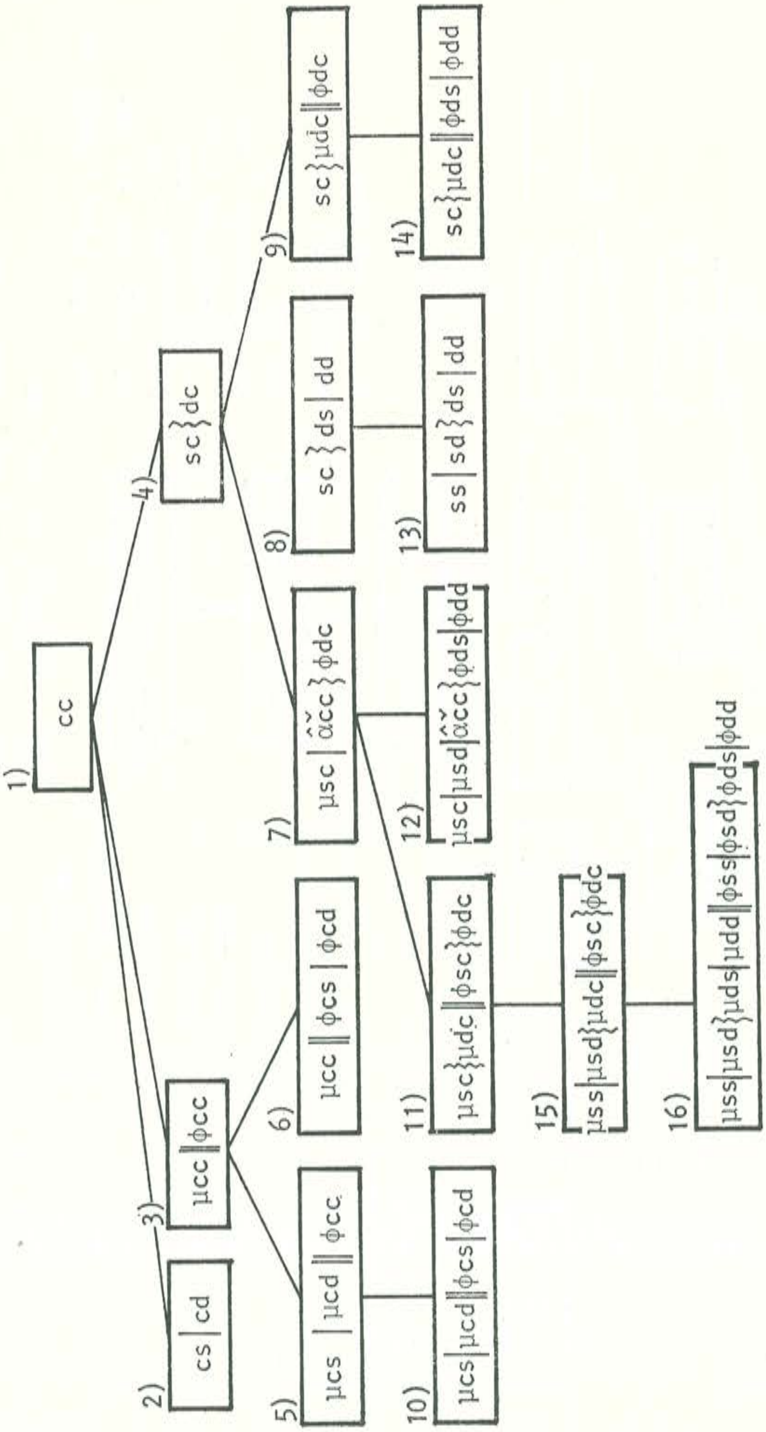


Figure 6. 8b Grandchild patterns.

ka:	*fp* = *ffb* = *fmz* = (reciprocally) *sc* = *μbsc* = *φzsc*
	XA∼XXJμ∼XYJφ∼(reciprocally) $\bar{A}\bar{X}$∼μJ$\bar{X}\bar{X}$∼φJ$\bar{Y}\bar{X}$
tcur:	*mm* = *mmz* = *φdc* = *φzdc*
	YY∼YYJφ∼$\bar{Y}\bar{Y}$∼φJ$\bar{Y}\bar{Y}$
prundj:	*pmb* = *μzcc*
	AYJμ∼μJ$\bar{Y}\bar{A}$
kwat:	*mf* = *mfb* = *μdc* = *μbdc*
	YX∼YXJμ∼$\bar{X}\bar{Y}$∼μJ$\bar{X}\bar{Y}$
pindj:	*pfb* = *φbcc*
	AXJφ∼φJ$\bar{X}\bar{A}$

6.9 Cousin patterns. Finally let us give a brief discussion of *cousin* patterns, which we have postponed until now because many systems have no special *cousin* terms at all (see the remark at the end of 6.4). For example, in the generational systems in Chapter Seven cousins are equated with siblings, and in the Crow-Omaha types in Chapter Twelve they are equated with relatives in higher or lower generations.

With respect to first cousins, there are five basic kinds of terminology:

1) GENERATIONAL: i.e., *crco*=*prco*=sibling; e.g. in Taromak-Rukai they are all called *taka* if male and *aki* female.

2) IROQUOIS: *crco*≠*prco*=sibling; e.g., among the Mbuti pygmies in Zaire cross-cousins are *sono* but parallel cousins and siblings are *namami*.

Under this heading 2) let us note the eight patterns shown in Figure 6.9a.

3) ENGLISH: *crco*=*prco*≠sibling.

4) DESCRIPTIVE: in some languages the eight kinds of first cousins, irrespective of sex of speaker, are distinguished from one another by kinterms which simply describe their relationship to ego; e.g. FBS is called father's-brother's-son. A notable example is furnished by Sanskrit, the ancient classical language of northern India, where we have:

fbs=*fbd*=*pitroyaputra* (*f*=*pita*, *fb*=*pitroya*, *s*=*d*=*putra*)
mbs=*matulaputra*, (*m*=*mata*, *mb*=*matula*) etc.
mbd=*matulaputri*.

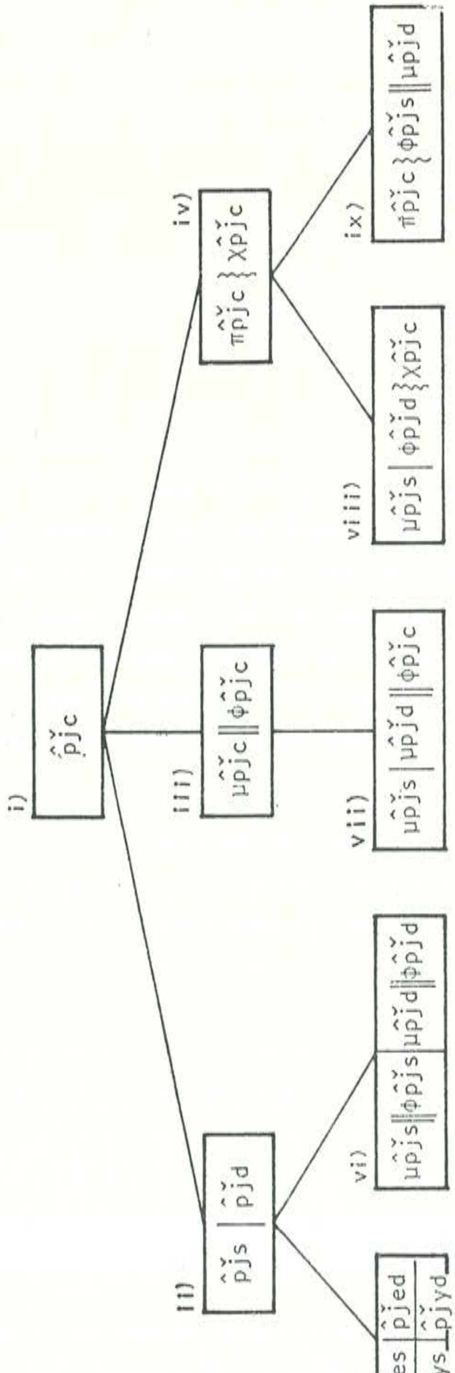


Figure 6.9 Cross-cousin patterns.

Such terminologies were called "descriptive" by Morgan (8. 2).

5) SUDANESE: siblings, parallel cousins, and cross-cousins, both patrilateral and matrilateral are distinguished from one another by kinterms which are not obviously descriptive.

With this summary of actually occurring string patterns we are ready to begin our survey of non-sectional kinship systems.

CHAPTER VII

The Generational Type

7. 1 Yurok kinlist. The consanguineal and affinal kinterms for the Yurok Indians in northern California [Gifford 1922] are given in Tables 7. 1a and 7. 1b. Again, as in English, non-prescriptive marriage is suggested by the large number of special affinal terms with small consanguineal-affinal overlap, and again ego does not apply the kinterm for mother (*netseko*) to any collateral relative of ego's father (cf. 2. 6), and in the kingraph (Figure 7. 3) there is no collateral path from the X-box to the Y-box.

Table 7. 1a Yurok consanguineal kinlist

Chain or string	Kinterms	Field-worker's description	Gloss
Λ	*nepcepts* | *netseko*	father | mother	*f* | *m*
$\bar{\Lambda}$	*negnemem* | *nemehi*	son | daughter	*s* | *d*
$\mu J \mu$, $\mu A^n J \bar{A}^n \mu$ $n=1, 2, 3, \cdots$	*nepa*	male speaker's brother and non-removed male cousins	μb
$\phi J \mu$, $\phi A^n J \bar{A}^n \mu$	*nelai*	female speaker's brother and non-removed male cousins	ϕb
$\mu J \phi$, $\mu A^n J \bar{A}^n \phi$	*neweyits*	male speaker's sister and non-removed female cousins	μz
$\phi J \phi$, $\phi A^n J \bar{A}^n \phi$	*nelet*	female speaker's sister and non-removed female cousins	ϕz
$AJ\mu$	*netsim*	uncle	*pb*
$AJ\phi$	*netul*	aunt	*pz*
$J\bar{A}\mu$	*nektsum*	nephew	*js*
$J\bar{A}\phi$	*neramets*	niece	*jd*
AA	*nepits* | *nekuts*	grandfather | grandmother	*pf* | *pm*
$\bar{A}\bar{A}$	*nekapeu*	grandchild, sibling's grandchild	*cc*

Table 7. 1b Yurok affinal kinlist

Chain or string	Kinterm	Field-worker's description
V	*nenos* | *nepeu*	husband | wife
YV | XV	*nepareu* | *netsewim*	father-in-law | mother-in-law
$\bar{A}V$	*netsneu* | *nekep*	son-in-law | daughter-in-law
VJ	*netei* ‖ *netsna* | *netsuim*	spouse's brother | spouse's sister
$\hat{V}J\check{V}$ (i. e. HBW and WZH)	*netei* ‖ *netsuim*	spouse's same-sex sibling's spouse
YH | XW	*netsim* | *netul*	stepfather | stepmother
$V\bar{A}$	*nektsum* | *neramets*	stepson | stepdaughter
JJ	same as J (Table 7. 1a)	stepbrother | stepsister

7. 2 Yurok equivalence rules; merging systems. Since X and Y appear in the kinlists only as parts of A, J or V, Yurok has the non-bifurcate rule $X \sim Y$ characteristic of the English system, so that cross-cousins $XJ\bar{Y}$, $YJ\bar{X}$ are not distinguished from parallel cousins $XJ\bar{X}$, $YJ\bar{Y}$.

But then we notice a phenomenon quite foreign to English, namely that all (first non-removed) cousins are merged with siblings; e. g., $J \sim XJ\bar{X} = XX\bar{X}\bar{X} \sim XXJ\bar{X}\bar{X} = XXX\bar{X}\bar{X}\bar{X} \sim \cdots$. In other words J may be inserted or deleted at will without change of equivalence-class, a phenomenon expressed algebraically by the equivalence-rule $J \sim I$ and geometrically by the rule "in tracing out remain motionless for the chain J." A system with this rule is called a **merging** system. Thus the English system is non-bifurcate and non-merging, while the Yurok system is non-bifurcate and merging.

There are two apparent difficulties with the merging rule $J \sim I$. First it seems to assign the coverset *sibling* to ego himself, although nowhere in the world does ego call himself his own brother. But I is an auxiliary chain, so that like all other auxiliary chains it remains kintermless, regardless of the kinclass to which it may be assigned by equivalence-rules (cf. 3. 7).

Secondly, in generation G_1 the Yurok terminology has special lineal kinterms *nepcets* | *netseko* (father | mother) for the chains X, Y, $\bar{X}$, $\bar{Y}$, although by the rule $J \sim I$ they are equivalent to the collateral chains XJ, YJ, $X^2J\bar{X}$; $X^3J\bar{X}^2$, $\cdots$ (*netsim* | *netul*); and similarly in G_{-1} there are special lineal kinterms *negnemem* | *nemehi* (son | daughter) for the chains $\bar{X}$, $\bar{Y}$, although by the rule J~I they are equivalent to the collateral chains J$\bar{X}$, J$\bar{Y}$, XJ$\bar{X}^2$, X^2J$\bar{X}^3$ ... (*nektsum* | *neramets*). In fact, about half of all merging systems have one or more of these special lineal kinterms, which compel us to make a supplemental statement in the description of the system and to insert the lineal terms in parentheses in the kingraph. Thus for the Yurok system we write J~I except that X$\not\sim$XJ, Y$\not\sim$YJ, $\bar{X}\not\sim$J$\bar{X}$, $\bar{Y}\not\sim$J$\bar{Y}$ and in the kingraph (Figure 7. 3) we adjoin (*f*), (*m*) to the G_1-box and (*s*), (*m*) to the G_{-1}-box. For such kinclasses the phrase "focal chain" will be used to refer either to the lineal focus, e. g. X, or to the shortest collateral chain, e. g., XJ.

7. 3 Yurok kingraph; the name "generational". On the basis of the rules X~Y, J~I the Yurok consanguineal kingraph can be drawn as in Figure 7. 3. Since each generation consists of one kinclass, the system is called "generational".

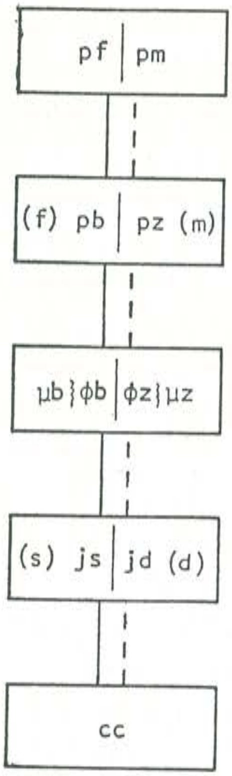


Figure 7. 3 Yurok consanguineal kingraph.

7.4 Description of the Yurok system; cut-off rules. Since the rules X∼Y, J∼I can change a lower turn only into another lower turn, no affinal chain can be equivalent to any consanguineal chain. Thus a complete description of Yurok must, as in English, include a specific list of the affinal chains that have a non-empty native coverset. Combining this list with the chain- and string-coincidences observable in the kinlist gives us the following description:

i) affinal chains with native coverset: (see Table 4.1b)
ii) equivalence-rules: X∼Y, J∼I except that $A \not\approx AJ$, $\bar{A} \not\approx J\bar{A}$.
iii) chain-coincidences: $A^2 \approx A^{2+n}$, $\bar{A}^2 \approx \bar{A}^{2+n}$; $AJV \approx AJ$, $VJ\bar{A} \approx J\bar{A}$.

Chain-coincidences of the form $A^2 \approx A^{2+n}$, $\bar{A}^2 \approx \bar{A}^{2+n}$ are called **cut-off rules** because they state that no new kinterms are introduced in the generations above G_2 or below G_{-2} (cf. 1.15). As for the string-coincidences, they can be stated in the alternative form, adopted from now on, of giving the generation-patterns (see Chapter Six). Thus the Yurok generation-patterns are:

20, 1 (*f*, *m*), 5 (*s*, *d*), 2, 1,

where there is no need to mention a cousin-pattern, since the equivalence-rules show that cousins are equated with siblings.

7.5 The Yurok system as a monoid. Since $y=x$ and $\bar{y}=\bar{x}$ in Yurok, this system also, like all non-bifurcate systems, is a monoid on two generators. Unlike the English system, however, the Yurok system is not the free monoid (5.4) but has the generating relation $x\bar{x}=i$. Consequently, the elements of the Yurok monoid (Table 7.5) are sequences of the form $\bar{x}\bar{x}\cdots\bar{x}xx\cdots x=\bar{x}^p x^q$, with $p, q=0. 1, 2, 3, \cdots$, since any pair of the form $x\bar{x}$ can be deleted.

Corresponding to the fact that special affinal kinterms must be specifically listed, the affinal kinterms in Table 7.5 are written with upper-case initial letters and put in square brackets. In any non-prescriptive system the affinal kinterms apply only to the focal-chains actually listed for them, whereas consanguineal kinterms apply to all chains in the kinclass. For

Table 7.5 The Yurok system as a monoid

Kinclass	
i	*b* | *z*
x	(*f*) *pb* | *pz* (*m*)
$\bar{x}$	*s* | *d*
xx	*pf* | *pm*
$\bar{x}x$	[H, W, VB | VZ, VJV]
$\bar{x}\bar{x}$	*cc*
xxx	*pf* | *pm*
$\bar{x}xx$	[*F-in-law* | *M-in-law*]
$\underline{x}\bar{x}x$	[*S-in-law* | *D-in-law*]
$\bar{x}\bar{x}\bar{x}$	*cc*
$xxxx$	*pf* | *pm*
$\bar{x}\bar{x}xx$	*kintermless*
⋮	⋮

example, the gloss *pb* | *pz* means that the native coverset ***netsim*** | ***netul*** applies not only to the focal chains XJ | YJ but also to all other chains $X^2J\bar{X}$, $Y^2J\bar{Y}$, $X^3J\bar{X}^2$, ⋯ equivalent to XJ and YJ; but the gloss *F-in-law* | *M-in-law* applies only to the chains VX | VY, not the longer chains VXJ, VYJ, ⋯; e. g., VX is ***nepareu*** (*F-in-law*) but VXJ is *kintermless.*

7.6 Reduction and expansion. The English equivalence-rules $X \sim Y$, $\bar{X} \sim \bar{Y}$ change neither the height nor the length of a chain, but in Yurok, with the additional rule $J \sim I$, every kinclass contains arbitrarily long chains. In such a case it is natural to ask:

i) given a long chain, how do we find its kinterm-coverset?

In particular, how do we find the kinterm for the product of two chains, say for ego's greatgrandmother's nephew?

ii) for a given coverset how do we find all the corresponding chains?

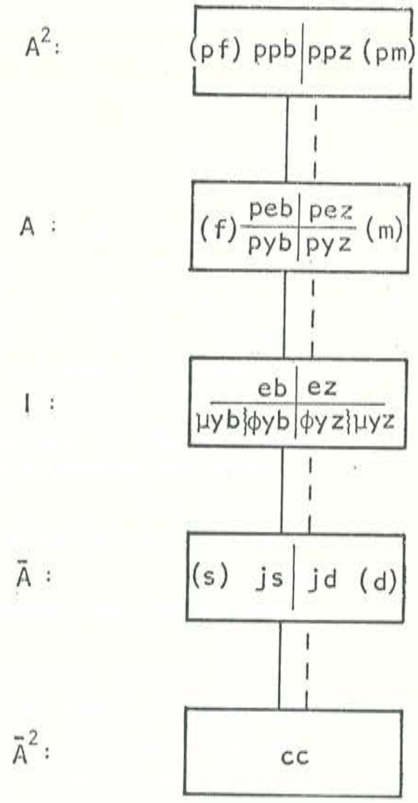
To answer question i) say for the chain $YXYX\bar{X}\bar{Y}$ (YXY=*greatgrandmother*, $X\bar{X}\bar{Y}$=*nephew* | *niece*) we may proceed either with the upper-case letters X, Y, $\bar{X}$, $\bar{Y}$ and equivalence-signs or with lower-case letters x, y, $\bar{x}$,

$\bar{y}$ and equality-signs. In the one case we first cancel $X\bar{X}$ and then $Y\bar{Y}$, obtaining $YXYX\bar{X}\bar{Y} \sim YXY\bar{Y} \sim YX$, so that YX is the desired leading focus, with the coverset *nepits* | *nekuts*. In the other case we obtain an element in the Yurok two-generator monoid by replacing matriletters (y and $\bar{y}$) with patriletters (x and $\bar{x}$), whereupon we have $xxxx\bar{x}\bar{x} = xxx\bar{x} = xx$, again with the coverset *nepits* | *nekuts* = *pf* | *pm* as listed in Table 7. 5. There are two reasons for introducing these lower-case letters and the corresponding monoid. First, they offer a direct way of comparing one kinship terminology with another; e. g., Yurok with English. Secondly, monoids are binary systems and the entire subject of pure algebra, with countless applications in many branches of science, can be defined as the theory of binary systems. So it is to be expected that our description of kinship terminologies as binary systems will be useful in the application of results from other sciences to the study of kinship.

As for question ii), all consanguineal chains with the coverset *nepits* | *nekuts* can be obtained by starting from the leading focus XX, inserting $X\bar{X}$ as often as desired and changing X to Y and $\bar{X}$ to $\bar{Y}$ wherever desired. The process of shortening down to the principal focus is called **reduction** and the reverse process is **expansion.**

7. 7 Lower Burma. Generational systems occur in many parts of the world. From the consanguineal kinlist for Lower Burma [Brant and Khaing 1951], we can construct the kingraph as in Figure 7. 7. The entire consanguineal system is then summed up by its equivalence-rules and generation-patterns.

7. 8 Twana. Another generational system is provided by the Twana Indians in the state of Washington [Gifford 1922]. As may be seen either from Table 7. 8 or Figure 7. 8, their system has two unusual features. First, distinct kinterms extend as far up and down as the fourth generation, with self-reciprocity or kinterms for $p^3 = c^3$ and $p^4 = c^4$. Secondly, among ego's younger siblings the sibling-pattern does not permit partition either by sex of referent, since $\phi yb = \phi yz$, or by sex of speaker, since $\mu yz = \phi yz$, or by relative sex of speaker and referent, since $\chi yj\ (\mu yz) = \pi yj\ (\phi yz)$.



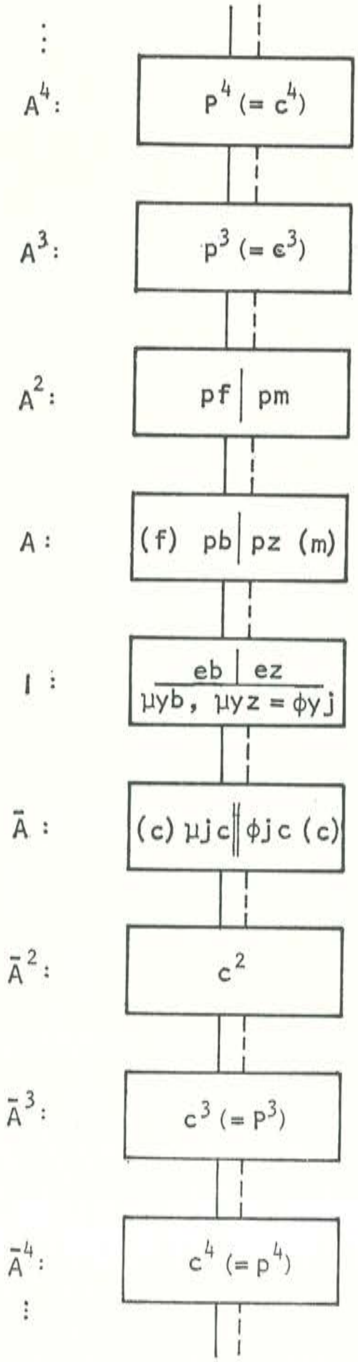
A^2	A	I	$\bar{A}$	$\bar{A}^2$
pf: *aphou*	*f*: *aphei*	*eb*: *akou*	*s*: *θa*	*cc*: *myi*
pm: *aphwa*	*m*: *amei*	*ez*: *ama*	*d*: *θami*	
ppb: *phoulei*	*peb*: *pharji*	*μyb*: *nyi*	*js*: *tu*	
ppz: *phwalei*	*pez*: *jiji*	*φyb*: *maun*	*jd*: *tuma*	
	pyb: *ulei*	*μyz*: *hnama*		
	pyz: *dolei*	*φyz*: *nyima*		

Generation patterns: 47, 2 (*f*, *m*), 5 (*s*, *d*), 2 (*ppb*, *ppz*), 1.

Figure 7.7 Lower Burma System.

Table 7. 8 Twana Consanguineal Kinlist

Strings	Native kinterms	Field-worker's description	Glosses
A	*bad* | *skoi*	father | mother	$f \mid m$
$\bar{\mathrm{A}}$	*bada*	child	c
$\mathrm{J}e\mu$, $\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^n e\mu$ $n=1, 2, 3, \cdots$	*tcat*	elder brother and elder non-removed male cousins, first, second, etc.	eb
$\mu\mathrm{J}y\mu$, $\mu\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^n y\mu$	*sukwai*	male speaker's younger brother and younger non-removed male cousins	yb
$\mu\mathrm{J}y\phi$, $\phi\mathrm{J}y$, $\mu\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^n y\phi$, $\phi\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^n y$	*alic*	male speaker's younger sister and younger non-removed female cousins female speaker's younger siblings and younger non-removed cousins	$\mu yz=\phi yj$
$\mathrm{J}e\phi$, $\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^n e\phi$	*tcac*	elder sister and elder non-removed female cousins	ez
$\mathrm{AJ}\mu$, $\mathrm{A}^{n+1}\mathrm{J}\bar{\mathrm{A}}^n\mu$	*kasi*	uncle and male cousins once-removed-up	pb
$\mathrm{AJ}\phi$, $\mathrm{A}^{n+1}\mathrm{J}\bar{\mathrm{A}}^n\phi$	*tcap*	aunt and female cousins once-removed-up	pz
$\mu\mathrm{J}\bar{\mathrm{A}}$, $\mu\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^{n+1}$	*slualac*	male speaker's nephew | niece and cousins once-removed-down	μjc
$\phi\mathrm{J}\bar{\mathrm{A}}$, $\phi\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^{n+1}$	*stalal*	female speaker's nephew | niece and cousins once-removed-down	ϕjc
AX, $\mathrm{A}^{n+2}\mathrm{J}\bar{\mathrm{A}}^n\mu$	*sila*	grandfather and male cousins twice-removed-up	pf
AY, $\mathrm{A}^{n+2}\mathrm{J}\bar{\mathrm{A}}_n\phi$	*kaya*	grandmother and female cousins twice-removed-up	pm
$\bar{\mathrm{A}}^2$, $\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^{n+2}$	*ibats*	grandchildren and cousins twice-removed-down	c^2
A^3, $\bar{\mathrm{A}}^3$, $\mathrm{A}^{n+3}\mathrm{J}\bar{\mathrm{A}}^n$, $\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^{n+3}$	*tcabaqw*	grandgrandparents and -children and all cousins three-times removed	$p^3=c^3$
A^q, $\bar{\mathrm{A}}^q$, $\mathrm{A}^{n+q}\mathrm{J}\bar{\mathrm{A}}^n$, $\mathrm{A}^n\mathrm{J}\bar{\mathrm{A}}^{n+q}$	*tsupiaqw*	greatgreatgrandparents and -children and all cousins four-times-removed	$p^4=c^4$



Generation patterns: 40 (irregular), 1 (*f*, *m*), 7, 2, 1.

Figure 7. 8 Twana Consanguineal Kingraph.

CHAPTER VIII

Morgan's Theories on Marriage and Terminology

8.1 Children of ego's cross-cousins in Seneca and Tamil. We have now examined one system (English) that is non-bifurcate and non-merging, and three (Yurok, Lower Burma, and Twana) that are non-bifurcate and merging. From now on all systems considered will be bifurcate-merging, i. e., they will have J$\sim$I but X$\not\sim$Y. We begin with two such systems, Seneca of Iroquois type in northeastern U. S. A. (Chapter Nine) and Tamil of Dravidian type in South India (Chapter Ten). These systems are of outstanding interest in the history of kinship theory because of Morgan's attitude toward them.

Although we shall find that in fact they are radically different from each other, Morgan considered them to be identical except for one detail, which he dismissed as puzzling but non-significant. It concerns the kinterms used by a male speaker for the children of his cross-cousins, about which Morgan writes (p. 482):

> ...among the Dravidian nations...of South India...all the children of my male cousins, myself a male, are my nephews and nieces; and all the children of my female cousins are my sons and daughters. ...In the Ganowanian [i. e., Amerindian] family this classification is reversed; the children of my male cousins, myself a male, are my sons and daughters, and of my female cousins are my nephews and nieces.

When Morgan speaks here of brothers and sisters he means all those relatives, e. g., parallel cousins, who go by the same kinterms as ego's own sons and daughters, and when he speaks of *cousin* he means only those cousins who go by different kinterms from sons and daughters, namely ego's cross-cousins. Similarly, when he speaks of sons and daughters, he includes all those relatives who go by the same kinterms as ego's own sons and daughters, e. g., ego's parallel nephews and nieces (children of ego's same-sex siblings), and when he speaks of nephews and nieces he means only those who go by different kinterms, namely children of ego's opposite-sex siblings. (Cf. our 2. 2 on the actual and classificatory convention.)

So in our terminology Morgan is stating that for Tamil:

$$\mu\hat{\mathrm{A}}\mathrm{J}\check{\bar{\mathrm{A}}}\bar{\mathrm{X}}\sim\mathrm{J}\bar{\mathrm{Y}}: \quad \mu\hat{p}\check{j}sc=\mu\check{j}s \mid \mu\check{j}d \qquad (\textit{marumakan} \mid \textit{marumakal}),$$

but

$$\mu\hat{\mathrm{A}}\mathrm{J}\check{\bar{\mathrm{A}}}\bar{\mathrm{Y}}\sim\bar{\mathrm{X}}: \quad \mu\hat{p}\check{j}dc= \ s \mid d \qquad (\textit{makan} \mid \textit{makal}),$$

whereas for Seneca:

$$\mu\hat{\mathrm{A}}\mathrm{J}\check{\bar{\mathrm{A}}}\bar{\mathrm{X}}\sim\bar{\mathrm{X}}: \quad \mu\hat{p}\check{j}sc= \ s \mid d \qquad (\textit{haahwuk} \mid \textit{kaahwuk}),$$

but

$$\mu\hat{\mathrm{A}}\mathrm{J}\check{\bar{\mathrm{A}}}\bar{\mathrm{Y}}\sim\mathrm{J}\bar{\mathrm{Y}}: \quad \mu\hat{p}\check{j}dc=\mu js \mid \mu jd \qquad (\textit{hayawanda} \mid \textit{kayawanda}).$$

This difference is dismissed by Morgan with the remark: "it is a singular fact that the deviation upon these relationships is the only one of any importance between the Tamil and the Seneca-Iroquois, which in all probability has a logical explanation of some kind." [For the explanation see 10. 3].

As will be seen in the next chapter, Morgan is far from correct in saying that this deviation is the only difference between Seneca and Tamil, and in fact on p. 390 he himself states: "it will be observed that in the Tamilian system [but not in Seneca] the terms for nephew and niece are used for son-in-law and daughter-in-law as well" (10. 5). But our present interest is to discover why he was so uncritically eager to argue that the two systems are identical.

Morgan believed that similarity in kinship terminology was a strong indication of common racial origin, and that his kinship tables therefore provided "a new instrument in ethnology". For this reason he was eager to prove the identity of Seneca and Tamil systems in view of "the great importance for the general history of mankind of establishing the Asiatic origin of the Ganowanian family". In an eloquent passage (p. 508) he writes:

> ...this conclusion...will furnish an additional illustration of the toilsome processes by which we strive to discover hidden truths when they lie open before us in the pathway upon which we tread. Although separated from each other by continents in space, and unnumbered ages in time, the Tamilian Indian of the Eastern hemisphere, and the Seneca Indian of the Western, as they severally address their kinsmen by the conventional relationships established in the primitive ages, daily proclaim their direct descent from a once common household. When the discoverers of the New World bestowed upon its inhabitants the name of Indians, under the impression that they had reached the Indies, they little suspected that children of the same original family, although upon a different continent, stood before them. By a singular coincidence error was truth.

Let us now examine the value of Morgan's evidence for this poignant conclusion.

8.2 Classificatory and descriptive terminologies. Morgan distinguishes two basic types of kinship terminology, to which he gives the names Classificatory and Descriptive. In essence, the difference between them lies in the presence (classificatory type) or absence (descriptive type) of the merging rule, but the concept "merging rule" is of later origin and Morgan defines the difference only in a rather vague way in terms of overlap between lineal and collateral lines. On p. 143 he writes:

> ...in the classificatory systems consanguinei are...arranged into great classes or categories...for example, my father's brother's son is my *brother*; ...the son of this collateral brother and the son of my own brother are both my *sons*...the principle of classification is carried to every person in the several collateral lines, near and remote, in such a manner as to include them all in the several great classes.

So the name "classificatory" is reasonable for Morgan's first type. But then the second type should go by some such name as "individualizing", since in English, for example, the term *father* refers only to one kintype, the term *uncle* to only two (FB and MB), etc. In other words, in a classificatory system the kinclasses are generally large and in a descriptive system they are small. Why then did Morgan use the name "descriptive" instead of say "individualizing"?

His choice of this name is determined, not by the recurrence of kintypes in large or small kinclasses, but by the linguistic form of the kinterms. For example, the English kinterm *grandmother* is descriptive of the corresponding relation in the sense that it consists of two parts, *grand* and *mother*, such that if we know the meaning of each part we can deduce the meaning of the whole term, whereas the Twana term *kaya* (grandmother) is a one-part word with no meaningful smaller parts that can themselves be independent words. For meaningful parts of this sort twentieth-century linguists have invented the term **lexeme**, defined by Webster as "a meaningful speech form that is part of the vocabulary of a language". Thus the word *grandmother* is bilexemic, but *kaya* is monolexemic. Similarly, Norwegian has bilexemic terms like *farbror* (father's brother) and old Erse, together with its attempted revival in present-day Ireland, is completely descriptive in the sense that all other kinterms are expressed by the lexemes for the six primary relations F, M, B, Z, S, D; e. g. *fb* is *drihar m'ahar* (brother of my father).

So Morgan divides kinship systems into two classes on the basis of two different logical principles, since "classificatory" refers to the manner of assembling kintypes into kinclasses and "descriptive" refers to the linguistic properties of the kinterms. Such a dichotomy would be acceptable, though logically displeasing, if all classificatory systems were in fact monolexemic and all individualizing systems were polylexemic. But in fact most individualizing systems, e. g. modern English, include several monolexemic terms like *uncle*, *aunt*, etc. in contrast to *grandfather*, *son-in-law*, *stepmother*, etc. Morgan explains such terms as later importations into an otherwise descriptive terminology; e. g. Old English does not have the terms *uncle* or *aunt*, which are borrowings through French from the Latin *avunculus* and *amita*. But there are too many "intrusions" of this sort, in too many different languages, to be due to mere borrowing. Consequently, Morgan's supposed dichotomy has now been abandoned.

8. 3 Morgan's theories on the history of marriage. Morgan accounted for his dichotomy of kinship terminologies by his theories about the history of marriage.

In Morgan's day thinkers in every field were greatly influenced by the publication in 1859 of Darwin's *Origin of Species.* For example, the philosopher Herbert Spencer, in his *Principles of Biology* (1864-67) and *Principles of Sociology* (1876-96), argued that evolution of every type began in a stage of "undifferentiated homogeneity" so that, in particular, human societies developed from "undifferentiated hordes". With his customary ebullient enthusiasm Morgan extended these ideas to the evolution of human marriage, which developed, according to Morgan, from a stage of undifferentiated sexual promiscuity with a correspondingly simple kinship terminology, consisting perhaps of the simple term *kinsman.*

In order to account for the generational system of kinship terminology he assumed a second state of "intermarriage between brothers and sisters", but not between parents and children, thus introducing the idea of a "generation". He argues (p. 483) that at this stage

> ...the children of my brothers are my children. Reason. I cohabit with all my brothers' wives... As it would be impossible to discriminate my children from those of my brothers, if I call any one my child I must call them all my children. One is as likely to be mine as another.

The third stage in kinship terminology, according to Morgan, is the "classificatory" system as in Seneca and Tamil, with $f=fb\neq mb$, i. e. with a distinction between father's side and mother's side, corresponding to a tribal organization into clans. To account for such a terminology Morgan assumed that growing awareness of the disadvantages of close intermarriage, e. g. the lack of defence alliances with other groups, led to a reformatory movement that broke up the intermarriages of brothers and sisters and thereby produced exogamous clans, since brothers and sisters are necessarily in the same clan, whether the clan is patrilineal or matrilineal.

This clan system was particularly suitable, Morgan says, for a stage of society in which vengeance for murder or other crimes was the responsibility not of the whole state, as in modern times, but of the clan, whose solidarity it was therefore desirable to perpetuate by retaining identical kinterms for father and uncle or sons and nephews, i. e. by creating a classificatory terminology.

Finally, the advance of civilization, with state justice and extensive private property, led to monogamous marriage, with two-parent families and a descriptive kinship terminology resulting from a desire to distinguish carefully between ego's direct heirs, i. e. his sons, and other male relatives in the generation below ego, e. g. ego's nephews.

Present-day anthropologists, however, consider that Morgan's evolutionary theories are quite wrong. The family is in fact older and much more widely distributed than the clan, and there is no correlation between the family system and advanced civilization, as measured say by property or food production, or by metallurgical and artistic skill. The basic argument against Morgan's theories is vividly stated by Lowie [1961, p. 58]:

> Morgan argues that the maternal uncles were called by the same name as the fathers because all **were** fathers in the sense of having free access to their sisters... The really fundamental error... lies in Morgan's assumption that a native term translated 'father' is synonymous in the native mind with 'procreator'. He cannot conceive that a Hawaiian could ever have called the maternal uncle 'father' unless at one time the uncle cohabited with his sister and was thus a possible procreator of her children. But this is to misunderstand the evidence, which does not teach us that the mother's brother is called father but that both mother's brother and father are designated by a **common term** not strictly corresponding to **any** in our language... His assumption leads to nonsensical consequences... the theory that all "fathers" are potential begetters involves the parallel that "mothers", whom a Hawaiian reckons up by dozens, are believed to have all conceived and borne him.

8. 4 Reasons for studying Morgan's work. At this point the reader may well ask: if Morgan's theories are so manifestly wrong, why have we described them at all? We have at least two reasons: first, all students of kinship eventually acquire a kind of filial piety towards Morgan. He is the original and still outstanding figure in their science, which he created suddenly and single-handedly, like Athena from the head of Zeus. His lists contain the longer collateral chains, like FFZD, that often cannot be found elsewhere and are nevertheless essential for an understanding for the structure of a given system. He was revered among the Seneca Indians, with whom he lived for extended periods, being honored in 1847 by membership in their Hawk clan and a suitable six-syllable name. His notable book *The League of the Iroquois* (1851) shows him to be an able and sympathetic observer of Amerindian institutions and customs. His list of the Seneca kinterms, collected by himself for more than 200 kintypes, is free of errors in contrast to similar lists obtained from informants in India and elsewhere, and it would be a great service to anthropology if his *Systems*... were to be published in re-arranged form (see e. g., 8. 6). As for his wide-ranging theories of marriage and social development, although they have been abandoned they have not been replaced by other theories of even remotely similar scope. His industry and enthusiasm, if not his boldness, remain an exemplar for his successors.

Our second reason is more practical. We wish to present the Seneca and Tamil systems side by side, just as Morgan did, not with his idea of emphasizing their similarities, but to make clear they are representatives of two fundamentally distinct types, Iroquois and Dravidian, which have been misunderstood for a century. With these motivations in mind, let us begin with a brief summary of Morgan's immense, six-hundred-page book *Systems of Consanguinity and Affinity in the Human Family.*

8. 5 Summary of Morgan's Systems... ; Linguistic questions. Morgan divides his book into three parts, labeled

Part I, Descriptive: Aryan, Semitic, Uralian
Part II, Classificatory: Ganowanian
Part III, Classificatory: Turanian and Malayan

Let us see why he chose these labels, beginning with the word "Aryan".

During the years 1846–1870, while Morgan was at work on his book, one of the great scientific achievements of the nineteenth century was reaching its peak, namely formulation of the relationship among the hundred-odd languages called Aryan, an achievement popularized by Müller [1861, 1863], whom Morgan frequently quoted. The situation may be summarized as follows.

About 2500 B. C. speakers of the original Aryan (or Indo-European) language began to spread from their original homeland, perhaps in south-central Russia, eastward into Persia and India, northward into the valley of the Volga, westward into central Europe, southward into the peninsulas of Greece and Italy, and elsewhere. In each case the invading language displaced the indigenous languages, and itself developed in various ways, becoming Sanskrit in India, Proto-Slavic in the Volga region, Proto-Germanic in central Europe, Greek and Latin in Greece and Italy, and so forth. Then at various later periods these daughter-languages produced grand-daughters, the modern Indo-European languages of India and Europe. Thus English, German, Dutch, etc. are daughters of Proto-Germanic; Italian, French, Spanish, etc. are daughters of Latin; Russian, Polish, Bulgarian, etc. are daughters of Proto-Slavic; and Hindi, Bengali, Gujarati, and Marathi in north and central India are daughters of Sanskrit. But the Dravidian (non-Aryan) languages, Tamil, Telegu, Kanarese, etc. in southern India remained relatively unaffected, except for importation of Sanskrit vocabulary. For the reasons discussed below, Morgan differed from the scientific linguists, both of his own time and of ours, in asserting that, like the Dravidian languages in the south, the four languages Hindi, Bengali, Gujarati, and Marathi in the north and central parts of India were non-Aryan in origin.

Morgan's kinlists in Part I begin with the four Semitic languages available to him, namely classical Hebrew, two forms of Arabic (one of them spoken by Lebanese Christians) and Aramaic. All four are of pronounced descriptive type.

Then follow thirty Indo-European languages, including English but not the four above-mentioned languages of north and central India, which Morgan puts appear in Part III (see below).

Under Uralian, the final heading in Part I, Morgan includes two forms of Turkish and three Ugrian languages: Hungarian, Finnish and Estonian. In putting the Turkish languages under this heading Morgan is in disagreement both with modern linguists, who call them Altaic, and with some of the linguists of his own day, who called them Turanian. Morgan himself says (p. 385) "so material an innovation upon the Turanian family... has not been made without hesitation and solicitude." His motive for the action, and the reason for his hesitation, are examined below under the heading Turanian.

The name Ganowanian for the languages in Part II was invented by Morgan himself, who explains (p. 131) that it is a compound from *Gano*, an arrow, and *Waano*, a bow, taken from the Seneca dialect of the Iroquois language and intended to include all the Amerindian languages. But modern linguists have divided these languages into at least five families and have therefore abandoned the term Ganowanian. Morgan gives the kinlists for 72 Amerindian languages, together with three Eskimo languages, which (again against modern practice) he calls Tungusian, remarking on the considerable independent evidence that the American Eskimos originally came from Asia. For the actual Tungusic languages in northern Asia, e. g. Manchurian and Evenki, Morgan was unable to obtain kinlists.

Part III, labeled Turanian and Malayan, itself has four parts; namely Chapters One through Three, Chapter Four, Chapter Five and Chapter Six. The second of these four parts, namely Chapter Four is called Unclassified Asiatic Nations and contains Burmese and the Karen languages of Burma. Chapter Five, called Malayan, includes six systems from the Pacific Islands, all of generational type. The final Chapter Six presents Morgan's general conclusions, applicable to the entire book. As for the first three chapters, they all have the label "Turanian", being devoted respectively to the Dravidian systems mentioned above (Tamil, Telegu and Kanarese), to the Indo-European languages available to Morgan from India, namely Hindi, Bengali, Gujarati, and Marathi, and finally, in Chapter Three, to the Chinese and Japanese systems. Morgan's statements in these three chapters are in disagreement with generally received opinion in many respects, two of which require our particular notice.

First, although it had already been proved, see e. g. Bopp [1833-1849,] that the four languages Hindi, Bengali, Gujarati, and Marathi are Aryan in origin, i. e. that they are descendants of Sanskrit, some of the missionaries from whom Morgan obtained his kinlists maintained the opposite view as late as 1870, at which time Morgan writes (p. 399):

> ...when the Sanskrit branch of the Aryan family entered India, the Sanskrit vocables [vocabulary] overwhelmed the primitive language to such an extent that Hindi and Bengali, and other dialects of this language... are

> still placed in the Aryan family of languages; although by the true criterion of classification, that of grammatical structure, they are not admissible into this connection since most oriental scholars concur [here Morgan misstates the case] in representing it [i.e., the grammatical structure] to be that of the aboriginal speech.

But modern opinion holds that by any valid criterion—and everyone agrees on the primacy of grammatical structure—Hindi, Bengali, etc. belong to the Aryan family. Why then did Morgan choose the wrong side in this debate?

The answer, see below, is the same as for a second question: why does Morgan's use of the word "Turanian" admit none of the languages (Tungusic, Mongolian, Turkic, Malayan) assigned to that heading by Müller, and also none of those assigned by modern scholars (namely, the languages spoken in the five Turkestan areas), and yet does contain a remarkable assortment of other languages, namely Dravidian, Indo-European (the four Hindi, Bengali, etc.), and (tentatively) Chinese and Japanese?

The answer to both questions lies in the fact that with the enthusiasm of a pioneer Morgan believes in a close connection between kinship terminology, on the one hand, and language-affiliation and social institutions, on the other. As we have seen above, he believes that a classificatory terminology implies an earlier stage in the evolution of marriage and must therefore precede a descriptive terminology. Descriptive languages can be descendants of classificatory ones but not vice versa. Hindi, Bengali, etc. are classificatory (9.6) but Sanskrit is descriptive. Consequently, Morgan sides with those missionaries who claim, mistaking the linguistic evidence, that Hindi, Bengali, etc. are not descended from Sanskrit but are pre-Aryan in origin. Similarly he asserts, this time correctly but for a wrong reason, that the Dravidian languages, with classificatory terminology, are not to be grouped with the Turkish languages, which have a descriptive terminology, although he expresses this opinion with considerable reluctance, since it involves disagreement with Müller, whose *Lectures on the Science of Language* he otherwise accepts as a guide.

But present-day anthropologists are much more cautious about accepting correlation between kinship terminology and social institutions or linguistic affiliations. Classificatory and descriptive terminologies are in any case vaguely defined, and nothing prevents either of them from developing toward the other.

8. 6 Explanation for the neglect of Morgan's lists. Lounsbury [1964a] expressed his surprise that Morgan's mistake of identifying the two basically different Iroquois and Dravidian types had gone unnoticed for almost a hundred years. The real principle operative in an Iroquois-type kinship system was discovered by Lounsbury on looking through Morgan's kinlists in 1954-55. He wrote [1079]: it was contrary to

> all of the expectations to which we had been led by the anthropological theoretical writings on the subject. It is surprising that the essential data pertinent to a subject about which so much has been written should have been in print and available to all for nearly a century without anyone's having taken account of the classification of any but the closest collateral kintypes. The classic theory predicts correctly only to the immediate (closest) uncles and aunts [FB, MB, FZ, MZ] and first cousins. Beyond this its predictions are half right and half wrong.
>
> There *do* exist systems which classify kintypes in the way that the Iroquois type was imagined to. These are the "Dravidian" type of systems. They are... founded... on a mode of reckoning... that, unlike the Iroquois, takes account of the sexes of all intervening links. The Dravidian and Iroquois types are rarely distinguished in anthropological literature, all passing under the label "Iroquois type". Actually, they are systems premised on very different principles of reckoning, and deriving from social structures that are fundamentally unlike.

There have been many reasons for this neglect of Morgan's lists. They are incomplete because of the difficulties of communication in his day; in particular, they do not include Africa (except for one tribe), Australia, South America, the Tungus peoples in northern Asia, or the Indian tribes in western United States, although subsequently California has become especially important for Amerindian kinship studies. Linguistic opinion has always been against many of Morgan's classifications of languages. His distinction between descriptive and classificatory systems and his consequent theories on the history of marriage have been discredited, and he neglects the effect of prescribed marriage on kinship teminology, thereby overlooking important differences between the Iroquois and Dravidian systems. But perhaps most important is the purely practical reason that in his desire to present all of his 139 systems together he has adopted an arrangement of the data that is extremely inconvenient for the study of any one system. For each of the 98 classificatory kinship systems in Parts II and III he lists 268 kintypes, always in prolix unabbreviated language, beginning with "my great grandfather's father" (A^2X^2), column 1, through such types as "my father's father's father's sister's daughter's daughter's daughter's daughter", male speaking, ($\mu X^3 J\bar{Y}^4 \phi$)", and ending with "twins" in column 268. Since there are only 34 Seneca kinterms altogether (19 consanguineal and 15 affinal), each kinterm occurs in several columns. For example, *haahwuk*= son, occurs in 17 columns ($\bar{A}\mu$, $\mu J\bar{X}\mu$, $\cdots$, $\phi Y^3 J\bar{Y}^4 \mu$, see 9.1), so that for our study of recurrences of the term *haahwuk*, we must painstakingly collect the data from all 17 columns. Finally, to indicate how Morgan might have profited from a more concise notation let us note that he buttresses his argument for the supposed identity of Seneca and Tamil with nine examples of the following kind:

> ...the relationship to each other of the daughter of the daughter of the daughter of a brother and the daughter of the daughter of the daughter of the brother's sister is the same in the two systems.

In our subsequent chapters let us try to make amends for this unfilial and costly neglect of Morgan's kinlists by removing some of its causes.

CHAPTER IX

The Iroquois Type

9. 1 Seneca consanguineal kinlist. Morgan's information about Seneca consanguineal kinterms in the five central generations can be arranged as in Table 9. 1a:

Table 9. 1a Seneca consanguineal kinterms from Morgan

Glosses		Native kinterms		Strings
$gf \mid gm$	:	*hocsote* $\mid$ *ocsote*	:	AX, AY, X^2J, Y^2J, $X^3J\bar{X}\mu$, $X^3J\bar{Y}\phi$, $Y^3J\bar{X}\mu$, $Y^3J\bar{Y}\phi$
$f \mid fz$	:	*hanih* $\mid$ *ahgahuc*	:	X, XJ, $X^2J\bar{X}\mu$, $X^2J\bar{Y}\phi$, $X^3J\bar{X}^2\mu$, $X^3J\bar{Y}^2\phi$
$mb \mid m$	:	*hocnoseh* $\mid$ *noyeh*	:	Y, YJ, $Y^2J\bar{X}\mu$, $Y^2J\bar{Y}\phi$, $Y^3J\bar{X}^2\mu$, $Y^3J\bar{Y}^2\phi$
$eb \mid ez$ / $yb \mid yz$	:	*haje* $\mid$ *ahje* / *haga* $\mid$ *kaga*	:	J, $XJ\bar{X}$, $YJ\bar{Y}$, $X^2J\bar{X}^2$, $Y^2J\bar{Y}^2$, $X^3J\bar{X}^3$, $Y^3J\bar{Y}^3$
$\hat{p}\check{j}c$		*ahgareseh*	:	$XJ\bar{Y}$, $YJ\bar{X}$, $X^2J\bar{Y}^2$, $Y^2[\bar{X}^2$, $X^3J\bar{Y}^3$, $Y^3J\bar{X}^3$
$s \mid d$		*haahwuk* $\mid$ *kaahwuk*	:	$\bar{A}$, $\mu J\bar{X}$, $\phi J\bar{Y}$, $\mu XJ\bar{X}^2$, $\phi XJ\bar{X}\bar{Y}$, $\mu XJ\bar{Y}\bar{X}$, $\phi XJ\bar{Y}^2$, $\mu Y\bar{X}^2$, $\phi YJ\bar{X}\bar{Y}$, $\mu YJ\bar{Y}\bar{X}$, $\phi YJ\bar{Y}^2$, $\mu X^2J\bar{X}^3$, $\phi X^2J\bar{Y}^3$, $\mu Y^2J\bar{X}^3$, $\phi YJ\bar{Y}^3$, $\mu X^3J\bar{X}^4$, $\mu Y^3J\bar{X}^4$, $\phi^3J\bar{Y}^4$
$\mu zs \mid \mu zd$	:	*hayawanda* $\mid$ *kayawanda*	:	$\mu J\bar{Y}$, $\mu XJ\bar{X}\bar{Y}$, $\mu XJ\bar{Y}^2$, $\mu YJ\bar{X}\bar{Y}$, $\mu YJ\bar{Y}^2$, $\mu X^2J\bar{Y}^3$, $\mu Y^2J\bar{Y}^3$
$\phi bs \mid \phi bd$	:	*hasoneh* $\mid$ *kasoneh*	:	$\phi J\bar{X}$, $\phi XJ\bar{X}^2$, $\phi XJ\bar{Y}\bar{X}$, $\phi YJ\bar{X}^2$, $\phi YJ\bar{Y}\bar{X}$, $\phi X^2J\bar{X}^3$, $\phi Y^2J\bar{X}^3$
$cs \mid cd$	:	*hayada* $\mid$ *kayada*	:	$\bar{A}^2$, $A\bar{A}^3$, $A^2\bar{A}^4$, $\cdots$

Here we have given only the kintypes actually listed by Morgan, but his incidental statements show that the entire consanguineal system can be described as Table 9. 1b.

Table 9. 1b Complete Seneca consanguineal system

<table>
<tr><th>Glosses</th><th>Native Kinterms</th><th>Kinstrings</th><th>Range</th></tr>
<tr><td>pf | pm</td><td>hocsote | ocsote</td><td>$A^{2+m+n}J\bar{A}^n$</td><td>G_2 and higher</td></tr>
<tr><td>f | fz</td><td>hanih | ahgahuc</td><td>$X, XA^mJ\bar{A}^m$</td><td>G_1, starting with X</td></tr>
<tr><td>mb | m</td><td>hocnoseh | noyeh</td><td>$Y, YA^mJ\bar{A}^m$</td><td>G_1, starting with Y</td></tr>
<tr><td>eb | ez / yb | yz</td><td>haje | ahje / haga | kaga</td><td>$J, \hat{A}A^mJ\bar{A}^m\hat{\bar{A}}$</td><td>$G_0$, starting and ending with X and $\bar{X}$ or with Y and $\bar{Y}$</td></tr>
<tr><td>$\hat{p}\check{j}c$</td><td>ahgareseh</td><td>$\hat{A}A^mJ\bar{A}^m\acute{\bar{A}}$</td><td>$G_0$, starting and ending with X and $\bar{Y}$ or with Y and $\bar{X}$</td></tr>
<tr><td>s | d</td><td>haahwuk | kaahwuk</td><td>$\hat{\alpha}A^mJ\bar{A}^m\hat{\bar{A}}$</td><td>$G_{-1}$, ending in $\bar{X}$ for male ego, in $\bar{Y}$ for female ego</td></tr>
<tr><td>$\mu z\phi \mid \mu zd \parallel \phi zs \mid \phi zd$</td><td>hayawanda|kayawanda ‖ hasoneh|kasoneh</td><td>$\hat{\alpha}A^mJ\bar{A}^m\acute{\bar{A}}$</td><td>$G_{-1}$, ending in Y for male ego, in X for female ego</td></tr>
<tr><td>cs | cd</td><td>hayada | kayada</td><td>$A^mJ\bar{A}^{2+m+n}$</td><td>G_{-2} and lower</td></tr>
</table>

9. 2 Affinal kinterms in Seneca. Seneca has an impressive list of affinal kinterms (Table 9. 2) with no significant affinal-consanguineal overlap. As we may therefore expect (2. 6), the Seneca tribe does not have prescribed marriage, so that in Figure 9. 4 there is no collateral path from the X-box to the Y-box.

Table 9. 2 Seneca affinal kinterms from Morgan

<table>
<tr><td>hpf | hpm</td><td>hagasa | ongasa</td><td>HAX | HAY, $(H=\bar{Y}X)$</td></tr>
<tr><td>wpf | wpm</td><td>hocsote | ocsote</td><td>WAX | WAY, $(W=\bar{X}Y)$</td></tr>
<tr><td>hf | hm</td><td>hagasa | ongasa</td><td>HX | HY</td></tr>
<tr><td>wp</td><td>ocnahose</td><td>WA</td></tr>
<tr><td>fzh | fbw</td><td>hocnoese | ocnoese</td><td>XJH | XJW</td></tr>
<tr><td>mzh | mbw</td><td>hocnoese | ahganiah</td><td>YJH | YJW</td></tr>
<tr><td>$\alpha\check{j}v \,\}\, \phi zh \mid \mu bw$</td><td>ahgeaneo } hayao | ahgeahneah</td><td>$\mu JH \sim \phi JW$ $\phi JH \mid \mu JW$</td></tr>
<tr><td>v (=h | w)</td><td>dayakene</td><td>V (=H | W)</td></tr>
<tr><td>cv (=dh | sw)</td><td>ocnahose | kasa</td><td>$\bar{A}V\mu \mid \bar{A}V\phi$</td></tr>
</table>

9.3 Seneca equivalence-rules. We note that parallel cousins are coverset-equivalent to siblings, so that Seneca is a **merging** system with the equivalence-rule $J \sim I$. We also note that $fb \neq mb$, so that Seneca is **bifurcate** and in fact, as was stated in 8.1, all the systems considered in the rest of the book will be "bifurcate-merging".

Seneca also has the property that patrilateral cross-cousins $XJ\bar{Y}$ are coverset-equivalent to matrilateral $YJ\bar{X}$, giving us a third equivalence-rule $XJ\bar{Y} \sim YJ\bar{X}$, and therefore $X\bar{Y} \sim Y\bar{X}$. In any merging system the auxiliary chains $X\bar{Y}$ and $Y\bar{X}$, which in fact cannot link ego to any alter (3.7), are nevertheless equivalent to $XJ\bar{Y}$ and $YJ\bar{X}$ and may therefore be called "cross-cousin chains", being regarded as abbreviations for $XJ\bar{Y}$ and $YJ\bar{X}$. Similarly, we may write $\mu\bar{Y}$ for $\mu J\bar{Y}$ (male speaker's sister's child) and $\phi\bar{X}$ for $\phi J\bar{X}$ (female speaker's brother's child) without fear of misunderstanding.

Finally, the fact that in Seneca all chains for *f* | *fz* start with X and all chains for *mb* | *m* start with Y gives us the two equivalence-rules $XX \sim XY$ and $YX \sim YY$, together with their reciprocal $\bar{X}\bar{X} \sim \bar{Y}\bar{X}$ and $\bar{X}\bar{Y} \sim \bar{Y}\bar{Y}$. A bifurcate-merging system with the rules $X\bar{Y} \sim Y\bar{X}$, $XX \sim XY$ ($\bar{X}\bar{X} \sim \bar{Y}\bar{X}$) and $YX \sim YY$ ($\bar{X}\bar{Y} \sim \bar{Y}\bar{Y}$) is said to be of **Iroquois type.**

9.4 Seneca kingraph. The Seneca consanguineal kingraph can now be constructed as in Figure 9.4, where the four grandparental chains XX, XY, YX, YY, all with the same coverset *hocsote* | *ocsote*, must go into two separate boxes because XX and YX are not coverset-equivalent since they produce distinct coversets when extended by $J\bar{X}$; namely *hanih* | *ahgahuc* for $XXJ\bar{X}$ and *hocnoseh* | *noyeh* for $YXJ\bar{X}$.

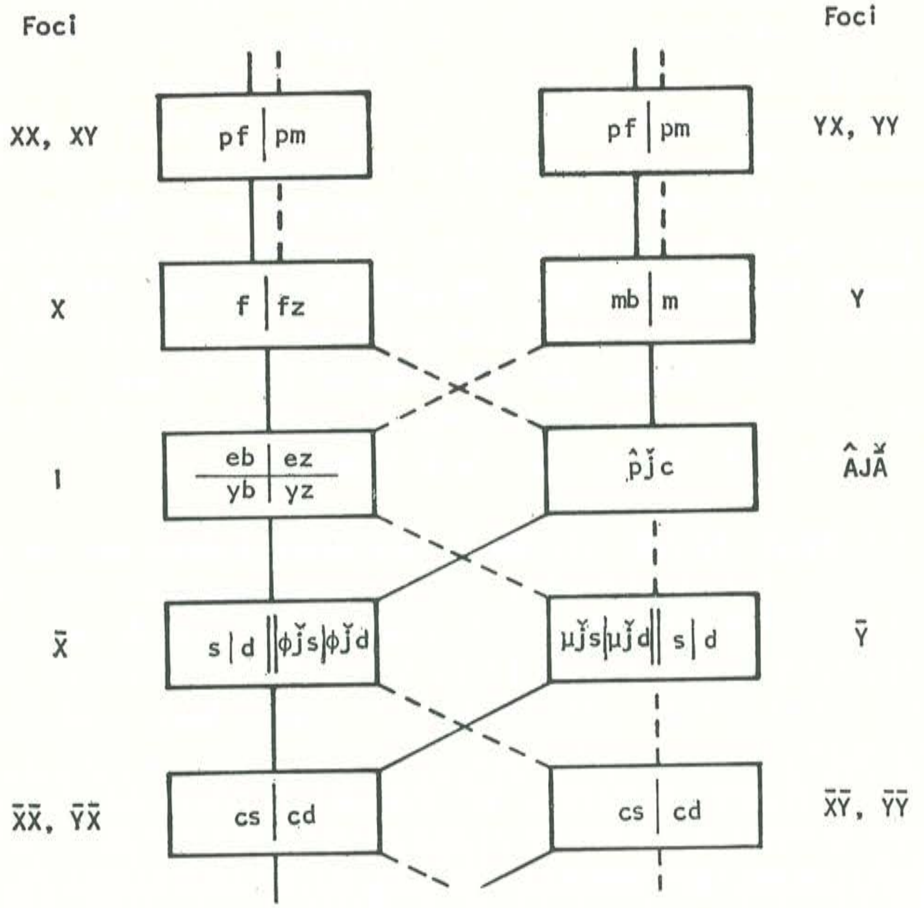
As an example of reduction and expansion in Seneca consider the problem of finding the kinterm for the string $\mu XYX\bar{X}\bar{Y}\bar{Y}\bar{X}\phi$ (male speaker's second-cousin-once-removed-female). Algebraically, we have

$$\begin{aligned} XYX\bar{X}\bar{Y}\bar{Y}\bar{X} &\sim XY\bar{Y}\bar{Y}\bar{X} && \text{by the rule } X\bar{X} \sim I \\ &\sim X\bar{Y}\bar{X} && \text{by the rule } Y\bar{Y} \sim I \\ &\sim X\bar{X}\bar{X} && \text{by the rule } \bar{Y}\bar{X} \sim \bar{X}\bar{X} \\ &\sim \bar{X} && \text{by the rule } X\bar{X} \sim I, \end{aligned}$$

so that the desired kinterm *kaahwuk* is given by $\mu X\phi = \mu XJ\phi$ (see Table 9.1a).

Geometrically, the same result may be traced-out immediately on Figure 9.4.

Similarly, Morgan's two statements about the children of ego's cross-cousins in Seneca, namely $\mu XJ\bar{Y}\bar{X} \sim YJ\bar{X}\bar{X}$ $(s \mid d)$ and $\mu XJ\bar{Y}\bar{Y} \sim \mu YJ\bar{X}\bar{Y}$ $(\mu\check{j}s \mid \mu\check{j}d)$ can now be verified either algebraically from the equivalence-rules or by tracing-out on Figure 9.4.



Equivalence-rules: J~I, XX~XY, $\bar{X}\bar{X} \sim \bar{Y}\bar{X}$, YX~YY, $\bar{X}\bar{Y} \sim \bar{Y}\bar{Y}$, $X\bar{Y} \sim Y\bar{X}$

Generation-patterns: 24, [2 *i*], 3, 14 (*s*, *d*), 2, 2

Figure 9.4 Seneca kingraph.

9.5 Seneca as a monoid. The generating relations for the Seneca monoid on the four generators x, $\bar{x}$, y, $\bar{y}$ are given by:

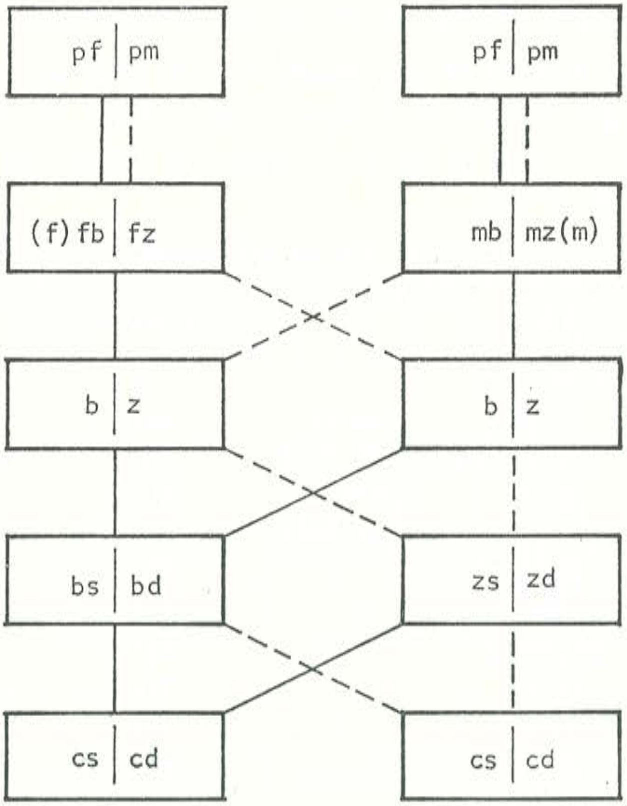
$$x\bar{x}=y\bar{y}=i,\ xx=xy,\ \bar{x}\bar{x}=\bar{y}\bar{x},\ yx=yy,\ \bar{x}\bar{y}=\bar{y}\bar{y},\ x\bar{y}=y\bar{x}.$$

In Table 9.5 the elements of this monoid, i.e. the kinclasses of the Seneca kinship system, are arranged in dictionary order. Again the affinal expressions MZH, WS, ... must be written in upper-case letters and enclosed in square brackets as in 7.5.

Table 9.5 The Seneca monoid

Kinclass	Gloss		Kinclass	Gloss
i	*eb/yb, ez/yz*		$\bar{x}xx$	kintermless
x	*f* | *fz*	[MZH]	$\bar{x}x\bar{y}$	kintermless
$\bar{x}$	*s* | *d* || $\phi\check{j}s$ | $\phi\check{j}d$	[WS | WD]	$\bar{x}\bar{x}x$	kintermless
y	*mb* | *m*	[FBW]	$\bar{x}\bar{x}\bar{x}$	*cc*
$\bar{y}$	$\mu\check{j}s$ | $\mu\check{j}d$ || *s* | *d*	[HS | HD]	$\bar{x}\bar{x}y$	[SW]
xx	*pf* | *pm*		$\bar{x}\bar{x}\bar{y}$	*cs, ce*
$x\bar{y}$	$\hat{p}\check{j}c$		$\bar{x}yx$	[WP]
$\bar{x}x$	kintermless		$\bar{x}\bar{y}x$	[DH]
$\bar{x}\bar{x}$	*cs* | *cd*		$\bar{x}\bar{y}y$	kintermless
$\bar{x}y$	W, JW		yxx	*pf, pm*
$\bar{x}\bar{y}$	*cs* | *cd*		$\bar{y}xx$	[HF, HM]
yx	*pf* | *pm*		$\bar{y}x\bar{y}$	kintermless
$\bar{y}x$	[H, JH]		$\bar{y}yx$	kintermless
$\bar{y}y$	kintermless		xxxx	*pf, pm*
xxx	*pf* | *pm*		⋮	⋮
$x\bar{y}x$	[FZH]		$\bar{x}yxx$	[WPF | WPM]
$x\bar{y}y$	[MBW]		$\bar{x}yyx$	[WPF | WPM]
			$\bar{y}xxx$	[HPF | HPM]
			$\bar{y}xyx$	[HPF | HPM]
			⋮	⋮

9.6 Hindi. The Iroquois type is widespread throughout the world, with great variety in its generation patterns. In most cases, cross-cousins are distinguished from siblings, as e.g. in Seneca, but in many systems all (first non-removed) cousins, patrilateral and matrilateral, are equated with siblings even though otherwise the two sides of the house, e.g. FB and MB are sharply distinguished. This chain-coincidence $XJ\bar{Y}\approx YJ\bar{X}\approx J$ requires



pf | pm	dada | dadi
fb | fz	chacha | phupi
mb | mz	mama | mausi
f | m	pita | mata
b | z	bhai | bahin
bs | bd	bhatija | bhatiji
zs | zd *	bhauja | bhauji
s | d	beta | beti
cs | cd	pota | poti

* ϕzc and ϕfbdc have special terms

Generation patterns: 3, 3(f, m), 14, 2, 2

Figure 9.6 Hindi kingraph.

the supplemental statement indicated by the [1] for the cousin-pattern (cf. 6. 9) under Figure 9. 6.

Examples are provided by the four Aryan languages in India—Hindi, Bengali, Gujarati, Marathi—for which Morgan so energetically tried to prove non-Aryan origin (8. 5). Figure 9. 6 gives the Hindi system from which the other three differ only in slight details. If Morgan had asserted complete similarity between Seneca and Hindi, rather than Seneca and Tamil (8. 1), he would have been more nearly correct, although his argument for common ethnological origin would have remained just as unsound.

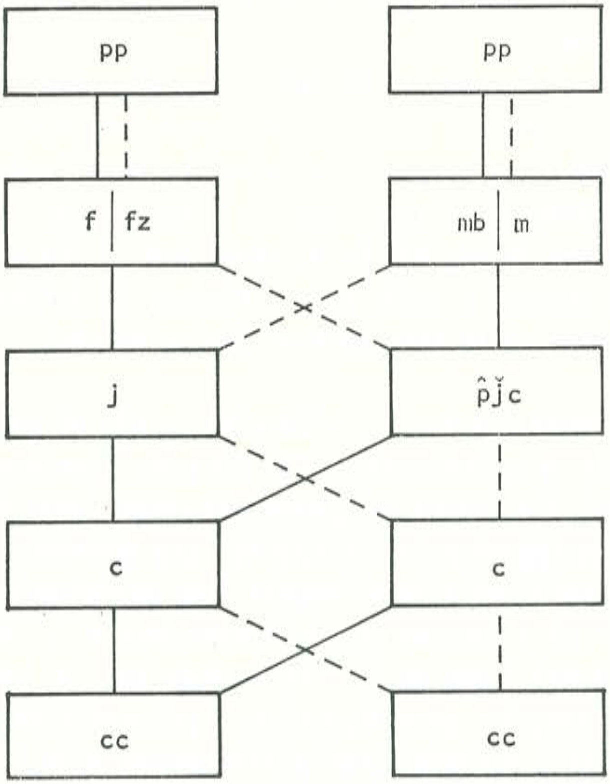
9. 7 The Mbuti pygmies. A widespread feature of kinship systems of all kinds is lack of sex-discrimination in the lower generations as compared with the higher; e. g. almost all systems distinguish father from mother but many do not distinguish son from daughter, and distinction of grandfather from grandmother is much more common than distinction of grandson from granddaughter. In a bifurcate system, father's side is by definition distinguished from mother's side in G_1. An example showing just this minimum necessary distinction for sex of the referent is provided by the Mbuti pygmies (see Figure 9. 7) in the Ituri forest in northeastern Zaire.

Here we have the following information (Ichikawa, 1978) about the nine consanguineal kinterms of the system.

Table 9.7 Kintypes for the Mbuti Pygmies

<table>
<tr><th>Kinterm</th><th></th><th>Kin</th><th>Glosses</th></tr>
<tr><td>tata</td><td>:</td><td>in G_2 or higher</td><td>pp</td></tr>
<tr><td>epa | kula</td><td>:</td><td>in G_1 starting with X</td><td>f | fz</td></tr>
<tr><td>noko | ema</td><td>:</td><td>in G_1 starting with Y</td><td>mb | m</td></tr>
<tr><td>namami</td><td>:</td><td>children of epa or ema</td><td>j</td></tr>
<tr><td>sono</td><td>:</td><td>children of noko or kula</td><td>$\hat{p}\check{j}c$</td></tr>
<tr><td>miki</td><td>:</td><td>in G_{-1}</td><td>c</td></tr>
<tr><td>mikilimamiki</td><td>:</td><td>in G_{-2} or lower</td><td>cc</td></tr>
</table>

From this information we can draw the kingraph and give the generation patterns as in Figure 9. 7.



Generation patterns: 1, [2i], 3, 1, 1, 1.

Figure 9.7 Kingraph for the Mbuti pygmies.

9.8 Shastan, Tolowa, Comanche, Nepal. In order to illustrate how the entries would appear in our proposed catalog, we now list four more examples of Iroquois type. Since the type has thus been stated once for all, there is no need to give the equivalence-rules or to draw the kingraph. Only the generation-patterns are necessary.

Shastan:	9,	[2 iii],	3 (*f*, *m*),	r,	13,	r
Tolowa:	24,	[2 iv],	3 (*f*, *m*),	a,	13,	4
Comanche:	1,	[1],	3,	2,	13,	*r*
Nepal:	24,	[1],	4 (*f*, *m*),	2,	2,	2

CHAPTER X

The Dravidian Type

10. 1 Kinlist for Tamil and Telegu. The Tamil and Telegu systems of Dravidian type are related to each other in the same way as Seneca and Ojibwa of Iroquois type (cf. Morgan's statements 1. 4); i. e. they differ from each other only in their partition of cross-cousin strings. Morgan's information about them can be arranged as in Table 10. 1. For brevity we usually refer only to Tamil. The system for Kanarese, the third most important Dravidian language, is almost the same, though not so completely reported by Morgan's missionary informants.

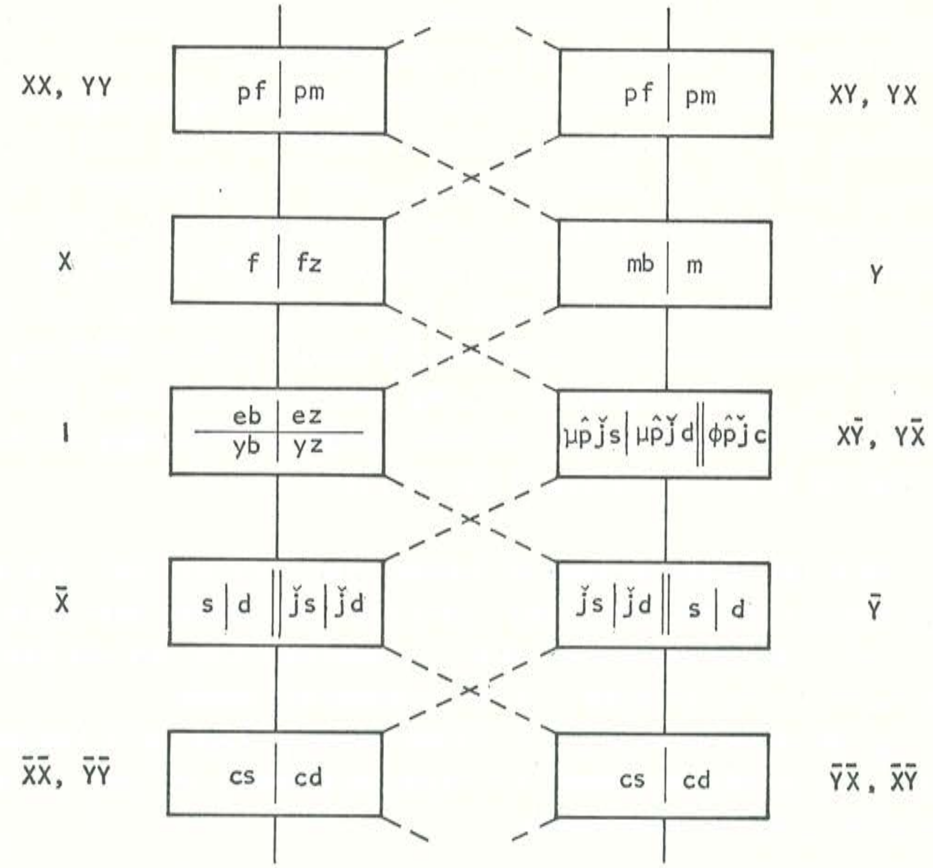
10. 2 Tamil-Telegu kingraph. From Table 10. 1 we read off the merging-rule J$\sim$I and the cross-cousin rule $X\bar{Y}\sim Y\bar{X}$ as in Seneca. Then the fact that all the chains with coverset $f \mid fz$ are even (see Table 10. 1) and all those with coverset $mb|m$ are odd gives us the equivalence-rules XX$\sim$YY, XY$\sim$YX, together with their reciprocal rules $\bar{X}\bar{X}\sim\bar{Y}\bar{Y}$, $\bar{Y}\bar{X}\sim\bar{X}\bar{Y}$, in contrast to the Seneca rules XX$\sim$XY, YX$\sim$YY etc., in 9. 3.

From the above we can construct the Tamil-Telegu kingraph as in Figure 10. 2. Here the distinction between even and odd chains is geometrically expressed by the fact that the boxes for even chains are on ego's side, i. e. the left column of the figure, while the boxes for odd chains are on the right side. In other words, an even (odd) chain crosses from one side to the other an even (odd) number of times, while in the Seneca kingraph (Figure 9. 4) this statement is no longer valid for chains rising beyond the generation G_1.

Table 10. 1 Tamil and Telegu kinlists

<table>
<tr><th>Focal string</th><th>Glosses</th><th>Tamil kinterms</th><th>Telegu kinterms</th><th>Range</th></tr>
<tr><td>A^2</td><td>pf | pm</td><td>paddan | paddi</td><td>tata | avva</td><td>chains in G_2 and higher</td></tr>
<tr><td>X</td><td>f | fz</td><td>takkappan | attai</td><td>tandri | menatta</td><td>even chains in G_1</td></tr>
<tr><td>Y</td><td>mb | m</td><td>maman | tay</td><td>mama | talli</td><td>odd chains in G_1</td></tr>
<tr><td>I</td><td>eb | ez
yb | yz</td><td>annan | tamakay
tambi | tangay</td><td>anna | akka
tamudu | chellelu</td><td>even chains in G_0</td></tr>
<tr><td>$\hat{A}\check{A}$ for Tamil</td><td>$\mu\hat{p}\check{j}s \mid \mu\hat{p}\check{j}d \parallel \phi\hat{p}\check{j}c$</td><td>maittunan | maittuni || machchan</td><td></td><td>odd chains in G_0</td></tr>
<tr><td>$\hat{A}\check{A}$ for Telegu</td><td>$\hat{p}\check{j}se \mid \hat{p}\check{j}de$
$\hat{p}\check{j}sy \mid \hat{p}\check{j}dy$</td><td></td><td>bava | vadine
maradi | maradalu</td><td>odd chains in G_0</td></tr>
<tr><td>$\mu\bar{X}$, $\phi\bar{Y}$</td><td>s | d</td><td>makan | makal</td><td>koduku | kuturu</td><td>in G_{-1}, even for male ego, odd for female</td></tr>
<tr><td>$\phi\bar{X}$, $\mu\bar{Y}$</td><td>$\check{j}s \mid \check{j}d$</td><td>marumakan | marumakal</td><td>alludu | kodalu</td><td>in G_{-1}, odd for male ego, even for female</td></tr>
<tr><td>$\bar{A}^2$</td><td>cs | cd</td><td>peran | pertti</td><td>manamadu | manamaralu</td><td>in G_{-2} and lower</td></tr>
</table>

An even (odd) chain is one with an even (odd) number of the matri-letters Y and $\bar{Y}$.



Generation patterns 24 [2 vii for Tamil, 2 v for Telegu], 3, 5, 2, 2

Figure 10. 2 Tamil-Telegu kingraph.

10. 3 Contrast between Seneca and Tamil. Let us now examine what Lounsbury (8. 6) calls "the classic theory", namely that, as Morgan asserted, Seneca is essentially identical with Tamil. We shall find that when Tamil rules are applied to the Seneca system the predictions are correct, as Lounsbury says, "only for immediate uncles and aunts and first cousins. Beyond this they are half right and half wrong."

Both Seneca, with the rules XX$\sim$XY, YX$\sim$YY, and Tamil, with the rules XX$\sim$YY, XY$\sim$YX, are bifurcate in the sense that in generation G_1 they both have XJ$\nsim$YJ, but for Seneca, in contrast to Tamil, the bifurcation,

i. e. the distinction between chains beginning with X and chains beginning with Y, continues throughout all the higher generations.

Consider the two chains, XYX and XYY, rising into the third generation. In Seneca these two chains are equivalent because they both begin with X and in Tamil they are inequivalent because XYX is odd and XYY is even. Let us now adjoin any descending chain, say $\bar{X}\bar{Y}$, so as to bring these chains down into G_1. Then in Seneca the two chains, $XYX\bar{X}\bar{Y}$ and $XYY\bar{X}\bar{Y}$, will have the same coverset $f \mid fz$ (Figure 9. 4), but in Tamil they will have distinct coversets; namely $f \mid fz$ for $XYX\bar{X}\bar{Y}$ but $mb \mid m$ for $XYY\bar{X}\bar{Y}$ (Figure 10. 2). For chains rising beyond G_1, the predictions for Seneca based on Tamil rules are correct in half the cases, namely those in which the chain in question is even, and wrong in the other half.

10. 4 Six further examples of Dravidian type. As we shall soon see, the difference between Seneca and Tamil runs much deeper than might be expected from this single illustration. As Lounsbury says: the two systems derive from social structures that are fundamentally unlike.

In the meantime let us give six further examples of systems of Dravidian type. Again only the generation patterns are necessary (cf. 9. 8) and will be given in our proposed catalog.

Moala:	2, [2 viii],	3,	7,	2,	1
Piaroa:	24, [2 vi],	3,	5,	2,	2
Garo:	24, [2 vi],	4 (*f*, *m*),	5,	13,	4
Byansi:	24, [2 vi],	4 (*f*, *m*),	5,	13,	4
Nasioi:	24, [2 vi],	3,	5,	2,	1
Xingu Carib:	24, [2 i],	3,	5,	2,	1

10. 5 Bilateral cross-cousin prescribed marriage in Tamil. The field-workers inform us independently of kinship terminology that Seneca practices non-prescribed marriage and Tamil practices bilateral cross-cousin marriage. From our formalist point of view we shall wish to see what evidence we can find for these marriage practices in the terminologies alone. For Seneca the question has already been dealt with in 2. 6. As for Tamil it was mentioned there that the paucity of special affinal kinterms (*kanavan* =husband and *mainaivi*=wife) already gives some indication of prescribed marriage and that this indication will be strengthened by a strong overlap between consanguineal and affinal terms. In Tamil the recorded overlap is truly impressive (Table 10. 5), all of it indicating bilateral cross-cousin marriage.

Finally, the best evidence for this type of prescribed marriage is afforded by the consanguineal terminology itself. In our formal notation the four criteria listed in 2. 6 become: $\mathrm{X}K\sim\mathrm{Y}$, $\mathrm{Y}\bar{K}\sim\mathrm{X}$, $\bar{K}\bar{\mathrm{X}}\sim\bar{\mathrm{Y}}$, $K\bar{\mathrm{Y}}\sim\bar{\mathrm{X}}$, where the chain K is collateral. Then bilateral cross-cousin is established for Tamil by the fact that these criteria are satisfied both for $K=\mathrm{X}\bar{\mathrm{Y}}$ and $\bar{K}=\mathrm{Y}\bar{\mathrm{X}}$. For we have

$\mathrm{X}K\sim\mathrm{Y}$: since *tay*=$f\hat{p}\check{j}d$ $(\mathrm{XX}\bar{\mathrm{Y}}\phi\sim\mathrm{XY}\bar{\mathrm{X}}\phi)$=*mother* (Y)
$\mathrm{Y}\bar{K}\sim\mathrm{X}$: since *maman*=$m\hat{p}\check{j}s$ $(\mathrm{YX}\bar{\mathrm{Y}}\mu\sim\mathrm{YY}\bar{\mathrm{X}}\mu)$=*father* (X)
$\bar{K}\bar{\mathrm{X}}\sim\bar{\mathrm{Y}}$: since *makan* | *makal*=$\phi\hat{p}\check{j}s \mid \phi\hat{p}\check{j}d$ $(\phi\mathrm{Y}\bar{\mathrm{X}}\bar{\mathrm{X}}\sim\phi\mathrm{X}\bar{\mathrm{Y}}\bar{\mathrm{X}})=\phi s \mid \phi d$ $(\bar{\mathrm{Y}})$
$K\bar{\mathrm{Y}}\sim\bar{\mathrm{X}}$: since *makan* | *makal*=$\mu\hat{p}\check{j}s \mid \mu\hat{p}\check{j}d$ $(\mu\mathrm{X}\bar{\mathrm{Y}}\bar{\mathrm{Y}}\sim\mu\mathrm{Y}\bar{\mathrm{X}}\bar{\mathrm{Y}})=\mu s \mid \mu d$ $(\bar{\mathrm{X}})$.

Geometrically expressed each of the collateral paths $\mathrm{Y}\bar{\mathrm{X}}$ and $\mathrm{X}\bar{\mathrm{Y}}$ leads from the X-box to the Y-box (Figure 10. 2).

On the other hand, the Murngin terminology (16.3) indicates matrilateral cross-cousin marriage, i. e. with MBD but not FZD; for there we have (cf. 2. 6 and see Figure):

arndi=*fmbd* $(\mathrm{XYJ}\bar{\mathrm{X}}\phi)=m$ but *ffzd* $(\mathrm{XXJ}\bar{\mathrm{Y}}\phi)$=*waku* $\neq m$
bapa=*mfzs* $(\mathrm{YXJ}\bar{\mathrm{Y}}\mu)=f$ but *mmbs* $(\mathrm{YYJ}\bar{\mathrm{X}}\mu)$=*mari-elker* $\neq f$

and reciprocally:

waku=$\phi fzsc$ $(\phi\mathrm{XJ}\bar{\mathrm{Y}}\bar{\mathrm{X}})=\phi c$ $\phi mbsc$ $(\phi\mathrm{YJ}\bar{\mathrm{X}}\bar{\mathrm{X}})$=*gawel* | *arndi* $\neq \phi c$
gatu =$\mu mbdc$ $(\mu\mathrm{YJ}\bar{\mathrm{X}}\bar{\mathrm{Y}})=\mu c$ $\mu fzdc$ $(\mu\mathrm{XJ}\bar{\mathrm{Y}}\bar{\mathrm{Y}})$=*gurrong* $\neq \mu c$

So to the set of equivalence-rules for Tamil we may add $\mathrm{H}=\bar{\mathrm{Y}}\mathrm{X}\sim\mathrm{W}=\bar{\mathrm{X}}\mathrm{Y}\sim\mathrm{X}\bar{\mathrm{Y}}\sim\mathrm{Y}\bar{\mathrm{X}}$, expressing bilateral cross-cousin marriage. We now wish to show that such a kinship system forms the kind of mathematical structure technically known as a "group".

Table 10. 5 Consanguineal-affinal overlap in Tamil

<table>
<tr><th>Consanguineal gloss</th><th>Affinal gloss</th><th>Kinterms (overlap between consanguineal and affinal)</th><th>Affinal chains and strings</th></tr>
<tr><td>pf | gm</td><td>vgf | vgm</td><td>paddan | paddi</td><td>HAA, WAA</td></tr>
<tr><td>f | fz</td><td>mzh | mbw
| wm
| hm</td><td>takkappan | attai</td><td>YJH | YJW
| WY
| HY</td></tr>
<tr><td>mb | m</td><td>fzh | fbw
wf |
hf |</td><td>maman | tay</td><td>XJH | XJW
WX |
HX |</td></tr>
<tr><td>eb | ez
―――
yb | yz</td><td>fzdh | fzsw

mbdh | mbsw
hzh | hbw
wzh | wbw</td><td>annan | tamakay
―――
tambi | tangay</td><td>$XJ\bar{Y}H$ | $XJ\bar{Y}W$

$YJ\bar{X}H$ | $YH\bar{X}W$
HJH | HJW
WJH | WJW</td></tr>
<tr><td>$\mu\hat{p}\check{j}s$ | $\mu\hat{p}\check{j}d$ ‖ $\phi\hat{p}\check{j}c$</td><td>fbdh | fbsw ‖ mzsw
mzdh | mzsw ‖ zh
hb | hz ‖
wz ‖
bw ‖</td><td>maittunan | maittuni ‖ machchan</td><td>$XJ\bar{X}H$ | $XJ\bar{X}W$ ‖ XJYW
$XJ\bar{Y}H$ | $YJ\bar{Y}W$ ‖ JH
$HJ\mu$ | $HJ\phi$ ‖
$WJ\phi$ ‖
JW ‖</td></tr>
<tr><td>s | d</td><td>μzdh | μzsw
ϕbzh | ϕbsw</td><td>makan | makal</td><td>$\mu J\bar{Y}H$ | $\mu J\bar{Y}W$
$\phi J\bar{X}H$ | $\phi J\bar{X}W$</td></tr>
<tr><td>$\check{j}s$ | $\check{j}d$</td><td>μbdh | μbsw
| ϕzsw
μdh | sw</td><td>marumakan | marumakal</td><td>$J\bar{X}H$ | $\mu J\bar{X}W$
| $\phi J\bar{Y}W$
XH | YW</td></tr>
</table>

CHAPTER XI

The Dravidian and Generational Groups

11. 1 Definition of a group. In 5. 1 we stated that a closed binary system $\mathfrak{B}$ is a semigroup if its multiplication is associative and that a semigroup is a monoid if the multiplication has an identity-element, call it i. We now state that a monoid $\mathfrak{B}$ is a **group** if for every element a in $\mathfrak{B}$ there is an **inverse** element, call it a^{-1}, in $\mathfrak{B}$ such that $aa^{-1}=a^{-1}a=i$.

It is clear that no element a can have two inverses, call them a^{-1} and $a_0^{-1}\neq a^{-1}$. For then we would have

$$\begin{aligned} a^{-1} &= a_0^{-1}aa^{-1} && \text{since } a_0^{-1}a=i \\ &= a_0^{-1} && \text{since } aa^{-1}=i. \end{aligned}$$

Thus in a group every element has exactly one inverse, but in a mere monoid some elements have one inverse and some have none.

For example, the set $\mathfrak{B}$ of all integers $\cdots, -3, -2, -1, 0, 1, 2, 3, \cdots$ under addition is a group, with 0 for its identity-element, since for every integer p there exists in $\mathfrak{B}$ an integer $-p$ such that $p+(-p)+(-p)+p=0$. But under ordinary multiplication this same set $\mathfrak{B}$ is merely a monoid, because no integer except ± 1 has an inverse; e. g. there exists no integer p such that $2p=1$, since $\mathfrak{B}$ does not include fractions.

Similarly, our dictionary $\mathfrak{D}$ of all words (chains) under concatenation is only a monoid. For if any non-empty word K, i. e. any word of length greater than zero, is multiplied by any word at all, the result is at least as long as K and therefore cannot be the identity-element I, which is of length zero.

Now let us consider an abstract kinship system, i. e. a quotient $\mathfrak{D}/P$ (4. 5), where P is a stable partition of $\mathfrak{D}$. This kinship system may be a group or may be only a monoid, depending on the nature of its generating relations, so that we now wish to determine what relations are necessary and sufficient if the system is to form a group.

Since we are interested only in merging systems, we already have $\mathrm{x}\bar{\mathrm{x}}=\mathrm{y}\bar{\mathrm{y}}=i$. But these conditions are not sufficient. For example, Seneca is a merging system that cannot be a group, for the following reason.

11.2 Cancellation in a group. For purposes of computation, i.e. of utilizing given properties of a kinship system to deduce others, groups are more serviceable than mere monoids because "cancellation" is always possible in a group but not always in a monoid, in the sense that if a, b, c are elements of a group, then from the equation $ab=ac$ or $ba=ca$ we may cancel the a to obtain a true result $b=c$.

For in a group we need only multiply by a^{-1} on both sides of $ab=ac$ to obtain $a^{-1}(ab)=(a^{-1}a)b=b=a^{-1}(ac)=(a^{-1}a)c=c$, so that $b=c$ as desired. (Note the importance of associativity.) But in a monoid the inverse element a^{-1} may not exist. For example, in the set $\mathfrak{Z}$ of all integers under ordinary multiplication we have $0\times2=0\times3=0$ but $2\neq3$, so that the 0 cannot be cancelled, the difficulty being that in this monoid the element 0 has no inverse.

Similarly, in the Seneca monoid, cancellation is not always possible. For example, we have $\mathrm{xxj}=\mathrm{xyj}$ (both are *gf* | *gm*=*hocsote* | *ocsote*) but $\mathrm{xj}\neq\mathrm{yj}$ since *f* | *fz*≠*mb* | *m* (*hanih* | *ahgahuc*≠*hocnoseh* | *noyeh*; see Table 9.1a), so that the initial x cannot be cancelled. In other words, the Seneca system cannot be a group. In Tamil, on the other hand, cancellation is always possible; e.g.
$\mathrm{xx}\bar{\mathrm{y}}=\mathrm{xy}\bar{\mathrm{x}}$ (both are *mb* | *m*=*maman* | *tay*; see Table 10.1) and
$\mathrm{x}\bar{\mathrm{y}}=\mathrm{y}\bar{\mathrm{x}}$ (both are *maittunan* | *maittuni* || *machchan*).

11.3 Necessary and sufficient conditions for a group. In a merging system we already have $\mathrm{x}\bar{\mathrm{x}}=\mathrm{y}\bar{\mathrm{y}}=i$, so that if the elements x and y are to have inverses at all, these inverses must be the elements $\bar{\mathrm{x}}$ and $\bar{\mathrm{y}}$, which means that $\bar{\mathrm{x}}\mathrm{x}=i$ and $\bar{\mathrm{y}}\mathrm{y}=i$. And conversely, any abstract system whose equivalence-rules include these four: $\mathrm{x}\bar{\mathrm{x}}=\bar{\mathrm{x}}\mathrm{x}=\mathrm{y}\bar{\mathrm{y}}=\bar{\mathrm{y}}\mathrm{y}=i$ is necessarily a group because the inverse k^{-1} of any class of chains k, say $k=\mathrm{xy}\bar{\mathrm{y}}\bar{\mathrm{x}}\bar{\mathrm{x}}$ is then provided by the reciprocal chain $\bar{k}=\text{xxy}\bar{\text{y}}\bar{\text{x}}$; for then $k\bar{k}=\text{xy}\bar{\text{y}}\bar{\text{x}}\bar{\text{x}}\text{xxy}\bar{\text{y}}\bar{\text{x}}$ reduces to i by successive steps starting from the center of $k\bar{k}$.

From the Tamil equivalence-rules listed above, the two relations $\bar{\text{x}}\text{x}=\bar{\text{y}}\text{y}=i$ follow at once. For we have

$$\begin{aligned}
\bar{\text{x}}\text{x}&=\bar{\text{x}}\text{xy}\bar{\text{y}} && \text{because} \quad \text{y}\bar{\text{y}}=i\\
&=\bar{\text{x}}\text{yx}\bar{\text{y}} && \text{because} \quad \text{xy}=\text{yx}\\
&=\text{y}\bar{\text{x}}\text{x}\bar{\text{y}} && \text{because} \quad \bar{\text{x}}\text{y}=\text{y}\bar{\text{x}}\\
&=\text{y}\bar{\text{x}}\text{y}\bar{\text{x}} && \text{because} \quad \text{x}\bar{\text{y}}=\text{y}\bar{\text{x}}\\
&=\text{y}\bar{\text{y}}\text{x}\bar{\text{x}} && \text{because} \quad \bar{\text{x}}\text{y}=\bar{\text{y}}\text{x}\\
&=i && \text{because} \quad \text{x}\bar{\text{x}}=\text{y}\bar{\text{y}}=i.
\end{aligned}$$

Consequently, unlike Seneca, the Tamil system is a group.

11.4 Non-redundant set of generating relations for Tamil. Our list of generating relations for Tamil has now become

$$\bar{\text{x}}\text{x}=\bar{\text{y}}\text{y}=\text{x}\bar{\text{x}}=\text{y}\bar{\text{y}}=i,\ \bar{\text{x}}\text{y}=\bar{\text{y}}\text{x}=\text{x}\bar{\text{y}}=\text{y}\bar{\text{x}},\ \text{xx}=\text{yy},\ \text{xy}=\text{yx},\ \bar{\text{x}}\bar{\text{x}}=\bar{\text{y}}\bar{\text{y}},\ \bar{\text{x}}\bar{\text{y}}=\bar{\text{y}}\bar{\text{x}},$$

where we recall that each of these pairs of lower-case letters represents a class, e. g. $\text{xx}=\{\text{XX}\}$, of chains XX, $\text{XXX}\bar{\text{X}}$, $\cdots$ that are equivalent to one another, e. g. $\text{XX}\sim\text{YY}$, under the equivalence-rules of the Tamil system, and a relation like $\text{xx}=\text{yy}$ means that $\text{xx}=\{\text{XX}\}$ and $\text{yy}=\{\text{YY}\}$ are the same class.

Then the above set of generating relations, which we may synonymously refer to as equivalence-relations, is redundant, since some of them can be deduced from the rest. For example, we have just seen in 11.3 that the relations $\bar{\text{x}}\text{x}=\bar{\text{y}}\text{y}=i$ are so deducible. Thus we now wish to eliminate some of these relations in order to produce a complete, non-redundant set. We shall find that if we keep intact the four earmarks of a group, namely $\bar{\text{x}}\text{x}=\bar{\text{y}}\text{y}=\text{x}\bar{\text{x}}=\text{y}\bar{\text{y}}=i$, and also retain the two relations $\text{xy}=\text{yx}$ and $\text{xx}=\text{yy}$, we already have a set of relations that implies all the rest.

To begin with, we may omit the relations $\bar{\text{x}}\bar{\text{x}}=\bar{\text{y}}\bar{\text{y}}$ and $\bar{\text{x}}\bar{\text{y}}=\bar{\text{y}}\bar{\text{x}}$ reciprocal to $\text{xx}=\text{yy}$ and $\text{xy}=\text{yx}$. For each of the two classes $\bar{\text{x}}\bar{\text{x}}$ and $\bar{\text{y}}\bar{\text{y}}$ is inverse to the class $\text{xx}=\text{yy}$, so that the two of them must be the same class, i. e. we must have $\bar{\text{x}}\bar{\text{x}}=\bar{\text{y}}\bar{\text{y}}$, because every group element, i. e. in this case every class in the partition of the set of all chains, has exactly one inverse (11. 1), and similarly for the class $\bar{x}\bar{y}=\bar{y}\bar{x}$ inverse to the class $xy=yx$.

More generally, we made the assumption that if a given kinship system has the equivalence-rule $K \sim L$, where K and L are chains, then it also has the rule $\bar{K} \sim \bar{L}$. We now see that if the system is a group, there is no need to assume this property, since it follows logically from the fact that in a group every element has exactly one inverse.

Finally, the four relations $\bar{x}y=\bar{y}x=x\bar{y}=y\bar{x}$ may all be omitted, e. g.

$$\begin{aligned} \bar{x}y &= y\bar{y}\bar{x}y && \text{since} \quad y\bar{y}=i \\ &= y\bar{x}\bar{y}y && \text{since} \quad \bar{y}\bar{x}=\bar{x}\bar{y} \\ &= y\bar{x} && \text{since} \quad \bar{y}y=i. \end{aligned}$$

So as a complete non-redundant set of rules for Tamil we have:

$$\bar{x}x=x\bar{x}=\bar{y}y=y\bar{y}=i, \quad xx=yy, \quad xy=yx.$$

11. 5 Commutative groups and MBD-marriage. Since in a group we have $\bar{x}=x^{-1}$ and $\bar{y}=y^{-1}$, the two letters $\bar{x}$ and $\bar{y}$ can be replaced by negative powers of x and y. Thus every element in the Tamil group can be expressed as a product of powers (positive, negative or zero) of the two elements x and y. Consequently, the Tamil system is the **group on two generators**, say x and y, with the generating relations $xx=xy$, $xy=yx$.

Since $xy=yx$, this group is **commutative**; i. e. any product kk' is equal to the same product $k'k$ in reverse order. In particular, $\bar{x}y=y\bar{x}$ (cf. the above proof); or in words, every commutative kinship system has MBD-marriage ($w=\bar{x}y=y\bar{x}$=matrilateral cross-cousin). And conversely, every kinship system with MBD-marriage is a commutative group, a group because it has prescriptive marriage, and commutative because it can be generated by $\bar{x}$ and y with $\bar{x}y=y\bar{x}$.

11. 6 Kinterms for arbitrarily long affinal chains. The consanguineal kingraph for a non-prescriptive system, e. g. Figure 9. 4 for Seneca, is valid only for consanguineal chains. For example, tracing-out the two chains $\bar{X}Y$ and $Y\bar{X}$, one of which is affinal, would lead us to the wrong conclusion that Seneca has MBD-marriage. But the kingraph for a prescriptive system can be used for chains of any kind.

In 2.10 we agreed that all systems, prescriptive or not, have kinterms for arbitrarily long consanguineal chains. What then are we to say about arbitrarily long affinal chains in prescriptive systems? Consider the chain $XJ\bar{X}WYJ\bar{Y}H$ (cousin's wife's cousin's husband) discussed in 3.1. Certainly this chain has no native kinterm in English, a non-prescriptive system. But what about Tamil? Here we find, either by algebraic reduction or by tracing-out on Figure 10.2 that the leading focus is $X\bar{Y}$. Are we then to conclude that e.g. a Tamilian female speaker would apply the corresponding kinterm *p̂ǰs=machchan* to such a distant relative? Or in Murngin we find, e.g. tracing-out on Figure 16.3b that the leading focus is J, with the kinterm *eb=wawa.* Would ego then apply the kinterm "elder brother" to this remote relative?

Here we encounter the same lack of a definite stopping-place as with consanguineal relations in 2.10, and again we simply assume that a chain of any length will go by the same kinterm as its focal chain. Again our actual information varies from tribe to tribe; for example, the Murngin flatly state that their kinterms are applicable to chains of any length.

11.7 The Tamil system in terms of x and w. We have already seen that the same group can be defined by various sets of generating relations. But it can also have various sets of generators. Up to now we have written the equivalence-rules in terms of X and Y, but for prescriptive systems it is often convenient to rewrite them in terms of $X, \bar{X}, W, \bar{W}$, as may be done by replacing Y with XW and $\bar{Y}$ with $\bar{W}\bar{X}$, as in the kingraph in Figure 11.7, where the dotted lines are husband-wife lines or **spouse-lines**, and $\bar{W}$ may be replaced by W, since ego's wife W and ego's sister's husband are in the same section.

With this change of generators from x and y to x and w we obtain the non-redundant set of equivalence-rules

$$xw=wx, \quad ww=i$$

for Tamil, where the four relations $x\bar{x}=\bar{x}x=\bar{w}w=w\bar{w}=i$ are implied

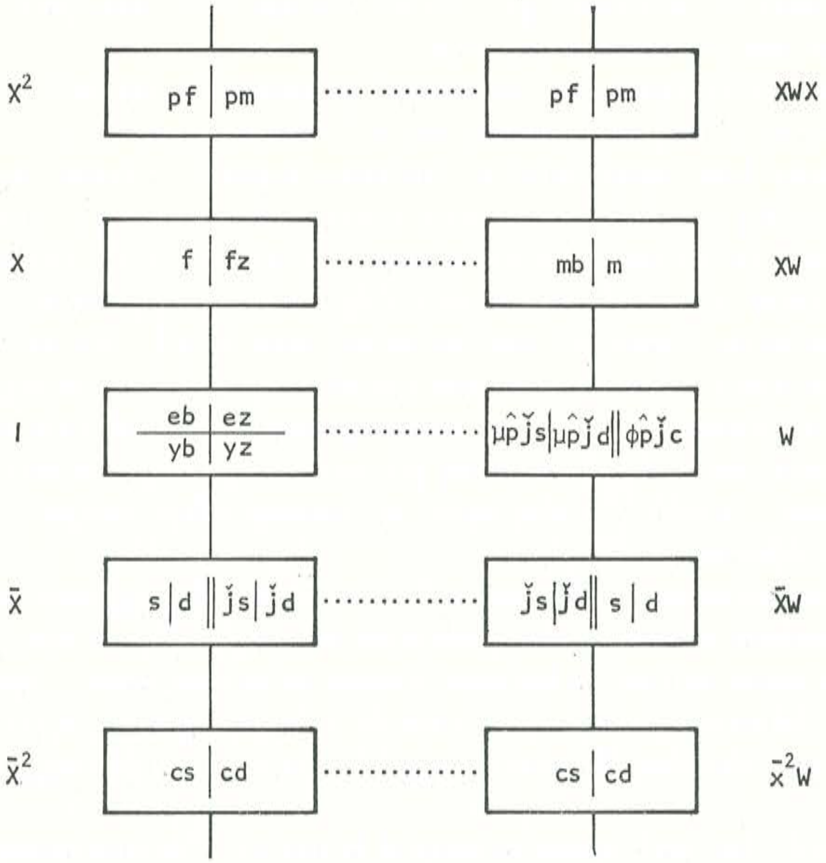


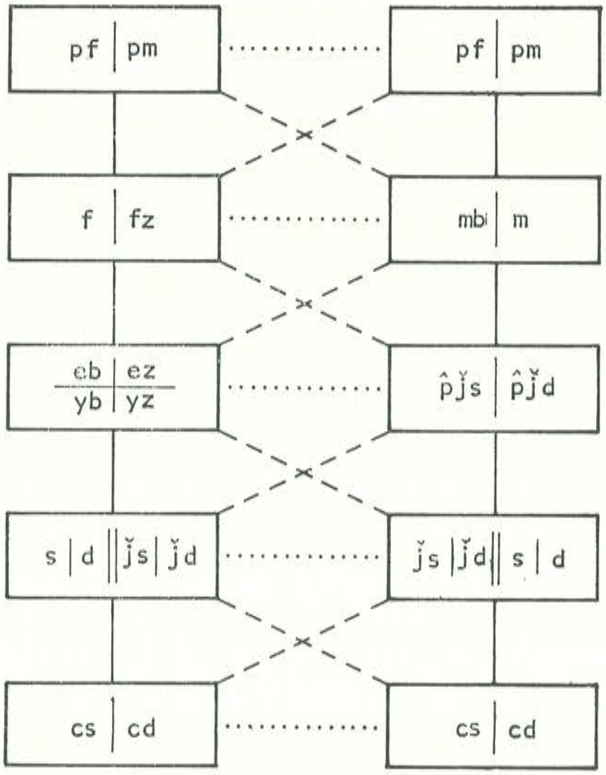
Figure 11.7 Tamil kingraph in terms of $\bar{X}$, X, $\bar{W}$, W.

by our speaking of the system as a group. Since the Dravidian group is commutative with $w^2=i$, every element of the group, i.e. every kinclass of kinchains for the kinship system, can be uniquely expressed in the form x^h or $x^h w$, with h positive, negative or zero. For example, consider the chain $x^4 w^6 \bar{x} \bar{w} \bar{x}$. By commutativity we can bring all the patri-letters x and $\bar{x}$ to the left, obtaining $x^2 w^5$, and then by the rule $w^2=i$, we can write $w^5=(w^2)^2 w=w$, obtaininng $x^2 w$, as desired. Arranging these elements in dictionary order with x preceding w then gives Table 11.7.

11.8 Piro kingraph and kinlist. As an example of a Dravidian system far removed from South India, consider the kingraph in Figure 11.8 for the Piro Indians in eastern Peru.

Table 11. 7 The Dravidian group

Chains	Glosses	Chains	Glosses
i :	*eb/yb, ez/yz*	x^3 :	*pf | pm*
x :	*f | fz*	x^{-3} :	*cs | cd*
x^{-1} :	*s | d || ǰs | ǰd*	x^2w :	*pf | pm*
w :	*µpjs | µpjd || φp̂ǰc* [h | w]	$x^{-2}w$:	*cs | cd*
x^2 :	*pf | pm*	x^4 :	*pf | pm*
x^{-2} :	*cs | cd*	x^{-4} :	*cs | cd*
xw :	*mb | m*	x^3w :	*pf | pm*
$x^{-1}w$:	*ǰs | ǰd || s | d*	$x^{-3}w$:	*cs | cd*
		⋮	⋮



pf | pm	:	*atxiru | axiro*
f | fz	:	*uru | saplo*
mb | m	:	*ukoxiru | unro*
eb | ez / *yb | yz*	:	*yehwaklu | yehwaklo* / *epuru | epuro*
p̂ǰs | p̂ǰd	:	*anuru | meknaxiro*
s | d	:	*hituru | hsitso*
ǰs | ǰd	:	*palikleru | paliklero*
ss | dd	:	*mekahiu | mekahio*

Generation patterns: 24, [2 ii], 3, 5, 2, 2.

Figure 11. 8 Piro kingraph and kinlist.

11. 9 The Taromak-Rukai kinlist The generational systems described in Chapter Seven are non-prescriptive. But there also exist generational prescriptive systems. We choose an example taken from the aboriginal village of Taromak-Rukai on the southeast coast of Taiwan, where the field-worker collected his data (Table 11. 9) in 1963, just six years before the village was destroyed by a typhoon and the resulting fire.

Table 11. 9 Taromak-Rukai Kinlist

Chains	Native kinterms	Field-worker's description
A^n, A^nJ	*naumo*	FF, MF, FFB, MFB, FFF, FFFB etc.
A^n, A^nJ	*kaingo*	FM, MM, FMZ, MMZ, MMM, MMMZ etc.
A, AJ, AJV, VA	*nama*	F, FB, MB, FZH, MZH, HF, WF
A, AJ, AJV, VA	*naina*	M, FZ, MZ, FBW, MBW, HM, WM
J, $AJ\bar{A}$, $A^2J\bar{A}^2$, $A^3J\bar{A}^3$	*taka/aki*	J, FBC, FZC, MBC, MZC and all second and third cousins (non-removed)
$\bar{A}$, $J\bar{A}$, $VJ\bar{A}$, $\bar{A}V$	*lalake*	C, BC, ZC, WBC, WZC, HBC, HZC, SW,
$\bar{A}^n$, $J\bar{A}^n$	*agan*	SS, SD, DS, DD etc.
V	*sakatsikele*	V
VJ, $VAJ\bar{A}$, ···	*sagada*	VJ, VFBC, VFZC, ···, all *taka/aki* with V prefixed
VJV, $VAJ\bar{A}V$, ···	*saleve*	VJV, VFBCV, VFZCV, all *taka/aki* with V prefixed and suffixed

11. 10 Prescribed (classificatory) sister-marriage in Taromak-Rukai. With respect to consanguineal chains the situation in Table 11. 9 is the same as for the generational systems in Chapter Seven; i. e. Taromak-Rukai has the equivalence-rules $X \sim Y$, $J \sim I$. In contrast to these other systems, however, the kinterms for affinal chains show extensive overlap with consanguineal kinterms; e. g. *nama*, *naina* and *lalake* are consanguineal and affinal, as follows:

nama: $X\ (F) \sim X\bar{Y}X\ (FZH) \sim YJ\bar{Y}X\ (MZH) \sim \bar{Y}XX\ (HF) \sim \bar{X}YX\ (WF)$

naina: $Y\ (M) \sim XJ\bar{X}Y\ (FBW) \sim Y\bar{X}Y\ (MBW) \sim \bar{Y}XY\ (HM) \sim \bar{X}YY\ (WM)$

lalake: $\bar{A}$ (C)$\sim\bar{X}Y\bar{X}$ (WBC)$\sim\bar{X}YJ\bar{Y}$ (WZC)$\sim\bar{Y}XJ\bar{X}$ (HBC)$\sim$ $\bar{Y}X\bar{Y}$ (HZC)$\sim\bar{A}\bar{X}Y$ (SW)$\sim\bar{A}\bar{Y}X$ (DH).

Thus the Taromak-Rukai terminology has all the properties listed in 2. 6 as as indications of prescribed marriage with collateral *K*-relative, and the equivalences $X\sim\bar{X}YX$ (WF)$\sim\bar{Y}XX$ (HF) etc. show that in this case we have $\bar{X}Y\sim\bar{Y}X\sim I\sim J$, which means that $K\sim J$, i. e. a male marries his classificatory sister. Unlike the cousin-marriages in other systems, where ego may marry either a true or a classificatory cousin of the prescribed types, sister-marriage means marriage with classificatory sister only, since marriage with true sister, or with any lineal relative, is proscribed by incest-taboos, little understood but inordinately powerful and almost universal. In the Taromak-Rukai case every woman in the same generation as ego is ego's classificatory sister but the field-worker tells us that there is a definite preference for actual second-cousins (non-removed).

11. 11 Kingraph for Taromak-Rukai. From the above information we can draw the kingraph for the Taromak-Rukai system (generational prescriptive) as in Figure 11. 11.

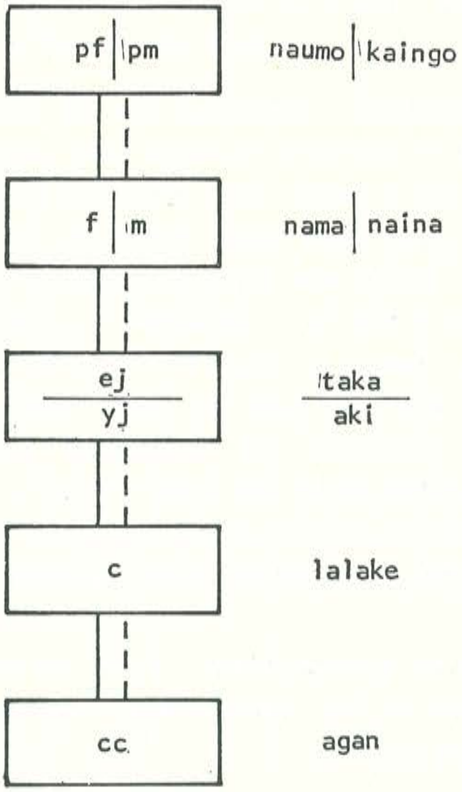
11. 12 The Taromak-Rukai group. Up to now we have stated the Taromak-Rukai generating relations in the form $x\sim y$ ($X\sim Y$), $\bar{x}y\sim\bar{y}x\sim x\bar{x}\sim y\bar{y}\sim i$ ($V\sim J\sim I$). But from these rules we can derive

$$\bar{x}x=\bar{y}y=i;\ \text{e. g.}\qquad \bar{x}x=\bar{x}y\bar{y}x \quad \text{since} \quad y\bar{y}=i$$
$$=i \quad \text{since} \quad \bar{x}y=\bar{y}x=i.$$

Thus the system is a group, and from the above set of rules we may eliminate $xy=yx=i$, as being implied by the others:

$$\text{e. g. } \bar{x}y=\bar{x}x \quad \text{since} \quad y\sim x$$
$$=i \quad \text{since} \quad \bar{x}x=i.$$

Since y may be replaced by x, and y by x, every element in the Taromak-Rukai group can be expressed as a product of powers—positive, negative or zero—of x alone, and since the group has no other generating



Generation patterns: 4, 1, 1, 2, 1

Figure 11. 11 Taromak-Rukai kingraph.

relations it is called the **free group on one generator**, or the **infinite cyclic group**, as represented in Table 11. 12. Here the special affinal kinterms *v*, *vj*, *vjv* must again be put in square brackets (cf. Table 9. 5) because they are rule-equivalent but not coverset-coincident to the sibling kinterms. But they are now written in lower-case letters because the field-worker specifically tells us that they refer to all equivalent affinal chains; as he expresses it "*sakatsikele* refers not only to ego's spouse but also to the spouse of every *taka/aki* of ego."

11. 13 Monoids, infinite groups and finite groups. The two groups considered up to now, namely the Dravidian and the Generational, have an infinite number of elements, i. e. of distinct classes of chains. But there

Table 11. 12 Taromak-Rukai as a group

Kinclasses i. e. elements of the group	Glosses
i :	*ej*/*yj* *v*, *vj*, *vjv*
x :	$f \mid m$
$\bar{x}$:	*c*
x^2:	$pf \mid pm$
$\bar{x}^2$:	*cc*
x^3:	$pf \mid pm$
$\bar{x}^3$:	*cc*
⋮	⋮
x^n:	$pf \mid pm$
$\bar{x}^n$:	*cc*

also exist prescriptive kinship systems with only a finite number of elements, namely the so-called section-systems of Australasia; for example, the Kariera system has four elements, and the Aranda has eight. The number of elements in a binary system is called its **order**. Thus non-prescriptive kinship systems are monoids of infinite order, prescriptive non-sectional systems are groups of infinite order, and section-systems are groups of finite order. Since we have already made the passage from monoids to infinite groups, it would now be natural to proceed to finite groups, but we must first interpolate (Chapter Twelve) an extremely important type of monoids, namely the Crow-Omaha systems, postponed until now because we wished to juxtapose the Seneca and Tamil systems for more convenient discussion of Morgan's attitude toward them.

CHAPTER XII

Crow-Omaha Systems

12. 1 The Omaha skewing rule. The phenomenon of skewing, i. e. of using the same kinterms in successive generations, occurs throughout the world. In many systems the skewing may perhaps be explained on the ground that when a father dies his daughters look to their oldest brother for the protection and advice formerly provided by their father, so that from the point of view of their children an MB (uncle) becomes equivalent to an MF (grandfather), and inversely nephew | niece becomes equivalent to grandson | granddaughter. In Old English, for example, the kinterm *eam* meant not only "maternal uncle" but also "maternal grandfather", and the reciprocal terms *nefa* | *nift* meant not only "nephew | niece", as in modern English, but also "grandson | granddaughter". Similarly, the Latin word *avunculus* (uncle) meant a smaller, i. e. younger, *avus* (grandfather), the idea of smallness being indicated by the diminutive ending *-culus*, as in "homunculus" or "animalcule".

In other words, ego's MB (uncle) regards his sister, ego's M (mother), as though she were his (the uncle's) daughter and therefore ego's MBD, a situation which in many systems has led to terminological identification of MBD and M; e. g. in the Omaha tribe in Nebraska MBD and M are both *enaha*. Thus we have $YJ\bar{X}\phi \sim Y$, suggesting the equivalence-rule $Y\bar{X} \sim Y$, where again $Y\bar{X}$ is written for $YJ\bar{X}$, as in 9. 3.

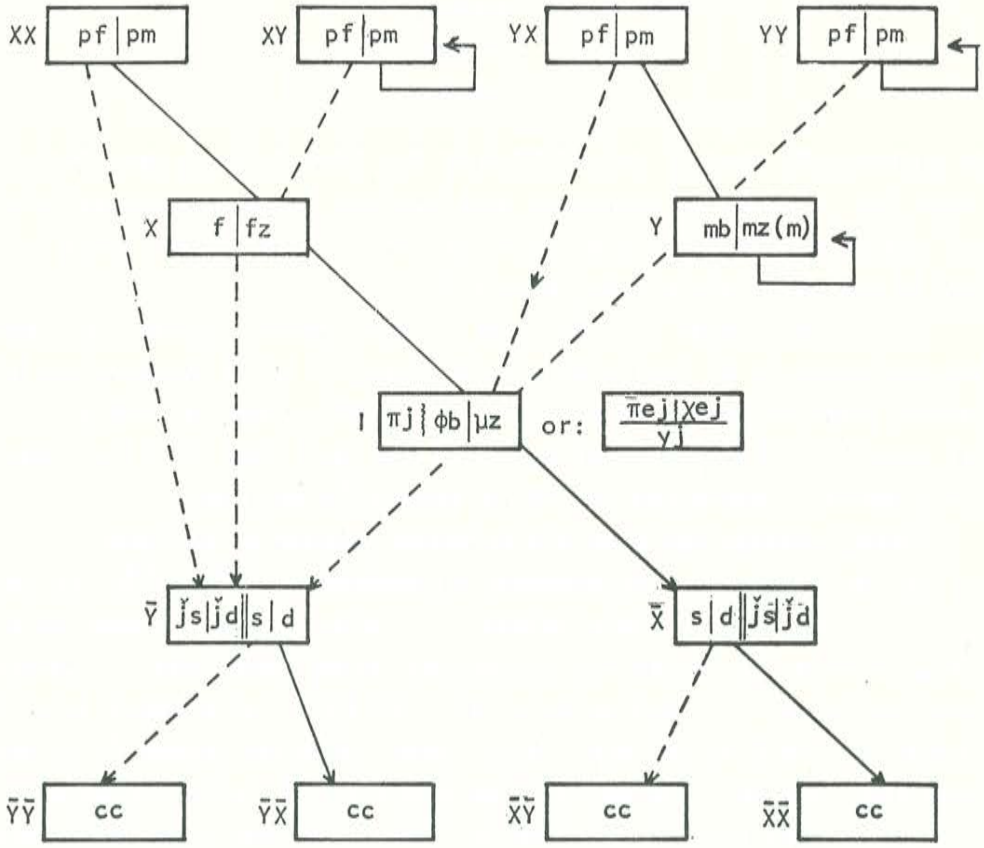
The equivalence $Y\bar{X} \sim Y$, together with its inverse $X\bar{Y} \sim \bar{Y}$, is called the **Omaha skewing rule** because it "skews" the generations by equating the kinterm for $Y\bar{X}$ (MBD) in generation G_0 with the kinterm for Y (mother) in G_1; and a kinship system that has such a rule is said to be of Omaha type.

12. 2 Fox kinlist and kingraph. As a standard example for a system of Omaha type we consider the Fox Indians in Iowa, the 51st of Morgan's 77 Ganowanian tribes. The information in Table 12. 2 is taken from Tax [1937].

Table 12. 2 Data for the Fox Indians

Glosses	Native kinterms	Examples
$pf \mid pm$	*nemeco* $\mid$ *nogomes*	AA, AAJ, $AYJ\bar{X}$, $AYJ\bar{X}\bar{X}$, $AYJ\bar{X}\bar{X}\bar{X}$, $AYJ\bar{X}\bar{X}\bar{X}\bar{X}$, $\cdots$
$f \mid fz$	*nos* $\mid$ *nesegwis*	X, XJ, $XXJ\bar{X}$, $XYJ\bar{Y}$,
$mb \mid mz \ (m)$	*necisa* $\mid$ *negi* (*negy*)	(Y), YJ, $YXJ\bar{X}$, $YYJ\bar{Y}$, $YJ\bar{X}$, $YJ\bar{X}\bar{X}$, $YJ\bar{X}\bar{X}\bar{X}$, $\cdots$
$\hat{j} \} \phi b \mid \mu z$ or: $\dfrac{\pi ej \} \chi ej}{\upsilon j}$	*netotam* } *netewam* $\mid$ *netegwam* $\dfrac{\textit{nesese} \} \textit{nemise}}{\textit{nesime}}$	J, $XJ\bar{X}$, $YJ\bar{Y}$, $XXJ\bar{X}\bar{X}$, $XYJ\bar{Y}\bar{X}$, $YXJ\bar{X}\bar{Y}$, $YYJ\bar{Y}\bar{Y}$, $YJ\bar{X}\bar{Y}$, $YJ\bar{X}\bar{X}\bar{Y}$, $YJ\bar{X}\bar{X}\bar{X}\bar{Y}$, $YXJ\bar{Y}$, $YXXJ\bar{X}\bar{Y}$, $\cdots$
$s \mid d$	*negwis* $\mid$ *netanes*	$\bar{A}$, $\phi J\bar{Y}$, $\phi XJ\bar{Y}$, $\phi XXJ\bar{X}\bar{Y}$, $\phi XXJ\bar{Y}$, $\phi XYJ\bar{Y}\bar{Y}$, $\phi XYJ\bar{X}\bar{Y}\bar{Y}$, $\phi YJ\bar{Y}\bar{Y}$, $\phi YJ\bar{X}\bar{Y}\bar{Y}$, $\phi YXJ\bar{Y}\bar{Y}$, $\phi YYJ\bar{Y}\bar{Y}\bar{Y}$, $\phi YYJ\bar{X}\bar{Y}\bar{Y}\bar{Y}$, $\mu J\bar{X}$, $\mu XJ\bar{X}\bar{X}$, $\mu YJ\bar{Y}\bar{X}$, $\mu YXJ\bar{X}\bar{Y}\bar{X}$, $\mu YJ\bar{X}\bar{Y}\bar{X}$, $\mu YJ\bar{X}\bar{X}\bar{Y}\bar{X}$, $\mu YXJ\bar{Y}\bar{X}$, $\mu YYJ\bar{Y}\bar{Y}\bar{X}$, $\mu YYJ\bar{X}\bar{Y}\bar{Y}\bar{X}$, $\cdots$
$\check{j}s \mid \check{j}d$	*nenegwa* $\mid$ *necemi*	same as for $s \mid d$ with change of sex of speaker
cc	*nocisem*	$\bar{A}\bar{A}$, $J\bar{A}\bar{A}$, $XJ\bar{Y}\bar{A}$, $XXJ\bar{Y}\bar{A}$, $\cdots$

From the chains in the right-hand column we deduce the set of equivalence-rules: $J \sim I$, $X\bar{Y} \sim \bar{Y}$, which characterize the Omaha type and enable us to draw the kingraph as in Figure 12. 2. Here the G_2-generation must be split into four boxes because of the differences in its immediate descendants, and the G_0-generation has only one box because cross-cousins have been absorbed into other generations, the patrilateral cross-cousins $X\bar{Y}$ moving downward into G_{-1} and the matrilateral $Y\bar{X}$ upward into G_1. Since Figure 12. 2 shows no collateral path from the X-box to the Y-box, the Fox terminology is non-prescriptive.



Equivalence-rules: J∼I, XȲ∼Ȳ, YX̄∼Y

Generation patterns: 7 or 13, 3 (*m*), 5, 2, 1

Figure 12. 2 Fox kingraph, of Omaha type.

12. 3 Tracing-out on an Omaha kingraph. In Figure 12. 2, as in any kingraph, algebraic equivalences are geometrically represented by alternative paths between boxes. Thus the equivalence-rule XȲ∼Ȳ is represented by the two paths XȲ and Ȳ from the I-box to the Ȳ-box. The XȲ-path runs up the patriline to the X-box and then down the matriline to the Ȳ-box, while the Ȳ-path runs directly down to the same Ȳ-box in one step.

Or again, the equivalence XXJȲ∼Ȳ can be verified either algebraically as follows:

$XXJ\bar{Y} \sim XX\bar{Y}$	because	$J \sim I$
$\sim X\bar{Y}$	because	$X\bar{Y} \sim \bar{Y}$
$\sim \bar{Y}$	because	$X\bar{Y} \sim \bar{Y}$,

or geometrically because the $XXJ\bar{Y}$-path first takes us up to the XX-box, where the J leaves us motionless and then the $\bar{Y}$-matriline carries us at one step three generations down from the XX-box to the $\bar{Y}$-box, which can also be reached by the alternative path $\bar{Y}$.

As a third example, the fact that a male speaker applies the same kinterm *netanes* to his MFMZDSD (third cousin) as to his daughter can be verified either by tracing-out the chain MFMZDSD or else by writing it in the form $\mu YXYJ\bar{Y}\bar{Y}\bar{X}\phi$ and then cancelling first the J, then the $Y\bar{Y}=J$, then the X before $\bar{Y}$ and finally the $Y\bar{Y}=J$, leaving $\bar{X}\phi$ (daughter).

Finally, consider the effect of a re-entrant patriline of the form $| \leftarrow |$, say for the Y-box, where it represents the equivalences $Y\bar{X} \sim Y\bar{X}\bar{X} \sim Y\bar{X}\bar{X}\bar{X} \sim \cdots$, i. e. MB$\sim$MBS$\sim$MBSS$\sim$MBSSS$\sim\cdots$, with the same kinterm *necisa* for ego's uncle, first-cousin, first-cousin-once, twice, three-times... removed down and so on. For such a chain, say $Y\bar{X}\bar{X}\bar{X}\bar{X}\bar{X}$, the algebraic method cancels the first $\bar{X}$ by the rule $Y\bar{X} \sim Y$, then cancels the second $\bar{X}$ by the same rule, then the third etc., arriving finally at $Y\bar{X}$, while the geometric method goes first from the I-box to the Y-box and then circles harmlessly around the re-entrant patriline, remaining constantly in the same box.

Both methods answer the basic question of recurrence of kinterm-coversets for strings. The geometric method, beginning at the left and proceeding step by step to the right, is quicker than the algebraic method, which begins in the certer and proceeds in both directions. On the other hand, the algebraic method applies equally well to chains of any length, whereas the geometric method may become unclear for chains rising into higher generations beyond the diagram.

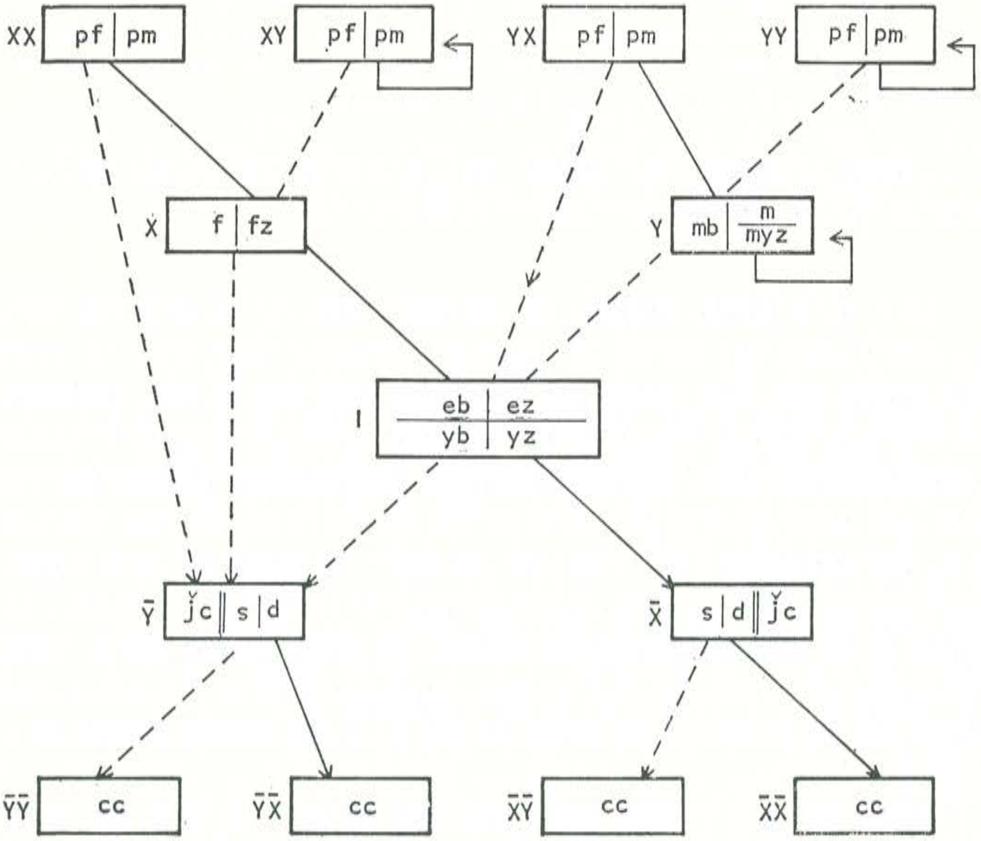
12. 4 An entertaining passage from Morgan. The fact that the same kinterm *necisa* applies to infinitely many successive generations was a source of amusement to Morgan. In an entertaining passage in *Systems* ..., p. 179, he writes:

> there is no doubt whatever of the actual existence and daily recognition of these relationships, novel as they are. ...I first discovered this deviation while working out the system of the Kaws in Kansas in 1859. The Kaw chief...insisted on it against all doubts and questionings. ...Afterwards in 1860, at the Iowa reservation in Nebraska, [my adult informant] pointed out a boy near us, and remarked that the boy was his uncle, and the son of his mother's brother, who was also his uncle.

Morgan summarizes his feelings with the words "under this system a new-born infant becomes the uncle of a centenarian."

12. 5 Four Omaha subtypes. In the Fox system, as we have just seen, the role of ego's MF but not the kinterm (*nemeco*) is taken over by ego's MB (*necisa*). In some systems the kinterm is taken over as well, producing the string-coincidence $YX \sim YJ\mu$, and therefore also the reciprocal string-coincidence $\bar{X}\bar{Y} \sim \mu J\bar{Y}$. For example, in the Wintu system YX and $YJ\mu$ are both *ape*, which we have glossed as *pf* because YX is shorter than $YJ\mu$ (cf. 3. 6), and reciprocally $\bar{X}\bar{Y}$ and $\mu J\bar{Y}$ are both *tai*, which we have correspondingly glossed as *cc*. These statements can be verified by tracing-out on Figure 12. 5c; e. g. to find the box for $\mu J\bar{Y}$ we at first ignore the μ, since tracing-out refers only to chains, then remain motionless for the J and finally descend to the $\bar{Y}$-box, where we find *cc* as the kinterm applied by a male speaker.

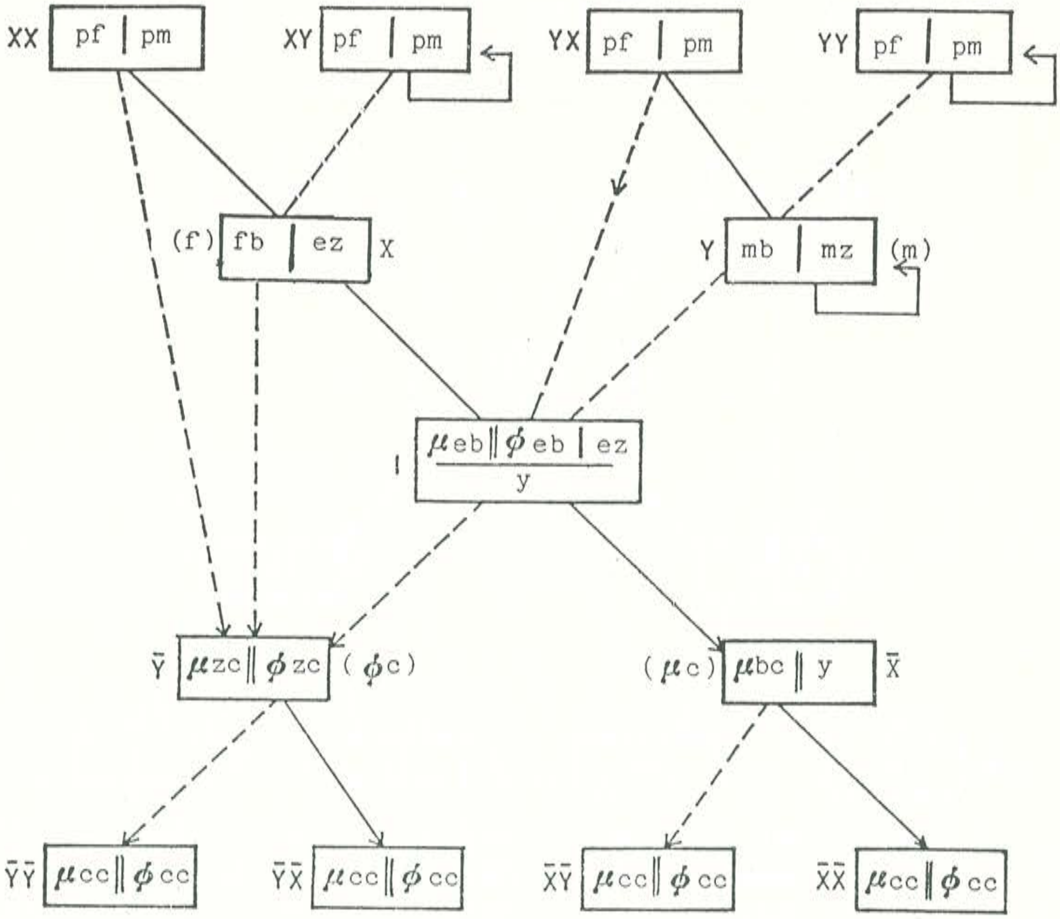
Again, just as a Fox ego regards his MB as an uncle who has taken over the role but not the kinterm of ego's MF, so ego's mother will regard him (ego's MB) as a brother who has taken over the role but not the kinterm of father, so that his sisters, who are also the mother's sisters, appear to ego's mother as persons who have taken over the role of father's sisters but have retained the kinterm for sisters. But in some systems they take over the kinterm for FZ as well, producing the string-coincidence $XJ\phi \sim J\phi$, and therefore the reciprocal coincidence $\phi J\bar{X} \sim \phi J$. For example, in Wintu (see again Figure 12. 5c) $XJ\phi$ and $Je\phi$ are both *hutuntce*, to be glossed as *ez* (elder sister), while $\phi J\bar{X}$ and ϕJ are both *lane*, to be glossed as *yj* (younger sibling), where *ez* naturally goes into the higher generation and *yj* into the lower.



pf	:	*papa*	*mb*	:	*kaka*	*s*	:	*kotco*
pm	:	*ama*	*eb*	:	*tatei*	*d*	:	*tune*
f	:	*upu*	*ez*	:	*tete*	*ǰc*	:	*upsa*
fz	:	*ene*	*yb*	:	*iti*	*cc*	:	*atce*
m=mez	:	*ami*	*yz*	:	*uta*			
myz	:	*anisu*						

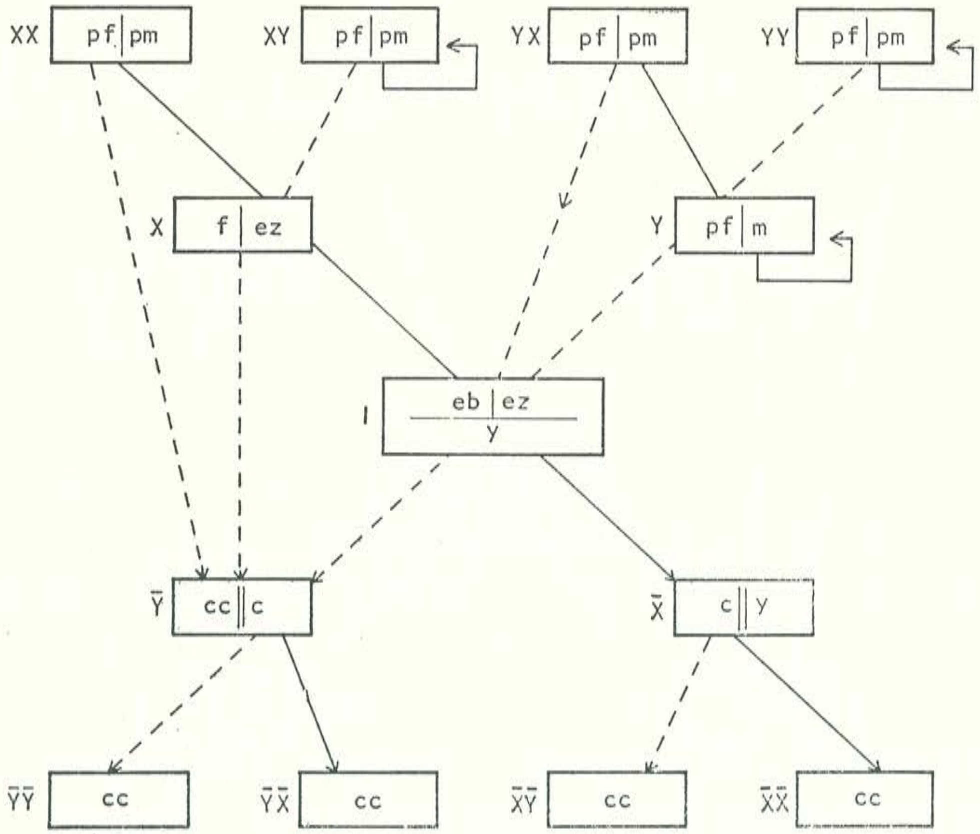
Generation patterns: 24, 3(irregular), 3, 2, 1.

Figure 12. 5a Southern Miwok kingraph, subtype Omaha I.



pf | *pm*	:	*maw* | *hawan*
(*f*) *fb* | *fz*	:	(*tat*) *tabun* | *wis*
mb | *mz* (*m*)	:	*ican* | *mehun* (*smetik*)
μeb || *φeb* | *ez* / *y*	:	*bukcl* || *sclel* | *wis* / *ihcin*
(*μc*) *μbc* || *φbc*	:	(*nican*) *uicnn* || *yal*
μzc || *φzc* (*φc*)	:	*ican* || *ihciu* (*al*)
μcc || *φcc*	:	*mam* || *yal*
Generation patterns:		26, 3(f, m), 7(μc,φc), 2, 3.

Figure 12. 5b Tzeltal kingraph, subtype Omaha II.



pf	:	*ape*	*m*	:	*nake*	*y*	:	*iane*
pm	:	*amake*	*eb*	:	*labe*	*c*	:	*de*
f	:	*dantce*	*ez*	:	*hutuntce*	*cc*	:	*tai*

Generation patterns: 12, 3, 7, 2, 1

Figure 12. 5c Wintu kingraph, subtype Omaha IV.

These additional string-coincidences may be listed as follows:

i) $XJ\phi \sim J\phi$ and $\phi J\bar{X} \sim \phi J$; i. e. paternal aunt equals elder sister (*fz=ej*) and reciprocally female speaker's fraternal nephew | niece equals sibling.

ii) $YX \sim YJ\mu$ and $\bar{X}\bar{Y} \sim \mu J\bar{Y}$; i. e. maternal uncle equals grandfather (*mb=mf*) and reciprocally male speaker's sororal nephew | niece equals grandchild.

Then Lounsbury distinguishes the following four Omaha subtypes (still others exist; cf. 12. 8):

Omaha I, with neither i) nor ii);
Omaha II, with i) but not ii);
Omaha III, with ii) but not i);
Omaha IV, with both i) and ii).

Figure 12. 5a, b, c give examples of Omaha I, II and IV. The Fox system would also serve for Omaha I, and the Latin and Old English for Omaha III (cf. 12. 1).

12. 6 Wintu cousins again. From the field-worker's remarks on Wintu we can extract the following information:

Table 12. 6a Kinchains for Wintu

<table>
<tr><th>Kinterms</th><th></th><th>Kinchains</th></tr>
<tr><td>labe | hutuntce
lane</td><td>:</td><td>J, XJX̄, YJȲ, YJX̄Ȳ, YXJȲ, XÂJÂ̂X, YÂJÂ̂Ȳ,
XÁÂJÂ̂ẤX̄, YÁÂJÂ̂ẤȲ</td></tr>
<tr><td>ape | nake</td><td>:</td><td>YJ, YJX̄", YÂJÂ̂X̄, YÁÂJÂ̂ẤX̄, AYJX̄X̄, YYJX̄Ȳ</td></tr>
<tr><td>tai || de</td><td>:</td><td>XJȲ, XÂJÂ̂Ȳ, XÁÂJÂ̂ẤȲ, XXJȲĀ, YXJȲȲ</td></tr>
<tr><td>dantce | hutuntce</td><td>:</td><td>XJ, XYJX̄Ȳ</td></tr>
<tr><td>tai || lane</td><td>:</td><td>μJȲ, ϕJX̄</td></tr>
<tr><td>de || lane</td><td>:</td><td>YXJȲX̄</td></tr>
<tr><td>de</td><td>:</td><td>μJX̄, ϕJȲ</td></tr>
<tr><td>tai</td><td>:</td><td>XJȲĀ"</td></tr>
</table>

If we arrange the sixteen possible cross-second-cousins as in the following list, in which each of the eight unreduced chains represents two cousins, brother and sister to each other, the truth of the statements in 2. 7 can be verified by simple counting; e. g. for a speaker of either sex *ape* occurs three times in the list, *amake* twice etc., for a male speaker *tai* occurs six times, and *hutuntce* once, and for a female speaker *tai* occurs four times, *hutuntce* twice and *labe* once.

Table 12. 6b Wintu second-cousins

Unreduced kinchain	First reduction	Reduction to focal kintype	Native coverset
$XX\bar{Y}\bar{X}$	$X\bar{Y}\bar{X}$	$\bar{Y}\bar{X}$	*tai* | *tai*
$XX\bar{Y}\bar{Y}$	$X\bar{Y}\bar{Y}$	$\bar{Y}\bar{Y}$	*tai* | *tai*
$XY\bar{X}\bar{X}$	$XY\bar{X}$	XY	*ape* | *amake*
$XY\bar{X}\bar{Y}$	$XY\bar{Y}$	X	*dantce* | *hutuntce*
$YX\bar{Y}\bar{X}$	$Y\bar{Y}\bar{X}$	$\bar{X}$	*de* | *de* ‖ *labe* | *hutuntce*
$YX\bar{Y}\bar{Y}$	$Y\bar{Y}\bar{Y}$	$\bar{Y}$	*tai* | *tai* ‖ *de* | *de*
$YY\bar{X}\bar{X}$	$YY\bar{X}$	YY	*ape* | *amake*
$YY\bar{X}\bar{Y}$	$YY\bar{Y}$	Y	*ape* | *nake*

The native coversets in the right-hand column can be determined either algebraically from the equivalence rules or else geometrically, i. e. each of the chains in the left-hand column can be traced-out on the kingraph in Figure 12. 5c.

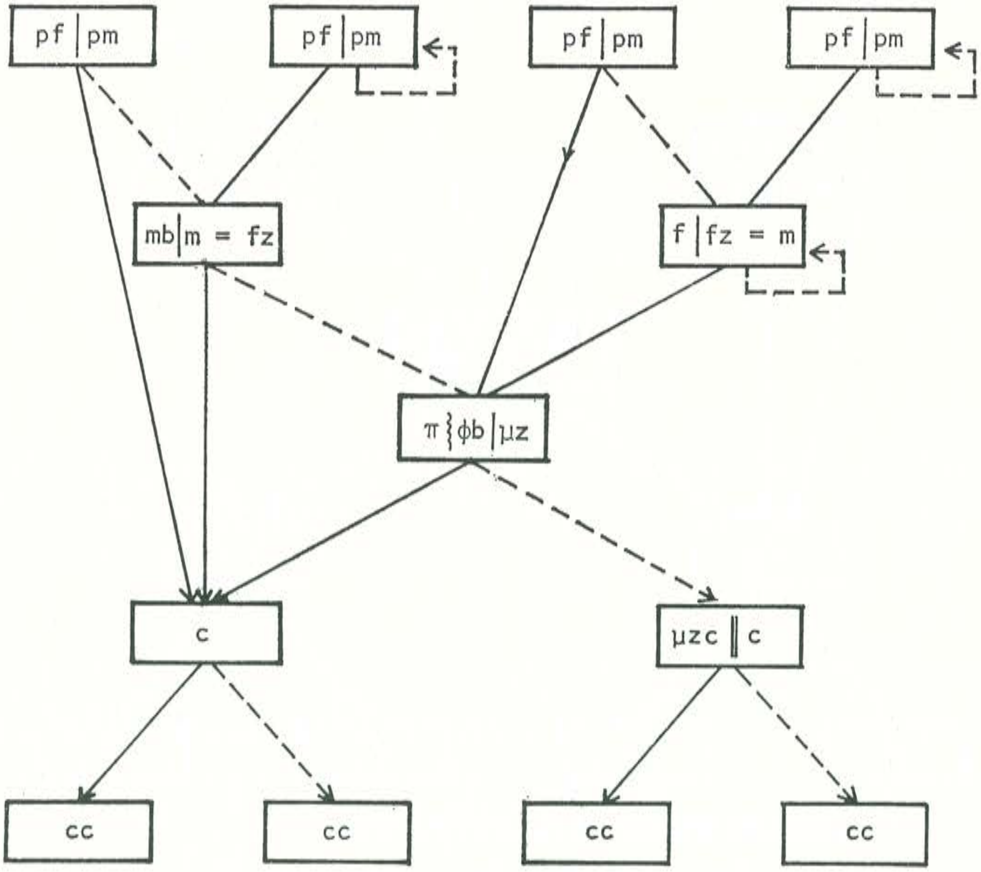
12. 7 The Crow skewing rule. A kinship system with the equivalence-rules $X\bar{Y} \sim X$, $Y\bar{X} \sim \bar{X}$ obtained by interchanging the roles of X and Y in the Omaha rules $Y\bar{X} \sim Y$, $X\bar{Y} \sim \bar{Y}$ (12. 2) is said to be of the **Crow type.** Then the corresponding additional string-coincidences (cf. 12. 5) are:

i) $YJ\mu \sim J\mu$ and $\mu J\bar{Y} \sim \mu J$; maternal uncle equals elder brother (*mb*= *ej*) and reciprocally male speaker's sororal nephew | niece equals sibling.

ii) $XY \sim XJ\phi$ and $\bar{Y}\bar{X} \sim \phi J\bar{X}$; paternal aunt equals grandmother (*fz*= *pm*) and reciprocally female speaker's fraternal nephew | niece equals grandchild.

Here again Lounsbury distinguishes four subtypes:

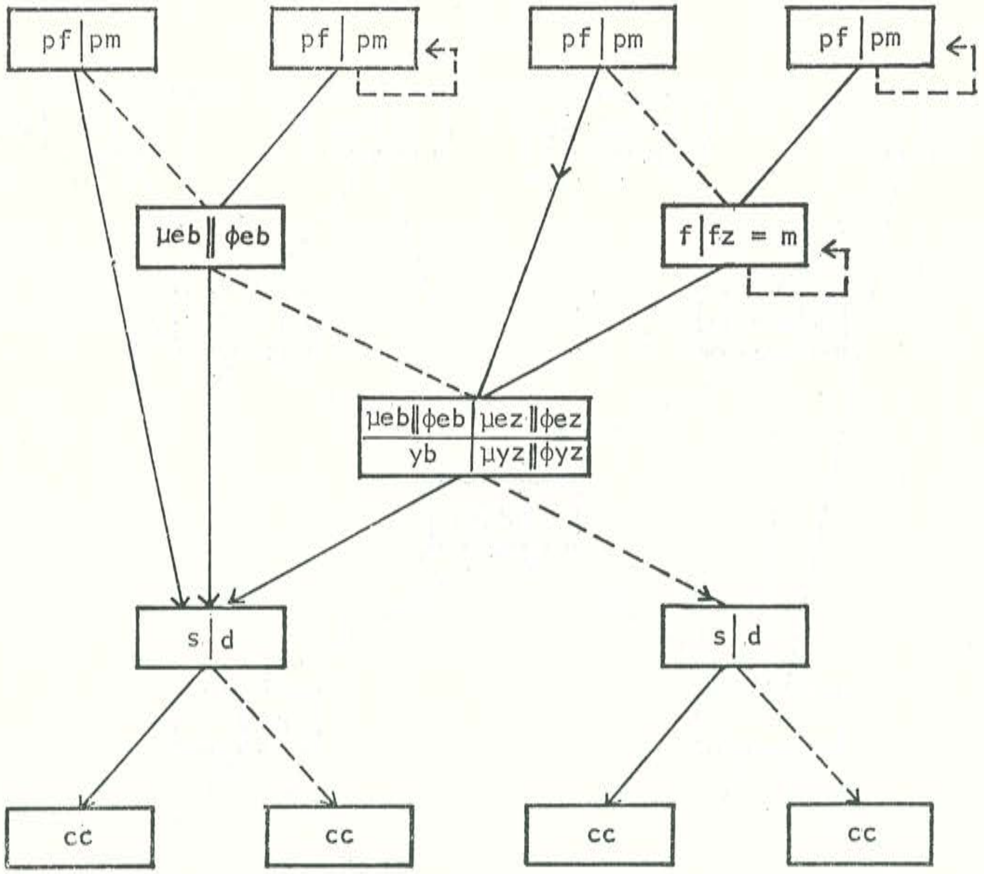
Crow I, with neither i) nor ii): see Figure 12. 7a;
Crow II, with i) but not ii): see Figure 12. 7b;
Crow III, with ii) but not i): see Figure 12. 7c;
Crow IV, with both i) and ii).



pf | *pm*	:	*atipat* | *atika*
f | *fz=m*	:	*atias* | *atira*
mb | *m=fz*	:	*tiwatsiriks* | *atira*
π } *ϕb* | *μz*	:	*irari* } *iratsti* | *itakri*
c	:	*pirau*
μzc	:	*tiwat*
cc	:	*raktiti*

Generation patterns: 7, 3(fz=mz), 1(irregular), 2, 1.

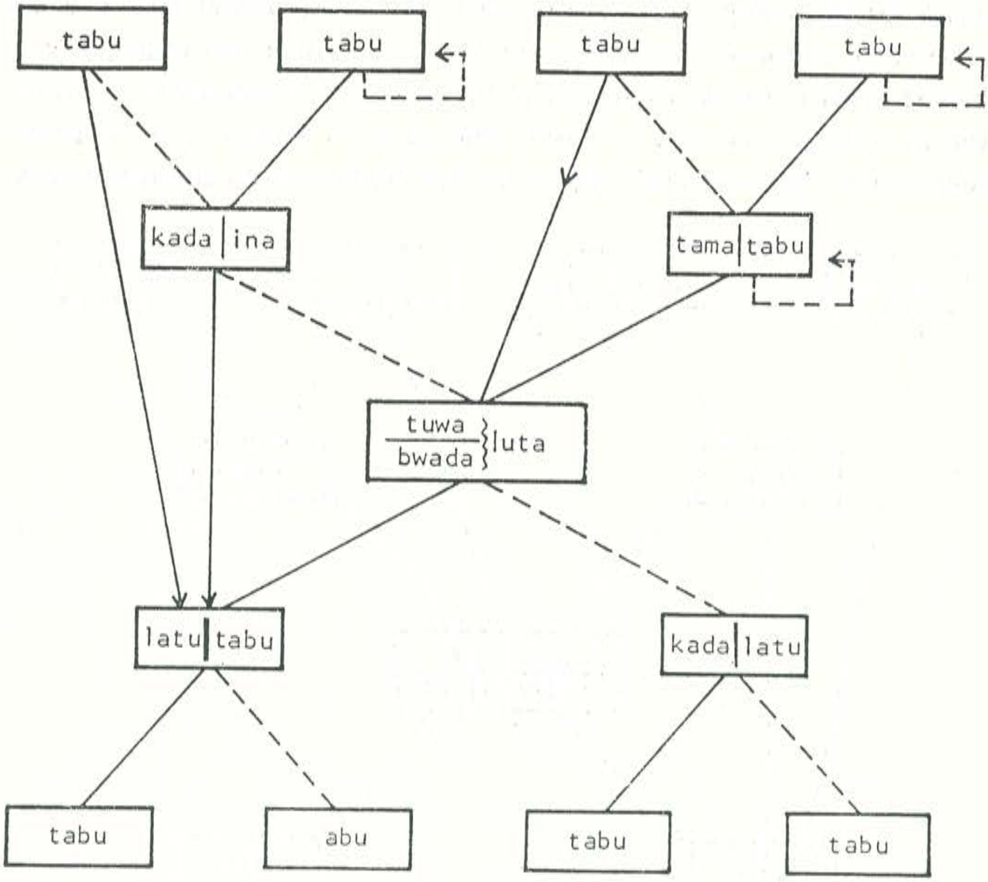
Figure 12. 7a Republican Pawnee kingraph. subtype Crow I.



Generation patterus: 49, 3(irregular), 2, 2, 1.

Figure 12. 7b Crow kingraph, subtype Crow II.

12. 8 Other systems. It will be noted that the definitions of Crow I and Omaha I are purely negative; i. e. they do not involve the additional string-coincidences. Under each of these subtypes I it would be possible to set up a large number of further subtypes. For example, we might distinguish between "bifurcate" systems, with $fb \neq mb$, $fz \neq mz$, and "semi-bifurcate" with say $fb \neq mb$ but $fz = mz = m$ as in Republican Pawnee (Figure 12. 7b), or Hopi (Figure 12. 8); or between those systems in which the cut-off rules (no new kinterms outside the five central generations) are strictly obeyed and those which allow certain exceptions; e. g. the Republican Pawnee system



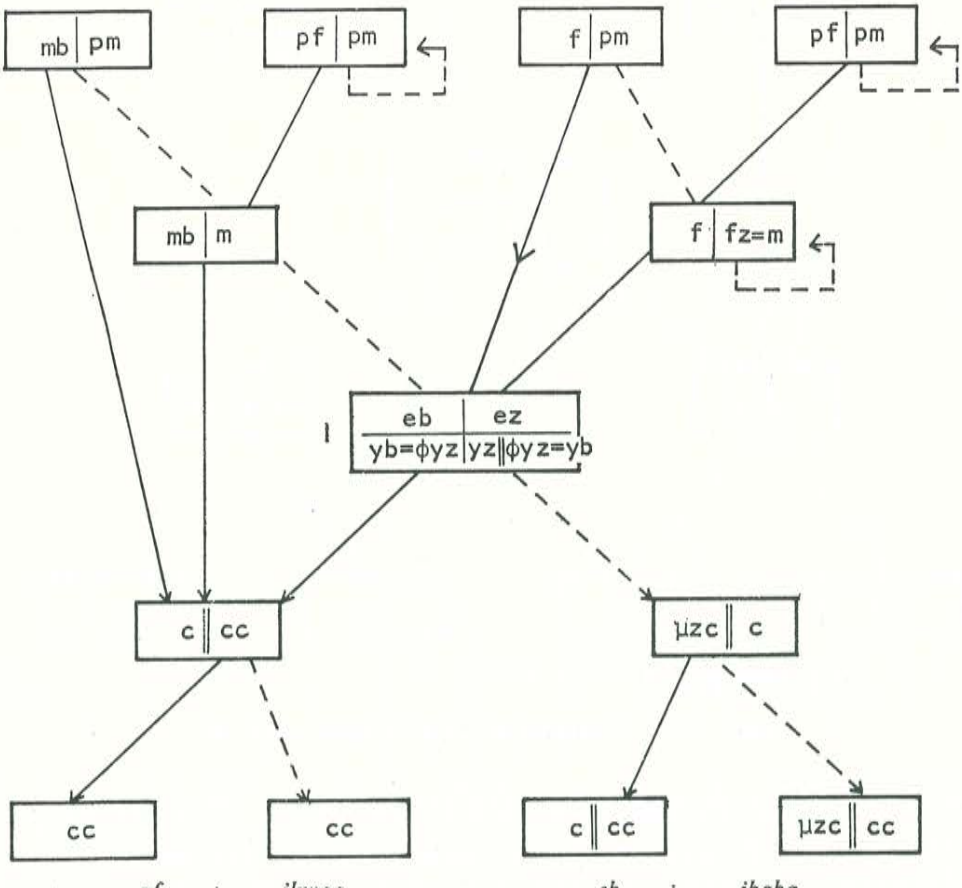
Generation patterns: 5, 3, 7, 1, 1.

Figure 12.7c Trobriand kingraph, subtype Crow III.

has certain strange three-generation cyclings like $X^{n+3}=X^n$, which are probably remnants of some earlier prescribed marriage but have not been satisfactorily explained. Or again in the above classification the system of the Hopi Indians in the Arizona Pueblos (Figure 12.8) belongs to Crow I, since it has neither of the two sets of string-coincidences necessary to qualify it for Crow II, III, IV. But it does have two other pairs of coincidences (see Figure 12.8).

i) $YY\mu \sim Y\mu$ and reciprocally $\mu\bar{Y}\bar{Y} \sim \mu\bar{Y}$,

ii) $XY\mu \sim X\mu$ and reciprocally $\mu\bar{Y}\bar{X} \sim \mu\bar{X}$, which should qualify it for the title Crow V. In the present text, intended to serve as a general introduction to the classification and cataloguing of kinship systems, we cannot discuss all the numerous ramifications of Crow-Omaha systems. In spite of their differences of subtype, i. e. of string-equivalences, they are bound together by their characteristic equivalence-rules:



pf :	*ikwaa*	*eb* :	*ibaba*
pm :	*isoo*	*ez* :	*ieqoqa*
f :	*inaa*	*yb*=*φyz* :	*itopque*
fz :	*ikaa*	*μyz* :	*iciwa*
mb :	*itaha*	*μzc* :	*itiwaaya*
m :	*inao*	*c* :	*iti*
		cc :	*imoyi*

Generation patterns: 39 (irregular), 3, 7, 2(irregular), 1(irregular).

Figure 12. 8 Hopi kingraph, of Crow type.

$X\bar{Y} \sim X$, $Y\bar{X} \sim \bar{X}$ for the Crow type, in which the matriletters Y, $\bar{Y}$, are cancelled and $Y\bar{X} \sim Y$, $X\bar{Y} \sim \bar{Y}$ for the Omaha type, in which the patriletters X, $\bar{X}$ are cancelled, thereby skewing the generations. We recommend to our readers the problem of cataloguing these subtypes.

More generally, now that we are on the point of passing to systems of a radically different kind, namely the Australasian section-systems, we must regretfully point out that we have also paid no attention to certain non-sectional systems that cannot easily be fitted into our present scheme of equivalence-rules. For example, we have said nothing about the Chinese system, which is bifurcate, i. e. does not have the rule $X \sim Y$, and non-merging, i. e. does not have the rule $J \sim I$. We hope that others will find our formal (X, Y)-notation to be useful in cataloguing these systems as well.

CHAPTER XIII

Kariera Sectional Relations; Permutation-Groups

13. 1 Personal and sectional relations. Up to now recurrences of personal kinterms have been described by assigning linking chains to classes in the given terminology, i. e. in a partition of the set of all chains, the classes themselves being elements of a monoid or group. For Australasian section-systems our purpose remains the same, namely to describe recurrences of personal kinterms, but our procedure is different. We first give an account of relations among sections, which is then utilized to describe recurrence of kinterms among personal relations.

13. 2 The four Kariera sectional relations. The Kariera tribe is divided into two unnamed moieties. In one moiety the two sections (2. 16) are named **Burung** and **Karimera**, where for convenience we may take Burung to be the even section, i. e. consisting of the even-numbered generations, and in the other moiety they are named **Banaka** and **Palyeri,** where we take Banaka to be the even section. We often abbreviate these names to their first three letters Bur, Kar, Ban, Pal.

Since Bur and Kar are sets of alternate patrigenerations, the fathers of all persons in Bur are in Kar and the fathers of all persons in Kar are in Bur. So we may say that Kar is in the "sectional father-relation" to Bur and conversely, and similarly for Ban and Pal. Then just as the personal father-relation X is the set of pairs (a, b) of persons in U such that b is the father of a, so the sectional father-relation for the set of four sections Bur, Kar, Ban and Pal is the set of pairs (Bur, Kar), (Kar, Bur), (Ban, Pal), (Pal, Ban), such that the second member of each pair is the father-section of the first member.

Thus the sectional father-relation replaces each of the four sections by its father section, i. e. by the section directly underneath it in the following array, which we denote by lower-case x in analogy with our notation x for the set of all personal chains equivalent to the personal father-relation X:

$$x: \begin{pmatrix} \text{Bur} & \text{Kar} & \text{Ban} & \text{Pal} \\ \text{Kar} & \text{Bur} & \text{Pal} & \text{Ban} \end{pmatrix};$$

or as we may say, the father-relation "rearranges" the sections.

Similarly the lower-case letter i will **denote the sectional-identity array.**

$$i: \begin{pmatrix} \text{Bur} & \text{Kar} & \text{Ban} & \text{Pal} \\ \text{Bur} & \text{Kar} & \text{Ban} & \text{Pal} \end{pmatrix}$$

in which every section is replaced by itself. This array may also be called the (sectional) sibling-relation, since ego is in the same section with ego's siblings.

The marriage-rules of the Kariera tribe state that Bur and Ban exchange wives, and also Kar and Pal, from which it follows that Pal is mother to Bur and conversely, and similarly for Ban and Kar. The natives themselves express these rules by saying:

Burung is father to Karimera and conversely
Banaka is father to Palyeri and conversely
Burung is mother to Palyeri and conversely
Karimera is mother to Banaka and conversely
Burung is wife to Banaka and conversely
Karimera is wife to Palyeri and conversely

Denoting the sectional mother-relation by y and the sectional wife-relation by w we thus have the set of four permutations;

$$i: \begin{pmatrix} \text{Bur} & \text{Kar} & \text{Ban} & \text{Pal} \\ \text{Bur} & \text{Kar} & \text{Ban} & \text{Pal} \end{pmatrix}$$

$$x: \begin{pmatrix} \text{Bur} & \text{Kar} & \text{Ban} & \text{Pal} \\ \text{Kar} & \text{Bur} & \text{Pal} & \text{Ban} \end{pmatrix}$$

$$y: \begin{pmatrix} \text{Bur} & \text{Kar} & \text{Ban} & \text{Pal} \\ \text{Pal} & \text{Ban} & \text{Kar} & \text{Bur} \end{pmatrix}$$

$$w: \begin{pmatrix} \text{Bur} & \text{Kar} & \text{Ban} & \text{Pal} \\ \text{Ban} & \text{Pal} & \text{Bur} & \text{Kar} \end{pmatrix}.$$

Since the men in Burung give their (classificatory) sisters (i. e. the women in Burung), as wives to the men in Banaka and conversely, and similarly for Karimera and Palyeri, the natives refer to the system as "sister-exchange marriage", although it might equally well be called "daughter-exchange" (cf. 16. 12), since e. g. the men in Burung give their daughters, i. e. the women in Karimera, as wives to the men in Palyeri and conversely.

13. 3 Permutation-groups. Each of the four sectional relations i, x, y, w is seen to be a rearrangement of the four sections, a concept which we now wish to develop more generally, for use with other Australasian section-systems.

Let U be a finite set of n elements $a_0, a_1, \cdots, a_{n-1}$ of any kind, and consider the operation of replacing each element a_i by an element a_j in such a way that no two elements are replaced by the same element. This operation may be described by writing the elements of U in any desired arrangement and then writing under each a_i the element a_j by which a_i is replaced. For example, if U is the set of four integers 1, 2, 3, 4 and if the operation, call it P, consists of replacing 1 by 2, 2 by 3, 3 by 4, and 4 by 1, we may describe P in the form

$$P = \begin{pmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 1 \end{pmatrix} \quad \text{or} \quad P = \begin{pmatrix} 2 & 1 & 4 & 3 \\ 3 & 2 & 1 & 4 \end{pmatrix}, \text{ etc.,}$$

with any desired arrangement of the elements in the first row.

This operation of replacement is called a **permutation** of the elements of U.

The **product** of two permutations, say $P_3 = P_1 P_2$, is defined as the permutation P_3 that results from carrying out the first permutation P_1 followed by the second P_2. Thus if

$$P_1=\begin{pmatrix}1 & 2 & 3 & 4\\ 2 & 1 & 4 & 3\end{pmatrix} \quad \text{and} \quad P_2=\begin{pmatrix}1 & 2 & 3 & 4\\ 4 & 3 & 2 & 1\end{pmatrix},$$

then P_1 took 1 into 2 and P_2 took 2 into 3, therefore P_3 takes 1 into 3, and similarly for the other elements so that we have

$$P_3=P_1P_2=\begin{pmatrix}1 & 2 & 3 & 4\\ 3 & 4 & 1 & 2\end{pmatrix}.$$

Multiplication of permutations is clearly associative; i. e. $(P_0P_1)P_2=P_0(P_1P_2)$; cf. the associativity of chains.

Consequently, a set $\mathfrak{G}$ of permutations of the elements of any finite set is a finite group if it includes the inverse of each permutation in $\mathfrak{G}$ and the product of each two permutations in $\mathfrak{G}$. For example, the set of all permutations of the four integers 1, 2, 3, 4 is a finite group, called the **symmetric group** Σ_4.

The order of the group Σ_4, i. e. the number of permutations in it (11. 13) is easily calculated, since for any fixed arrangement in the upper row we have four choices for the integer to replace the first upper element, i. e. to be put in first place in the lower row, then for each of these four choices there remain three choices for the integer in second place, then for each of these $4\times3=12$ choices there remain two choices for the third place and one choice for the fourth, making $4\times3\times2\times1=24$ choices in all.

More generally, the order of the group Σ_n, i. e. the total number of permutations of n elements, is given by $n(n-1)\times\cdots\times3\times2\times1$, a number usually denoted by $n!$ and called **factorial** n.

But there exist smaller groups of permutations of the four integers. For example, the set of four permutations

$$P_0:\begin{pmatrix}1\ 2\ 3\ 4\\ 1\ 2\ 3\ 4\end{pmatrix},\quad P_1:\begin{pmatrix}1\ 2\ 3\ 4\\ 2\ 1\ 4\ 3\end{pmatrix},\quad P_2:\begin{pmatrix}1\ 2\ 3\ 4\\ 4\ 3\ 2\ 1\end{pmatrix},\quad P_3:\begin{pmatrix}1\ 2\ 3\ 4\\ 3\ 4\ 1\ 2\end{pmatrix},$$

is closed under multiplication (e. g. $P_1P_2=P_3$, as we have just seen) and under taking of inverses, since each permutation is its own inverse.

13. 4 The Kariera (or Klein) group. If we compare the permutations

P_0, P_1, P_2, P_3 of the four integers 1, 2, 3, 4 in 13. 3 with the permutations i, x, y, w of the four sections Bur Kar Ban Pal in 13. 2, we see that the two sets of permutations are identical except for the names given to their elements. Consequently, the four permutations i, x, y, w in 13. 2 also form a group. Such groups are said to be **isomorphic** to each other (**iso-** same, **morph-** form) or to be the same abstract group. In pure algebra this group of four elements is called the **four-group**, or the **Klein four-group** in honor of the German mathematician Felix Klein (1849–1925), but in the present setting we shall call it the **Kariera group**.

Since any of the four permutations in the Kariera group may be multiplied by any other, we can set up a **Cayley multiplication-table** (Figure 13. 4), so called in honor of the British mathematician Arthur Cayley (1821–1895).

	i	x	y	w
i	i	x	y	w
x	x	i	w	y
y	y	w	i	x
w	w	y	x	i

Figure 13. 4 Multiplication-table for the Kariera group.

13. 5 Sectional kingraphs for Kariera. It is easy to verify, by actually carrying out the permutations, that:

i) $x=\bar{x}$, $y=\bar{y}$, $w=\bar{w}$, and therefore $x^2=y^2=w^2=i$;

ii) $y=xw$, $w=\bar{x}y=xy$, $x=y\bar{w}=yw$.

Thus the four elements of the group may be expressed either in terms of x and y, or of x and w, or of y and w.

Corresponding to these three choices of a pair of generators we may draw the kingraph for the sectional relations in various ways, five of which are illustrated in Figure 13. 5. The section marked i, i. e. the one containing

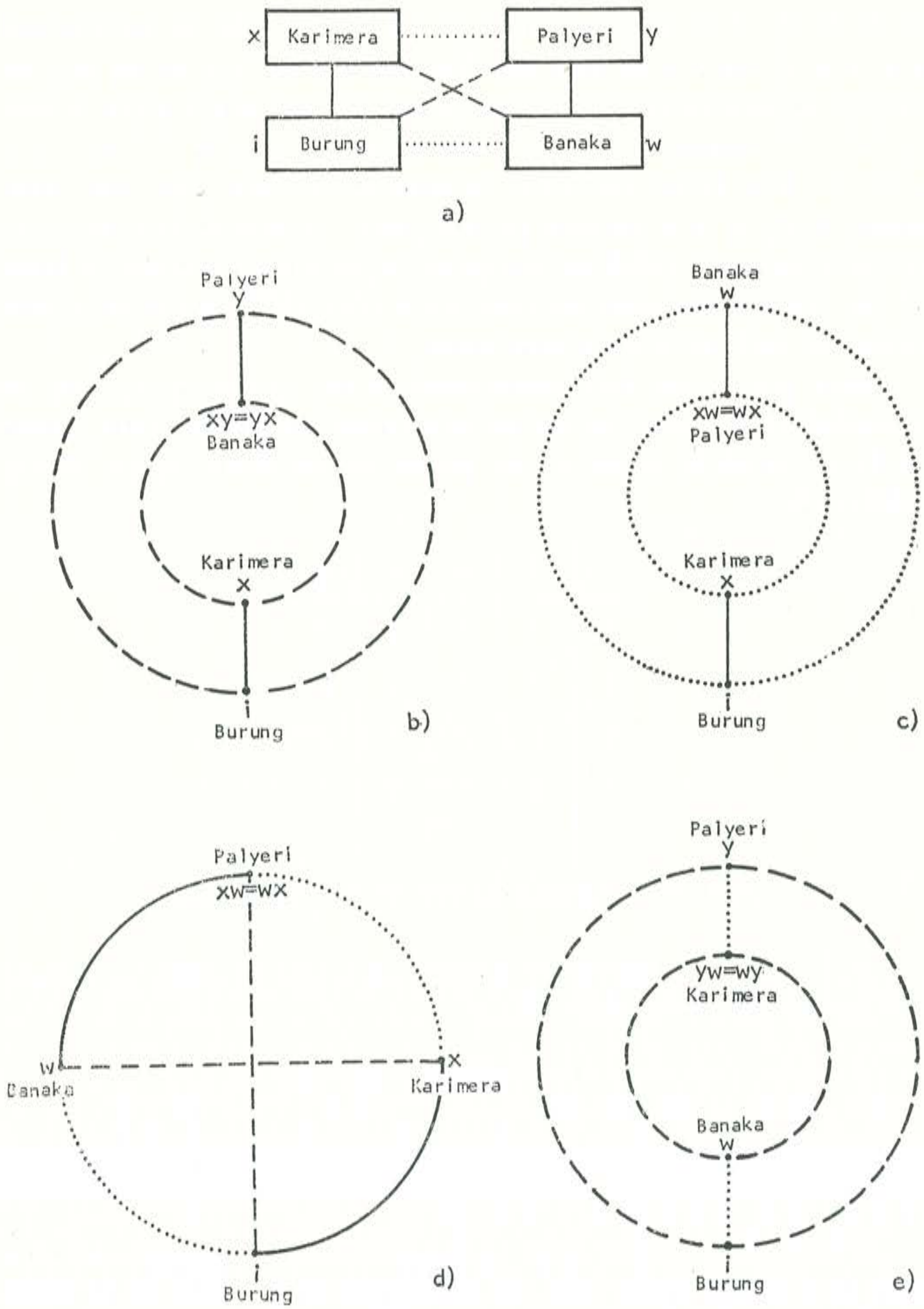


Figure 13. 5 Sectional kingraph for Kariera.

ego, may be chosen at will. In the figure we put ego in Burung, thereby fixing the sections of all ego's relatives.

The notation yw in Figure 13. 5 may appear strange at first sight, since it seems to refer to ego's mother's wife. The explanation is simple. The sectional relation $yw = y\bar{x}y$ first sends ego's section into ego's mother's section and then sends that section into its wife-section, namely the section containing the wives of ego's mother's brothers, actual and classificatory.

13. 6 Sectional reduction. Sectional relations differ from personal relations in several important ways. No person can be his own father's father but in Kariera every section is in the father's-father relation to itself. Personal relations involve a large number of persons and a fairly large number of kinterms, say from 10 to 35, corresponding to the large number of possible relations between persons. On the other hand, sectional relations involve a small number of sections and relations. For example, in Kariera there are only four sections and only four distinct relations. For if a and b are any two sections, distinct or not, then either aib $(a=b)$ or axb or ayb or awb.

In other words, every sectional chain, say $k = yx\bar{y}\bar{x}y$ can be reduced either to i or to x or to y or to w.

By tracing-out on any of the Figure 13. 5 we find that $yx\bar{y}\bar{x}y$ reduces to y, and more generally: if we define the **patri-height** of a chain as the height of the part consisting only of the parti-letters x, $\bar{x}$, and similarly for **matri-height**, we see that a chain will reduce to

i: if its patri-height is even and its matri-height is even,
x: if its patri-height is odd and its matri-height is even,
y: if its patri-height is even and its matri-height is odd,
w: if its patri-height is odd and its matri-height is odd.

CHAPTER XIV

Kariera Personal Relations

14. 1 Equivalence-rules for personal kinchains. As always, however, our chief interest is in the reduction of personal kinchains, for which purpose the convenient reduction just now demonstrated for sectional chains will be valuable only to the extent to which the personal terminology of the tribe has been adapted to its section-system; i. e. to the extent to which ego applies the same kinterms to every person in his own section as to his actual siblings, the same to every person in his father's section as to his actual father and paternal aunt, the same to every person in his mother's section as to his actual mother and maternal uncle, and finally the same to every person in his cross-cousin section $x\bar{y}=\bar{y}x=w$ as to his actual cross-cousins. Presumably the adaptation of personal kinterms to sections will be closer in tribes that have had a section-system for a greater length of time.

So we proceed as follows. We describe the Kariera personal terminology as being the kinship system with the equivalence-rules

$$X\bar{X}\sim Y\bar{Y}\sim \bar{X}X\sim \bar{Y}Y, \quad X^2\sim Y^2\sim I, \quad XY\sim YX$$

obtained by rewriting in upper-case letters the generating relations for the sectional system with equivalence instead of equality. If on examining the actual personal kinterms we find any discrepancies, they must be noted in supplemental remarks (cf. 4. 7).

14. 2 Grid for personal kinterms. To investigate the extent of this adaptation it will be convenient to begin not with the terminology of the Kariera tribe itself but with a terminology stated by Elkin [1954] to be the set of kinterms that would be used by speakers of the Nyul-nyul language farther north to describe the Kariera system. Elkin provides us with these kinterms in the form of Figure 14. 2.

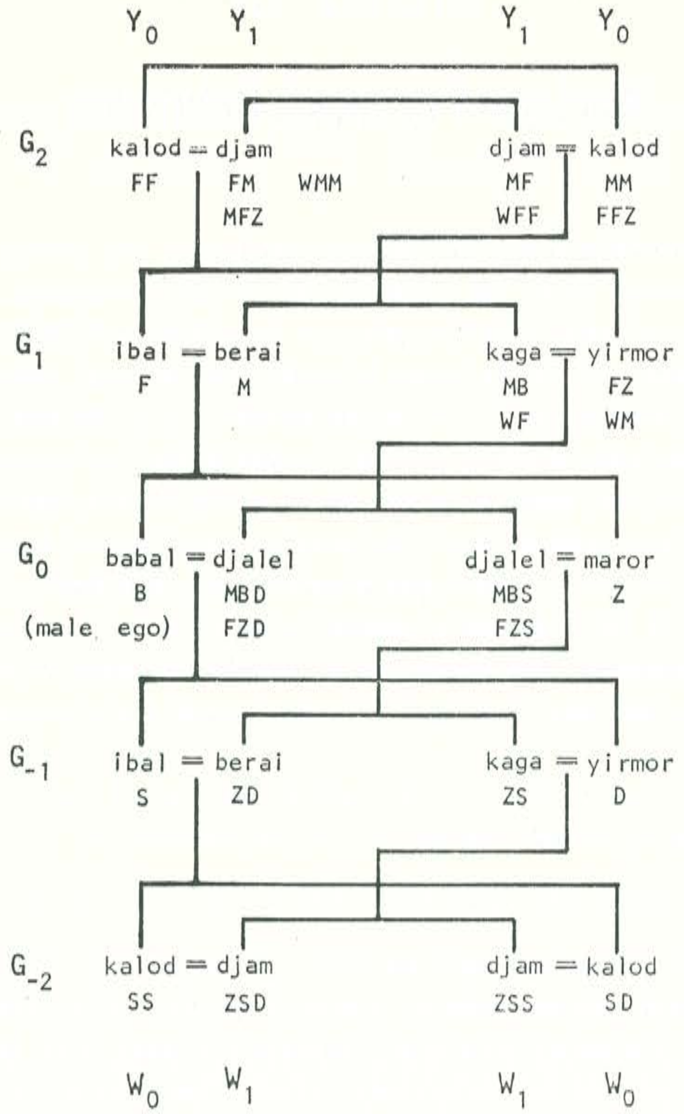


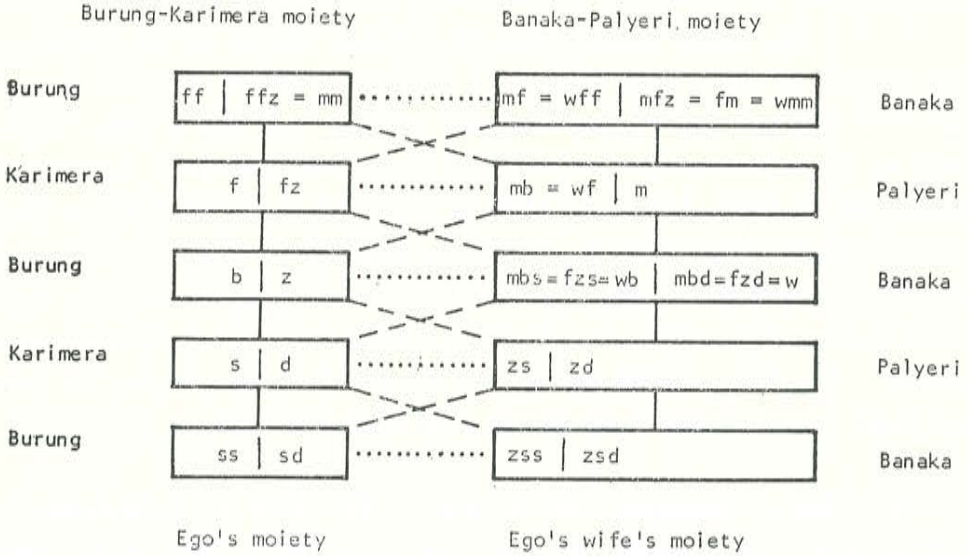
Figure 14. 2 Grid for a kinship system of Kariera type.

In Figure 14. 2 the kinterms are arranged in four vertical columns with one entry in each column for each of the five generations. Then the twenty entries are joined in brother-sister pairs by ten horizontal braces . The longer braces, from the leftmost column to the rightmost, join siblings in ego's own moiety, FF to FFZ, F to FZ, B to Z, S to D and SS to SD, say the Burung-Karimera moiety, and the shorter braces, from the inner left column to the inner right, join siblings in ego's wife's moiety, MF to MFZ, MB to M, MBS to MBD, ZS to ZD and ZSS to ZSD, i. e. the Banaka-Palyeri moiety. This arrangement brings spouses close together on the page, so that they can be joined by signs of equality, from which lines are drawn down to the pair of siblings who are children of those spouses. The lines running down from the equality signs on the left have the shape , and those on the right have the shape .

14. 3 Kariera kingraph. But a grid of this kind is inconvenient in several ways. For example, the line from *kalod* (ego's MM in the upper right corner) down to her daughter *berai* (ego's M) changes direction four times, so that tracing-out the answer to a question like: "what kinterm does ego apply to ego's SWFFZ", becomes a laborious task. (For the answer see 14. 7.) More generally, the basic properties of the system, namely its kinterm-recurrences, are obscured by the fact that chains with the same kinterms are not brought together at the same place in the diagram, e. g. *kalod* occurs in all four corners.

So let us redraw Figure 14. 2 with two vertical columns, one for each of the moieties, by putting brother and sister in the same box, i. e. in the same section, with the Burung-Karimera moiety on the left and the Banaka-Palyeri moiety on right, and again let us join each section to its father-section by a solid line, to its mother-section by a dashed line and to its spouse-section by a dotted line, as in Figure 14. 3.

14. 4 Contrast between Tamil and Kariera. Our diagram now resembles the Tamil diagram in Figure 10. 2 and therefore still fails to represent the fact that, while the Tamil system has no sections and consequently no vertical periodicity, e. g. the grandparent terms are not the same as the grandchild terms, the Kariera system is sectional, so that e. g. a male ego's FF and SS are in the same section, say Burung, with the same kinterm, *kalod.*

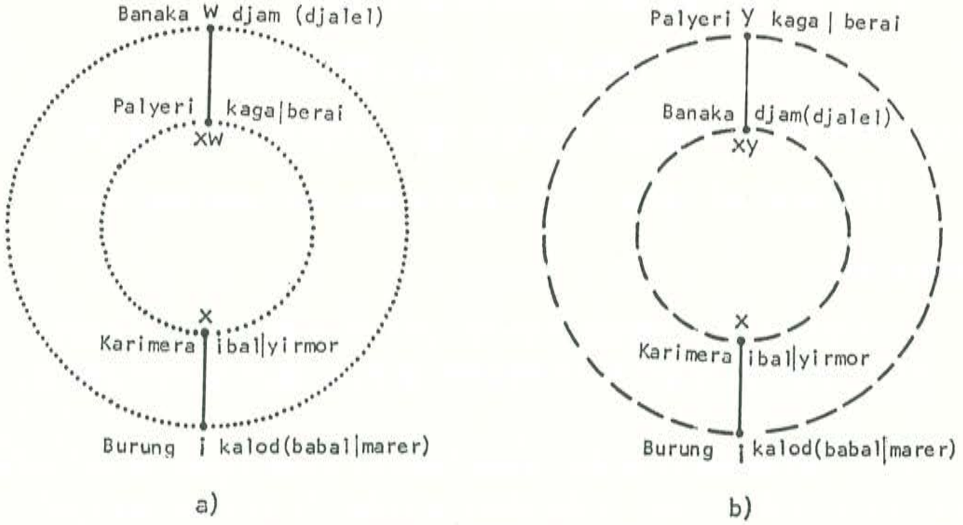


ff | mm	:	kalod	mf | fm	:	djam
f | fz	:	ibal | yirmor	mb | m	:	kaga | berai
b | z	:	babal | marer	mbs | mbd	:	djalel
s | d	:	ibal | yirmor	zs | zd	:	kaga | berai
ss | sd	:	kalod	zss | zsd	:	kalod

Figure 14. 3 Kariera kingraph.

Expressed in terms of marriage regulations, the difference between the Tamil system (non-sectional) and Kariera system (sectional) lies in the fact that a Tamil male marries into his own generation whereas in the Kariera system he is only required to marry into the proper section, which means that his wife may be separated from him by any even number of generations, although it will most often happen that they are in the same generation. In general, this fact has little bearing on their actual relative age, since in any society two persons in different generations below some common ancestor may nevertheless be of the same age. However, it may occasionally happen that a 70-year old man marries a 10-year old girl, an event that has sometimes given umbrage to missionaries and civil servants, although a detailed knowledge of the system would suggest that in such cases the young girl is disadvantaged in some way, perhaps by the death of her father, and the elderly man has social obligations toward that segment of the tribe into which he has the privilege of marrying. His purpose is to take care of the girl until she and some young man in his segment are old enough for a marriage in which they can take care of themselves.

14.5 Alternative forms for the Kariera kingraph. If we redraw Figure 14.3 in such a way as to bring together at one point on the page all those points that represent the Burung section, and similarly for the other three sections, we arrive at diagrams like those in Figure 14.5.



kalod	:	FF, MM, FFB, FFZ, MMB, MMZ, ···
babal | *marer*	:	B, Z, FBS, FBD, ···
ibal | *yirmor*	:	F, FB, FZ, μS, μD, μSSS, μSSD, ···
kaga | *berai*	:	MB, M, MMM, WF, ϕS, ϕD, ϕDDS, ϕDDD, ZS, DH, ···
djam	:	FM, MFZ, WFF, ZSS, ZSD, ···
djalel	:	MBS, FZS, WB, ZH, MBD, FZD, W, ···

Figure 14.5 Alternative forms of the Kariera kingraph.

14.6 Adaptation of personal kinterms to the section-system. From any of these diagrams (Figures. 14.2, 14.3, 14.5) we see that the personal kinterms have been adapted to the section-system with two exceptions. First, when alter is in ego's section, say Burung, and is therefore separated from ego by an even number of generations in ego's own moiety, the kinterm is *kalod*, except that ego's actual siblings have the special kinterms $b \mid z =$ *babal* | *marer*, which are then extended to all Burung relatives in ego's own generation. Secondly, when alter is in ego's wife's section, i. e. Banaka if ego is in Burung, and is therefore separated from ego by an even number of generations in the other moiety, the kinterm is *djam*, except that ego's actual wife has a special kinterm *djalel*, which is then extended to all Banaka relatives in ego's generation. In Figure 14. 5 these special kinterms are enclosed in parentheses.

So we can now describe the system as follows:

$$\mathrm{X}^2 \sim \mathrm{Y}^2 \sim \mathrm{I}, \quad \mathrm{XY} \sim \mathrm{YX},$$

except that chains of height zero have special kinterms, or in detail

$$\hat{p}\hat{p} = kalod, \quad \hat{p}\check{p} = djam, \quad f \mid fz = ibal \mid yirmor, \quad mb \mid m = kaga \mid berai$$

except that:

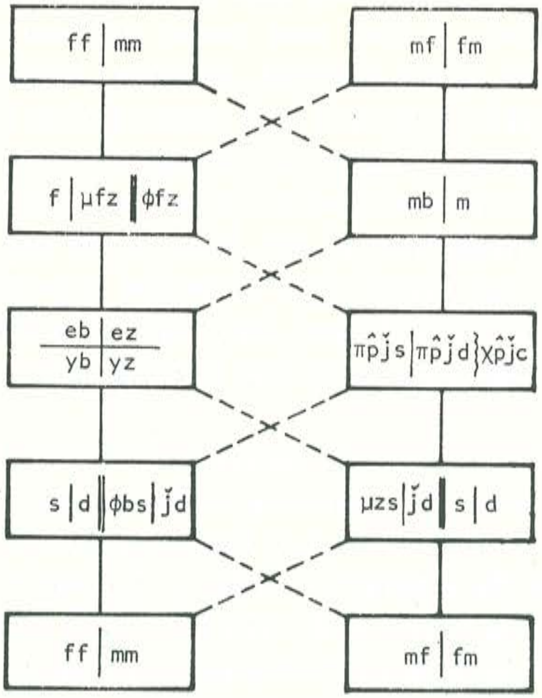
$b \mid z = babal \mid marer$ (extended to all relatives in G_0 in ego's section)
$h \mid w = djalel$ (extended to all relatives in G_0 in ego's spouse's section)

14. 7 Determination of the correct kinterm. From Figure 14, we can at once trace-out the answer to the above question (14. 3) about ego's SWFFZ ($\bar{\mathrm{X}}\bar{\mathrm{X}}\mathrm{YXXJ}\phi$ if ego is male and $\bar{\mathrm{Y}}\bar{\mathrm{X}}\mathrm{YXXJ}\phi$ if ego is female), namely to *berai* (mother) if ego is male and to *yirmor* (paternal aunt) if ego is female.

Or algebraically, the chain $\bar{\mathrm{X}}\bar{\mathrm{X}}\mathrm{YXXJ}\phi$ is of even patri-height and odd matri-height and therefore reduces to Y, and the chain $\bar{\mathrm{Y}}\bar{\mathrm{X}}\mathrm{YXXJ}\phi$ is of odd patri-height and even matri-height and therefore reduces to X (13. 7). The immediacy of these reductions, geometric or algebraic, in contrast with the laboriousness of determining the same result from Figure 14. 2, indicates the practical advantages of introducing group theory into the study of kinship.

In actual practice the aborigines make use of the section-system to determine the correct kinterm in the following way. If a young Kariera male encounters an unknown fellow-tribesman (cf. 1.2) ego will call out the name of his section, e. g. "I am Burung", whereupon alter will reply with the name of alter's section. If alter's section is Karimera, ego knows at once that the correct term is *ibal*, since Karimera is father-section to Burung and alter is male. (If alter were female, the term would be *yirmor*). Similarly, if alter's section is Palyeri, the correct kinterm is *kaga*. But if alter is in Banaka or in ego's own section Burung, further discussion is necessary to determine whether or not ego and alter are in the same generation. By continued questions about their respective relatives they will discover a linking chain between them. If this chain is of height zero, ego will apply the kinterm *djalel* to an alter in Banaka and *babal* to an alter in ego's own section Burung; and if the linking chain is not of height zero, ego will apply *djam* to an alter in Banaka and *kalod* to an alter in Burung.

A similar lack of complete assimilation of personal kinterms to the section-system occurs in all aboriginal section-systems. For example, from Figure 14.7, which gives the Kariera kinterms in the Kariera language itself, we see that here the assimilative process, of personal kinterms to the sectional structure, has already gone rather far. Again there are special terms for G_0 but the G_2-kinterms are identical with G_{-2}-kinterms and the G_1-kinterm *toa* for μFZ is identical with the G_{-1}-kinterm *toa* for the inverse relative ϕBS in G_{-1}.



ff (= μss = φds)	:	maeli	m	:	nganga
mm (= μsd = φdd)	:	kandari	πp̂ǰs	:	kumbali
fm (= μdd = φsd)	:	kabali	πp̂ǰd	:	bungali
mf (= μds = φss)	:	tami	χp̂ǰc	:	nuba
f	:	mama	s	:	mainga
μfz	:	toa	d	:	kundal
φfz	:	yuro	φds (=μfz)	:	toa
mb	:	kaga	ǰd	:	ngaraia
			μzs	:	kuling

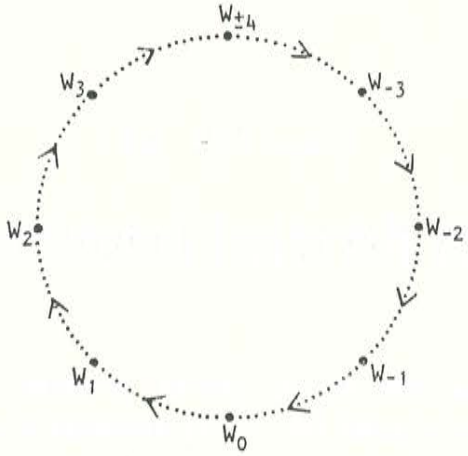
Figure 14.7 Kinterms in the Kariera language.

CHAPTER XV

The Karadjeri Connubium

15. 1 Connubium with circular indirect exchange. One of the most striking features of aboriginal life is the exchange of gifts, which is often competitive because the giver of more valuable gifts enjoys greater prestige, as in the elaborate **potlatches** among the Indians on the northwest coast of America. The exchange may be direct, between two clans, or it may be indirect, in the sense that one clan, call it W_0, gives wives to another W_1, but W_1 gives, not back to W_0, but to W_2, and so on up to a last clan in a cycle, which then gives back to W_0 as in Figure 15. 1, and cases are known where the compensating gifts back to W_0 were not received until after the death of all the original initiators of the gifts from W_0 to W_1. (Cf. the "long-term investment" in 21. 5).

In particular, the gifts may take the form of bride-wealth, in payment for the most valuable of all aboriginal possessions, namely wives, so that the gifts move in one direction, along the arrows around the cycle in Figure 15. 1, and the wives move in the other direction, against the arrows. As always in our diagrams, a dotted line is a wife-line, with an arrow pointing in the direction in which a male moves in order to find his wife. Thus a wife-line with no arrow, i. e. a line pointing in both directions (as in Kariera, see Figure 13. 5), shows direct (symmetric) exchange of wives, and a wife-line with an arrow shows indirect (asymmetric) exchange. In Figure 15. 1, the clan W_1 is called a **direct wife-giver** to W_0, and W_0 is a **direct wife-taker** from W_1. Then W_2 and W_3 are **indirect givers** to W_0, and W_{-1}, W_{-2} are **indirect takers** from W_0, while $W_4 = W_{-4}$, at an equal distance from W_0 in both directions, is an indirect giver to W_0 and also an indirect taker from W_0.



Subscripts are positive for givers to W_0, negative for takers from W_0.

Figure 15. 1 Indirect or asymmetric exchange of gifts etc.

Then by a **marriage-alliance** or **connubium, with circular indirect exchange** we mean a set of n clans, $n>2$, which can be arranged in a circle such that the even section in each clan takes its wives from the even section of its clockwise neighbor, and similarly for the odd sections.

The generating relations for the group of sectional relations in such a connubium are given by:

$$x^2 = w^n = i, \qquad xw = wx,$$

with $x^2=i$ because there are two sections in each clan, $w^n=i$ because there are n clans, and $xw=wx$ because the permutation xw takes ego's clan into the section of opposite parity (i. e. from even to odd and from odd to even) in the next clan clockwise, and wx produces the same result. Consequently a tribe with circulating indirect exchange has MBD-marriage (11. 5), and this marriage must be matrilateral, i. e. ego's wife cannot be ego's FZD since she is in clan W_{-1}, with $\bar{w}=w$ for $n>2$.

15. 2 Karadjeri prescriptive grid. The simplest example of a section-system with indirect exchange is provided by the Karadjeri tribe on the west coast of Australia, just north of the Kariera. Here Elkin presents his kinterm information in the form of Figure 15. 2a, again with an equal-sign

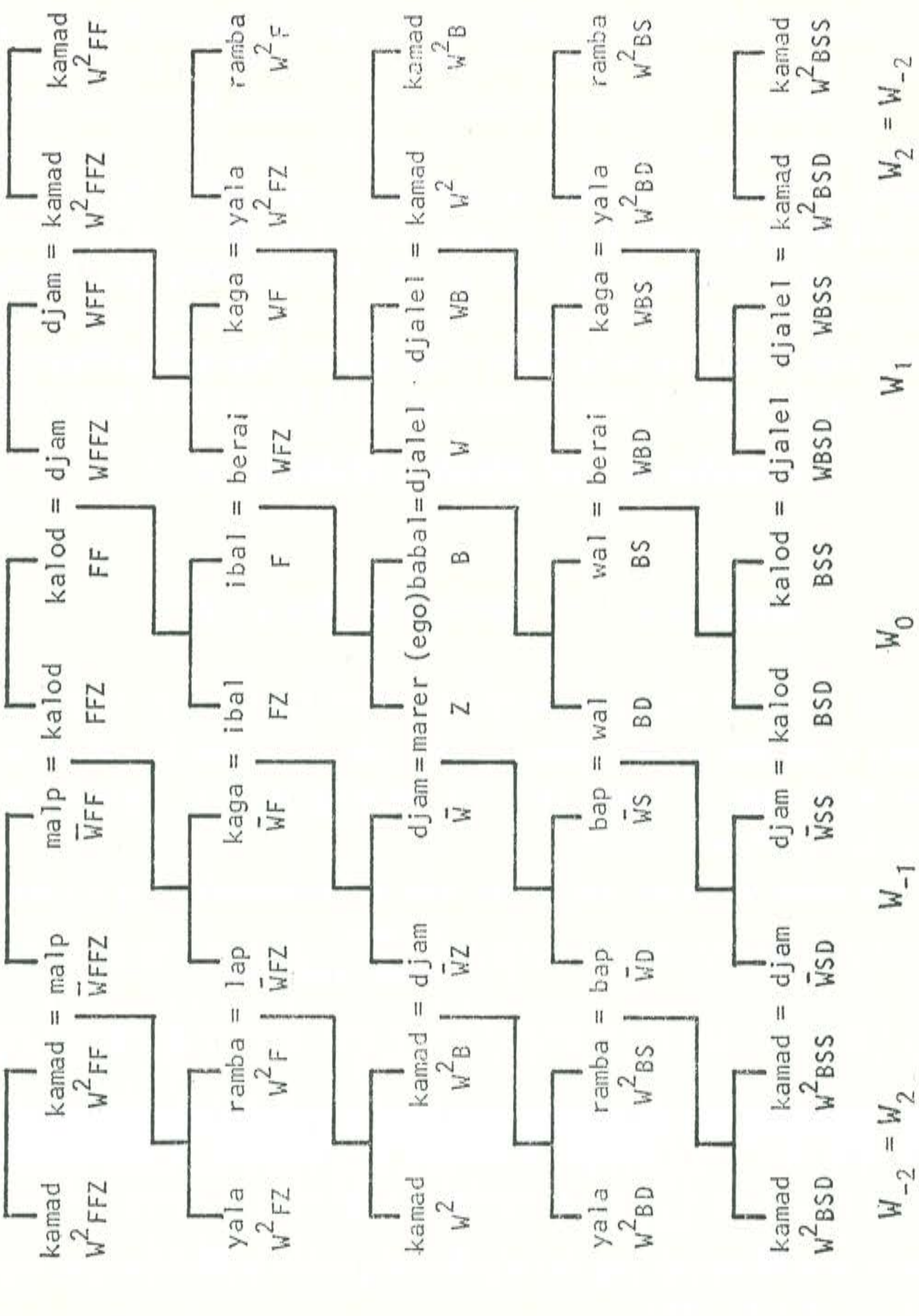


Figure 15. 2a Karadjeri prescriptive grid.

joining spouses, a horizontal brace joining siblings, and bent lines for patridescent.

Although at first sight Figure 15.2a appears to contain five vertical patrilines (which we have labeled W_{-2}, W_{-1}, W_0, W_1, W_2), it is to be noted that the kinterms on the left (which Elkin has labeled W^2FFZ and W^2FF in G_2, W^2FZ and W^2F in G_1 etc.) are identical with the corresponding kinterms on the right, and Elkin specifically informs us that they refer to the same set of persons, i. e. to the same patrilineage, which may therefore be labeled $W_{\pm 2}$. Consequently, there are only four clans altogether, forming a circular connubium of four clans. Thus Elkin's table of kinterms (Figure 15. 2a) may be redrawn as in Figure 15.2b, and the Karadjeri permutation-group, i. e. the group of sectional relations, is the commutative group with

generators x, w and generating relations $x^2 = w^4 = i$

or

generators x, y and generating relations $x^2 = y^4 = i$.

15.3 Karadjeri kingraphs and kinlist. When Figure 15. 2b is redrawn in such a way that points representing the same section are brought to one point on the page (cf. Figure 14. 5 as a redrawing of 14. 3), the results are diagrams like Figures 15.3a, b.

The entire Karadjeri kinlist can now be accommodated in a scheme like 15. 3c, where for W_{-1} the notation $\left\{\begin{matrix} \textit{malp} \\ \textit{kaga} \mid \textit{bap} \end{matrix}\right\}$ opposite the generations $\left\{\begin{matrix} G_2 \\ G_1 \end{matrix}\right\}$ means that *malp* is the coverset for all even positive generations and *kaga* | *bap* for all odd positive generations, and the notation $\left\{\begin{matrix} \textit{djam} \\ \textit{bap} \end{matrix}\right\}$ opposite the generations $\left\{\begin{matrix} G_0 \\ G_1 \end{matrix}\right\}$ means that *djam* is the coverset for all even non-positive generations and *bap* for all odd non-positive generations, and similarly for the other clans.

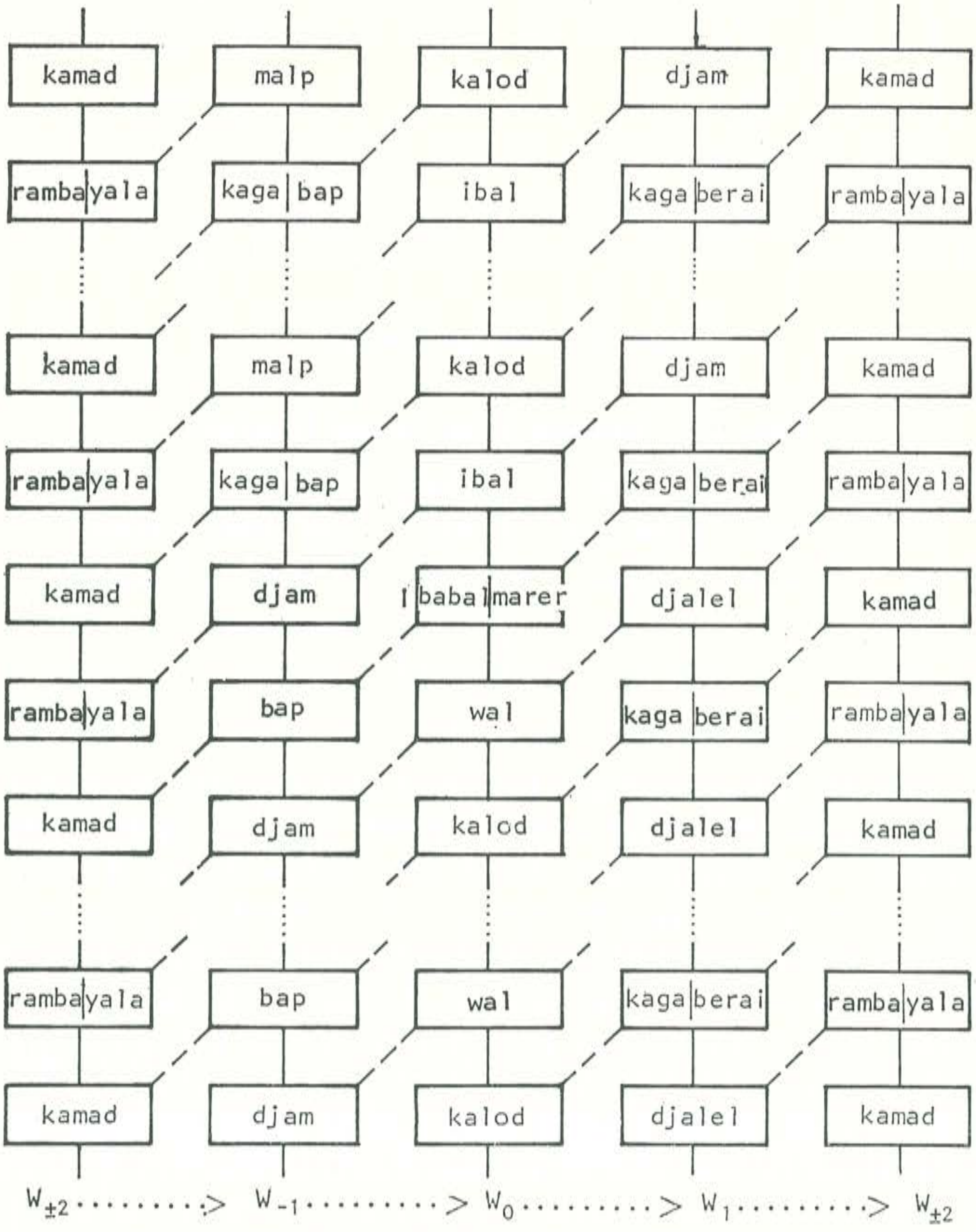


Figure 15 2b Karadjeri System.

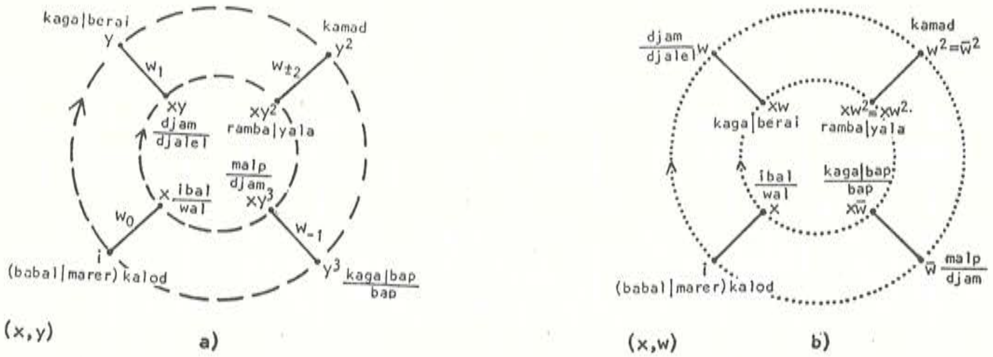


Figure 15. 3 Karadjeri kingraph.

Table 15. 3 Karadjeri kinlist showing periodicity

G_2		*malp*	*kalod*	*djam*	
G_1	*ramba*	*kaga | bap*	*ibal*	*kaga | berai*	*ramba*
G_0	*kamad*	*djam*	*babal | marer*	*djalel*	*kamad*
G_{-1}		*bap*	*wal*	*kaga | berai*	
G_{-2}			*kalod*		
	$W_{\pm 2}$	W_{-1}	W_0	W_1	$W_{\pm 2}$

15.4 ZD-exchange marriage. In 13. 2 we have seen that the Kariera natives describe their system as sister-exchange, and that it might also be described as daughter-exchange. Let us now calculate the type of female relative exchanged in Karadjeri marriage. If we denote by K the chain by which a male p_0 is linked to the female relative whom p_0 gives in marriage to a male p_1, we can determine K from the fact that p_1 is the husband of the K-relative of p_0 and conversely. For we have $p_0\mathrm{KH}p_1$ and $p_1\mathrm{KH}p_0$, so that $p_0\mathrm{KH}p_1\mathrm{KH}p_0$, or more concisely $p_0\mathrm{KHKH}p_1$, which means $\mathrm{KHKH}\sim\mathrm{I}$. Geometrically speaking kh is thus half of a full circuit, see e. g. Figure 15. 3b, from ego's section back to ego's section.

Since $w^4=i$, we have $\bar{w}^4=h^4=i$, and since $x^2=i$ it follows that $x^2h^4=i$ is a full circuit and therefore xh^2 is a half circuit. Thus $kh=xh^2$, so that $k=xh=x\bar{y}x=\bar{y}$, which means that the female K-relative in question is

$\mu\bar{\mathrm{Y}}\phi \sim \mu \mathrm{J}\bar{\mathrm{Y}}\phi = \mu$ZD. In other words, Karadjeri has "sister's-daughter-exchange marriage".

This ZD-cxchange marriage, with $k=\bar{y}$, can be traced-out conveniently on Figure 15.3a. Since $h=\bar{y}x$, so that $kh=\bar{y}\bar{y}x$, the path $\bar{y}\bar{y}x$ will bring us half-way around from the point i, as may be verified by tracing-out $\bar{y}\bar{y}x$ a second time beginning now at $xy^2=\bar{y}^2x$ and ending up at i. The figure shows that males who exchange their ZD's in this way are *ramba* to each other.

CHAPTER XVI

Murngin (6, 4)-Marriage

16. 1 Murngin clans. The Murngin tribe, which leads a hunting and gathering life around scattered waterholes in Arnhem Land, northwestern Australia, consists of approximately 60 clans, divided into two moieties Dua and Yiritcha. The clan, the basic unit of economic and religious organization, is patrilineal, exogamous, patrilocal and virilocal: namely, every person belongs permanently to his or her father's clan, no person may marry within his own clan, a male remains permanently in the territory of his own clan, and a female moves after marriage from her father's territory to the territory of her husband. Typical names for the clans come from natural phenomena or from plants and animals; for example,

1)	Warumeri:	red cloud
2)	Kalpu:	sharp pointed clouds
13)	Birkili:	high clouds
14)	Djambarpingu:	small bird
17)	Daiuror:	snake

The numbers 1), 2),..., 17) are taken from Warner's list [1937: 39-51], who gives the names of 43 clans and states that his list is not complete.

16. 2 The Murngin controversy. There are many reasons why the Murngin system deserves a central place in kinship studies. Field-workers have provided us with a rich supply of data, the system is more intricate than others, it gives us a key to the understanding of connubial complexes (16. 6), and during the forty years from the first article on the subject [Warner, 1930] to the most recent book [Liu, 1970] it was the subject of active controversy, best described in Barnes's "*Inquest on the Murngin*" [1967]. In his final paragraphs Barnes writes:

> ...the central facts of their marriage system remain as obscure as ever ...The subsection arrangements seem to be in a muddle... Warner's first reports were inconsistent, and yet at the same time so full of information ...that they were bound to attract attention.... Hence the unravelling of the mysteries of the Murngin became an intellectual challenge... It is now probably too late to retrieve knowledge of the social structure of the Murngin as it was in Warner's day [1926–1929].

Yet even while Barnes was writing these despairing words, Liu [1967, 1969] was constructing a solution on theoretical grounds and Shapiro [1967, 1968, 1969], working in the field without knowledge of Liu's theory, was making the ethnographic discoveries that would validate the theory. The present chapter and the next two describe Liu's theory and show how it is validated by Shapiro's discoveries.

The most important of these discoveries, at least for our present purposes, are the following two. In his first article Shapiro writes:

> In come cases, the total marriage network is limited, consisting of four or six sibs [these are our clans] "marrying in a circle"...From another point of view, however, most of the sibs...constitute a single large marriage network [this is our connubial complex: see 16.6].

Then in the second article comes the truly remarkable discovery:

> [Shapiro 1968, p. 349] The Aborigines...consciously practice ZDD [marriage] exchange...
>
> An informant...who had lived for some time with non-"Murngin" Aborigines spontaneously compared it with sister exchange, practiced, he pointed out, by some of the peoples with whom he had been in contact.

16. 3 Warner's kinterm chart. In his 1930 article Warner published the kinterm chart reproduced here as Figure 16.3a.

We are told by Warner and other informants that the kinterms in Figure 16. 3a are not limited to the five central generations but may be extended to any desired number of higher and lower generations, as shown in our Figure 16. 3b for the abbreviations Bur_0, Bul, etc. see 16. 7), where we have rearranged Warner's patrilines so as the make them vertical, as in our

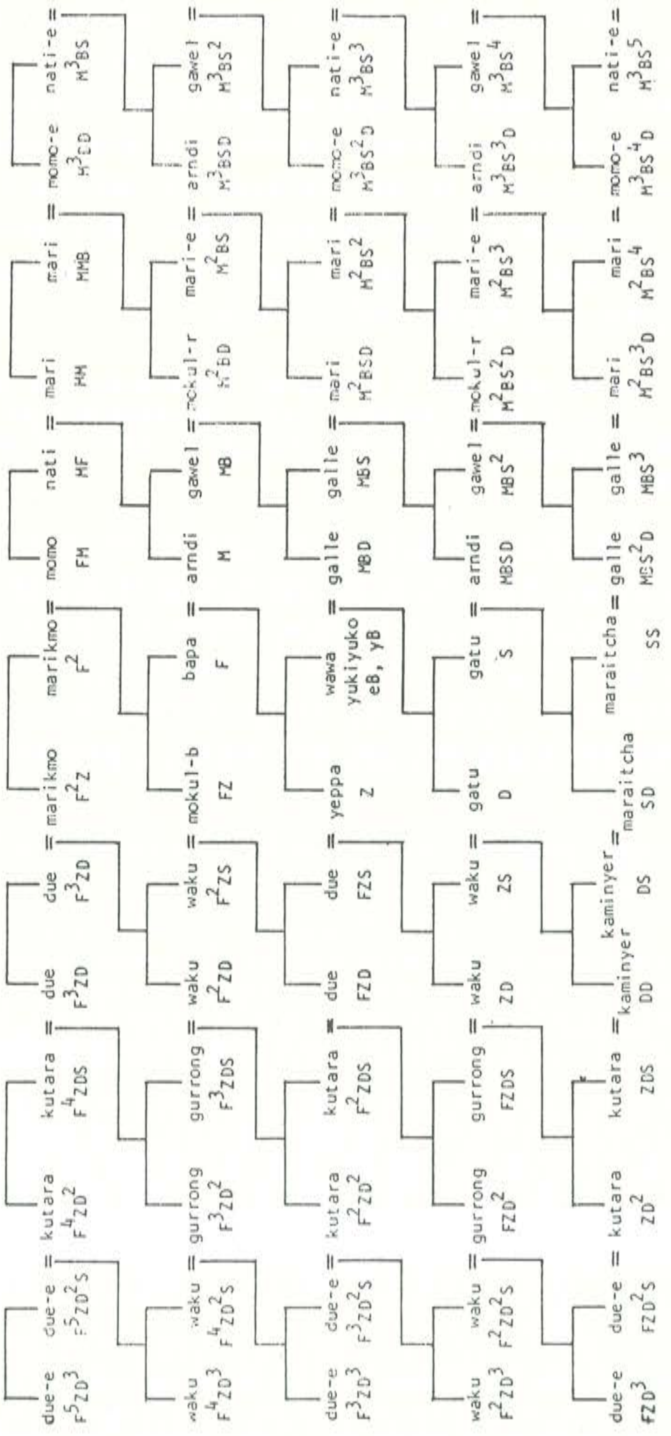


Figure 16.3a Warner's kinterm chart.

rearrangement in Figure 15. 3a of Elkin's diagram in Figure 15. 2a. By following the matriline in Figure 16. 3b down two generations from ego's subsection (enclosed by a double rectangle) to ego's ZDD ($\mu J\bar{Y}\bar{Y}\phi$) we see that in Warner's transcription the Murngin kinterm for a male speaker's sister's daughter's daughter is *kutara*, so that ZDD-exchange marriage is described by the natives themselves as *kutara*-exchange. Shapiro, who transcribes ZDD as *gutarra*, tells us [1968: 351] that they call it *gutarrana gurrupanmirri*.

Concerning his chart Warner 1937: 57 writes:

> ...there are seven lines of descent and five generations in each lineage. The seven lines of descent include a man's or woman's own patrilineal line, three lines of descent related to him through his father and three through his mother.

The three lines related to ego through ego's mother and labeled W_1, W_2, W_3 in our Figure 16.3b refer to the patrilineages of ego's M, ego's MM and ego's MMM respectively, and the three related to ego through ego's father, namely W_{-1}, W_{-2}, W_{-3}, refer to the patrilineages of ego's FZH, FZHZH and FZHZHZH. Alternatively, the seven lines refer to the patrilineages of ZHZHZH, ZHZH, ZH, self, WB, WBWB, WBWBWB.

16. 4 The basic problem. Now comes the basic problem, stated thus by White [1963: 119]:

> Warner's chart of kinterms ends in mid-air three generations away from ego both on the ZH and the WB sides... what male kinship personality does ego's ZHZHZHZ marry and what female personality does ego's WBWBWB marry?

Barnes [1967: 28] states the same problem thus:

> the men in Warner's extreme right-hand column must marry, and the women in the extreme left-hand column, and the problem is to determine what ego calls the spouses of these relatives.

Lévi-Strauss [1963: 305] remarks:

> Warner's study leaves some basic problems unanswered, especially the way in which marriage takes place on the lateral borders of the system.

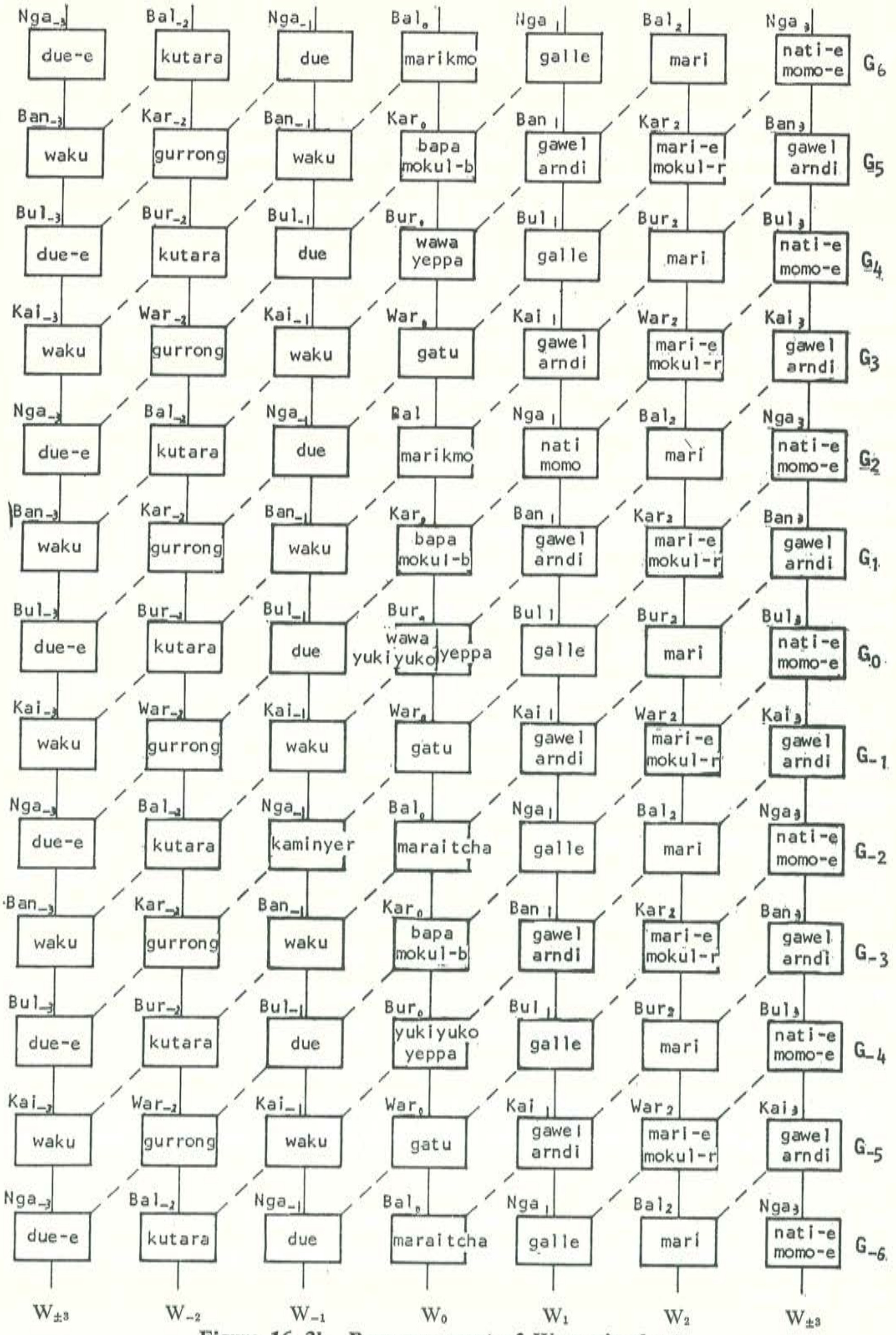


Figure 16. 3b Rearrangement of Warner's chart.

Warner himself [1930: 210-211] states the difficulty thus:

> this asymmetrical cross-cousin marriage causes a female relative in the third patrilineal column to the right of ego to go unmated (in the kinship system) or a never ending addition to this system ... but as one line is added to each side of the system a new one is necessary.

Warner suggests [1937: 115] that the desired closure of the system is obtained by intermarriage of the outside line on the right with the line second from the right, and of the outside line on the left with the line second from the left. But as White remarks, this suggestion can be refuted at once. For let us consider two ego's, call them p_0 and p_1, with p_0 in Warner's central column and p_1 in Warner's rightmost column, so that p_1 is *nati-elker* to p_0. Then sister-exchange marriage is proscribed for p_0, in Warner's central column, and prescribed for p_1, in Warner's rightmost column, an impossible situation since the original ego p_0 can be chosen arbitrarily. In White's words [1963: 121, cf. our 13. 2], "the whole structure must look the same from the point of view of any (male) ego."

In the chart for Karadjeri corresponding to Warner's chart for Murngin (Figure 15.3a corresponding to Figure 16.3b) there are five vertical patrilines, but in that case there is no difficulty because the leftmost line is identical with the rightmost. But in Warner's chart the kinterms in the W_{-3}-line on the left are distinct from those in the W_{+3}-line on the right, so that there appear to be seven lines altogether, although the number of clans must be even, since they alternate between the two moieties. As Lawrence and Murdock say (see just below) the relatives at the lateral extremes cannot marry each other since they belong to the same patrimoiety. Moreover, the native themselves have emphatically stated that Warner's chart can be extended arbitrarily far to left and right by repeating the pair of lines W_{-2} and W_{-3} as often as desired to the left, to form pairs of lines W_{-4} and W_{-5}, W_{-6} and W_{-7} etc. and similarly repeating the lines W_2 and W_3 on the right to form W_4 and W_5, W_6 and W_7 etc. Thus it seems that there may be nine lines, or eleven, or any odd number, although we have just seen that if we are to have a self-consistent closed system the number of lines must be even.

16.5 The imaginary eighth line. Most of the attempts to resolve the paradox recognize the need for some kind of cycling. For example, if the kinterms in the line labeled W_{-3} of Figure 16.3b were the same as those in W_3, the whole figure could be wrapped around a vertical cylinder in such a way that the W_{-3} line would coincide with the W_3 line, and we would have the desired closure, just as in the Karadjeri case.

With this idea of cycling in mind Lawrence and Murdock [1949] proposed to insert an "eighth line", on the left and again on the right of Warner's chart, i.e. just once altogether when the chart is wrapped around a cylinder. They write:

> in his seven-line kinship chart Warner gives no indication of the marriages of the relatives at either lateral extreme. Clearly they cannot marry each other since they belong to the same patri-moiety. Conceivably they might marry persons to whom no kinship terms apply, but this would be distinctly un-Australian and, in addition, would practically require special affinal terms which are not reported.
>
> It seemed more probable that an eighth patriline might exist, its men intermarrying with Patriline 7 [our W_{-3}] and its women with Patriline 1 [our W_3].

To meet the obvious question: why did Warner not report kinterms for this imagined eighth line, Lawrence and Murdock say "the occurrence of... 'wrong marriages' with inappropriate relatives [see 17.6] rendered difficult the discovery of cycling throughout the eight patri-lines."

We shall not attempt to describe the cogent arguments advanced against this nebulous eighth line, since the interested reader can read about them in detail in Barnes's "*Inquest*".

In a letter to Lawrence and Murdock, quoted by them in their 1949 article, the Australian missionary-anthropologist Webb describes his perplexity over "a perpetual extension of lines laterally with no possible hope of the cycling that I expected and my informants affirmed." For Webb's proposed solution, also rejected by anthropologists, the reader is again referred to the "*Inquest*". Of interest to us is the information in his letter that the natives insisted on the existence of cycling and kept trying to point out to him.

This seven-line problem remained constantly the same: just how did the system cycle, and if it did, why have Warner and subsequent field-workers failed to say so.

16. 6 Four-clan and six-clan connubia; connubial complex. In his three articles [1967, 1968, 1969] Shapiro was not directly concerned with the seven-line problem but rather with demonstrating the dominant role of matrilines in certain parts of the Murngin social system (16. 14), and he therefore overlooked the fact that his data provided the solution to the problem.

In his first article [1967: 354] Shapiro writes (cf. the quotation in our 16. 2):

> the clans that are linked directly in marriage (i. e. those in a wife-giver — wife-taker relationship) are usually associated with territories that are adjacent to each other, or at least close by. In some cases, the total marriage network is limited, consisting of four or six clans "marrying in a circle" associated with territories covering only a small part of northeastern Arnhem Land. From another point of view, however, most of the clans in the entire Murngin area constitute a single large marriage network.

Before the publication of Shapiro's actual discovery of these four-clan and six-clan connubia which had remained unnoticed by earlier field-workers, Liu [1967] had already postulated their existence on the theoretical grounds described below in 16. 12. Consequently Shapiro's discovery was welcome news to Liu; for as he himself says [1970], "there was no ethnographic data to verify my postulation until Shapiro provided them." To describe this verification we must first examine certain features of Murngin social organization.

16. 7 Murngin subsections. In the Murngin tribe each of the two sections in a clan divided into two named subsections (cf. 2. 16) with constituent generations and names as follows (see e. g. Webb 1933: 407):

Dua moiety (name of subsection)	constituent generations	Yiritcha moiety (name of subsection)
Warmut:	$\ldots, G_3, G_{-1}, G_{-5}, G_{-9}, \ldots$	Kaijark
Balang:	$\ldots, G_2, G_{-2}, G_{-6}, G_{-10}, \ldots$	Ngarit
Karmarung:	$\ldots, G_1, G_{-3}, G_{-7}, G_{-11}, \ldots$	Bangardi
Buralang:	$\ldots, G_0, G_{-4}, G_{-8}, G_{-12}, \ldots$	Bulain

The assignment of G_0 to the Buralang subsection is arbitrary but fixes the generations for the other subsections.

Here again we abbreviate the names to their first three letters

Bur, Kan, Bal, War in the Dua moiety
Bul, Ban, Nga, Kai in the Yiritcha moiety,

and for definiteness we assume that ego is in the Djambarpingu (small bird) clan of the Dua moiety, which we therefore denote by W_0. Then the direct giver clan for W_0 will be denoted by W_1, the direct taker from W_0 by W_{-1}, the giver for W_1 by W_2, the taker from W_1 by W_2 and so on, so that we have a circular indirect exchange as in Figure 16. 7.

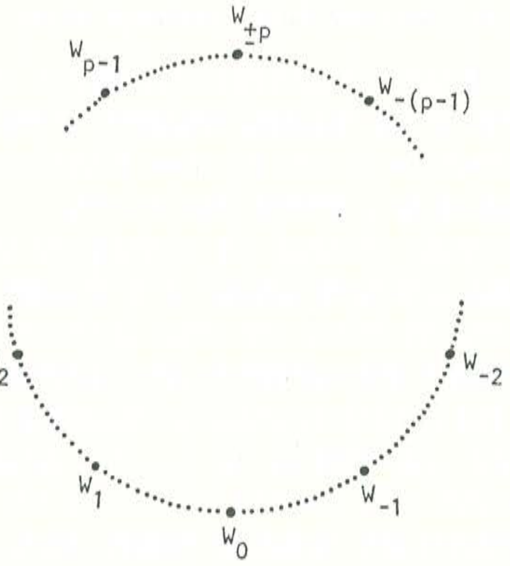


Figure 16. 7 Murngin circular connubium

Since marriage is cross-moiety, the two moieties Dua and Yiritcha alternate around the circle, so that the number of clans $n>2$ must be even and may therefore be 4, 6, 8, 10, ... The existence of such cycles in Murngin is now known for $n=4$ and $n=6$ (see Shapiro's statement in 16. 6) and is theoretically possible for $n=8$, 10, 12, ... , as in Figure 16. 7, where $p=n/2$. Since we have chosen to put ego in a Dua subsection, namely Buralang, the clans numbered W_0, W_2, W_{-2}, . . . with even subscripts will be Dua clans, and the clans W_1, W_{-1}, $W_{-3}, \ldots$ with odd subscripts will be Yiritcha clans. The Buralang subsection in the W_0-clan will be denoted by Bur_0, in the W_2-clan by Bur_2, in the W_{-2} clan by Bur_{-2}, and similarly for Kar_0, Kar_2, Kar_{-2} etc., Bul_1, Bul_3, Bul_{-1} etc., and so on.

16. 8 Regular and non-regular marriages. In the kind of marriage described by Webb, Elkin, etc. as "regular" (for alternate marriage see 17. 5) the rules are as follows:

Warmut and Kaijark exchange wives
Balang and Ngarit exchange wives
Karmarung and Bangardi exchange wives
Buralang and Bulain exchange wives,

but in every case bilateral cross-cousin marriage is proscribed, i. e. the exchange is indirect: if the Buralang subsection in clan W_0 takes wives from the Bulain subsection in clan W_1, then Bulain must take wives from the Buralang subsection of a different clan $W_2 \neq W_0$.

However, non-regular marriages are frequent for many reasons. For example, the average number of persons in a Murngin clan cannot have been much more than 60 at any one time, so that even under the most favorable circumstances a given subsection often contained more marriageable males than could find wives in the proper corresponding subsection, and this difficulty was greatly aggravated by the fact that polygyny was practiced by the more influential older members of the tribe (cf. 16.14), a practice that could be maintained only because of frequent deaths among the younger men, who fought with one another over females to whom they had a better or worse right, or perhaps no right at all; and occasionally, a female would abandon her customarily passive role in this matter, to elope with an "irregular" husband. Nevertheless, it is the rules, i. e, the regular marriages, that influence the kinship terminology, since the child of any kind of non-regular marriage is assigned to the subsection to which it would belong if the mother had made a regular marriage, or to use the picturesque native expression "the father is thrown away." Thus a statement like "Buralang is father to Warmut" (see just below) refers only to regular marriages. If a Buralang man makes a regular marriage with a Bulain woman, his child is indeed assigned to Warmut, but if he makes an alternate marriage (17.5) with a Ngarit woman his child is assigned to Karmarung; for if the child's mother had made a regular marriage she would have married into Balang, which is in the father relation to Karmarung; and similarly, for wrong marriages (see 17.6, 17.7).

16.9 Relations and graph for the generators x **and** w. As generating relations for the group of sectional relations in the (6,4)-Murngin case we will have $x^4=i$ because each clan has four subsections, and $w^6=i$ because the six clans "marry in a circle" (cf. Karadjeri in 15.3, with $x^2=w^4=i$); and as always for circular indirect exchange the group will be commutative, i. e. $xw=wx$. Consequently, the Cayley graph for the group can be drawn as in Figure 16.9.

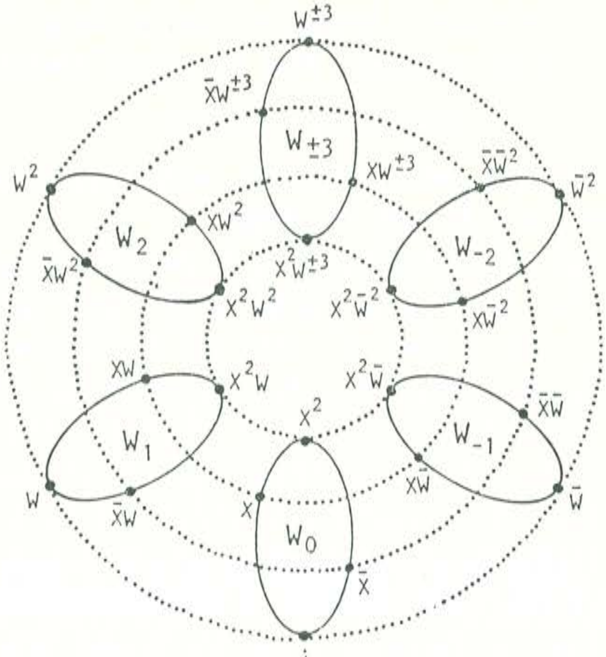


Figure 16.9 The six patricycles and four wife-cycles in a regular (6, 4)-connubium; all cycles run clockwise.

The six clans in Figure 16.9 may be described as follows:

W_0	is the clan of ego's B and Z	(and of ego himself or herself)
W_1	is the clan of ego's BW	(or W if ego is male)
W_{-1}	is the clan of ego's ZH	(or H if ego is fmale)
W_2	is the clan of ego's BWBW	(or WBW if ego is male)
W_{-2}	is the clan of ego's ZHZH	(or HZH if ego is female)
$W_{-3}=W_{\pm 3}$	is the clan of ego's BWBWBW	(or WBWBW if ego is male or ZHZHZH or HZHZH if ego is female).

Since ego's clan W_0 has three giver clans, W_1 (direct giver) and W_2, W_3 (indirect givers) and three taker clans, W_{-1} (direct taker) and W_{-2}, W_{-3} (indirect takers), the number of clans might seem to be seven, but in fact it is only six because $W_3=W_{-3}$ is both giver and taker.

16. 10 Generators x and y. In order to obtain generating relations for the group in terms of x and y, instead of x and w, we set $w=\bar{x}y$ in $x^4=w^6=i$, so that $(\bar{x}y)^6=\bar{x}^6y^6=x^2y^6=i$. Thus the desired relations are

$$x^4=x^2y^6=i, \qquad xy=yx.$$

The reason for the extra complication here, namely the presence of x^2 in the relation $x^2y^6=i$, may be seen as follows.

In passing from ego's subsection Bur_0 in clan W_0 to ego's wife's subsection Bul_1 in clan W_1, e.g. by tracing-out in Figure 16.9, we raise the clan-index by one, and similarly for each step through the six-clan cycle $W_0 \to W_1 \to W_2 \to W_3=W_{-3} \to W_{-2} \to W_{-1} \to W_0$. But we do not raise the generation from one clan to the next, so that in returning to clan W_0 we arrive at the same subsection, thereby completing a wife-cycle of length six $(w^6=i)$.

But in passing from ego's subsection Bur_0 in clan W_0 to ego's mother's subsection Ban_1 in clan W_1 by tracing-out the line $y=xw$ from Bur_0 to Ban_1, we raise by one not only the clan-index but also the generation. In tracing-out $y=xw$ six times we thus pass successively through $Ban_1(y)$, $Bal_2(y^2)$, $Kai_3(y^3)$, $Bur_{-2}(y^4)$, $Ban_{-1}(y^5)$, arriving after the sixth step at $Bal_0(y^6)$ in the original clan W_0 but six (i.e. two) subsections higher than before, so that we have $y^6=x^6w^6=x^2 \neq i$ and therefore $x^2y^6=x^4=i$.

However, after another passage around the six clans we come back to the same clan W_0 twelve generations higher and thus in the original subsection Bur_0, so that $y^{12}=i$. So it might seem as though $x^4=i$, $y^{12}=i$, is a set of defining relations for the 6-regular connubium. But that set would produce a group of 48 elements, whereas the connubium has only 24. It is necessary to incorporate the relation $x^2y^6=i$, whereupon there is no need to mention $y^{12}=i$ explicitly, since $x^4=x^2y^6=i$ already implies $i=(x^2y^6)^2=x^4y^{12}=y^{12}$.

Since y^{12} is the lowest power of y that is equal to the identity, each matricycle consists of 12 subsections and therefore, since there are only 24 subsections altogether, the (6,4)-Murngin connubium consists of exactly two matrilines (cf. Shapiro's remarks below in 16.14).

Then just as Figure 16.9 shows the (6,4)-connubium as six patricycles and four wife-cycles, so we may draw Figure 16.10 to show the connubium as six patricycles and two matricycles.

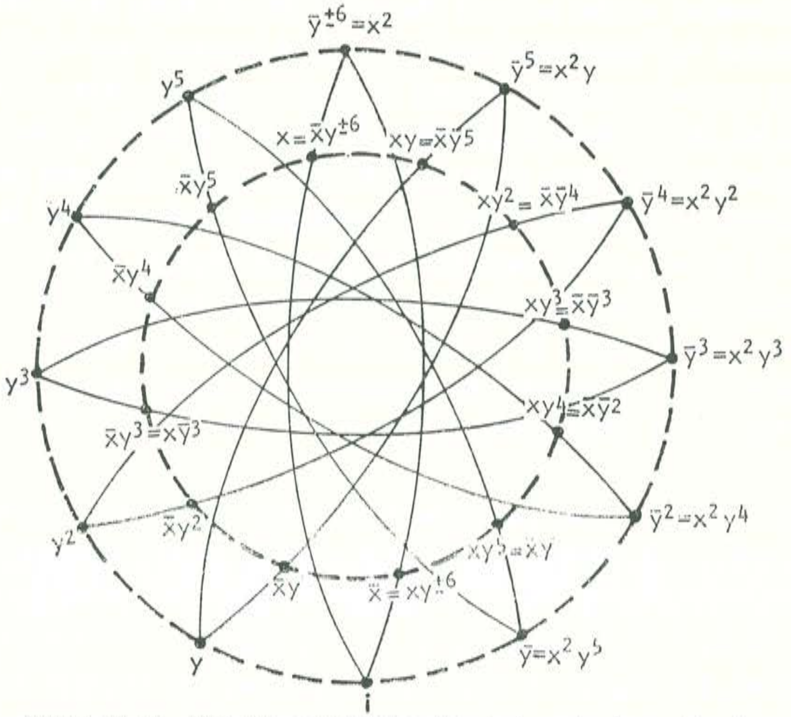


Figure 16. 10 The two matricycles (circles) and six patricycles (ellipses) in a regular (6, 4)-connubium.

16. 11 Generators y **and** w. Finally, Figure 16.3b shows all three kinds of lines, patrilines (vertical) matrilines (diagonal) and wife-lines (horizontal). Because this figure fails to bring the left-column into coincidence with the right column although they represent the same clan $W_{\pm 3}$, the two matrilines, ego's and ego's wife's, appear as broken lines in the drawing rather than as single straight lines. For example, in G_3 ego's ascending matriline jumps from *gawel* | *arndi* on the right over to *waku* on the left, since these two boxes represent the same subsection $Kai_{\pm 3}$.

From Figure 16.3b it is easy to read off that the two matrilines are in fact cycles, of length twelve generations, e. g. ego's matriline is in the same subsection Bal_0 for G_6 and for G_{-6}. Similarly that the patrilines are cycles of length four generations, e. g. Bur_0 in G_4 is the same subsection as Bur_0 in G_0, and the wife-lines are cycles of length six clans, and therefore the three kinds of lines—solid, dashed or dotted—appear as actual closed cycles. To make the geometric picture correspond to the ethnographic facts, i. e. to bring together at one point on the paper all the boxes in Figure 16.3b that represent the same subsection, it would be necessary not only to wrap the figure around a vertical cylinder so as to bring W_{-3} into conjunction with W_3 but also to bend it over from the top so as to bring Bur_0 in G_4 into conjunction with Bur_0 in G_0 etc. In other words, the figure should be drawn on the surface of a torus, i. e. a doughnut with a hole. However, instead of drawing the somewhat complicated diagram that would then result from projecting this torus onto the plane of the paper, we can attain the same result by means of a graph like Figure 16.11, where to lighten the drawing we have omitted the six patricycles, which can be traced out on the figure from relation $x = yh = yw$.

16. 12 Six-line chart and exchange marriage. Liu began his theoretical investigation of the Murngin system as a result of reading Needham's [1957] article on circulating connubium in Eastern Sumba (cf. our 18.1). On the analogy of the Kariera (degenerate) marriage-cycle of two clans, each with two sections, Liu argued that the four subsections in Murngin may have resulted from the existence of four-clan marriage cycles; and then the existence of still longer cycles in Eastern Sumba made it seem probable that longer

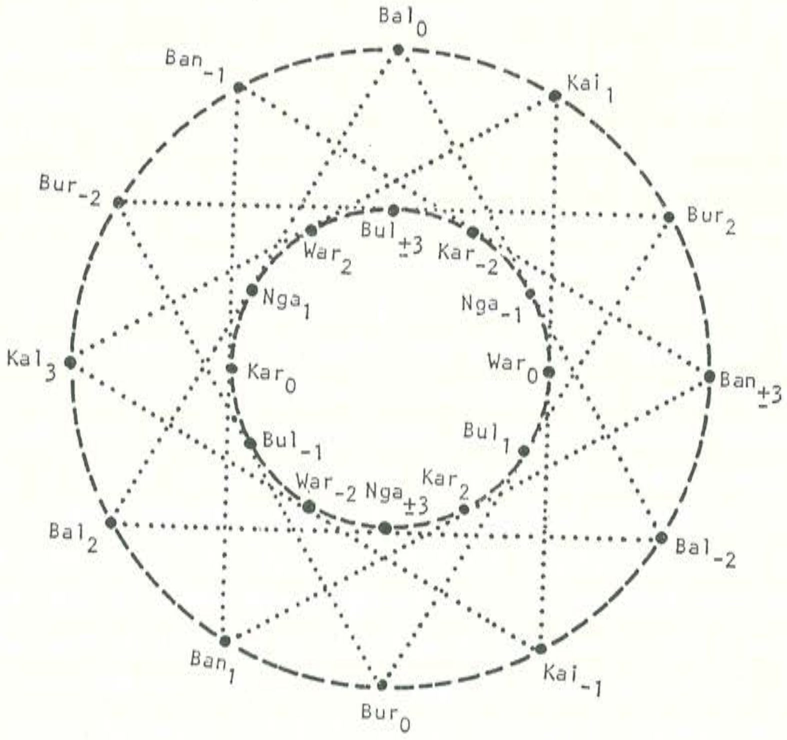


Figure 16. 11 **The two matricycle (clockwise circles) and four wife-cycles (counter clockwise triangles) in a regular (6, 4)-connubium.**

cycles existed also in Murngin. In Sumba the cycles may be of any length, even or odd, but in Murngin they must be of even length 4, 6, 8,.... In view of the controversy over Warner's seven-line chart, Liu first concentrated his attention on the 6-clan connubium. On comparing Warner's seven-line chart for Murngin with Elkin's five-line chart for Karadjeri, Liu postulated that, just as Elkin's leftmost kinterms refer to the same persons as his rightmost, the two sets of kinterms being identical with each other, so also Warner's leftmost kinterms refer to the same persons as his rightmost, even though in this case the two sets of kinterms are quite different from each other.

More specifically, he postulated that in the even generations the kinterm *due-elker* on the left in Figure 16.3b refers to the same persons as the kinterms *nati-elker* | *momo-elker* on the right, and in the odd generations *waku* on the left refers to the same persons as *gawel* | *arndi* on the right. Consider, for example, the sons and daughters of those female relatives whom ego calls *gurrong*. In some cases they are to be called *due-elker* and in other *nati-elker* | *momo-elker* and our ignorance of the principle on which the decision is made (cf. 16.13) is due to the failure of field-workers to ask this question because it never occurred to them that Warner's left-hand and right-hand kinterms could refer to the same persons.

Liu's suggestion that Warner's seven-line chart in fact contains only six lines was mentioned in his early publication [Liu 1967, 1968, 1969] many of which were largely inaccessible to the intellectual public at arge. In any case it would probably have made little impression, since there was nothing in the ethnographic evidence either to validate or to refute it until the publication of Shapiro's findings. In his 1968 article Shapiro speaks of "grappling with sister's daughter's daughter exchange." It would seem that his difficulties arise from the fact that he everywhere speaks of ZDD-exchange-marriage as though it were equally applicable to four-clan, six-clan and longer connubia, whereas in reality it applies only to the six-clan case. To see this, let us examine the question of female-relative exchange from a general point of view (cf. the Karadjeri case in 15.4).

Let the connubium have 2n clans, each with 2m segments, where the word "segment" is used to mean either "section" or "subsection". Then the generating relations are $x^{2m}=w^{2n}=i$. Thus

in Kariera: $x^2=w^2=i$: $m=n=1$
in Kardadjeri: $x^2=w^4=i$; $m=1$, $n=2$
in (4,4)-Murngin: $x^4=w^4=i$; $m=2$, $n=2$
in (6,4)-Murngin: $x^4=w^6=i$; $m=2$, $n=3$.

As before (15.4) we now let K denote the type of female relative exchanged and let p_0, p_1 be the two exchanging males, who are therefore in the KH-relation to each other. Since $w^{2n}=i$ and therefore $w^{2n}=h^{2n}=i$, it follows that $x^{2m}h^{2n}=i$, so that $x^{2m}h^{2n}$ is a full circuit of segments beginning and ending with p_0's segment. Thus the half-circuit $x^m h^n$ will take us from p_0 to p_1. So we have $x^m h^n=kh$ or $k=x^m h^{n-1}=x^m(\bar{y}x)^{n-1}=x^{m+n-1}\bar{y}^{n-1}$. But $x^{2m}=i$ implies $x^m=x^{-m}$, so that $k=x^{n-m-1}\bar{y}^{n-1}$.

Substituting the appropriate values of *m* and *n* gives:

in Kariera	$k=\bar{x}\bar{y}^0=\bar{x}$,	$\mu K\phi=\bar{X}\phi=D$ (cf. 13.2)
in Karadjeri	$k=x^0\bar{y}=\bar{y}$,	$\mu K\phi=\mu\bar{Y}\phi\sim\mu J\bar{Y}\phi=\mu ZD$
in (4, 4)-Murngin	$k=\bar{x}\bar{y}$,	$\mu K\phi=\bar{X}\bar{Y}\phi=\mu DD$
in (6, 4)-Murngin	$k=\bar{x}^0\bar{y}^2=\bar{y}^2$,	$\mu K\phi=\mu\bar{Y}\bar{Y}\phi=J\bar{Y}\bar{Y}\phi=\mu ZDD$.

Thus Kariera has D-exchange, Karadjeri has ZD-exchage, (4,4)-Murngin has DD-exchange and (6, 4)-Murngin has ZDD-exchange.

These exchanges may be traced out on the corresponding kingraphs; e. g. the ZDD-exchange for (6, 4)-Murngin either on Figure 16.10 or on Figure 16.9. On Figure 16.10 the male p_1 will be found at the point labeled xy^3 at a distance $\bar{y}\bar{y}h=\bar{y}\bar{y}\bar{y}x$ from p_0 at the point i, and then the same path $\bar{y}\bar{y}\bar{y}x$ starting now from p_1 will bring us back to p_0. On Figure 16.9, drawn in terms of x and w, we may replace $\bar{y}=(xw)^{-1}$ by wx and then trace out $\bar{y}\bar{y}h=(wx)^2w=x^2w^3$, bringing us to p_1 at the point labeled $x^2w^{\pm 3}$, which is seen to be symmetrically placed with respect to the starting-point p_0.

In view of these results it would be interesting to ask the field-workers whether, for example, the Karadjeri actually refer to their system as ZD-exchange. As for the Murngin we have the clear-cut statement from Shapiro that they "consciously practice ZDD-exchange."

On discovering that his theoretical solution of the sevenline Warner problem was now supported by Shapiro's discovery of six-clan circular connubia and ZDD-exchange, Liu published the theory in his English-language book [1970], with the comment "the extraordinary fact reported by Shapiro that a sister's daughter's daughter exchange-marriage is practiced in the Murngin society needs no more be an enigma."

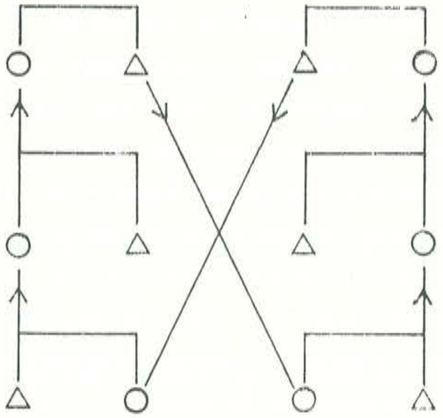
16. 13 Choices between giver and taker kinterms. But Shapiro's articles contain more evidence for the correctness of Liu's theory. Although he nowhere mentions the general problem of deciding between kinterms on the left and right he does make one relevant statement:

> whether *nati-elker* (or *momo-elker*) or *due-elker* is applied to a given individual whose mother is *gurrong* is dependent largely upon considerations of relative age, which need not concern us here.

This isolated statement is truly tantalizing, since the question is important not only for the Murngin system but for all connubial complexes as well (18.6). Let us try to see just what form the consideration of relative age might take and what might be meant by "largely".

From the point of view of an ego in clan W_0 the two clans W_1 and W_2 are giver clans, for which ego will use giver kinterms, i. e. terms taken from columns W_1 and W_2 of Warner's chart; and W_{-1} and W_{-2} are taker clans, for which ego will use taker kinterms from the W_{-1} and W_{-2} columns. But the clan $W_{\pm 3}$ is both giver and taker, so that our question can be worded: will ego use the giver kinterms *gawel* | *arndi* and *nati-elker* | *momo-elker* from Warner's rightmost column or the taker kinterms *waku* and *duo-elker* from his leftmost column?

To investigate this question we must further examine Shapiro's statements about ZDD-exchange marriage, with the help of his diagram reproduced as our Figure 16.13a.



Males are represented triangles, females by circles the lines with arrowheads are both matrilines and wife-lines

Figure 16. 13a ZDD-exchange (Shapiro's).

If we confine our attention to the eight persons directly concerned, namely ego, ego's Z, ego's ZD, ego's ZDD and similarly for alter, the same situation is shown by Figure 16.13b, in which the subscripts 0 and 1 refer to the two matrilines M_0 and M_1.

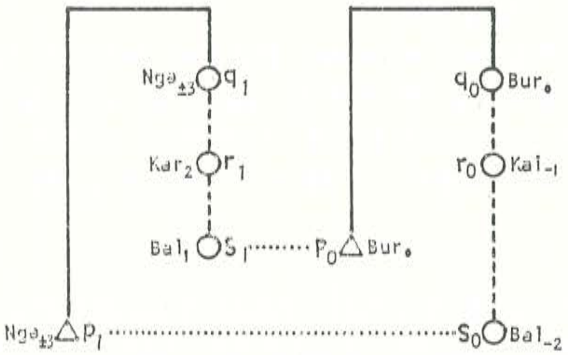


Figure 16. 13b. Alternative diagram for ZDD–exchange.

Let us now recall the general principle (cf. 3.6) that if ego is linked to alter by two kinchains if different length, then ego will base his choice of kinterm on the shorter chain.

Let us apply this principle to ego=p_0 and alter=q_1 in Figure 16.13b. By tracing out we see that q_1 is both WMM ($\bar{X}YYY$) and ZDDHZ ($J\bar{Y}\bar{Y}\bar{Y}XJ\phi$) to p_0, where the WMM-path running through the two linking relatives s_1 and r_1 in the giver clans W_1 and W_2 is shorter than the ZDDHZ-path through p_0's sister and three linking relatives r_0, s_0, p_1 in the taker clans W_{-1} and W_{-2}. Consequently, p_0 will regard q_1 as his WMM, not his ZDDHZ, and will therefore apply to q_1 the giver kinterm (*momo-elker*) on the right of Warner's chart, rather than the taker kinterm on the left.

Convesely, p_0 is both DDH and BWMMB to q_1, so that q_1 will regard p_0 as her DDH, linked to her through her taker clans, and will therefore apply to p_0 the taker-kinterm *due-elker.*

But now consider p_0 and p_1. Here each of them is both ZDDH and WMMB to the other, so that the taker chain and giver chain are of equal length. Since Shapiro says that the decision depends on their relative ages, we conjecture that ego will apply the giver term *nati-elker* to alter if alter is older than ego, and the taker term *due-elker* if alter is younger than ego. This admittedly uncertain conjecture is based on the fact that the columns on the right distinguish sex of the referent but columns on the left do not (cf. the giver terms *gawel* | *arndi* with the taker term *waku*) and in kinship systems throughout the world ego makes much less distinction among younger relatives than among older.

Consequently, Shapiro's statement that the choice of kinterm depends "largely on considerations of relative age" can now be reworded: the choice depends on the relative length of kinchains through giver and taker clans, and when these lengths are equal it depends on the relative age of ego and alter.

16. 14 Mother-in-law exchange. Shapiro's account of a ZDD-exchange takes the form of a narrative of successive events. He tells us that the natives themselves regard the transaction as a ceremonious bestowal on a male in one matriline, call it M_1, by males in the other line, call it M_0, followed by an equally ceremonious reciprocal bestowal by M_1 on M_0, and that these ceremonies are bestowals not of a wife, or at least only indirectly so, but of a future mother-in-law. In order to follow Shapiro's narrative more easily, let us denote the two male beneficiaries by p_0 and p_1, their sisters by q_0 and q_1, their daughters by r_0, r_1 and their sisters' daughters by s_0 and s_1, (see Figure 16.13b) and finally, since the choice of kinterms depends "largely on relative age" let us assign the following dates of birth to these eight persons:

p_0:	Bur_0:	July 1900	p_1:	Nga_{-3}:	January 1900
q_0:	Bur_0:	July 1901	q_1:	Nga_{-3}:	January 1901
r_0:	Kai_0:	July 1915	r_1:	Kar_2:	January 1915
s_0:	Bal_0:	July 1930	s_1:	Bul_1:	January 1930

Shapiro's narrative can than be presented as follows. We suppose that q_0, a sister of p_0, was married in 1913 at the normal age of ten to twelve. Then in 1919 her daughter r_0, now four years old, is bestowed by p_0, i. e. the MB of r_0, on a male p_1 in the other matriline, not as p_1's future wife but as p_1's future mother-in law. That is to say, at a special ceremony and with the advice and consent of the girl's mother p_0 and of close male relatives in the matriline M_0, the male p_0, now about twenty years old, bestows on p_1, his approximate contemporary in the other matriline M_1, the right of marriage, if p_1 subsequently chooses to exercise it, with the future daughters of the four-year-old girl r_0. In Shapiro's words [1969], "he has first claim to all daughters she will eventually bear." To this ceremony Shapiro [1969] gives the name "mother-in-law bestowal".

Then let us suppose that in 1930 the girl r_0, now fifteen years old, gives birth to her first daughter s_0. If p_1 chooses to exercise his right, he will begin to cohabit with s_0 about 1940, when he is forty years old and she "is about ten or twelve years old," in accordance with the common custom among Australian aborigines that the older men pre-empt young girls for their wives (cf. 16.8).

To emphasize the importance of matriliny, Shapiro points out that in such cases the young girl's father, whom we may call h_1 (cf. Figure 16.11) because he is the husband of r_0 and is therefore in matriline M_1, has no authority over the disposal of his daughter s_0; the marital fate of a girl in the matriline M_0 depends entirely on persons in her own matriline and not on her father, who is in the other matriline. Shapiro writes [1968: 351]:

> in discussing this institution, informants did indeed refer to it as ZDD exchange (*gutarrana gurrupanmirri*, cf. 16.3). However, since the initial object of bestowal in northeast Arnhem Land is a mother-in-law rather than a wife, it can also be seen as an exchange of sister's daughters.

If p_1 reciprocates by bestowing his ZD on p_0 as p_0's future mother-in-law, the whole transaction will be regarded as a fair exchange of economic goods between the two matrilines From the point of view of the patriclans this ZDD-marriage exchange in a 6-regular connubium is indirect, since ego in W_0 takes his wife from W_1 but from the point of view of matriclans the exchange is direct, since ego in M_0 gives his ZDD as a wife to alter in M_1 and receives alter's ZDD in return. Although the six patriclans are overt, i. e. there are specific names for them because they are partilocal and patrilineal, nevertheless it is the two latent, unnamed matriclans that play the dominant role in marriage arrangements in a 6-regular connubium.

The occurrences of kinterms from Warner's left and right columns are then explainable as in Table 16.14.

If one include the two husbands h_0 and h_1, although Shapiro tells us that they are powerless to affect the marriages of their daughters, then ZDD-exchange marriage involves the persons listed in Table 16.14.

Table 16. 14a Choice of kinterms from the left and right columns of Warner's bond

Ego	Alter	Choice of kinterm	Reason
p_0	p_1	giver	p_1 is older
p_1	p_0	taker	p_0 is younger
p_0	q_1	giver	giver path is shorter
q_1	p_0	taker	taker path is shorter
p_1	q_0	giver	giver path is shorter
q_0	p_1	taker	taker path is shorter
q_0	q_1	giver	q_1 is older
q_1	q_0	taker	q_0 is younger
r_0	r_1	giver	r_1 is older
r_1	r_0	taker	r_0 is younger
s_0	s_1	giver	s_1 is older
s_1	s_0	taker	s_0 is younger

Their interrelationships can be conveniently traced-out on Figure 16.14 (which repeats the relevant part of Figure 16.11), and then the corresponding kinterm can be traced-out on Figure 16.3b.

To verify, for example, that q_1 is actually the DHZ of r_0, we start at r_0 in Figure 16.14, run along the matriline against the arrow to r_0's daughter s_0, then along the wife-line, again against the arrow, to s_0's husband p_1, where we find that q_1 is sister to p_1 and therefore DHZ to r_0.

To verify that *gurrong* is the corresponding kinterm, we begin at the ego-box in Figure 16.3b, go down diagonally to *waku* for the D, then horizontally to the left for the H and remain motionless for the Z, where we find the kinterm *gurrong*, as desired.

To show that p_0 and p_1 are in the ZDDH-relation to each other, we begin at either one of them in Figure 16.14, move two steps counterclock wise on the matricycle to reach ZDD, and finally move along the husband-line, thereby arriving at the other of the two exchanging males p_0 and p_1. Tracing out the ZDDH-relation on Figure 16.3b then gives us *due-elker* on the left on Warner's chart, for the younger of the two, and *nati-elker* on the right, for the older.

Table 16. 14b Relationships of persons involved in ZDD-exchange marriage

ego \ alter	p_0	p_1	q_0	q_1	r_0	r_1	s_0	s_1	h_0	h_1
p_0		nati-e =	yukiyuko yZ	momo-e WMM	waku ZD	mokul-r WM	kutara ZDD	galle W	gawel WF=WMH	gurrong ZDH
p_1	due-e ZDDH=WMMB		momo-e WMM	yukiyuko yZ	mokul-r WM	waku ZD	galle W	kutara ZDD	gurrong ZDH	gawel MB
q_0	wawa eB	due-e DDH		momo-e BWMM=DDHZ	waku D	mokul-r BWM	kutara DD	galle BW	gawel MB	gurrong DH
q_1	due-e DDH	wawa eB	due-e DDHZ=BWMM		mokul-r BWM	waku D	galle BW	kutara DD	gurrong DH	gawel MB
r_0	gawel MB	gurrong DH	arndi M	gurrong DHZ		momo-e MBWM=DHZD	waku D	mokul-r MBW	mari MMB	due H
r_1	gurrong DH	gawel MB	gurrong DHZ	arndi M	due-e DHZD=MBWM		mokul-r MBW	waku D	due H	mari MMB
s_0	mari MMB	due H	mari MM	due HZ	arndi M	gurrong HZD		momo-e MMBW	waku HZDH	bapa F
s_1	due H	mari MMB	due HZ	mari MM	gurrong HZD	arndi M	due-e HZDD		bapa F	waku HZDH
h_0	waku ZD	mari-e WMB	waku ZD	mokul-r WM	kutara ZDD	galle W	arndi WMBW	gatu D=WD		due-e ZDDH
h_1	mari-e WMB	waku ZD	mokul-r WM	waku ZD	galle W	kutara ZDD	gatu D=WD	arndi WMBW	nati-e WMMB	

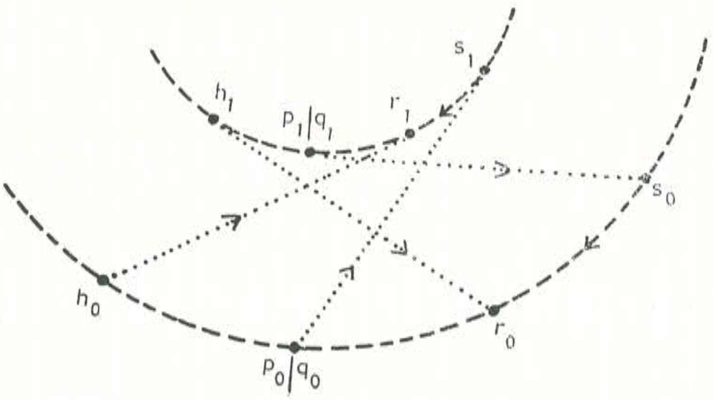


Figure 16. 14 The ten persons involved in ZDD-exchange marriage.

CHAPTER XVII

Other Murngin Marriage

17.1 The (4, 4) connubium. Let us now consider the other kind of connubium discovered by Shapiro, namely "four clans marrying in a circle" (16.6). As generating relations for the group of sectional relations in this (4, 4)-case we will have $x^4 = i$ because each clan still has four subsections and $w^4 = i$ because there are now four clans in the circle, and again the group will be commutative, with $xw = wx$. Thus the sectional kingraph can be drawn as in Figure 17.1a.

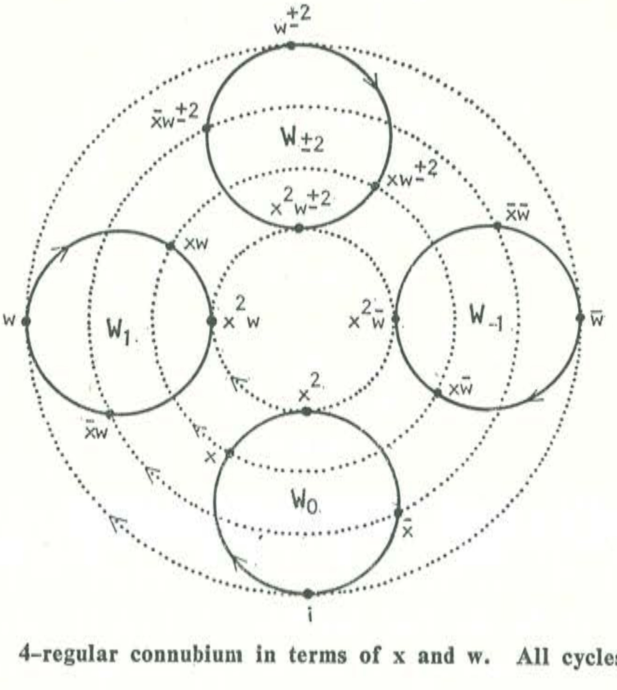


Figure 17.1a 4-regular connubium in terms of x and w. All cycles clockwise.

The four clans, or patricycles, in Figure 17.1a may be described as follows:

W_0 is the clan of ego's B or Z, and of ego himself or herself
W_1 is the clan of ego's BW, or W if ego is male
W_{-1} is the clan of ego's ZH, or H if ego is female
$W_{\pm 2}$ is the clan of ego's BWBW (or WBW if ego is male) or ZHZH (or HZH if ego is female)

Thus ego's clan has one direct giver clan W_1, one direct taker clan W_{-1}, while one clan $W_{\pm 2}$ is both indirect giver and indirect taker.

In order to obtain generating relations for the corresponding group in terms of x and y, instead of x and w as just above, we set $w = \bar{x}y$ in $w^4 = i$, obtaining $(\bar{x}y)^4 = \bar{x}^4 y^4 = y^4 = i$. Thus the desired relations are $x^4 = y^4 = i$ and the corresponding kingraph can be drawn as in Figure 17. 1b.

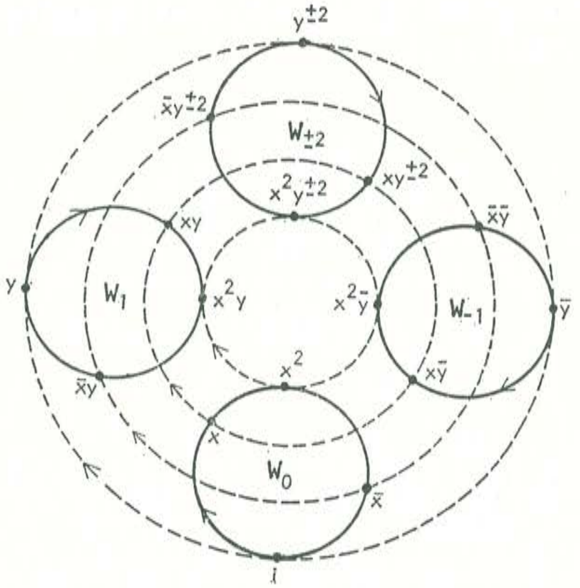


Figure 17. 1b The 4-regular connubium in terms of x and y.

17. 2 Three keys to the decipherment of Warner's chart. The question now arises; how do the four patrilines in a (4, 4)-connubium fit into Warner's seven-line chart, or rather, as we now know, into his six-line chart. Liu's answer is that Warner's chart is not specifically a six-line chart at all, but rather a chart with any even number of lines, 4, 6, 8,... greater than two, since the natives tell us (cf. 16.4) that the chart can be extended as far as desired both to left and right. Thus various scholars considered Warner's table as containing 7, 9, 11,... lines but no one considered it as a table for 5 lines as well, until Liu theorized in 1967 that the five central lines form a kinterm table for a connubium of 4 clans, as in Figure 17.2.

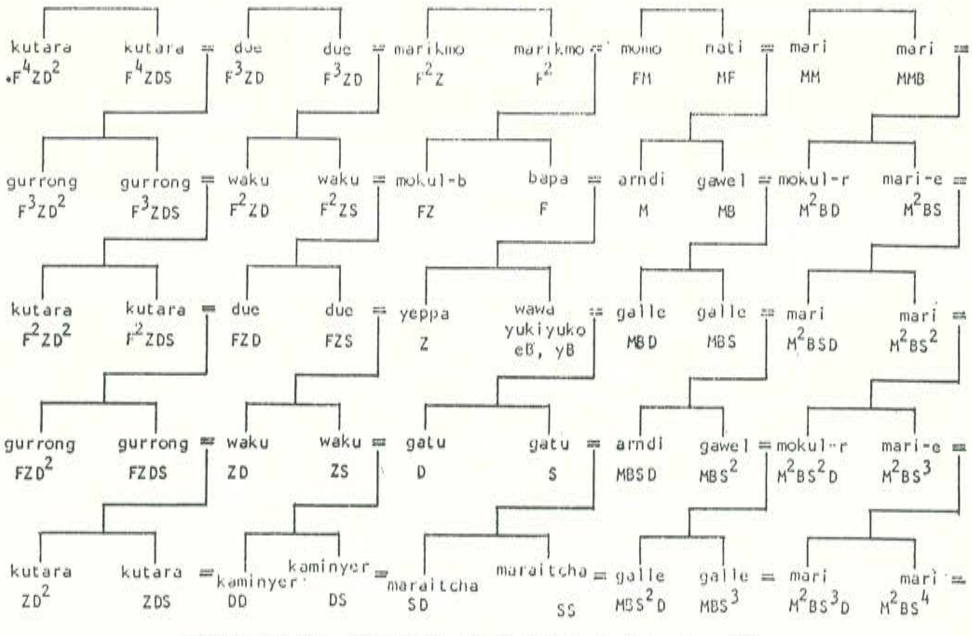


Figure 17.2a Warner's chart for a 4-clan connubium

Thus the decipherment of Warner's chart rests on three assertions:

i) The seven-line chart applies only to six-clan connubia and is in fact a six-line chart since the kinterms in the two outside lines are applied to persons in the same clan. It was the unwitting but universal assumption that different lines of kinterms must apply to different clans that led to Webb's perplexity (16.5) about failing to find the cycling affirmed by his native informants.

ii) The five interior lines, when taken out from the seven as in Figure 17.1, themselves form a kinterm chart applicable to four-clan connubia.

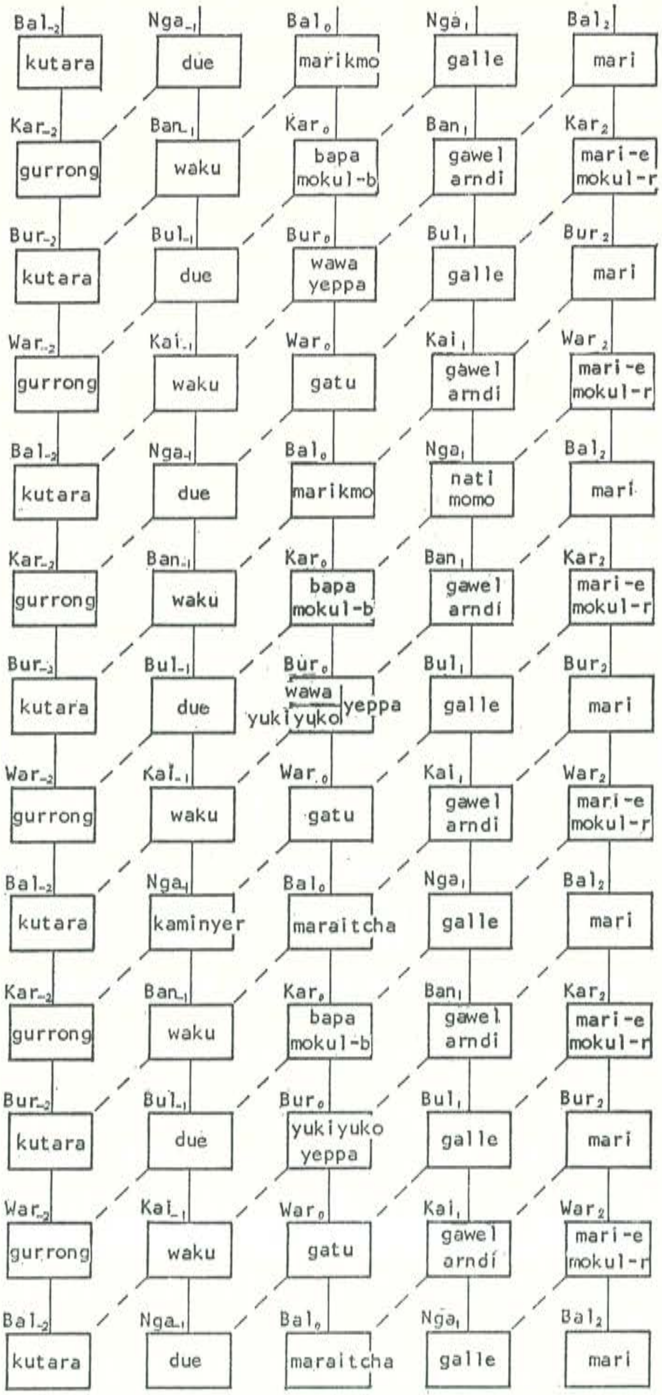


Figure 17. 2b Kinterm chart for 4-clan connubium.

iii) Warner's chart is in fact not one chart but arbitrarily many, since we are informed by Warner and Webb that it can be extended laterally to any desired number of columns on the left and right according to the rule (in our notation):

$$W_4 = W_6 = W_8 = \ldots = W_2$$
$$W_5 = W_7 = W_9 = \ldots = W_3$$
$$W_{-4} = W_{-6} = W_{-8} = \ldots = W_{-2}$$
$$W_{-5} = W_{-7} = W_{-9} = \ldots = W_{-3}.$$

Thus from the (2n+1)-central lines in the extended chart, by amalgamating the leftmost and rightmost columns in the same way as for five or seven lines, we obtain a kinterm chart for a $2n$-connubium with any even number of clans, eight, ten, twelve etc., and it was this situation that the natives were trying to make clear to Webb when they insisted on the two seemingly contradictory statements that Warner's table cycles and also extends arbitrarily for to left and right.

17. 3 Giver and taker kinterms in the (4, 4)-clan. Again Shapiro's discoveries have provided the ethnographical evidence. In connection with his emphasis on matriliny he draws the matrisequence in Figure 17. 3. From this diagram we may read off the matricycle (for an ego in subsection W_0) as follows:

$M =$ *andi* (in W_1) , $M^2 =$ *mari* **or** *kutara* (in $W_{\pm 2}$),
$M^3 =$ *waku* (in W_{-1},) $M^4 =$ *yeppa* $= M^0 = Z$ (in W_0), $M^5 = M$ etc.

In 16. 13 we discussed Shapiro's question "whether *natielker* | *momo-elker* or *due-elker* is applied to a given individual whose mother is *gurrong*" A corresponding question here, not mentioned by Shapiro since he does not make the distinction between (6, 4)- and (4, 4)-connubia is "whether *mari* or *kutara* is the kinterm to be applied to a person who is the mother of *gawel* | *arndi*" Liu's tentative suggestion is the same as before: if ego is connected to his MM and his ZDD, actual or classificatory, by chains of equal length, ego will choose the giver term *mari* for persons older than ego and the taker term *kutara* for persons younger than ego.

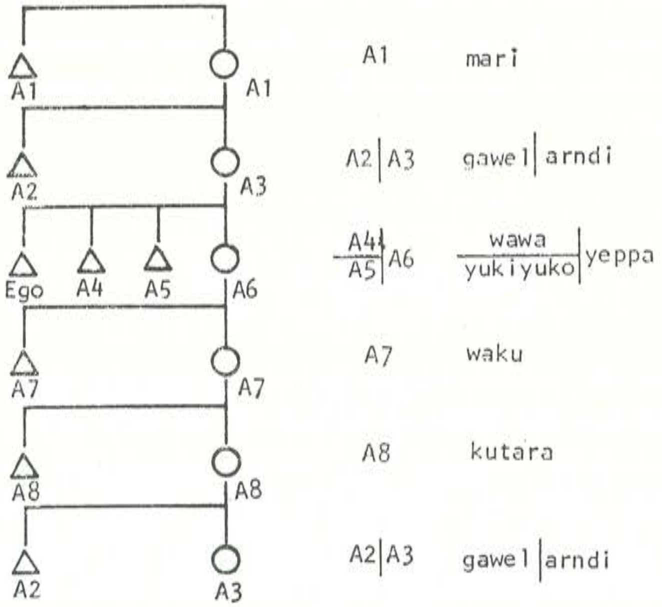


Figure 17. 3 Ego's matrisequence (from Shapiro)

17. 4 Daughter's daughter exchange. In 16. 12 we have found that a (4, 4)-Murngin connubium has $DD = \bar{X}\bar{Y}\phi$ exchange, in contrast to the ZDD $= \mu J\bar{Y}\bar{Y}\phi \sim \bar{Y}\bar{Y}\phi$ exchange of the (6, 4)-Murngin connubium. Then just as the natives describe the (6,4)-system as *kutara*-exchange (i. e. ZDD-exchange), so it would seem that they must describe the (4, 4)-system as *kaminyer*-exchange (i. e. μDD-exchange) but we have no information on this point.

In contrast with the native awareness of Z-, ZD- and ZDD-.exchange in various societies, there is no indication that this DD-exchange has any social significance. In the (6, 4)-case Shapiro's argument (16. 14) shows that the marriage arrangements are regarded by the natives as being not so much an indirect exchange of wives as a direct exchange of mothers-in-law between the two matrilines in the system, but there seems to be no reason to believe that in the (4, 4)-system the marriages were regarded as any kind of direct exchange among the four matrilines involved in this case. Shapiro's remark that the father has no control over the disposal of his daughters apparently refers only to six-clan connubia, since Warner's statements [1937: 75, 92, 94 etc.] imply that in many cases marriages are arranged by the fathers.

17.5 Right marriage. Up to now we have been examining regular Murngin marriage, as defined by Webb (our 16.8). But this concept is not mentioned by Warner himself. He discusses only right and wrong marriage, which may be defined as follows.

In the Murngin system the two moieties have the distinctive names Dua and Yiritcha, and similarly the eight subsections Buralang, Warmut etc., but the sections (sets of alternate generations in the moieties) have only the compound names Burlang-Balang, Warmut-Karmarung, Bulain-Ngarit and Banaka-Kaijark (cf. 2.16). If we abbreviate that names of these four sections to Burbal, Warkar, Bulnga and Bankai, a connubium of four clans W_0, W_1, W_{-1}, $W_{\pm 2}$ marrying in a circle will appear as in Figure 17.5. Such a Murngin connubium is said to have **right marriage**, or to be a **4-right connubium**, with similar definitions for 6-right, 8-right, 10-right, ... connubia.

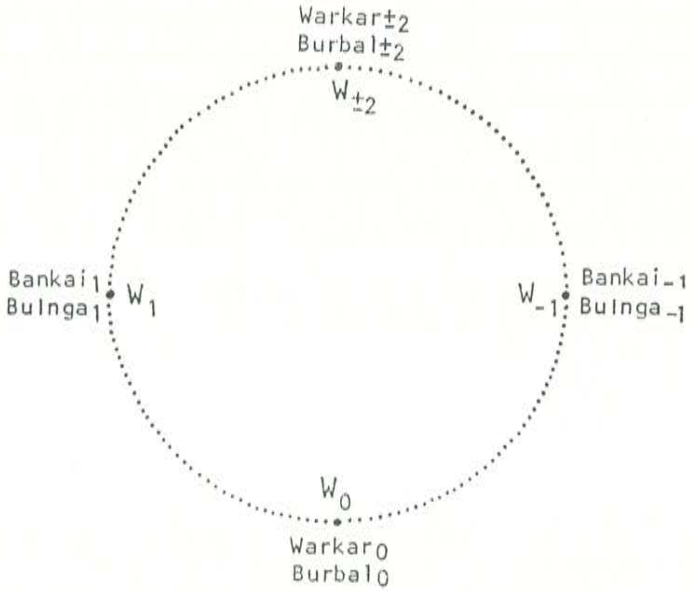


Figure 17.5 Murngin 4-right connubium.

Thus if ego is in Buralang, the rules for right marriage give him a choice of wife from either of the two subsections, namely Bulain and Ngarit, of the Bulnga section. If he marries into Bulain, the marriage is regular (16.8) and if into Ngarit, it is **alternate.** Thus right marriage is simply the combination of regular and alternate. All other marriages, into a wrong subsegment or outside of the tribe, are wrong.

From Figure 17.5 we see that the group for a Murngin right marriage connubium of four clans is the same as the Karadjeri group (15.1) with the defining relations $x^2=w^4=i$.

Similarly a 2n-right connubium will have $x^2=w^{2n}=i$, in contrast to regular marriage with $x^4=w^{2n}=i$, and the decipherment of Warner's kinterm chart will be the same for right as for regular marriage.

17.6 Wrong marriage; sister-exchange. We must now give some attention to the numerous kinds of wrong marriage. As we have seen, all right marriages (regular or alternate) are with MBD, and since wrong marriages are simply any other kind, they do not easily lend themselves to mathematical analysis. However, among the many kinds incidentally mentioned by Warner, it appears that direct sister exchange of Kariera type is the commonest; for example, Warner says [1973: 113] that ego and ego's MMB frequently belong to the same clan, as would always be the case with direct sister-exchange.

As an example of Z-exchange and ZDD-exchange in one diagram consider Figure 17.6 [Shapiro, 1968] showing an actual sequence of marriages in which two males, known to Shapiro, exchanged ZDD. Shapiro calls them No. 19 and No. 500 but for easier comparison with our Figure 16.11 we have changed their names to p_0 and p_1. In Figure 17.6 the arrows run from each clan to the clan which is not only its wife-clan but also, as always with MBD-marriage, its mother-clan. Thus we have $p_0\mathrm{Z}q_0\mathrm{D}r_0\mathrm{D}s\mathrm{H}p$ and similarly $p_1\mathrm{Z}q_1\mathrm{D}r_1\mathrm{D}s_1\mathrm{H}p_0$, or more concisely $p_0\mathrm{ZDDH}p_1$ and $p_1\mathrm{ZDDH}p_0$. Thus the clan Djambarpingu, represented by p_0, has a ZDD-exchange with Daiuror, represented by p_1.

On the other hand, the brother of r_1, call him u_1, who is also in Djambarpingu, gives his sister r_1 to the male t_1 in Bilkili and in return

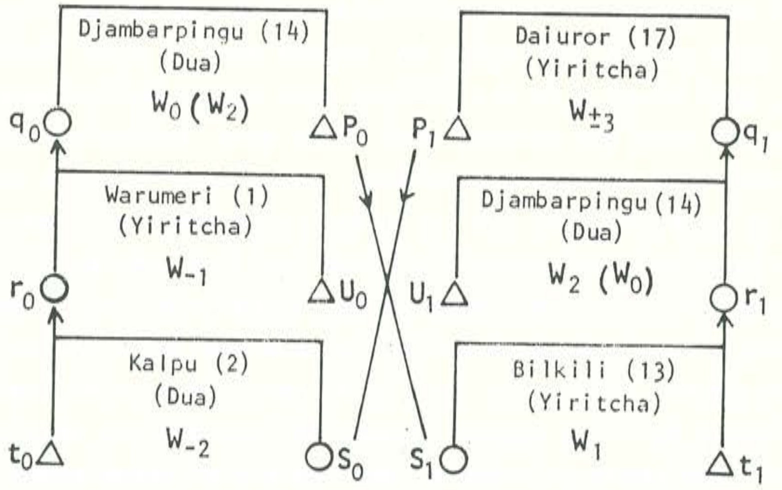


Figure 17.6 Shapiro's diagram (slightly modified) showing both ZDD-exchange and Z-exchange (cf. Figure 17.3).

receives t_1's sister s_1. Thus Djambarpingu, represented by u_1, has a Z-exchange with Bilkili, represented by t_1.

17. 7 Other wrong marriages. If there were no wrong marriages the kinterms given in ego's column on Warner's chart would refer to all members of ego's patriclan. But a wrong marriage causes ego to apply kinterms from other columns to members of ego's own clan.

Thus in Shapiro's example (Figure 17.6) if the marriage were regular, the male u_1 would be in W_2 from the point of view of p_0 as ego in W_0, i. e. u_1 would be in the column which in Warner's chart has the kinterms *mari* in even generations and *mari-elker* | *mokul-rumeru* in odd. But in fact, as a result of p_0's wrong marriage, u_1 is in the same clan as p_0=ego, so that u_1, being one generation above ego, is a classificatory father to p_0. However, the actual relationship between u_1 and p_0 may be quite distant, e. g. $p_0X^{m+1}J\bar{X}^m u_1$ with a fairly large value for m. Furthermore, the clans W_0, W_1, . . . are to be considered as made up of subclans, so that if m is large u_1 will be in a different subclan from p_0, i. e. their nearest common ancestor may be so many generations above them that subclans have been formed in one or more intermediate generations (see 2.13).

Now the kinterms are assigned (16. 8) as though all marriages were regular. Thus ego$=p_0$ will apply the kinterm *mari* to ego's classificatory father u_1, even though u_1 is in ego's own clan; and to the patridescendants of u_1 ego will apply the kinterms *mari* in the even generations and *mari-elker* | *mokul-rumeru* in the odd. In other words, some of ego's collateral relatives in ego's own clan, but not in ego's own patrilineal line, will be called by kinterms from column W_2, rather than from column W_0.

Warner [1937: 27, n.13] describes this situation by saying that ego's "clan... has a *mari* and *mari-elker* and a *mari* and *mokul-rumeru* for the male and female relatives in one's [i. e. ego's] clan other than one's own patrilineal line." In another passage he expresses the same idea by saying that such marriages create a *mari—mari-elker* | *mokul-rumeru* line of descent for ego on ego's clan.

Then in order to illustrate what may happen as a result of even further wrong marriages, he envisages the case that ego's male *mari*, our u_1, makes a wrong marriage with a *waku* (=ZD) in W_{-1}. The children of this marriage will be in ego's clan W_0 because their father is in W_0, and for the same reason they will be in the *mari—mari-elker* part of that clan, a subclan of W_0 which Warner simply calls the *mari—mari-elker* clan. But if their mother, in W_{-1}, had made a right marriage, these children would be in W_{-2}, so that ego will address them by the *gurrong-kutara* kinterms in column W_{-2}, thus creating a *gurrong-kutara* line of kinterms on the *mari—mari-elker* part of ego's clan.

As Warner says [p. 27]:

> A clan that would for a period have only a *mari* and *marelker* and a *mari* and *mokul* for the male and female relatives in one's clan other than one's own patrilineal line could by a wrong marriage of the male *mari*— let us say, to a *waku*— create a *gurrong-kutara* line of descent for ego in the old *mari-marelker* clan.

Such would appear to be the interpretation, with the help of some mathematics, of sentences of Warner's and of his kinterm chart as a whole that have hitherto been given up as hopeless. The history of science is full of examples to show that neither field-work alone nor mathematical theory alone is an adequate substitute for suitable alternation of both.

CHAPTER XVIII

Connubial Complexes

18. 1 Eastern Sumba complex. We now turn to the third kind of marriage-network listed in Shapiro's first article [1967: 354]: "most of the clans in the entire Murngin area constitute a single large marriage network" (cf. our 16. 6). To such a large network of interlocking cycles we give the name "connubial complex". If C and C' are any two clans in such a complex, a chain K is said to **link** clan C to clan C' if K links some person in C to some person in C'.

The largest known example of such a connubial complex is the Eastern Sumba system [Needham 1957] as in Figure 18. 1, where we have re-arranged Needham's original diagram so as to avoid criss-crossing of lines. The system is seen to consist of 24 clans with 14 interlocking cycles, 3 of them of length three, 3 of length four, 3 of length five, 3 of length six and 2 of length seven. Clan 1 takes wives from five other clans, namely 2, 4, 6, 11 13 and gives wives to only one, namely clan 3, a fact which would indicate that clan 3 is about as populous as 3, 4, 6, 11 and 13 combined. Clan 1 belongs to eight cycles, clan 12 to eight, clan 6 to four etc. Since Eastern Sumba does not have moieties, the cycles are not necessarily of even length.

18. 2 Murngin complex. We have seen that the Murngin system certainly contains four-clan cycles and six-clan cycles, and comparison with the Sumba system suggests that some of the Murngin cycles may be of considerable length 8, 10, 12, ...

To emphasize the similarities and differences of the Murngin and Sumba systems, we have constructed Figure 18. 2 by making the minimum number of changes in the Sumba diagram necessary to convert it into a possible

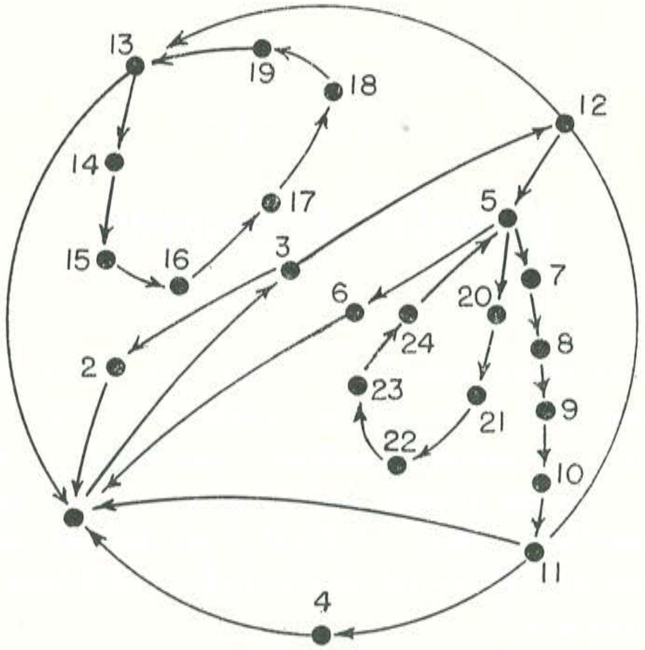


Figure 18. 1 Sumba connubial complex (after Needham)

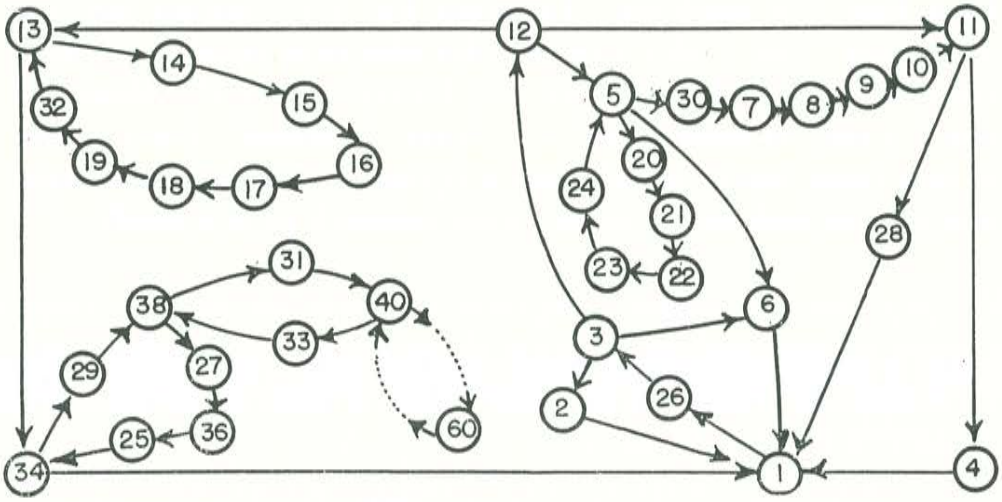


Figure 18. 2 Possible Murngin connubial complex with no wrong marriage.

Murngin diagram; i.e. arrows are drawn only from odd-numbered clans (Dua moiety) to even-numbered clans (Yiritcha moiety), with the result that all cycles are now of even length. To this end we have inserted clan 26 between 1 and 3, clan 28 between 1 and 11, clan 30 between 5 and 7, clan 32 between 13 and 19, and clan 34 between 1 and 13. Then in the lower left corner we have added new cycles so as to bring the entire number of clans up to 40, leaving the other 20 of the 60 Murngin clans unrepresented in order to lighten the drawing. In this way it is possible for a Murngin tribesman to travel from one corner to the other of the immense, sparsely populated Arnhem Land in northern Australia, a distance of more than 300 miles, without encountering any person with whom he cannot establish kinship through a sufficiently long chain of linking relatives.

18.3 Murngin kinterms. In practice, one Murngin male (ego) will determine the correct kinterm for another (alter) in the following way (cf. 1.2).

We suppose that ego is in the Buralang subsection of clan 1, which we take to be the Djambarpingu clan in the Dua moiety, so that ego will call out Djambarpingu-Buralang. In the simplest case, namely that alter is in ego's clan, the kinterm will be as listed in column W_0 of Warner's chart (Figure 16.3); namely *wawa* | *yukiyuko* if alter is in Buralang, *bapa* if in Karmarung, *gatu* if in Warmut, and *marikmo* | *maraitcha* if in Balang.

If alter is in a clan that is a direct giver to ego's clan (nos. 2, 4, 6, 28 or 34 in Figure 18.2), the kinterms are those listed in W_1: *galle* if alter is in Bulain, *gawel* if in Banaka or Kaijark; but if alter is in Ngarit, a discussion will be necessary to determine whether the shortest chain linking ego to alter is of height two, in which case the kinterm is *nati*, or of height minus-two, in which case the kinterm is *galle*.

Similarly, if alter is in a clan that is a direct taker from ego's clan (no. 26 in Figure 18.2), the kinterms can be read off from column W_{-1} in Figure 16.3, *due* if alter is in Bulain, and *waku* if alter is in Banaka or Kaijark; but if alter is in Ngarit, the term will be *due* if the linking chain is of height two and *kaminyer* if it is of height minus-two. In these three central lines the influence of the four subsections in each clan is apparent in the four-generation periodicity in ego's clan and in the exceptional terms *nati* | *momo* in the direct giver and *kaminyer* in the direct taker. In the more distant clans the choice of kinterm is already determined by alter's section.

For the more distant clans there are the following possibilities. For an alter in the Dua moiety ego must choose a kinterm from W_2 if alter's clan is an indirect giver to ego's (the terms in W_4, W_6, W_8, ... are identical with those in W_2), and from W_{-2} if alter's clan is an indirect taker; and for an alter in the Yiritcha moiety, ego must choose from W_3 or W_{-3}. If alter is in the Buralang-Balang section of Dua (i. e. if alter calls out either Buralang or Balang), the term chosen from W_2 will be *mari* and from W_{-2} it will be *kutara*, but if alter is in the Karmarung-Warmut section, the term from W_2 will be *mari-elker* and from W_{-2} it will be *gurrong*. Similarly, if alter is in the Bulain-Ngarit section of the Yiritcha moiety, the term from W_3 will be *nati-elker* and from W_{-3} it will be *due-elker*; but if alter is in the Banaka-Kaijark section, the term W_3 will be *gawel* and from W_{-3} it will be *waku*. Finally, if alter's clan is both indirect giver and indirect taker from ego's clan, we conjecture that ego will choose the giver terms if alter is older than ego, and the taker terms if alter is younger.

To take one example, let alter be in the Bangardi subsection of clan 30, which is an indirect giver to ego's clan because the smallest cycle running from clan 1 to clan 30 in the giver direction, i. e. along the arrows in Figure 18. 2, is 1, 26, 3, 12, 5, 30, 7, 8, 9, 11, 28, 1, with 30 nearer the beginning than the end. Thus ego will choose the kinterm *gawel*. Ordinarily, ego will know from memory whether alter's clan is a giver or taker to his own; otherwise an extended discussion may be necessary to find a chain of linking relatives.

18. 4 Purum complex and kinterms. A much simpler connubial complex is to be found in the Purum society on the border between India and Burma (see Figure 18. 4a). Here we have five clans in three cycles, each cycle being of length three, with the clan Thao in all three, Makan and Marrim in two each, and Parpa and Kheyang in one.

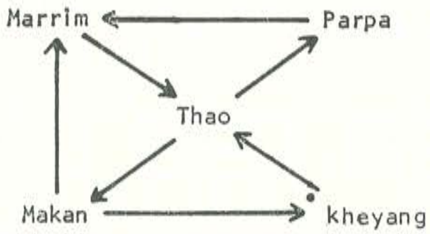


Figure 18. 4a The Purum connubial complex.

The kinterms for this Purum system [see e. g. Needham 1967, 76] may be arranged as in Figure 18. 4b.

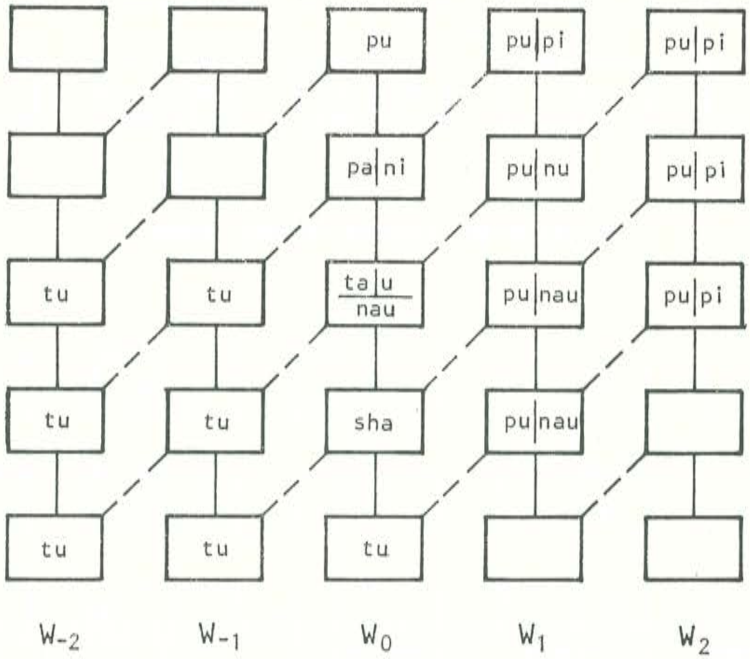


Figure 18. 4b Purum system.

18. 5 Jinghpaw (Kachin) and Siriono. In other cases we know the arrangement of the kinterms but do not know how many clans are involved nor how they are linked to one another. For example, in the Jinghpaw system (Jinghpaw is one of the dialects spoken in the Kachin Hills area in Burma) the kinterms are arranged as in Figure 18. 5a [Leach 1945:65], and for the Siriono in Bolivia [Holmberg 1969] they are as in Figure 18. 5b, where *akw* stands for *akwanindu* | *akwani*.

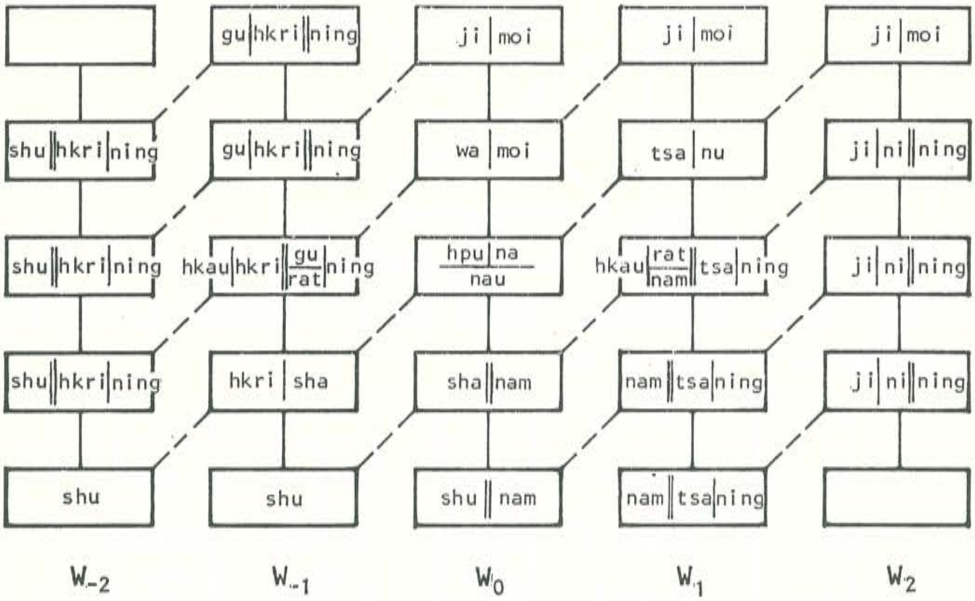


Figure 18. 5a Jinghpaw (Kachin) system.

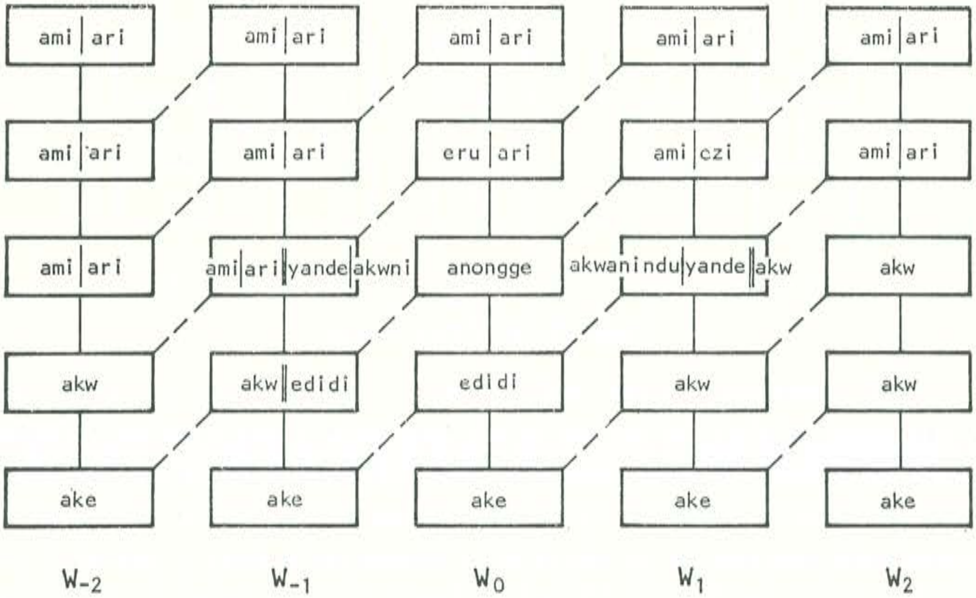


Figure 18. 5b Siriono system.

In all such cases, where the kinterms do not show periodicity, we assume that the terms for all generations above G_2 are the same as for G_2, and for all generations below G_{-2} they are the same as for G_{-2}. Also we assume that the tables can be extended to left and right by repeating the leftmost column as often as desired outwards on the left and the rightmost column outwards on the right (cf. 16.4).

18.6 Kinterms in any connubial complex. To find the kinterm applied by a given ego to a given alter in a system of patriclans with MBD marriage, we must find the shortest chain of the form W^n, with n positive, negative or zero, linking ego's clan to alter's clan, where we recall that in a merging system W^n means $(WB)^n$ or $(WB)^{n-1}W$ or $(BW)^n$ or $W(BW)^{n-1}$ according to the sex of speaker and referent (cf. 17.1). Then the correct kinterm occurs in column W_n of the kinchart, in alter's generation. If there are two such shortest chains, one with n positive and one with n negative, we again do not know the principle on which the choice is made and assume that it may differ from one society to another.

For example, in the Purum system (Figure 18.4), let ego (male) be in Makan and alter (female) in Thao, and let ego be connected to alter not only by a string equivalent to $\bar{W}^2$, i. e. alter is ego's classificatory WBW, but also by a string equivalent to W, i. e. alter is ego's classificatory ZHZ. Then ego must choose between the WBW-term *pi* and the ZHZ-term *tu*, and in this case ego will choose *tu* because the marriage-distance from clan Makan to clan Thao is greater along the forward path W^2 than along the backward path W^{-1}. In other words, ego chooses a kinterm to the left because alter's clan is a taker form ego's clan.

On the other hand, let alter be in Parpa, and again in the same generation as ego. Then the shortest forward path linking ego's clan to alter's clan is of length three; namely from Makan to Kheyang to Thao to Parpa, or form Makan to Marrim to Thao to Parpa, and the shortest backward path is of the same length; namely from Makan to Thao to Marrim to Parpa. Thus ego must choose between *pu* in column W_3 (with the same kinterms as W_2) and *tu* in column W_{-3}. Since *pu* | *pi* is listed only for G_0 and higher generations, and *tu* only for G_0 and lower, we tentatively assume that ego will choose *pi* if alter is older than ego and *tu* if alter is younger.

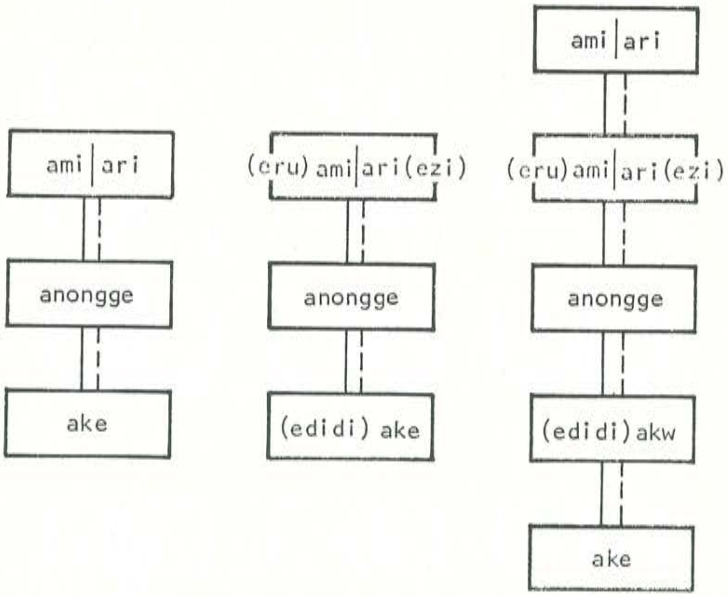
Now let the first of these two cases (namely that a male speaker is linked to a female referent by a string equivalent to W^2 and also by a string equivalent to $\bar{W}$) be applied to the Jinghpaw system, where the names of the clans are omitted, and to the Siriono, where the clans are completely latent. But the same reasoning as before, ego will choose the Jinghpaw term *hkri* on the left side rather than *ni* on the right side, and the Siriono term *ari* on the left rather than *akwani* on the right.

In the ambiguous case, where there are two shortest chains, each of length three, we tentatively assume, from the appearance of the Jinghpaw chart, that ego will choose a giver term for alter if alter is older than ego. On the other hand, the Siriono chart appears to give a clear indication of the opposite procedure, since the terms *ami* | *ari* for ego's generation in the left-most column apply to G_0 and higher generations, and the terms *akwanindu* | *akwani* (abbreviated to *akw* in Figure 18. 5b) apply only to G_0 and G_{-1}. But these conjectures can only be settled by asking questions in the field.

18. 7 The Siriono case. The Siriono tribe is particularly interesting both for its unusual kinship terminology and for its awesome technological backwardness. Although their rain-forest territory is criss-crossed with streams that often become too broad for wading, they have built no boats; they have never learned to make fire, which they must borrow from unfriendly neighbors and then preserve as carefully as possible, and their entire existence is spent so close to starvation that their speech, thoughts and action, and even their dreams, are dominated by an ever-insistent preoccupation with food. Their only social organization consists of small exogamous patrilineal groups which can be called clans only in the technical sense (2. 13). We are told that they practice MBD-marriage and therefore, since every member of the tribe appears to have a kinterm for every other member, they form a connubial complex, but we know nothing about the details.

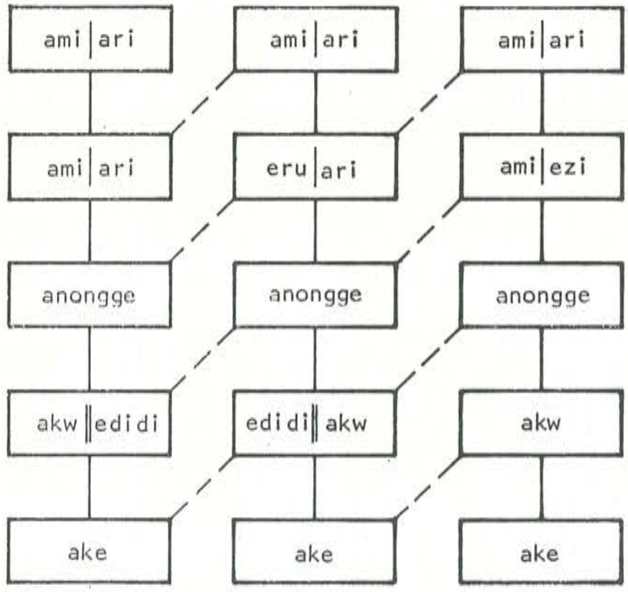
The kinship terminology is simple, with ten terms distributed as in Figure 18. 5b and one special affinal term *nininisi* for actual spouse. Noteworthy also is the special role of *yande* for potential spouse, i. e. MBD of a male ego and FZD of a female ego.

The position of the kinterms in Figure 18. 5b suggests that the kinship terminology may have evolved as in Figure 18. 7a, b, c, d, e.



Fignre 18. 7a, b, c Evolution of the Siriono system.

For in Figure 18. 7e we first note the lack of any distinctive term for cross-cousin, since *yande* is a late introduction to indicate potential spouse. This lack suggests that Siriono was originally of generational type, and the presence of the terms *ami=mb* and *ari=fz* in G_1 indicates that it was of three-generational type as in Figure 18. 7a. Then Figure 18. 7b introduces the lineal terms *eru=f*, *ezi=m* and *edidi=c*. But the presence of these lineal terms now distinguishes G_1, with four terms *ami*, *ari*, *eru* and *ezi*, from G_2 with two terms *ami* and *ari*. Recriprocally, therefore, G_{-1} became distinguished from G_{-2} by the introduction of the terms *akwanindu* | *akwani*, formed from *ake*, at which stage we have reached Figure 18. 7c. Then the introduction of prescribed MBD-marriage produces Figure 18. 7d. In



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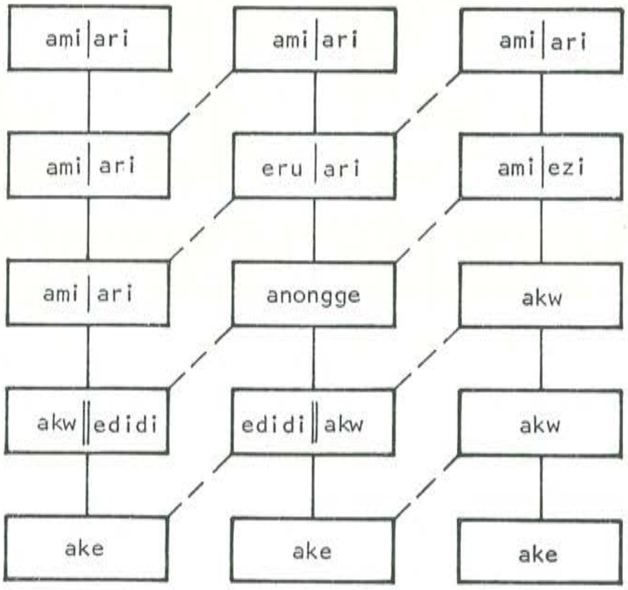


e)

Figure 18. 7d, e Evolution of the Siriono system.

this figure the *anongge* in the center means sibling, the *anongge* on the right means wife and also brother's wife and their siblings, and *anongge* on the left means husband, and also sister's husband, and their siblings. Since a husband is usually older than his wife, the *anongge* on the right will usually refer to persons younger than ego, a fact which may possibly account for their being denoted by the terms *akwanindu* | *akwani* from the next lower generation G_{-1}, whereas the *anongge* on the left will refer to persons older than ego and may therefore be denoted by the terms *ami* | *ari* from G_1, thus producing Figure 18. 7e. With the introduction of the term *yande* for potential spouse we arrive at the final Figure 18. 5b.

CHAPTER XIX

Aranda and Dieri Systems

19. 1 Alternating direct systems. As we have seen, a Kariera connubium has steady direct exchange, where "steady" means that ego marries into the same clan as his father, and similarly for ego's son and son's son etc., and "direct" means that if section S_0 takes wives from section S_1, then section S_1 takes wives from section S_0, so that steady and direct together imply bilateral cross-cousin marriage. On the other hand, a Karadjeri or Murngin connubium has "steady indirect exchange", which implies proscription of bilateral cross-cousin marriage but prescription of matrilateral. In these cases the $2n$ (four, six etc.) clans can be arranged in a circle in such a way that ego marries into the clan in the next position clockwise. However, many of 500-odd Australian tribes, and other tribes as well in Oceania, proscribe marriage with a first cousin of any kind.

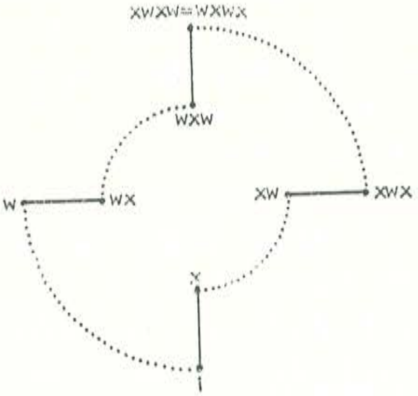
Most of these other systems have **alternating direct exchange**, in which the participating clans (three for Ambrym, four for Aranda or Dieri, six for Vao, and theoretically any number) can be arranged in a circle in such a way that each clan exchanges wives with the neighboring clan on one side in one generation and with the neighboring clan on the other side in the next generation. See Figures 19. 2a, b, c, d, e for Aranda; 19. 5 for Dieri; 20. 1, 20. 2 for Ambrym; 20. 4 for Vao. Systems with direct exchange of any kind necessarily have sister-exchange marriage but the type of female cousin whom ego marries will be different from system to system (cf. 21. 1).

19. 2 Diagram for the Aranda connubium. Commonest among all types of connubia is the Aranda system, to be found in nearly every part of Australia, including the Aranda tribe itself in the center of the continent from Lake Eyre northwards.

In the Aranda tribe the connubium consists of four unnamed clans in two unnamed moieties. In one of the clans the two sections are called Purula and Kumara, in another Ungalla and Umbitchana, in a third Panunga and Appungerta, and in the fourth Uknaria and Bultara. We shall call the four clans by the compound names Purula-Kamara, Ungalla-Umbitchana in Moiety A, and Panunga-Appungerta, Uknaria-Bultara in Moiety B, and for definiteness we assign ego to generation G_0 in the Purula section, whereupon the eight sections are necessarily assigned as follows:

Compound-name of clan	Even Generations	Odd Generations
	Moiety A	
Purula-Kumara	Purula	Kumara
Ungalla-Umbitchana	Ungalla	Umbitchana
	Moiety B	
Panunga-Appungerta	Panunga	Appungerta
Uknaria-Bultara	Uknaria	Bultara

Then the four clans can be arranged as in Figures 19. 2a,



Fignre 19. 2a Aranda connubium in terms of x and w.

By turning the patrilines outward we can conveniently arrange all the eight sections around one circle and then insert the matrilines around two squares as in Figure 19. 2b.

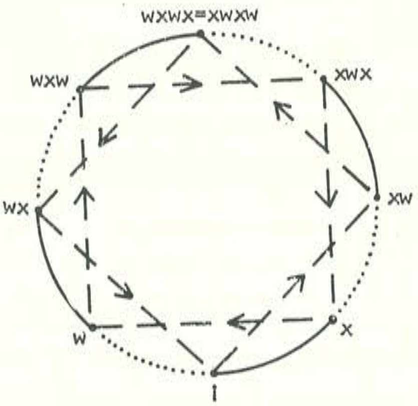


Figure 19. 2b Aranda connubium with x, y and w lines.

If we now wish to make a diagram with x and y lines only, we encounter the purely geometrical difficulty that since $y^2 \neq i$ the x and y lines cannot be placed around the circumference of a circle, like the x and w lines in Figure 19. 2b. This difficulty can be avoided if we make a three-dimensional drawing like the cylinder or thereby in Figure 19. 2c, d, which becomes Figure 19. 2e when projected onto the plane of the paper:

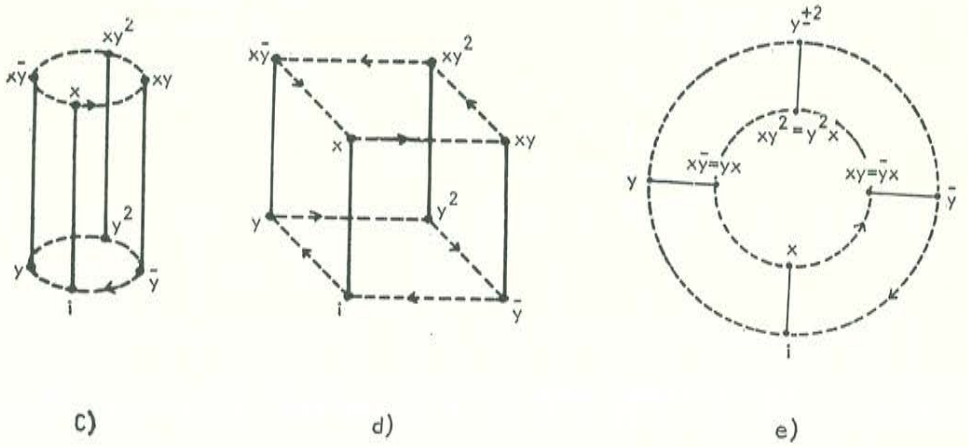


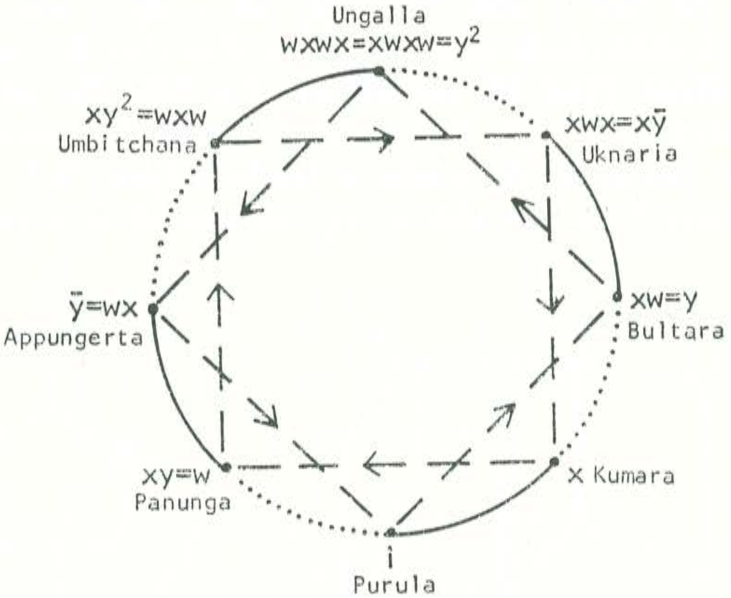
Figure 19. 2c, d, e Aranda connubium with x and y lines.

19. 3 Aranda kingraph. The native marriage-rules prescribe:

in the even generations

clan	Moiety		clan	Moiety
Purula-Kumara	in A	exchanges wives with	Panunga-Appungerta	in B
Ungalla-Umbitchana	in A	exchanges wives with	Uknaria-Bultara	in B
		in the odd generations		
Purula-Kumara	in A	exchanges wives with	Uknaria-Bultara	in B
Ungalla-Umbitchana	in A	exchanges wives with	Panunga-Appungerta	in B

In other words, in the even generations wives are exchanged between Parula and Panunga, and between Ungalla and Uknaria; and in the odd generations, they are exchanged between Kumara and Bultara, and between Umbitchana and Appungerta, as indicated by the dotted lines in Figure 19. 3.



i:	*aranga* $\left(\frac{kalja \mid kwaia}{itia}\right)^*$	$wx=\bar{y}$:	*amba*
x:	$\frac{kata \mid wonna}{alirra}$	$xwx=x\bar{y}$:	*tjimia* (*ankalla*)
$w=xy$:	*palla*	$wxw=xy^2$:	*marra*
$xw=y$:	*kamuna* | *maia*	$xwxw=y^2$:	*ebmanna*

* *kalja* also for FeBS, *itia* for FyBS etc.

Figure 19. 3 Section names and kinterms for Aranda.

Except for a few special terms like *noa* for actual wife or her actual sister, and *mbana* for actual husband, the kinterms, as given under Figure 19. 3, fit precisely into the section-system except that in the x-section (Kumara, odd generation) there is one coverset *kata* | *wonna* for the positive odd generations and another *alirra* for the negative odd generations, and in Purula and Uknaria there are special coversets (bracketed in Figure 19. 3) for relatives in ego's own generation G_0.

19. 4 Use of section-names to determine kinterms. An aboriginal ego must be able to address a given alter by the correct kinterm. Spencer and Gillen [1927: 55-61] gives thirty-two examples, sixteen of them showing the terms applied by a Purula man to the men and to the women in the eight sections, and sixteen showing the terms used by a Panunga woman. Examples for the terms applied by a Purula male apeaker are:

to a Purula man:
kalja: eB, FeBS, MMeZDS, MFeBDS
itia: yB, FyBS, MMyZDS, MFyBDS, DSDS, SSSS
aranga: FF, SS;
to an Ungalla woman:
ipmuna: MM, MMBSD, FFZDD, DDZD, SDDD

and of the terms applied by a Panunga woman:

to a Bultara man:
marra: HMB, DSS, FZDS, MBDS;
to a Kumara woman:
amba: D, ZD, SSD, FFZD, FFDD, MZDD.

By tracing-out on Figure 19. 2e, the reader may readily verify the kinterms given here for these twenty-seven kintypes.

Since both ego and alter can be chosen in sixteen ways, i. e. as male or female from each of the eight sections, among which Spencer and Gillen choose the Purula man and the Panunga woman, it follows that if they were to carry out their plan in full detail, they would need to give 256 examples. Since their thirty-two actual examples fill up more than six pages, their list of kinterms alone would require more than fifty pages of their book. Yet all this information is already contained in Figure 19. 3. For example, if an ego in the Umbitchana section encounters an alter in the Kumara section, ego knows at once, as soon as they have called out their respective section-names, that ego must address alter by the kinterm *ebmanna*, as we can deduce from Figure 19. 3 by noting that to get from Umbitchana to Kumara we must trace-out the path y^2, for which the kinterm *ebmanna* is listed just below the diagram.

19. 5 Cross-second-cousin marriage. To answer the question: what type of female relative does ego marry in Aranda, we must find the shortest collateral chains equivalent to $W=\bar{X}Y$. From the equation $\bar{x}=x$ and $y=\bar{y}^3$ we might be inclined to say $x\bar{y}^3$=first-cousin-twice-removed, and this answer among others is clearly correct. But in fact the marriage is never so described, either by the natives or by anthropologists. Rather it is called "cross-second-cousin marriage", i. e. marriage of persons whose parents are cross-first-cousins $X\bar{Y}$ or $Y\bar{X}$. For, as can be verified at once by tracing-out on Figure 19. 3, we have

$$w=yy\bar{x}\bar{y} \text{ (MMBDD)}=yx\bar{y}\bar{y} \text{ (MFZDD)}=xx\bar{y}\bar{x} \text{ (FFZSD)}=xy\bar{x}\bar{x} \text{ (FMBSD)}.$$

Clearly again each of these four answers is correct, but in fact the natives use only the first answer, namely MMBDD, in describing their marriage-system, for the following reason [Elkin, 1964: 100]:

> this example is not selected at random from the possible marriages. It expresses a significant fact, for in very many tribes with which I am acquainted ... the mother's mother's brother seems to be almost important relation a person possesses. He is mother's "uncle", and takes a leading part in arranging his niece's (ZD's) son's initiation and marriage .... It is his duty to find a wife or to see that a wife is found, for his niece's son, and one way to do that is to arrange for his daughter's daughter to marry him.

Then Elkin makes a further remark reminding us of a fact that speakers of English are prone to forget, namely that all marriage rules are to be understood in the classificatory sense. Ego's classificatory MMBDD may in fact be his actual MMBDD and therefore an actual second-cousin, or she may actually be a much more remote cousin, provided only that ego is linked to her by a chain equivalent to the chain MMBDD ($YY\bar{X}\bar{Y}$). Elkin says [1964: 101]:

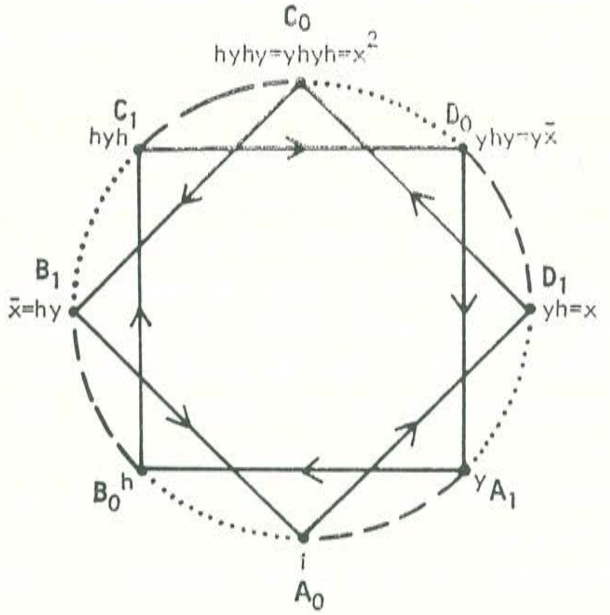
> his [i. e. ego's MMB's] very position in ego's mother's group of close relations has led to a disinclination to marriage with his daughter's daughter, and so many tribes with the Nyul-nyul kinship system forbid marriage with "own" second cousin, allowing it only with someone else, more distantly related but classified with her.

19. 6 The Dieri system. The (relatively rare) Dieri system is in all respects the same as the Aranda, with interchange of patri- and matri-concepts, i. e. of x and y and therefore of w (wife) and h (husband). In Aranda the (patrilineal) moieties have no specific names but the eight marriage classes have the names Purula etc. (see Figure 19. 3), but in Dieri the (matrilineal) moieties have the specific names Kararu and Matteri and the eight marriage-classes are left unnamed. For definiteness we call them A_0, A_1, B_0, B_1, C_0, C_1, D_0, D_1, where A_0, B_0, C_0 and D_0 are the even-generation sections of the four clans A, B, C, D and A_1, B_1, C_1, D_1 are the odd-generation sections.

The list of kinterms [Radclife-Brown 1914:55] is as follows:

1.	*yenku*	FF, FFZ, MMBSS, MMBSD, SS, SD, ZSDH, ZSSW
2.	*nadada*	MF, MFZ, MMBW, WMM, W, MMBDD, MFZDD, WB, DC
3.	*kami*	FM, FMB, WFF, FZS, FZD, MBS, MBD, ZSS, ZSD
4.	*kanini*	MM, MMB, WMF, WMFZ, MFZH, ZDS, ZDD
5.	*ngapari*	F, FB
6.	*ngandri*	M, MZ
7.	*papa*	FZ, MBW
8.	*kaka*	MB, FZH
9.	*tidnara*	FFZC
10.	*ngatamura*	MMBC, μS, μD
11.	*niyi*	eB, WZH
12.	*kaku*	eZ, WBW
13.	*ngatata*	yB, WZH, yZ, WBW

Thus the Dieri system can be represented at in Figure 19. 6 (cf. the Aranda Figure 19. 3), on which the reader is invited to trace-out some of the terms in the kinlist. Just as the Aranda male marries his MMBDD ($w=y^2\bar{x}\bar{y}$), so the Dieri male marries his FFZSD ($w=x^2\bar{y}\bar{x}$), where w for Dieri is obtained from w for Aranda by interchange of x and y.



i:	*kanini* $\left(\frac{\textit{niyi} \mid \textit{kaku}}{\textit{ngatata}}\right)$	y :	*kaka* | *ngandri*
h=yx :	*nadada*	yh=x :	*ngapari* | *papa*
$hy=\bar{x}$:	*ngatamura*	$yhy=y\bar{x}$:	*kami*
$hyh=yx^2$:	*tidnara*	$yhyh=x^2$:	*yenku*

Generating relations: $y^2=h^2=x^4=i$, with x=yh

Figure 19. 6 Dieri kingraph and kinlist.

CHAPTER XX

Ambrym, Vao and Kokata

20. 1 The Ambrym connubium. The Ambrym connubium [Deacon 1927] is a system with alternating direct exchange (19. 1) like Aranda but with three participating clans instead of four. In Figure 20. 1 the three clans are denoted by A, B, C, their even-generation sections by A_0, B_0, C_0 and their odd-generation sections by A_1, B_1, C_1. Thus males in the one generation in clan A exchange wives with their clockwise neighbor B and in the next generation they exchange with their counterclockwise neighbor C, as in Figure 20. 1a. (cf. Figure 19. 2a for Aranda.)

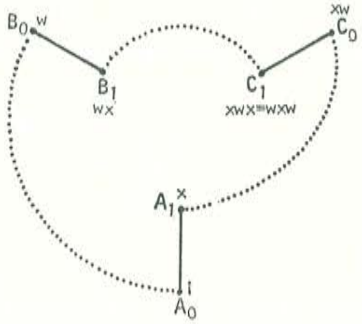
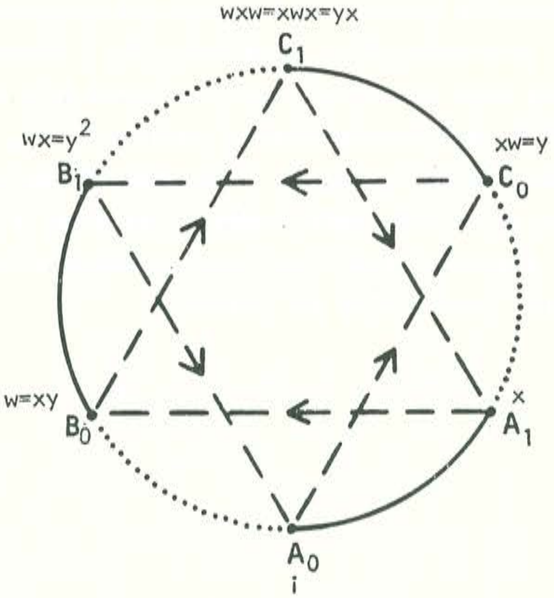


Figure 20. 1a Ambrym connubium in terms of x and w.

Then in the same way as the Aranda Figure 19.2 a was redrawn as Figure 19. 2b, so here we redraw the Ambrym Figure 29. 1a as Figure 20. 1b.

20. 2 Sections in Ambrym. For the Balap district in southwest Ambrym, this situation is described by Deacon [1927: 329] in non-mathematical language as follows:

The population is divided into three clans called *bwelem*. Descent in the *bwelem* is patrilineal: a man, his father, his father's father, son, son's son, and the children of all these belong to his own *bwelem*, similarly all classificatory fathers, fathers' sisters, brothers and sisters.... Each *bwelem*, however, is divided into two "lines" [the native's expression for our "section", cf. the Iatmul lines in 22.3] such that a man, his father's father, his son's son (and sisters of all these) belong to his line, while his father, his son, and his son's son's son belong to his father's line, all in the same *bwelem*. This two-line structure causes the father's father to be called "brother" etc. The three *bwelem* are referred to by a man as "my *bwelem*, my mother's *bwelem*, my mother's mother's *bwelem*".



i:	w	i:	xw
x:	wx	x:	y^2
xw:	wxw=xwx	y:	yx

Figure 20. 1b Ambrym connubium with x,y and w lines.

The natives also informed Deacon that the mother's mother's mother "comes back" to a man's own *bwelem*, and to his own line in that *bwelem*, and she is called "sister"; i. e. in our notation $y^3=i$.

Deacon then tells us how on two separate occasions he was given a diagrammatic representation of the system in which his informant placed large white stones on the ground in such positions that he was able to "reason about relationships in a way absolutely on a par with a good scientific exposition in a lecture-room." He tells us that the native's exposition can be represented as in Figure 20. 2, which is seen to be precisely equivalent to our Figure 20. 1b with straight lines for our curved lines, equal signs for our dotted lines and with our matrilines omitted.

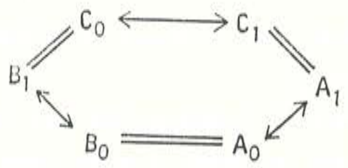


Figure 20. 2 Ambrym system (Deacon's figure).

In all three Figures, 20. 1a, b; 20. 2, it will be noted that the intermarrying persons in B and C are not in the same generation, but this anomaly is of little consequence, since generation and actual age are not closely correlated; e. g. in English ego's first cousin can be as much as half a century older than ego.

20. 3 Ambrym kinlist. For south Ambrym Deacon gives us the following list of kinterms and corresponding kinstrings. to which we have added our section designations, i, x, ...

x	*tata*	F, FFF, BS, HZS
x	*netuk*	C, μSSC
i	*könmasian*	B, WZH, FF, φZ, HBW
i	*vevenukuli*	μZ, μMMM
y^2	*metou*	ZC, WBC, WF
xy	*sŏg tevian*	μEZDS, μZH
xy	*sŏg vaven*	w, μFZDD, μBW
y	*misyuk*	FZH, MB, μDH
y	*nana*	M, μSW
i	*munukuli*	φB, φDDS
xy	*sŏg towor*	H, φFZDS, φZH, HB, φMMBS
xy	*evyok*	φFZDD, φBW, φMMBD, HZ
(see below)	*niuk*	FZ, MBW, FZD, WM, BD, HZD, MBW

(see below)	*membyug*	CC
(see below)	*vavu*	♂FZC, MEC, WM, MF, FM, MM, ♂MBC, HM, ♂DH, ♂FF

By tracing out these kinstrings on Figure 20.1, we find that they are in agreement with the structure of the connubium except that:

i) a mother imitates her husband in calling their children *netuk*, instead of *metou*,

ii) *vavu* is a catchall for grandparents and *membyug* for grandchildren.

iii) *vavu* and *niuk* are irregular in some cases.

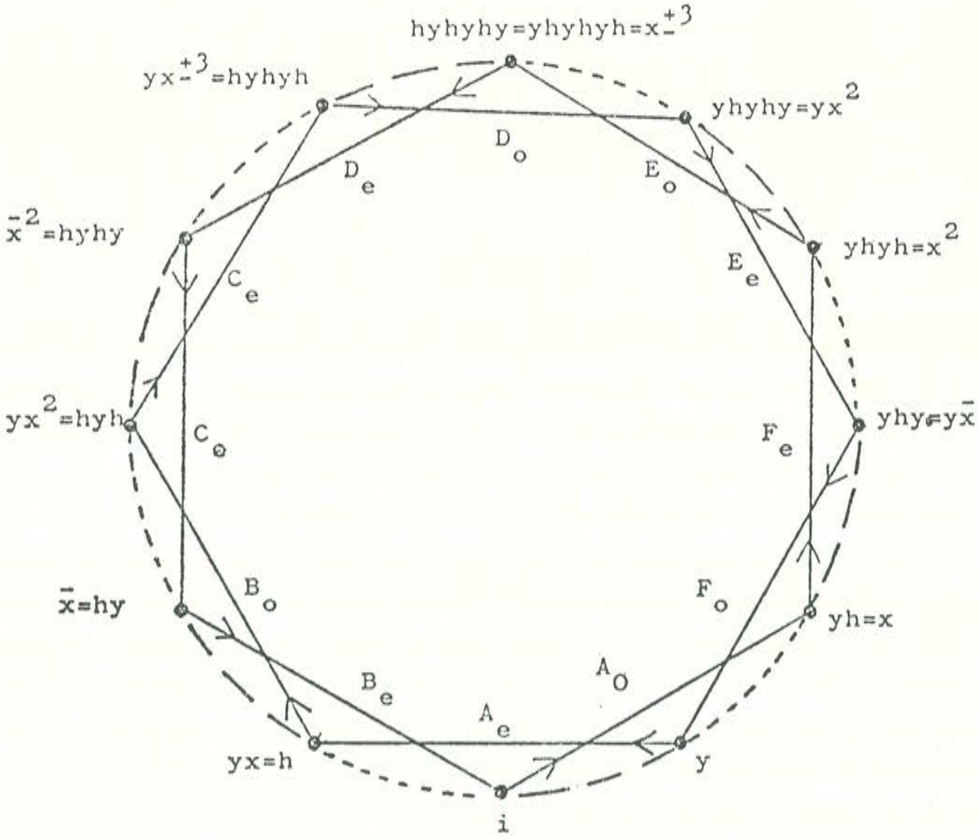
In this connection Deacon tells us that his informant... remarked, "some things are 'not straight' about the system," pointing out that *vavu* occurs in too many segments and "*niuk* is also not straight." Deacon says that the consciousness of these irregularities, besides being a great tribute to the man's intelligence, is an additional proof of the correctness of the system.

20. 4 Vao graph and group. We have now studied alternating direct exchange for Ambrym with three clans and for Aranda (patrilineal) and Dieri (matrilineal) with four. The corresponding five-clan connubium, though theoretically possible, is not known to exist (see 21.2), but the six-clan case (matrilineal) is represented by the Vao connubium, with kingraph and generating relations as in Figure 20.4.

From Figure 20.4 we see that $w=x^3\bar{y}\bar{x}^2$, which means that a male marries his third cousin FFFZSSD, just as in the Dieri system, also matrilineal but with four clans instead of six, ego marries his second cousin FFZSD (19.6).

By tracing-out the kinstrings in Table 20.4, the reader may verify how well the kinterms fit into the marriage-structure. Note the blanket terms *natuk* for child, *tumbuk* for grandparents, and *mambik* for grandchildren.

20. 5 Possible evolution of systems with direct exchange. Although it is our purpose throughout to describe the various systems rather than to speculate on their possible evolution, let us here take a bird's-eye view of



i:	*toghak* / *tehik* } *hogotuk*		y:	*soguk* | *tinak*	
x:	*temak* | *tinak*		yx:	*tahuk*	
$\bar{x}$:	*natuk*	(C of either parent)	$y\bar{x}$ ($=x\bar{y}$):	*netun sogok* *sogon tete*	($y\bar{x}$) ($x\bar{y}$)
x^2:	*tumbuk*	(all grandparents)	yx^2:	*pelegak* | *vinguk*	
$\bar{x}^2$:	*mambik*	(all grandchildren)	$y\bar{x}^2$:	....	
$x^{\pm3}$:	*toghak* / *tehik* |		$yx^{\pm3}$:	....	

Generating relations: $y^2=h^2=x^6=i$, with $x=yh$, $h=\bar{w}$

Figure 20. 4 Vao connubium in terms of x, y and h.

Table 20. 4 Vao kinterms

toghak	μeB, ϕeZ, FFF	*soguk*	MB, FZH, ZS, WBS
tehik	μyB, ϕyZ, SSS	*tinak*	M, MZ, FBW
hogotuk	μZ, ϕB	*tahuk*	WB, ZH
temak	F, FB, MZH	*netun sogok*	MBS
tinak	FZ, MBW	*sogon tete*	FZS
natuk	C	*pelegak*	WF, DH
tumbuk	PP	*vinguk*	SW
mambik	CC		

the information we have obtained about them by indicating how they may have developed from the simple Kariera system.

The Kariera system consists (13. 2) of two overt patrimoieties, each of which is divided into so-called "hordes", chiefly on the basis of the territory they occupy. In the Kariera tribe itself the number of hordes in either moiety is ten.

Then the Karadjeri and Aranda systems, each with four overt patriclans and two latent matriclans but with different marriage rules, may have resulted from the splitting of each of the two orginal moieties into two parts, consisting of half of the hordes in the moiety (five each if the original number was ten as in Kariera).

The question now arises: why should such a split take place?

Here we shall be content with the answer sometimes given that it results from the apparently universal phenomenon of mother-in-law avoidance. In a system like Kariera, with only two participating clans, i. e. the moieties A and B, if ego is in clan A, then ego's actual WM is also in clan A, together with all of ego's classificatory FZ's, many of whom will still be unmarried and therefore, in a patrilocal society, will still be living in ego's own clan. Then the fact that they are equivalent to ego's actual WM, i. e. that they go by the same kinterm (in Kariera the term is *toa*, see 14. 7) means that all the women in the first generation above ego, who may range in age from much younger to much older than ego, must be avoided in the same way as ego's actual WM, though less intensely. This awkward situation will gradually be eliminated if it happens, perhaps at first on the basis of geographical proximity alone, that a certain five of the hordes in the Kariera moiety A confine their marriages to a certain five in B, thereby producing the Karadjeri arrangement, in which ego applies the kinterm *yala* to his WM and a different kinterm *ibal* to his FZ, so that ego's clan has been split in two parts, with ego and his FZ in one part and ego's WM in the other. In Aranda the patrimoieties are split into two parts as in Karadjeri, although the marriage rule is different, and in Dieri it is the matrimoieties that are so split. Note the distinct Aranda terms *wonna* for FZ and *marra* for WM, and the distinct Dieri terms *ngatamura* for WM and *papa* for FZ.

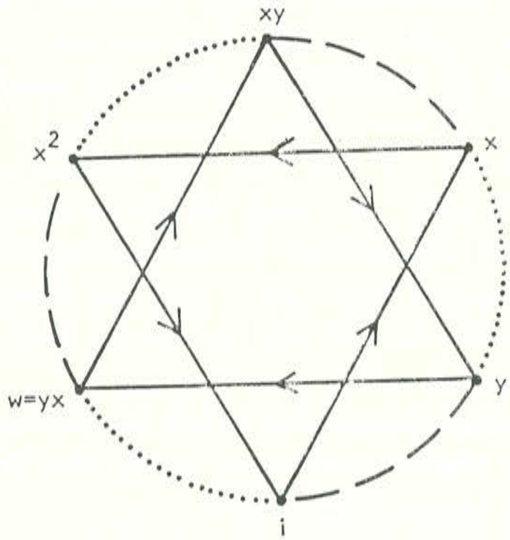
These new marriage arrangements, at first not consciously adopted, will gradually, like other customs, become part of the tribal law.

As expressed by Layard [1942: 102]:

> it is necessary to counteract the widespread impression that...such regulations are in any way imposed from above by some ingenious effort of conscious thought. Thus it is quite common to hear it said, "How could primitive peoples invent such complicated systems?" The answer is...that of course no one ever did invent it. It just happened, in obedience to innate and wholly unconscious laws; and the individuals composing it, far from ever having thought it out, are themselves caught up in it often... very much against their wills.

If just one of the two patrimoieties is divided in this way into two parts, while the other remains intact, we obtain the Ambrym system, and if just one of the matrimoieties splits we obtain a system, let us call it anti-Ambrym with Figure 20.5, that bears the same relation to Ambrym by interchange of x and y.

Layard points out [1942: 138] that this anti-Ambrym system (Figure 20.5) satisfies many of the requirements of the Vao kinship terminology (Figure 20.4). For example, by tracing out we find WB∼ZH, BW∼HZ, MB∼FZH∼ZS∼WBS, eB∼FFF and yH∼SSS on both figures. Layard also produces cogent evidence from their mythology to show that until recently the Vao natives did in fact practise anti-Ambrym marriage. But in the anti-Ambrym system we find W∼FZSD (Figure 20.5), whereas in Vao W∼FFFZSSD≁FZSD (Figure 20.4). Morever, in Vao, but not in anti-Ambrym, ego's wife is also ego's DD, a striking fact confirmed by the statement of



$$y^2 = w^2 = x^3 = i$$

Figure 20. 5 Anti-Ambrym connubium.

a native informant on the nearby island of Pentecost that "men marry their granddaughters". These discrepancies between anti-Ambrym (earlier-Vao) and the actual Vao system are explained if we assume that each of the three matriclans in earlier-Vao (i. e. anti-Ambrym) split into two parts, so that the intersection of these six parts with the two segments in each patriclan produced the twelve segments found by Layard at the time of his visit to the island of Vao.

20. 6 The Kokata system. As an appendix to our discussion of systems with alternating direct exchange, e. g. Ambrym with three clans, Aranda with four and Vao with six, let us now briefly describe the four-clan Kokata system, which is unique, so far as we know, in having a "rotating direct exchange", i. e. a system in which the four participating clans can be arranged in a circle in such a way that for male egos in the successive generations of a fixed clan the giver clan rotates around the circle, instead of alternating back and forth from left to right of ego's own clan.

Our field-information is summed up in Figure 20. 6 a, b,c.

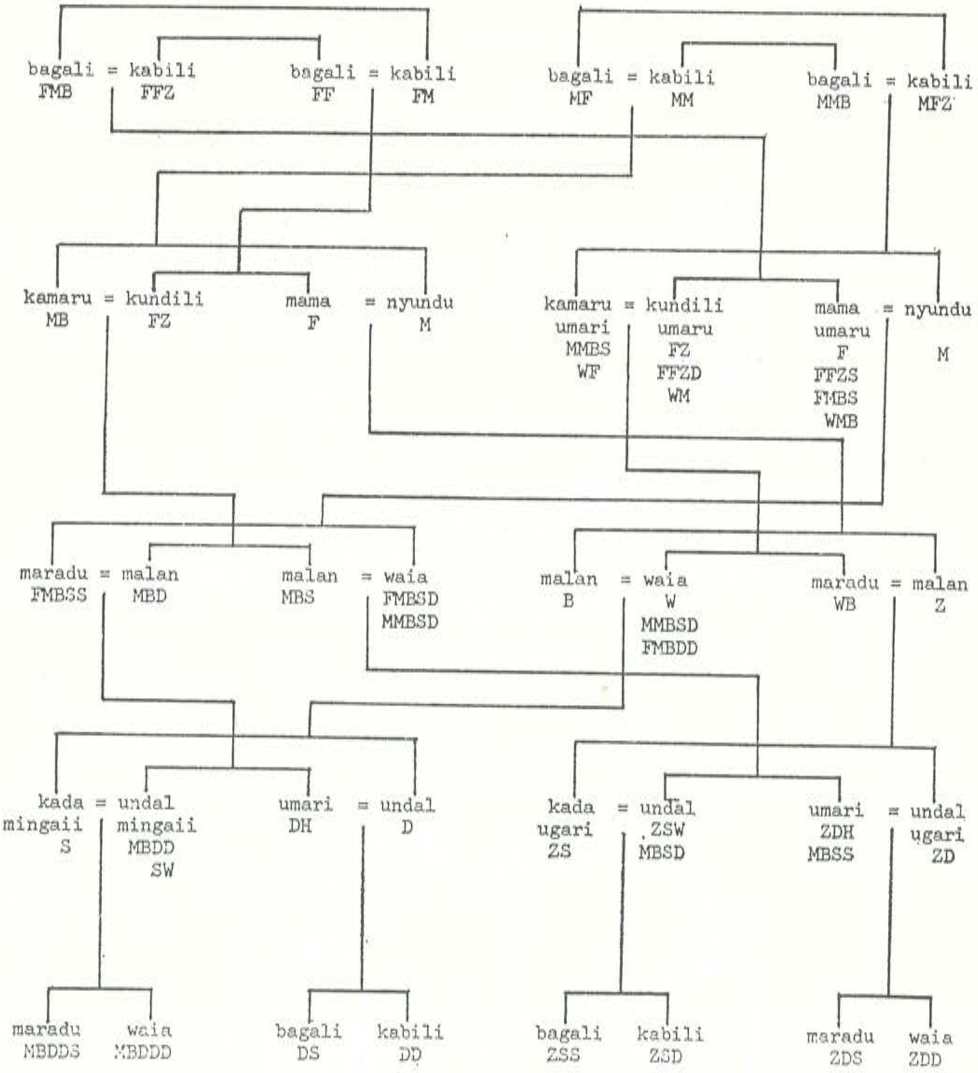
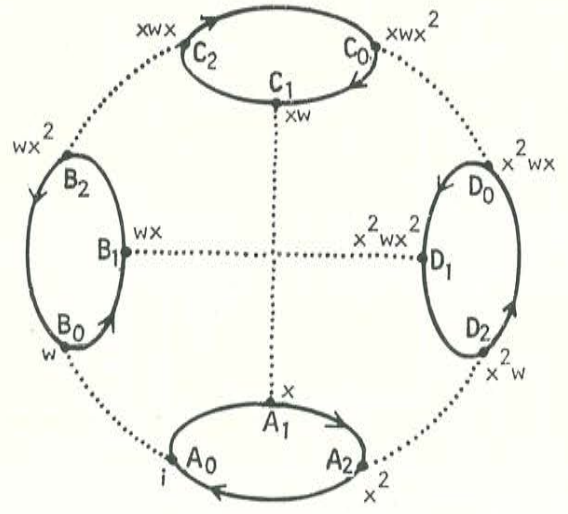


Figure 20. 6a Elkin's diagram for Kokata.

The kinterms in each of the twelve marriage-classes, i, x, x^2, w, ... marked on the figures may be arranged in the four patricycles as in Table 20. 6.

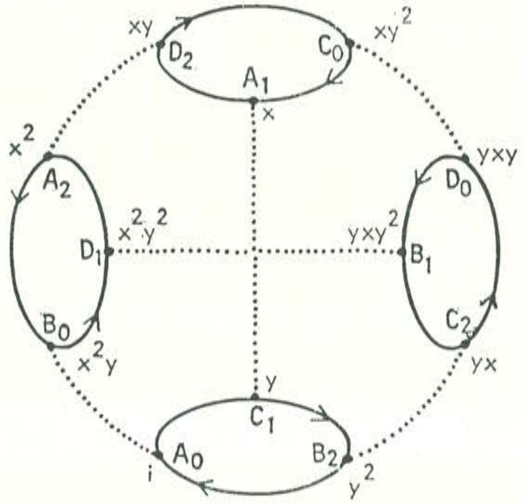
Each of the four Kokata clans, e. g. clan A, is thus divided into three parts, the first part A_0 containing generations... G_3, G_0, G_{-3}, G_{-6}, ..., the second A_1 containing... G_2, G_{-1}, G_{-4}, G_{-7}, ... and the third A_2 containing...



$x^3=w^2=y^3=i,$ $\qquad$ $x^3=y^3=(x^2y)^2=(y^2x)^2=i$

$w=x^2y=y^2x=y^2\bar{x}^2$

Figure 20. 6b Patricycles in Kokata (x, w).



Patricycles are $A_0A_1A_2$, BB_1B_2, $C_0C_1C_2$

Figure 20. 6c Matricycles in Kokata (y, w).

Table 20. 6 Kokata kinterms

<table>
<tr><td rowspan="3">ego's patricycle</td><td>A_0</td><td></td><td>i</td><td>malan</td><td>B | Z</td></tr>
<tr><td>A_1</td><td></td><td>x</td><td>mama | kundili
maradu | waia</td><td>F | FZ
MBDSS | MBDDD</td></tr>
<tr><td>A_2</td><td></td><td>x^2</td><td>bagali | kabili
kada, mingaii | undal, mingaii</td><td>FF | FFZ
S | D</td></tr>
<tr><td rowspan="3">wife's</td><td>B_0</td><td>w</td><td>x^2y</td><td>maradu | waia</td><td>MMBSS | MMBSD
FMBDS | FMBDD
WB | W</td></tr>
<tr><td>B_1</td><td>wx</td><td>x^2yx</td><td>kamaru, umari | nyundu
bagali | kabili</td><td>MMBS, WF | MMBD, WFZ
DS | DD</td></tr>
<tr><td>B_2</td><td>wx^2</td><td>x^2yx^2</td><td>bagali | kabili
kada, ugari | undal, ugari</td><td>MMB | MM
ZS | DD</td></tr>
<tr><td rowspan="3">mother's</td><td>C_1</td><td>xw</td><td>y</td><td>kamaru | nyundu
maradu | waia</td><td>MB | M
ZDS | ZDD</td></tr>
<tr><td>C_2</td><td>xwx</td><td>yx</td><td>bagali | kaibli
umari | undal</td><td>MF | MFZ
MBSS | MBSD</td></tr>
<tr><td>C_0</td><td>xwx^2</td><td>yx^2</td><td>malan</td><td>MBS | MBD</td></tr>
<tr><td rowspan="3">father's mother's</td><td>D_2</td><td>x^2w</td><td>xy</td><td>bagali | kabili
umari | undal</td><td>FMB | FM
DH | MBDD, SW</td></tr>
<tr><td>D_0</td><td>x^2wx</td><td>xyx</td><td>maradu | waia</td><td>FMBSS | FMBSD
MMBSS | MMBSD</td></tr>
<tr><td>D_1</td><td>x^2wx^2</td><td>xyx^2</td><td>mama, umari | kundili, umaru
bagali | kabili</td><td>FFZS | FFZD
FFMS | FMBD
WMB | WM
DS | DD</td></tr>
</table>

$G_1, G_{-2}, G_{-5}, G_{-8}, \ldots$. In this respect Kokata occupies an intermediate position between the section tribes—Kariera, Karadjeri etc.—and the subsection Murngin tribe. Since we wish to adhere to our definition of a section as a set of alternate generations, these parts cannot be called either sections or subsections; so we shall simply call them divisions.

Then since there are altogether twelve of these divisions, three in each of the four clans, the Kokata group, with generators x and w, or x and y, or y and w, and corresponding generating relations

$$x^3 = w^2 = i,$$
$$x^3 = y^3 = i,$$
$$y^3 = w^2 = i,$$

will be a non-commutative group of order twelve. In algebra it is denoted by $\mathfrak{A}_4$ and called the **alternating group of degree four.** Since $w = y^2 \bar{x}^2$ (cf. Figure 20. 6b), marriage is with second-cousin.

CHAPTER XXI

Patrilateral Cross-cousin Marriage

21.1 Regular permutation-groups. For all tribes with sections the marriage rules take the form of prescribing marriage with some kind of cousin. The chief types actually found are listed in Table 21.1.

Table 21.1 Types of prescribed marriage

Prescribed marriage	Generating relations
1. With first cousin:	
a) bilateral; e.g. Kariera (commutative)	$x^2=y^2=w^2=i$
b) matrilateral; e.g. Karadjeri (commutative)	$x^2=y^4=w^4=i$
c) patrilateral; e.g. Iatmul	$x^2=y^2=w^n=i$
(but see Chapter 22)	(21.2)
2. With first cousin once-removed; e.g. Ambrym	$x^2=w^2=y^3=i$
3. With second cousin; e.g. Aranda	$x^2=w^2=y^4=i$
4. With third cousin; e.g. Vao	$x^2=w^2=y^6=i$

In every case the number of permutations in the group is the same as the number of sections in the connubium. In other words, since it is the sections that are being permuted, the order of the group (5.1) is the same as its degree (13.3). For example, the Kariera connubium has four sections and the Kariera group consists of four permutations (13.4), the Karadjeri consists of eight permutations (Figure 15.3), and so on. Let us look at this situation a little more closely.

In the first place, if S_i and S_j are any two sections in the connubium, the group must include a permutation taking S_i into S_j, since otherwise the connubium would fall into two or more unrelated parts. A permutation-group with this property is said to be **transitive.**

Since for any fixed S_i there is at least one distinct permutation carrying S_i into each of the sections $S_0, S_1, \ldots, S_{n-1}$, the order of a transitive group is at least as great as its degree.

Secondly, every permutation in the group, except the identity, makes a complete shift of the sections in the sense that it leaves no section S_i unchanged. Such a group is said to be **complete.** Consequently, the permutation-group of any connubium is complete. For if a permutation P left S_i unchanged but took S_j into S_k with $S_j \neq S_k$, the system would not look the same (cf. 16.4) for males in S_i as for males in S_j. For example, if the permutation P were say the wife-relation, then classificatory sister marriage (cf. 11.10) would be prescribed for males in S_i but proscribed for males in S_j. In a complete group, no element S_i can be carried into the same element S_j by two distinct permutations P_0 and P_1, since $P_0P_1^{-1}$ would then be a non-identical permutation leaving S_i unchanged. So the order of a complete permutation-group cannot be greater than its degree.

A permutation-group that is both transitive and complete is said to be **regular,** so that the order of any regular group, and therefore of the permutation-group of any connubium, is equal to its degree, as we wished to prove. The mathematical statement that the group is regular is synonymous with the anthropological statement that every section is related to every other section and the system of sectional relations looks the same for every male person in it.

21.2 Contrast between patrilateral and matrilateral marriage. Since the other types in Table 21.1 have already been discussed, it remains to consider lc, i.e. patrilateral cross-cousin marriage in which ego marries a woman who is his (real or classificatory) FZD but not his MBD. In the present chapter we describe the radical contrast between patrilateral and matrilateral marriage, with an interpolation in 21.3 on the formal similarity of patrilateral marriage with alternating direct exchange.

In matrilateral marriage, as we have seen, the participating clans can be arranged is a circle such that males in the even sections of a clan seek wives in the even section of the next clan clockwise, and similarly for the odd sections. If the tribe has exogamous moieties the number of participating clans must be even, but otherwise it may also be odd, as in the hypothetical case of five clans C_0, C_1, C_2, C_3, C_4 in Figure 21. 2a.

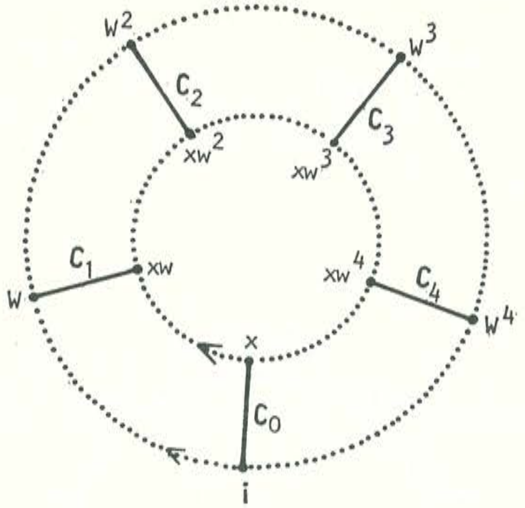


Figure 21. 2a Circular indirect exchange with five clans (matrilateral).

In this case, as we see e. g. by tracing-out on Figure 21. 2a, the generating relations are $x^2=w^5=i$, $xw=wx$. Since $y=xw=wx$, we have $y\bar{x}=xw\bar{x}=wx\bar{x}=w$ but $x\bar{y}=\bar{w}\neq w$, so that the marriage is in fact matrilateral, i. e. with MBD ($y\bar{x}$) but not with FZD ($x\bar{y}$).

In patrilateral cross-cousin marriage, on the other hand, the males in the even sections seek wives in the even section of the next clan clockwise, and in the odd sections they seek them in the next clan counter-clockwise, as in Figure 21. 2b, again drawn for a system of five clans.

If we redraw Figure 21. 2b in terms of x and y, with $y=xw$, we obtain Figure 21. 2c.

From either of these Figures 21. 2b or c, we find the generating relations $x^2=w^5=y^2=i$, with $y=xw$.

In its social and economic effects patrilateral marriage is quite different from matrilateral. In Chapter 16 we have seen that ZDD-marriage in Murngin is actually an exchange of economic goods, namely wives, between two matriclans. In the present chapter we are dealing with hypothetical

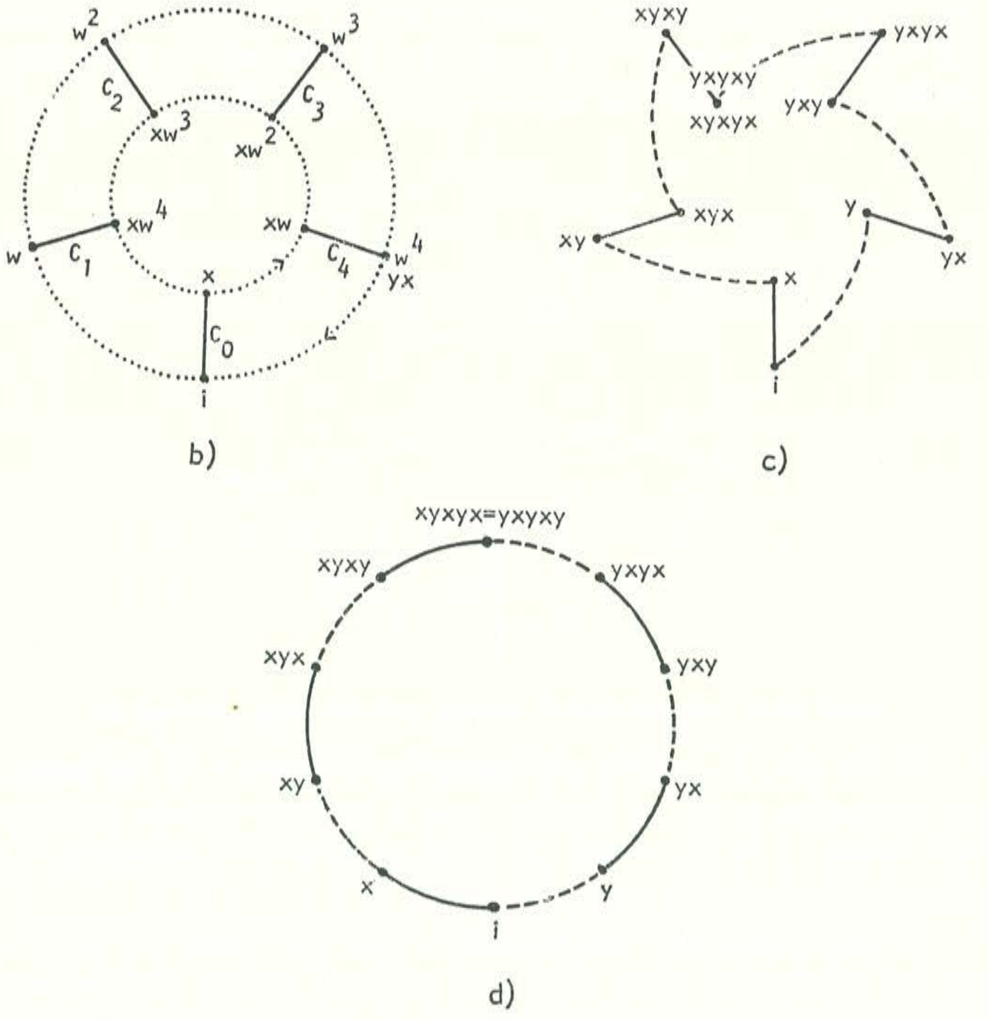


Figure 21. 2b, c, d Patrilateral marriage with five clans.

systems, each with five patriclans, practicing matrilateral marriage in the one case and patrilateral in the other. In the matrilateral case the males in C_0 may well regard the whole transaction as a risky long-term enterprise, since in every generation they send off their sisters to clan C_4, i. e. to a clan which does not directly reciprocate, so that the return on their investment depends on a long series of similar transactions around the circle of five clans. The patrilateral case, on the other hand, is psychologically more comfortable. For in this case, when the males in one generation of C_0 send their sisters to C_4, the investment is returned to their own clan C_0 by the same clan C_4 in the next generation. In other words, the daughter is sent back from C_4 to C_0 in payment for her mother, who was sent from C_0 to C_4 in the preceding generation (cf. cliché ii in 22. 2).

21. 3 Formal comparison of patrilateral marriage and alternating direct exchange. Since the generating relations for patrilateral marriage are $x^2=y^2=w^n=i$ and for alternating direct-exchange (Ambrym, Aranda, Vao) they are $x^2=w^2=y^n=i$, patrilateral marriage is like alternating-direct with interchange of the roles of y (mother) and w (wife), a fact which is geometrically evident from a comparison of Figure 21. 2c (patrilateral) with Figures 19. 2a and 20. 1a (direct-exchange). In other words, patrilateral marriage represents an alternating direct-exchange of mothers.

Consider, for example, the males in sections i and yx of Figure 21. 2c. The fathers of males in section i have married the females in section y, as indicated by the dotted line, considered as running from x to y. So these females, who are the FZ of males in yx, are also the mothers of males in i. Conversely, the fathers of section yx have married the females in x, as indicated by the dotted line, considered now as running from y to x, so that the FZ of males in i are also the mothers of males in yx. Thus the one section might say to the other: you have sent us your father's sisters to be our mothers and we have sent you ours; we have made a direct exchange of mothers.

Geometrically these remarks are illustrated by Figure 21. 3 a and b, which are obtained from each other by interchange of dashed and dotted lines.

From the point of view of pure algebra, the two figures show that the permutation-group for alternate direct-exchange with generating relations $x^2=w^2=y^n=i$ is the same abstract group (13. 4) as the patrilateral group with generating relations $x^2=y^2=w^n=i$, merely with different names for its elements. For a set of n participating clans, with $2n$ sections, this common abstract group is denoted by D_n and is called the **dihedral group** of order $2n$. The name "dihedral" comes from the fact that the group can be represented by a cylinder with two bases (**hedra**=base), namely top and bottom as in Figure 19.2c and d. It is not hard to prove that D_5 is the only non-commuta-

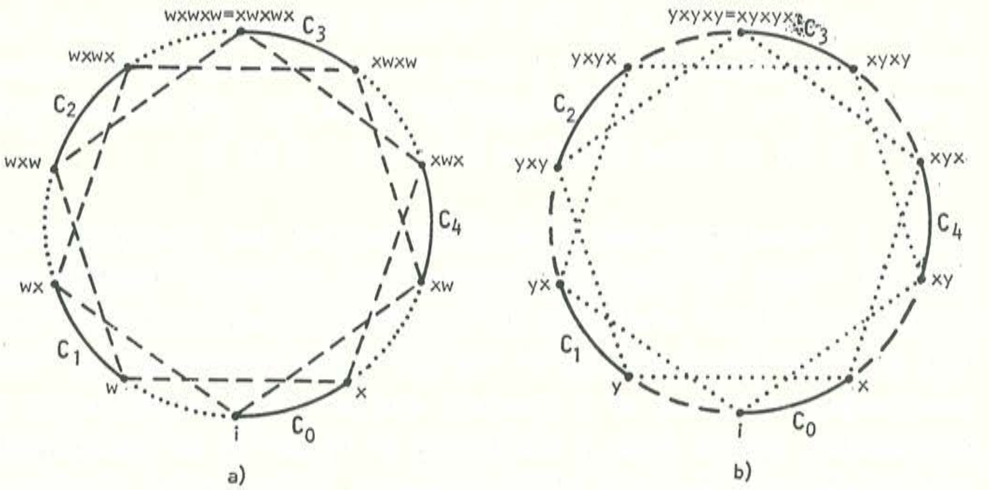


Figure 21.3 Alternating direct exchange (a) and patrilateral cross-cousin marriage. (b)

tive group of order ten; or in anthropological language, that the only two possibilities for a five-clan non-commutative connubium with patrilineal sections are alternating direct-exchange and patrilateral cross-cousin marriage. So far as we know, neither of these two five-clan possibilities is realized in practice (cf. 22.5).

21.4 Remarks of Lévi-Strauss. Returning now to the main theme of the chapter, namely the contrast between patrilateral and matrilateral marriage, we note that the patrilateral type is much rarer and seems to play only a secondary role to other types of marriage in the same tribe. A great deal has been written to account for this situation. Let us merely quote from Lévi-Strauss, who devotes to it the entire twenty-seventh chapter "Cycle of Reciprocity" in his huge book *The Elementary Structures of Kinship* [1949 etc.]. In a long chapter full of emotional eloquence and startling metaphors that make it seen more like a prose poem than a scientific argument, he writes:

> A human group need only proclaim the law of marriage with the mother's brother's daughter for a vast cycle of reciprocity between all generations and lineages to be organized, as harmonious and ineluctable as any physical or biological law, whereas marriage with the father's sister's daughter forces the interruption and reversal of collaborations from generation to generation and from lineage to lineage.

But in spite of its advantages MBD-marriage, in which clan C_0 gives wives to clan C_1 and receives wives from some other clan C_n at the end of a perhaps lengthy cycle is exposed to all the dangers of any long-term investment. For as Lévi-Strauss says,

> there is another side to the coin. Socially and logically, marriage with the mother's brother's daughter provides the most satisfactory formula. From an individual and psychological viewpoint, however, ... it is a risky venture. ... The system of patrilateral marriage is a safer operation precisely because its aims are less ambitious. ... Even among those societies which have undertaken matrilateral marriage, none has been able to rid itself completely of the disquiet engendered by the risks of the system, and they have held fast, sometimes vaguely, sometimes categorically, to that pledge of security which is provided by a certain coefficient of patrilaterality.

But Lévi-Strauss has an ominous warning for tribes that try to combine the social advantages of matrilateral marriage with the comfort and reassurance of patrilateral:

> Ghosts are never invoked with impunity. By clinging to the phantom of patrilateral marriage, systems of generalized exchange gain an assurance, but they are consequently exposed to a new risk. ... What incest is to reciprocity in general, such is the lowest form of reciprocity (patrilateral marriage) in relation to the highest form (matrilateral marriage). For groups which have reached the subtlest but also the most fragile form of reciprocity, by means of marriage between sister's son and brother's daughter, marriage between sister's daughter and brother's son represents the omnipresent danger but irresistible attraction of a 'social incest' more dangerous to the group, even, than biological incest.
>
> The force with which certain peoples who practice matrilateral marriage have condemned patrilateral marriage cannot cause any surprise. The one is not only the opposite and the negation of the other, but it also brings nostalgia and regret for it.

Lévi-Strauss then concludes his entire book, except for a general section called "Conclusions", with a quotation from a sacred Hindu poem describing the solemn sacrifice of one hundred and two gotra (heads of patrilineal families) "who prefer to throw themselves into the flames rather than allow the indescribably beautiful Vasavambika to make a marriage calculated to save the kingdom but contrary to the sacred rule of ... marriage between sister's son and brother's daughter:

> The one hundred and two *gotra* with Vasavambika at their head marched proudly towards one hundred and three fire-pots, but not before making their children promise to give their daughters in marriage to sons of their father's sisters even though the young men should be black-skinned, plain, blink of one eye, senseless, of vicious habits. ... As for Vasavambika she promised that those who violated the sacred custom of matrilateral marriage would have dumpy daughters, with gaping mouths, disproportionate legs, broad ears, crooked hands, red hair, sunken eyes, dilated eye-balls, insane looks, broad noses, wide nostrils, hairy bodies, black skin, and protruding teeth.

To this apocalyptic passage Lévi-Strauss adds the note: "these curses, hurled against those who perfer sister's daughters to brother's daughters, are by no means inconsequential. They express, with incomparable force, decisive differences in structure, which are such that the choice made between them by a society affects its destiny forever."

CHAPTER XXII

Iatmul

22. 1 "Explaining" the Naven. As an example of a tribe with at least some avowed patrilateral marriage we may take the Iatmul in New Guinea, a "fine, proud, head-hunting people who live in large villages" [Bateson, 1936: 4].

Our information about the kinterms comes from a single article and the ensuing book [Bateson, 1932, 1936, 1958]. The title of the book is *Naven*, the name of a ceremony in which the achievements, especially homicide, of a sister's child (*laua*, oftener a son than a daughter) are celebrated by one of the child's mother's brothers (*wau*). Some of the details of the ceremony seem not only bizarre and even revolting to Western eyes but diametrically opposed to Iatmul behavior in daily life; e. g. ordinary social intercourse preserves a rigid distinction between the sexes but in the Naven ceremony the *wau* becomes transvestite. So it is the announced purpose of the author to "explain" the *naven*, as far as possible, in the sense expressed in his opening words:

> if it were possible adequately to present the whole of a culture, stressing every aspect exactly as it is stressed in the culture itself, no single detail would appear bizarre or strange or arbitrary to the reader, but rather the details would all appear natural and reasonable as they do to the natives who have lived all their lives within the culture.

This task involves him in such abstruse topics as emotion and cognition, history and culture, and modern theories of information, communication and epistemology, all of which, as he engagingly argues, are indispensable for a proper study of society. His ideas in this respect have had considerable influence but his discussion of Iatmul kinship terminology has received little attention, having been analyzed, so far as we know, only in the article by Korn [ed. Needham 1971: 99-132, reprinted in Korn 1973: 80-110].

22.2 The four clichés. Bateson lists four native statements about marriage, which he refers to as "clichés".

i) a woman should climb the same ladder that her father's father's sister climbed.

Here he explains that climbing the ladder refers literally to entering a dwelling-house raised on poles and thus metaphorically to marriage into the same (patrilineal) clan; i. e. a woman should marry into the same clan as her FFZ. As a corollary Bateson states the same rule from the male point of view: "a man's possible wives are the women of his father's mother's clan; i. e. a man should marry into the same clan as his FF." In other words, if you are a man, do as your FF did, and if you are a woman, do as your FFZ did.

Such an emphasis on ego's marrying into his FF's clan tacitly implies that ego does not marry into his own father's clan; in other words, the Iatmul do not practice MBD-marriage.

The second, third and fourth clichés are:

ii) the daughter goes as payment for the mother.

This cliché expresses FZD-marriage (cf. 21.1).

iii) women should be exchanged.

Bateson tells us that this third cliché is often stated by the natives with special reference to sister-exchange.

iv) *laua*'s son will marry *wau*'s daughter.

Cliché iv) states that ego's wife's father is *wau* (=MB) to ego's father. So ego is linked to ego's wife by the chain FMBD. But ego's FMBD is in the same patrilineal clan as ego's FM, so that ego and ego's FF have married into the same clan. Thus a marriage that obeys cliché iv) necessarily obeys cliché i). Any marriage obeying the first cliché is called an ***iai*-marriage,** since the native word *iai* means "FM or FMBD or any women e. g. FMBSD in the same patrilineal clan as these" [Bateson 1958: 308].

22. 3 The two sections in Iatmul. As might be expected from the fact that a male should act like his FF and a female like her FFZ (cliché i), an Iatmul clan is divided into sections, which the tribesmen themselves call *mbapma*. The word literally means "line" (cf. the "lines" in Ambrym 20. 2), i. e. a line of men standing side by side, with spaces between them, filled in by members of the other *mbapma* standing just behind, a motif found elsewhere in Iatmul, e. g. in the initiatory rites. Bateson tells us [1958: 244]:

> a man's own generation, his paternal grandfather's generation, his patrilineal grandson's generation are grouped together as one *mbapma*, and in contrast to this his father's and son's generations are the opposite *mbapma*. ...A man may address his father's father either as *nggwail* (grandfather) or as *nyamul* (elder brother). This identification of relatives with others in analogous positions two generations away on a patrilineal line runs through the whole kinship system so that a man's son's wife is *nyame* (mother) and his son's wife's brother is *wau* (mother's brother).

22. 4 Kinlist. The remarkable extent to which the section-system has influenced the whole kinship terminology is shown in the following kinlist, where the few counterexamples arise chiefly from the fact that *iai* occurs in odd generations as well as even. In the (x, y)-notation this principle of alternation is expressed by the rule $x^2=i$ (implying also $\bar{x}^2=i$, $x=\bar{x}$ etc.). In Table 22.4 each kinterm is followed (in parentheses) by its focal string in (x, y)-form, and each non-focal string is also written in (x, y)-form (again in parentheses) to show its equivalence with the focal string under *iai*-marriage, i. e. under the rule $x^2=i$.

22. 5 Impossibility of setting up a connubium for Iatmul. Having seen that the Iatmul have marriage clichés which look at least vaguely like the various sets of marriage-rules for sectioned tribes, and having discovered the presence of sections in Iatmul, we might now feel optimistic about setting up some sort of Iatmul connubium, as was done for the sectioned tribes in earlier chapters.

Table 22.4 Iatmul kinlist indicating *iai*-marriage

nggwail (i):	FF (xx), FFZ (xx), μSS ($\bar{x}\bar{x}$), μSD ($\bar{x}\bar{x}$), eB
nyamun (i):	FF (xx), *e*B, ϕB, ϕ*e*Z
iai (xy):	FM, FMBSD (xy$\bar{x}\bar{x}$), all of the women of the same clan as these
tagwa (xy):	FM, W ($\bar{x}$y)
mbuambo (yx):	MF, MBS (y$\bar{x}$), MBD (y$\bar{x}$), MBSSS (y$\bar{x}\bar{x}\bar{x}$)
mbuambo (yy):	MM, MBSW (y$\bar{x}\bar{x}$y)
nyanggai (i):	μZ, FFZ (xx), μSD ($\bar{x}\bar{x}$)
tawontu (xy):	FMB, WB ($\bar{x}$y)
nyai | *iau* (x):	F, FB | FZ
nyame (y):	M, MZ, MBSD (y$\bar{x}\bar{x}$), μSW ($\bar{x}\bar{x}$y)
nyame (y$\bar{x}$):	MBD, MBSSD (y$\bar{x}\bar{x}\bar{x}$), any woman's of ego's mother's clan
wau (y):	MB, MMZS, MBSS (y$\bar{x}\bar{x}$), μSWB ($\bar{x}\bar{x}$y)
nondu (x$\bar{y}$x):	FZH, DH ($\bar{x}\bar{y}$x), reciprocal of *naisagut*
mbora (y$\bar{x}$y):	MBW, MBSSW (y$\bar{x}\bar{x}\bar{x}$y), μSWBW ($\bar{x}\bar{x}$y$\bar{x}$y)
naisagut (xy$\bar{x}$):	FMBS, WF ($\bar{x}$yx), WBC ($\bar{x}$y$\bar{x}$), mother of any woman who is *iai* to ego
laua ($\bar{y}$):	μZC, ZHF ($\bar{y}$xx)
tshuambo (i):	μyB, ϕyZ, μSS ($\bar{x}\bar{x}$)
lando ($\bar{y}$x):	ZH, ZHB
nian:	C
kanggat ($\bar{x}$):	ϕBC, reciprocal of *iau*
na (x$\bar{y}$):	FZC, DC ($\bar{x}\bar{y}$)
ianan ($\bar{y}\bar{x}$):	ϕSS, ZSS, reciprocal of *iai*

The first question will naturally be: how many participating clans will such an Iatmul connubium contain? The answer would appear to be "obviously five", for the following reason.

Bateson estimates (p. 402) that "in the Iatmul culture area there are in all between fifty and a hundred clans continually undergoing binary fission and fusion" (cf. the remarks on Kuma in 2.15). The clan of ego's MB and M is called *wau nyame nampa* (i. e. MB's and M's people), ego's ZC's clan is *laua nianggu* (ZC's people; *nampa*=people and *nianggu*=children are used synonymously), the clan containing ego's potential wives is *iai nampa*, ego's DH's clan is *kaishe nampa* (*kaishe* refers to cermonial exchange of shell currency), and finally ego's own clan is *nggwail warangka* (patrilineal ancestors, *nggwail*=FF, *warangka*=FFF). So we have the five clans:

clan of ego himself	: i
clan of ego's W and FM:	$\bar{x}y$ and xy
clan of ego's MB and M	: y
clan of ego's DH	: $\bar{x}\bar{y}x$
ego's ZC	: $\bar{y}$.

However, when we try to fit the Iatmul system into any possible connubium of five clans, we meet with complete failure. There are only two possibilities (21. 3) for a five-clan non-commutative connubium, namely the alternating direct exchange of Figure 21. 3a, and the patrilateral system of Figure 21. 3b, neither of which will fit in Iatmul system. For in alternating direct exchange the DH-clan ($\bar{x}\bar{y}x$) is identical with the MB-clan (y), since $\bar{x}=x$ and $\bar{y}x=h=\bar{w}=w$ so that $\bar{x}\bar{y}x=xw=y$ (or we may trace-out $\bar{x}\bar{y}x=y$ on Figure 21. 3a) and in the patrilateral system (Figure 21. 3b) the ZC clan ($\bar{y}$) is identical with the MB-clan (y), since $y^2=i$, so that $y=\bar{y}$. Consequently, the Iatmul system, which distinguishes the three clans MB, DH and ZC, cannot be either of the two sole possibilities. We have reached an impasse.

The trouble lies in the fact that we have been too much influenced by recollections of the situation in Australia. The Iatmul have say one hundred clans (22. 5), just as the Murngin have sixty (16. 1), but in the Murngin case, the sixty clans are grouped into sets of four, six, etc., forming connubia, whereas there is no indication of any such grouping among the Iatmul. In Murngin a clan is a certain fixed set of persons with a specific name: Red Cloud, Snake etc. (16. 1). If p_0 and p_1 are two males in the same clan in a connubium, and K is any kinchain, say $\bar{X}Y\equiv W$, then any wife of p_0 is necessarily in the same clan as any wife of p_1. In other words, we may speak of the wife-relationship between entire clans. But the Iatmul situation is different. The name say *wau nyame* (ego's MB's clan) does not refer to any fixed set of persons but varies from one ego to another, and there is no definite relationship among clans as a whole. If p_0 and p_1 are two persons in the same clan C_0, and p_0's wife is in clan

C_1, then p_1's wife may be in C_1 or may be almost anywhere else among the hundred Iatmul clans. There is nothing in the nomenclature to suggest the existence of fixed clans forming a connubium.

Bateson writes [*Naven* pp. 248–249]:

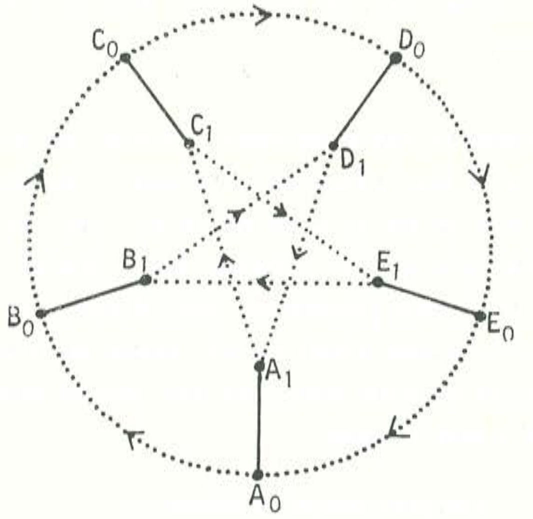
> A point which will almost certainly repay investigation may be seen in the resemblance between the Iatmul kinship system and the class systems of Australia, Ambrym etc. In all these systems ... we find an emphasis upon the alternation of generations. One conspicuous difference, however, between the Australian systems and that of the Iatmul is that the former are *closed*. An Australian community is divided into a fixed number of groups, and it is laid down which group shall marry which group and which generation shall marry which generation. This is not so in the Iatmul system, and even if the Iatmul confined themselves more rigidly to *iai* marriage they would not have a closed system like those of Australia.

22. 6 Shortcomings of a proposed connubium. In contrast to Bateson's view, and to our conclusion that there cannot exist a non-commutative connubium of five clans other than alternating-exchange or patrilateral marriage, Korn has suggested that such a connubium can be set up with FMBSD-marriage. The figure by which she illustrates her system [Korn, 1973: 97] can be redrawn as our Figure 22. 6. As can be seen from that figure and its legend, her system fits completely into the set of five distinct lines listed by Bateson.

She writes (p. 96):

> Marriage with the *iai* specified by FMBSD ..., if consistently observed, would lead, contrary to what Bateson thinks in this respect [1936: 249], to ... an asymmetric system by five patrilineal descent lines. The closed system implicit in the Iatmul terminology can be represented as in the figure. There are five lines: A, B, C, D, and E, related in such a way that A takes wives from B and C, B from C and D, C from D and E, D from E and A, and E from A and B, in alternate genealogical levels.

But Korn's suggestion violates the principle that a kinship system should look the same from the point of view of every male ego in it (cf. 16. 4). For example, it prescribes ZDD-marriage for males in the odd generations but proscribes the same type of marriage for males in the even generations, as can be seen by tracing-out on Figure 22. 7. For if we start from an



A: clan of ego
B: clan of ego's W, FM
C: clan of ego's MB, M
D: clan of ego's DH
E: clan of ego's ZC

Figure 22. 6 Iatmul system as proposed by Korn.

odd-generation section, say A_1, and trace-out ZDD, taking into account that $Y=XW$ and therefore $ZD\sim\bar{Y}=\bar{W}\bar{X}$, the path for $ZDD\sim\bar{Y}\bar{Y}=\bar{W}\bar{X}\bar{W}\bar{X}$ takes us through sections D_1, D_0, C_0 to C_1, which is the wife-section for A_1. But for the even generations, say for section A_0, the ZDD-path brings us to C_0, where the wife-section for A_0 is B_0. In fact, the whole system looks quite different for the even and the odd generations. For a male in an even section, say A_0, his MF is in the same section as his WBW (in each case C_0) but in in an odd section,. say A_1, his MF is in B_1 and his WBW in E_1. Mathematically expressed, section A_0 is carried into the same section, namely C_0, by the two permutations xwx (MF) and w^2(WBW), which are distinct from each other because xwx carries A_1 into B_1 and w^2 carries A_1 into E_1, in contravention of the definition of a complete group in 21. 1. Theoretically, of course, there might exist a marriage-alliance in which the marriage-rules would change from generation to generation, but such a system would be quite different from any that have been discovered or suggested up to now.

22.7 Randomness of Iatmul marriage. When we ask ourselves what kind of marriage is in fact prescribed by Cliché i) we find that this cliché is not a marriage-rule at all, at least not in the sense of prescribing marriage with any particular kind of relative, but is simply an adjuration to conservatism: do what your grandfather did, whatever it was. In symbols this rule reads: $x^2=i$, a rule which cannot alone describe a type of marriage. Since marriage involves both men and women any description of it must involve both x and y; thus

$$\bar{x}y=\bar{y}x=x\bar{y}=y\bar{x} \text{ (Kariera)},$$
$$w=yy\bar{x}\bar{y} \text{ (Aranda) etc.}$$

In fact no type of prescribed marriage is regularly practiced by the Iatmul. Bateson tells us that the natives take a pride in the marriage rules and look down on their neighbors as "dogs and pigs" who mate at random, but then he says (p. 91):

> this gibe is singularly inappropriate in the mouths of the Iatmul, since not only have they three positive marriage rules which conflict one with another, ... but the people do not adhere even to their negative rules. These negative rules are very vague, but there is a strong feeling against marrying own sister. ...Classificatory "sisters", women of own clan with whom genealogical connections can easily be traced, are sometimes taken as wives according to an oft-quoted cliché: "she is a fine woman so they married her inside the clan lest some other clan take her."

In general, however, it is considered desirable to go outside of one's own clan, either for marriage or for head-hunting. At least one Iatmul tribesman has earned his head-hunter's insignia by decapitating one of his wives, a person suitable for the purpose because she came from another village.

Again, although there was a very strong feeling against marriage with mother-in-law, one tribesman married his own mother-in-law while his wife was still alive and still married to him, and "it was nobody's business to say him nay in this individualistic culture", since he was a "great sorcerer and at the same time a great eater and fighter."

Lastly, "there are many marriages with outside groups—with women captured in war, or sent as peace offerings, women met on trading expeditions etc." So Bateson sums up the marriage system by saying that in practice marriage occurs very nearly at random.

The near-randomness of Iatmul marriage means that a male ego may marry into practically any other clan, just as in any tribe with non-prescribed marriage. But the continued existence of recognized sections (*mbapma*; 22. 3) strongly suggests that the Iatmul originally had some kind of prescribed marriage, at which time the five names for clans, *wau nyame nampa* etc. (22. 5) or other names from which these have developed, would refer to relationships among entire clans as in the Australian systems, instead of referring merely to the relatives of an individual ego. But whatever it may have been originally, the system has now become non-prescriptive, with vestigial remains of patrilateral marriage expressed in Cliché iii.

The principle of alternation of generations so clearly evident in the kinterms (22. 4) and in the sections (*mbapma*) can only have arisen in the earlier prescriptive stage. If that earlier stage was patrilateral marriage, in which one clan gives to another and receives from it in alternate generations (21. 2) the present confused state of marriage in Iatmul may perhaps be considered as support for the contention of Lévi-Strauss (21. 4) that patrilateral marriage provides no integration or solidarity in the community and is naturally disruptive.

Bateson tells us [1936: 92]:

> when we consider that the villages are very large, with a population ranging from two hundred to a thousand, it seems unlikely that an important affinal link will be perpetuated by analogous marriages in future generations. If therefore those old affinal links are necessary for the integration of the community, some means must be found of diagrammatically stressing them, a function performed by *naven*.

Unfortunately we have no space here to describe how this ceremony, so bizarre in Western eyes, contributes to such a result.

CHAPTER XXIII

Conjunctiveness in Sibling Terminologies

23. 1 The basic question. The preceding chapters have dealt with the central task of formulating concise and useful descriptions for kinship terminologies as a whole. The scope of the present chapter is narrower in one respect and much wider in another. It is concerned almost entirely with sibling terminologies but attempts to answer the following question of wide-ranging significance.

The number (23. 11) of theoretically possible sibling terminologies is 4,140, of which about fifty are actually found. So it is natural to ask: on what principle have these fifty-odd been chosen, there being no implication, of course, that any tribe in the history of mankind has consciously adopted a sibling terminology after comparing its advantages with those of the other 4,139 possibilities. We shall find that with negligible exceptions the actually occurring systems satisfy the (very restrictive) condition of being "conjunctive" in the sense of 23. 2. So our question becomes: why is it natural for a tribe to choose a conjunctive terminology? Since terminologies develop without conscious planning it is to be expected that the explanation will lie rather deep in human psychology.

23. 2 Definition of conjunctiveness. The words "conjunctive" and its antonym "disjunctive" are closely related in meaning to the words "and" and "or", and therefore to the concepts of "union" and "intersection", defined as follows. Let $S_0, S_1, \ldots, S_{n-1}$ be any set of subsets of a given underlying set U of elements of any kind. Then the set of elements that occur in S_0 **and** in S_1 **and** in S_2 ... **and** in S_{n-1} is called the **intersection** of the subsets $S_0, S_1, \ldots, S_{n-1}$, and the set of elements that occur in S_0 **or** in

S_1, **or** in S_2, ..., **or** in S_{n-1} is called their **union**, where "or" is used in the sense of "and/or", so that the union is the set of elements occurring in at **least one** of the subsets. Thus a partition of U can be defined as a set of subsets of U such that their union is the whole of U and the intersection of any two of them is empty.

Now let P_0, P_1, ..., P_{n-1} be any set of partitions of U. By a **conjunctive subset** of U we then mean either the entire set U or else a non-empty subset S of U which is the intersection of some of the classes in the partitions P_0, P_1, ..., P_{n-1}. In particular, each of the classes in any of these partitions is itself a conjunctive subset of U, since every set is the intersection of itself with itself. Then a partition P of U such that every class in P is a conjunctive subset of U is called a **conjunctive partition** of U. Thus conjunctiveness is defined only with respect to a given set U and a given set of partitions P_0, P_1, ..., P_{n-1} of U.

23.3 Partitions by material, manageability, shape and size. To give an illustration that will later provide an exact analog for sibling terminologies, let U be a heap of balls differing in material, shape and size; namely, with two materials "gold" and "aluminum", two shapes "round" (i. e. spherical) and "ellipsoidal", and two sizes "big" and "small". Let the set of gold balls be denoted by g, and similarly for the letters a, r, e, b and s. Let the set of those balls that are gold **and** round be denoted by gr, so that the set gr is the intersection of the two sets g and r, and similarly for the other combinations ge, ..., es of two letters; and finally let the set of balls that are gold **and** round **and** big be denoted by grb, and similarly for the other combinations grs, ..., aes, of three letters.

Now let P_0, P_1, P_2 be the three partitions by material, shape and size respectively; i. e. $P_0=(g, a)$, $P_1=(r, e)$, $P_2=(b, s)$. Then any non-empty set of balls that can be represented by one letter, say g, or by two letters, say gr, or by three letters, say grb, is conjunctive with respect to the set of partitions (P_0, P_1, P_2) and all other sets of balls except U itself are disjunctive. For example, the set, call it $g+r$, consisting of all balls that are gold *or* round (or both) is disjunctive.

A given set of balls may be conjunctive with respect to one set of partitions and disjunctive with respect to another. For example, let us suppose that very heavy balls, i. e. those that are gold and big, and also very light balls, i. e. those that are aluminum and small, are **inconvenient** to handle, while the balls of medium weight, i. e. $gs+ab$, are **convenient,** and let $P'=(c, i)$ denote the partition by manageability into "convenient" and "inconvenient". Then the set $g=ib+cs$ of gold balls is conjunctive with respect to (P_0, P_1, P_2) but disjunctive with respect to (P'_0, P_1, P_2). For the moment let us confine our attention to (P_0, P_1, P_2).

Altogether there are $1+6+12+8=27$ conjunctive subsets of U namely:

	Conjunctive subset	In geometric language (see just below)
i)	U itself:	one cube
ii)	*g, a, r, e, b, s*:	six faces
iii)	*gr, ge, gb, gs, ar, ae, ab, as, rb, rs eb, es*:	twelve edges
iv)	*grb, grs, geb, ges, arb, ars, aeb, aes*:	eight vertices

These twenty-seven conjunctive subsets can be represented geometrically as in Figure 23. 3, in which a one-letter set of balls is represented by a face of the cube, e. g. the set g of gold balls by the left face, a two-letter set, say gr, by the upper left edge, which is the intersection of two faces g and r, and a three-letter set, say grb, by a vertex, the intersection of three faces. Consequently, any partition P of the eight vertices is conjunctive (with respect to P_0, P_1, P_2) if each of the classes of P is either a face, an edge or a vertex; e. g. the partition (*g, ar, aeb, aes*) made up of one face, one edge and two vertices is conjunctive. But any other partition except U itself, is disjunctive; e. g. the partition $(g+ar, aeb, aes)$ is disjunctive because the class $g+ar$ is not just a face, or just an edge, or just a vertex.

23. 4 Product and factorization of partitions. A partition P that is conjunctive with respect to a given set of partitions $(P_0, P_1, \dots, P_{n-1})$ is called a **conjunctive product** of $P_0, P_1, \dots, P_{n-1}$; and conversely, if P is given, then any set of partitions with respect to which P is conjunctive is called a **(conjunctive) factorization** of P. Any partition P admits many such

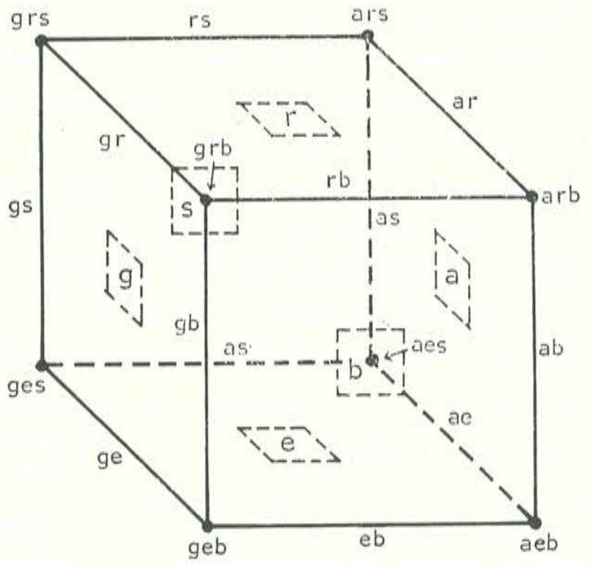


Figure 23. 3 Conjunctive sets on a cube.

factorizations, and conversely any set of partitions has many such products.

For example, let U be a pile of fruit in a bowl containing plums, apples and pears, and let us suppose that the plums are red, round and soft, the apples are yellow, round and hard, and the pears are yellow, ovaloid and soft. Let P be the three-class partition of U by type of fruit, and let P_0 be the two-class partition by color, P_1 by shape and P_2 by firmness. Then since each type of fruit is uniquely characterized by two of these three properties, the partition P can be conjunctively factorized in the three different ways (P_0, P_1), (P_0, P_2) or (P_1, P_2), e. g. in the factorization (P_0, P_1) the class of plums in P is the intersection of the class of red objects in P_0 with the class of round objects in P_1. Similarly, the partition P of the above set of balls into the eight classes *grb*, *grs*, *geb*, *ges*, *arb*, *ars*, *aeb*, *aes*, with each type of ball in a class by itself, is conjunctive with respect to the factorization (P_0, P_1, P_2) by material, shape and size and also with respect to the factorization $(P_0', P_1. P_2)$ by manageability, shape and size.

So we might ask whether one of these factorizations is somehow more "natural" than the other. In the present case it is probable that most persons, on looking at the balls, would say that the partition by material is more natural than the partition by manageability, but some persons, on handling them, might give the opposite answer. Although these distinctions have been introduced here merely for the sake of their analogy with sibling terminologies (23. 10), let us continue for the time being to talk about the balls, since they provide a more tangible setting for psychological experiments.

23. 5 Nomenclature from fields other than mathematics. Up to now our nomenclature has been chiefly mathematical. But the psychologists and others have their own technical terms. Our "underlying set" becomes the **universe of discourse** and any subset of U is a **concept.** Thus the set of round balls is the concept of "roundness", the set of *rb* balls is the concept of "round bigness" or "big roundness" and so forth. Any partition of U is a **categorization,** or **dimension,** or **attribute,** or **property,** or **component** of the elements of U, and a class in a partition is a **category.** Thus our P_1 is the "shape attribute", our P_2 is the "size attribute" etc. Any class in an attribute, i. e. any category in a partition, is a **value** of that attribute. The attribute values are assumed to be clear-cut; e. g. the big balls are noticeably bigger than the small ones. Finally, in the language of some linguists and anthropologists, a factorization of a partition is called a **componential analysis.**

23. 6 Componential analysis in anthropology. Let us here interpolate an example of componential analysis in anthropology. Let U be the set of all pairs of persons (a, b) in a Tamil-speaking tribe and let P be the partition of U into twenty-one classes in which two pairs (a, b) and (c, d) are in the same class if a applies to b the same kinterm as c applies to d, the kinterms being chosen from the nineteen terms in Table 10. 1 together with the two special affinal terms *kanavan*="husband" and *mainaivi*="wife", so that the kinterms may be regarded as labels for the classes in the Partition P.

Now consider the folllowing set of seven partitions of U.

P_0: is the five-class "generation" partition G_{2+}, G_1, G_0, G_{-1}, $G_{-(2+)}$, where

G_{2+} includes the pairs (a, b) such that the shortest chain linking a to b, call it $C(a, b)$, is of height at least two, G_1 includes the pairs such that $C(a, b)$ is of height one and so on;

P_1: is the two-class "even-odd" partition (E, O) with (a, b) in E if $C(a, b)$ is even (see Table 10. 1) and in O if $C(a, b)$ is odd;

P_2: is the two-class "sex-of-referent" partition (μ, ϕ) with (a, b) in μ if b is male and in ϕ if b is female;

P_3: is the two-class "sex-of-speaker" partition (m, f) with (a, b) in m if a is male and in f if a is female;

P_4: is the two-class "even-odd-sex-of-speaker" partition (β, γ), where the class β includes all pairs (a, b) with $C(a, b)$ even and a male and also all pairs with $C(a, b)$ odd and a female, and γ includes the other pairs.

P_5: is the two-class "relative age" partition (e, y) with (a, b) in e if b is older than a and in y if b is younger than a.

P_6: is the two-class "special-affinal-kinterm" partition (s, n), where (a, b) is in s if b is spouse to a and is otherwise in n (non-spouse).

Then the set of partitions $(P_0, P_1, \ldots, P_6)$ is a componential analysis of P, since the class in P labeled *paddan* is the intersection of the two classes G_{2+} in P_0 and μ in P_2, and similarly for the other classes, as follows: *paddan* (G_{2+}, μ), *paddi* (G_{+2}, ϕ), *takkappan* $(G_1\ E, \mu)$, *attai* (G_1, E, ϕ), *maman* (G_1, O, μ), *tay* (G_1, O, ϕ), *annan* (G_0, E, μ, e), *tamakay* (G_0, E, ϕ, e), *tambi* $(G_0, E\ \mu, y)$, *tangay* $(G_0\ E, \phi, y)$, *maittunan* (G_0, O, μ, m), *maittuni* (G_0, O, ϕ, m, n), *machchan* (G_0, O, f, n), *makan* (G_{-1}, μ, β), *makal* (G_{-1}, ϕ, β), *marumakan* (G_{-1}, μ, γ), *marumakal* (G_{-1}, ϕ, γ), *peran* $(G_{-(2+)}, \mu)$, *pertti* $(G_{-(2+)}, \phi)$, *kanavan* (s, μ), *mainaivi* (s, ϕ).

23. 7 The meaning of meaning. Continuing our excursus on componential analysis, let us now point out that the topic is of interest in general linguistics and philosophy because it attempts to define the "meaning" of each of the kinterms. The meaning of the word say *paddan* is regarded as being the answer to the question: what must we know about the pair of persons (a, b) in order to know that a applies the term *paddan* to b? Certainly it is sufficient to know that a and b are kinsmen, i. e. members of the same Tamil-speaking tribe, that b is at least two generations above a, and that b is male. So it is possible to take the view that the meaning of *paddan* lies precisely in these conditions.

More generally, let U be a set of elements of any kind, let P be any partition of U and let each of the classes of P be marked with a distinctive label whose meaning we seek to define in terms of a given componential analysis $(P_0, P_1, \ldots, P_{n-1})$ of P. For definiteness we shall continue to examine the particular case discussed just above, in which U is the set of pairs (a, b) of persons in a Tamil-speaking tribe, P is the partition of U generated by the Tamil kinship terminology, $P_0, P_1, \ldots, P_6$ are the seven partitions by generation, by even or odd chains etc., and the labels are the Tamil kinterms.

Now let an element in any of the classes of P be called a **denotatum** of the label of its class, e. g. in our Tamil case any pair of persons (a, b) such that a applies the kinterm *paddan* to b is a denotatum of the word *paddan*, and let the entire set of denotata of a label be called its **designatum**, so that the designatum of the word *paddan* is the entire set of pairs of persons (a, b) such that a applies the kinterm *paddan* to b. Since this designatum is a class in the partition Q and since Q is conjunctive with respect to $(P_0, P_1, \ldots, P_6)$, the designatum must be the intersection of certain classes in these partitions. Then the set of these certain intersecting classes is called the **significatum** of the word *paddan*. See Morris 1938.

In this way the significatum, or signification, or meaning, of a word may be regarded as a set of necessary and sufficient conditions for an element of U to be a denotatum of the given word. For example, a set of necessary and sufficient conditions for a pair of persone to be a denotatum of *paddan* is

i) membership in the class G_{+2} and
ii) membership in the class μ.

23. 8 The present state of componential analysis. But since every partition P can be componentially analyzed in many different ways, which one of them are we to choose in determining the meaning of a given word?

Suppose, for example, that the Tamil-speaking tribe in question contains no pair of persons (a, b) such that b is older than a but in a lower generation. Then the five-class partition P_0 can just as well be replaced by a three-class partition, call it P_0', with the three classes r_0, r_1, r_2, where (a, b) is in r_0 if a and b are in the same generation, in r_1 if they are one generation apart, and otherwise in r_2. The *paddan* class is now the intersection of r_{2+}, μ and e, with the result that, although its designatum remains unchanged, its significatum is no longer the set of two classes G_{2+} and μ but rather the set of three classes r_{2+}, μ and e.

In this way the word *paddan* may have different meanings for different observers of the given tribe, whether they are native children observing from within or anthropologists from without, just as for most speakers of English the word *nephew* will mean "brother's or sister's son", while for others, e. g. for those anthropologists who practice componential analysis, it may mean "one generation descending, collineal, male". Since each possible significatum of the word *paddan* corresponds to a certain componential analysis, we might consider the possibility of defining **the** meaning of *paddan* to be the set of all its significata, arising from all possible compontial analyses; or better perhaps from a set of preferred analyses, since it appears that some progress is being made toward fairly satisfactory criteria for preferring certain analyses to others.

Efforts of this kind to define the meaning of meaning have been motivated in part, both for general linguists and for anthropologists interested in kinship terminology, by the success of the phoneme, introduced into linguistics in the late nineteen-twenties. As we learn from any contemporary textbook, the definition of a phoneme as a certain equivalence class of sounds has produced considerable progress in theoretical linguistics and very great progress in the practical task of transcribing hitherto unwritten languages. Analogously, efforts are now being made, along the lines suggested above for the kinterm *paddan*, to define a "meaning" as a certain equivalence class of significata. Up to now, this componential analysis has been practiced chiefly by anthropologists, and chiefly for certain small classes of words with comparatively clear-cut meanings, e. g. kinterms or the names for plants or colors in aboriginal languages, the hope being that success in these simpler fields will lead to wider success comparable to the success of the phoneme. It is true that some anthropologists have scoffed at componential analysis e. g. by ironically asking: which is more natural, or as they sometimes say, which has greater "cognitive validity": to think of one's aunt as one's parent's sister or as "one-generation ascending, collineal, female"? Such gibes need not be taken seriously. It is true that in kinship terminology definition by product of relations, e. g. aunt as product of parent and sister, seems more natural than definition by componential analysis. But the aims and hopes of the componential analyst embrace much wider fields than just kinship terminology, e. g. the meaning of technical terms in physics or botany, or even in literature, music or art, where product-relations are not so readily available. However, it is still too early to say whether such success is attainable, and if it is, whether any significant role will be played in its attainment by the study of kinship terminology.

23. 9 Experiments on conjunctiveness. After this general excursus on componential analysis, i. e. conjunctive factorization, let us now return to our particular subject, namely conjunctiveness in sibling terminology.

The psychological interest of conjunctiveness is shown by experiments of the following kind, which demonstrate that conjunctive concepts are easier to "learn" than disjunctive ones. The experimenter shows to the subject an indiscriminate heap of balls described in 23. 3 with no comment on their properties. After choosing in his own mind some concept C_0, say $C_0=rb$, he asks the subject to draw a ball from the heap and then tells him, by saying "yes" or "no"‘ whether the chosen ball belongs to C_0. The subject then chooses a second ball, and a third etc., endeavoring after each trial to give a correct description of C_0. As soon as his description is correct, i. e. as soon as he has "learned" the concept, the experiment is repeated with another concept, say $C_1=gr+as$. Experiments with a large number of subjects have demonstrated that a concept will be learned much more quickly if it is conjunctive with respect to some set of clear-cut attributes of the balls. When trying to learn a concept like $C_0=rb$, the subject will soon begin to be affected, consciously or subconsciously, by the invariable presence of round big balls among the "yes" answers. But for the concept

$C_1 = gr + as$, which is disjunctive with respect to any set of noticeable attributes, the task is much harder, because the subject cannot find attribute-values whose presence is necessary and sufficient for success.

Finally, if a given subject is affected not so much by material as by manageability, a sufficient number of experiments will reveal his idiosyncrasy, even though it may be subconscious, because of the greater quickness with which he learns concepts that are conjunctive with respect to the set of partitions (P_0', P_1, P_2). We here assume that the distinction in material is much more clear-cut than the distinction in manageability, so that almost all subjects will prefer (P_0, P_1, P_2) to (P_0', P_1, P_2).

23. 10 Analogy with sibling terminologies. We are now ready to apply the analogy of the balls to sibling terminologies. The four attributes of material, manageability, shape, and size correspond respectively to relative sex, sex of speaker, relative age, and sex of referent, so that we now have the four partitions

$$P_0 = (\pi, \chi), \qquad P_0' = (m, f), \qquad P_1 = (e, y), \qquad P_2 = (\mu, \phi)$$

instead of the earlier $P_0 = (g, a)$ $P_0' = (c, i)$, $P_1 = (r, e)$, $P_2 = (b, s)$, and the cube in Figure 23. 3 must be relabeled as in Figure 23. 10.

The heap of balls now corresponds to sibling pairs of the eight types

$$\begin{array}{llll} \pi e\mu = me\mu, & \pi e\phi = fe\phi, & \pi y\mu = my\mu, & \pi y\phi = fy\phi, \\ \chi e\mu = fe\mu, & \chi e\phi = me\phi, & \chi y\mu = fy\mu, & \chi y\phi = my\phi, \end{array}$$

and a concept is a subset of these eight types; e. g. in English the *brother* concept is the subset $(\pi e\mu, \pi y\mu, \chi e\mu, \chi y\mu)$, and every child has the task of learning the sibling-kinterms associated with various concepts on being told in each case whether or not he is correct in assigning a certain kinterm from his native language to a certain pair of persons. A complete sibling terminology is a partition of the set of the eight sibling types, each class in the partition being associated with a native kinterm. For example, the English terminology *brother* | *sister* is a partition of the eight types into two classes, each containing four sibling types.

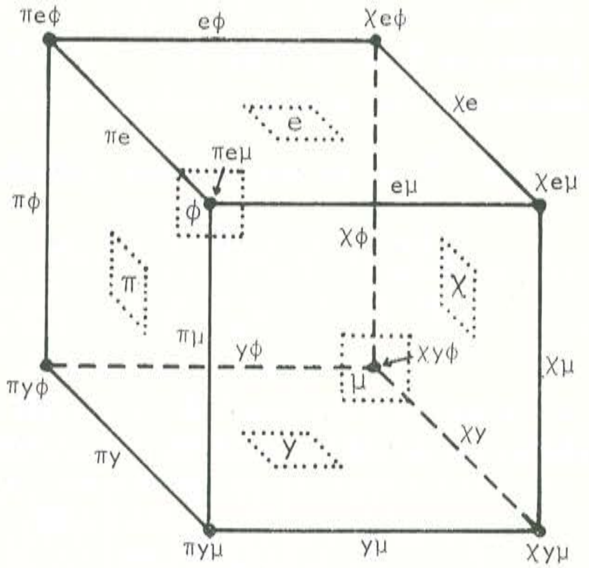


Figure 23. 10 Conjunctive sibling kinterms on a cube.

On the perhaps reasonable assumption that a sibling terminology is more likely to survive if it is easier to learn, we may expect that almost all the fifty-odd actual sibling systems are conjunctive with respect to $P_0P_1P_2$ or $P_0'P_1P_2$ or both, and that the few disjunctive systems will be represented by very few tribes. This argument that sibling terminologies are influenced by conjunctiveness will be more cogent in proportion as the total number of possible terminologies, i. e. the number of possible partitions of eight things, is large and the number of conjunctive partitions is small. So we must now calculate these numbers, beginning with the total set of partitions, for which we have already stated in 23. 1 that the answer is 4,140.

23. 11 The 4,140 possible sibling terminologies. To begin with, we have the one-class partition in which all eight elements are thrown into one class, as in the Mbuti terminology (6. 5) with the same kinterm *namami* for all eight sibling types. At the other extreme is the eight-class partition in which each of the eight elements is in a class by itself, as in the Ogalalla terminology with a separate kinterm for each of the eight sibling-types. All other partitions will consist of two to seven classes such that the sum of the numbers of elements in all the classes is equal to eight. So we have the twenty-two possibilities listed in Table 23. 11. In parentheses we give the number of partitions in each case, as calculated just below.

Table 23. 11 The 4,140 possible sibling terminologies

Number of classes	Number of elements in each class (with the number of corresponding partitions in parentheses)
one:	8(1)
two:	7,1(8); 6,2(28); 5,3(56); 4,4(35)
three:	6,1,1(28); 5,2,1(168); 4,3,1(280); 4,2,2(210); 3,3,2(280)
four:	5,1,1,1(56); 4,2,,1,1(420); 3,3,1,1(280); 3,2,2,1(840); 2,2,2,2(105)
five:	4,1,1,1,1(70); 3,2,1,1,1(560); 2,2,2,1,1(420)
six:	3,1,1,1,1,1(56); 2,2,1,1,1,1(210)
seven:	2,1,1,1,1,1,1(28)
eight:	1,1,1,1,1,1,1,1(1)

In Figure 6. 5c we have given one example for each of the numbers of distinct kinterms, from one to eight.

We now calculate the number of distinct partitions in each of the cases listed in Table 23. 11.

In the (5, 2, 1)-case, for example, we may first make any selection of five elements out of the eight to be put in the largest class, then any selection of two from the remaining three to be put into the next largest class, whereupon the last element necessarily goes into the smallest class. So we must find some convenient way of calculating the number of different ways of selecting five elements from eight, then two from three etc.; or more generally, of selecting r elements from a set of n elements. This number is denoted by its symbol ${}_nC_r$ and is called the "number of combinations, i. e. selections, of n things taken r at a time".

In 13. 3 we saw that the number of ways in which n elements can be arranged in a row is given by $n!=n(n-1)(n-2)\dots3\cdot2\cdot1$. But for any chosen value of r a given arrangement of the n elements may be regarded as being a selection of its first r elements. So without changing the selection we may rearrange the first r objects in $r!$ ways and for each of these $r!$

rearrangements we may then rearrange the last $(n-r)$ elements in $(n-r)!$ ways. Thus every selection corresponds to $r!(n-r)!$ arrangements, which means that the number $n!$ of arrangements is $r!(n-r)!$ times as great as the number ${}_nC_r$ of selections. Thus ${}_nC_r=n!/(r!(n-r)!)$.

In the two-class (7, 1)-case the larger class can be formed in the ${}_8C_7$ ways in which seven elements can be chosen from the eight, whereupon the remaining element necessarily goes into the other class. Thus the total number, call it $N(7,1)$ of possible partitions in this (7, 1)-case is given by $N(7,1)={}_8C_7=8!/(7!\ 1!)=8$. Similarly, in the (6, 2)-case we first select the six elements for the larger class in ${}_8C_6$ ways, whereupon the two remaining elements necessarily go into the other class, so that $N(6,2)=8!/(6!\ 2!)=28$. And similarly $N(5,3)=8!/(5!\ 3!)=56$. In the (5, 2, 1)-case we first select the five elements in ${}_8C_5$ ways and then the two elements in ${}_3C_2$ ways, giving $N(5,2,1)={}_8C_5\times{}_3C_2=8!/(5!\ 3!)\times 3!(2!\ 1!)=8!/(5!\ 2!\ 1!)=168$, and similarly $N(4,3,1)=8!/(4!\ 3!\ 1!)=280$. In each case the factor $1!=1$ may, if we wish, be left unwritten; e. g. $N(4,3,1)=8!/(4!\ 3!)$.

In all these cases we can at once write down the answer in the form $8!/(p!\ q!\ \ldots r!)$ with $p+q+\ldots+r=8$, where $p>q>\ldots>r$ are the numbers of elements in the largest, next largest, ..., smallest class. But when two of the classes are of the same size, as e. g. in the English (4, 4)-case, the $8!/(4!\ 4!)$ partitions will be equal in pairs, since the partition obtained by choosing one set of four for the first class and putting the second four into a second class is the same as the one obtained by choosing the two sets of four in the opposite order. Similarly, the (3, 2, 1, 1, 1)-partitions with three classes of equal size are equal to one another in sets of $3!=6$, since the partition remains unaffected by the order in which the three 1's are chosen. So the number $8!/(3!\ 2!)$ must be divided by $3!$, giving $8!/(3!\ 2!\ 3!)=8\times7\times5\times4=560$. Again, in the (2, 2, 2, 1, 1)-case the number $8!/(2!\ 2!\ 2!)$ must be divided by $3!$ because of three 2's, and by $2!$ because of the two 1's, giving $8!/(2!\ 2!\ 2!\ 3!\ 2!)=420$. In this way all the numbers in parentheses in Table 23. 11 can be rapidly calculated. Their sum is 4,140, as stated in 23. 1.

23. 12 The 154 conjunctive cases. From these 4,140 possible partitions we can now easily select the ones that are conjunctive with respect to the three partitions $P_0=(\pi, \chi)$, $P_1=(e, y)$, $P_2=(\mu, \phi)$.

Since a face contains four points, an edge two and a vartex one, we can at once eliminate all those partitions involving a 3, 5, 6 or 7, so that we are left with the following cases (in addition to the two extreme Mbuti and Ogalalla systems, with one and eight terms respectively):

$$4, 4(3);\ 4, 2, 2(12);\ 4, 2, 1, 1(24);\ 2, 2, 2, 2(9);\ 4, 1, 1, 1, 1(6);$$
$$2, 2, 2, 1, 1(44);\ 2, 2, 1, 1, 1, 1(42);\ 2, 1, 1, 1, 1, 1, 1(12),$$

where we have added in parentheses the number of conjunctive partitions in each case (see just below), the sum of all of them being 154. While there is no difficulty in calculating these numbers algebraically, a geometric argument is easier to follow and in the present case our powers of visualization can be aided by the following device.

We imagine ourselves provided with a solid $2'' \times 2'' \times 2''$ **cube** of wood labeled j, six $2'' \times 2'' \times 1''$ **slabs** labeled π, χ, e, y, μ, ϕ, twelve $2'' \times 1'' \times 1''$ **strips** labeled πe, πy, $\pi\mu$, $\pi\phi$, χe, χy, $\chi\mu$, $\chi\phi$, $e\mu$, $e\phi$, $y\mu$, $y\phi$, and eight $1'' \times 1'' \times 1''$ **blocks** labeled $\pi e\mu$, $\pi e\phi$, $\pi y\mu$, $\pi y\phi$, $\chi e\mu$, $\chi e\phi$, $\chi y\mu$, $\chi y\phi$ as in Figure 23. 12 (cf. the labeling in Figure 23. 10).

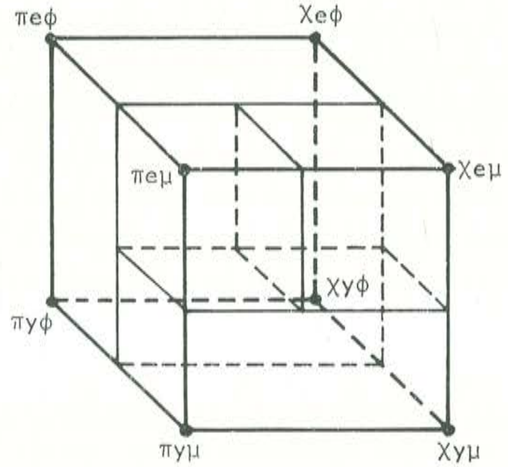


Figure 23. 12 The cube made up of one slab, one strip and two blocks.

Then the 154 sibling terminologies conjunctive with respect to (P_0, P_1, P_2) will exactly correspond to the 154 ways (see just below) is which the cube can be built up from the eight blocks, four strips, two slabs or the cube itself. For example, Figure 23.12 shows the cube constructed from one slab (the ϕ-slab forming the back half), one strip (the lower front $y\mu$-strip) and the two blocks $\pi e\mu$ and $\chi e\mu$. This construction of the cube represents a kinship terminology with four kinterms, one for sisters (ϕ), one for younger brothers ($y\mu$), one for parallel elder brother ($\pi e\mu = me\mu$) and one for cross elder brother ($\chi e\mu = fe\mu$). In other words it is the terminology also represented by

$$\boxed{\frac{\pi e\mu \,\}\, \chi e\mu}{y\mu} \Big| \,\phi} \quad \text{or} \quad \boxed{\frac{me\mu \,\|\, fe\mu}{y\mu} \Big| \,\phi}$$

In building up this terminology on the cube we imagine ourselves as first placing the slab in upright position at the back, then laying the strip along the bottom of the front half, and finally laying the two blocks on top of the strip. Although the whole procedure will be quite easy to visualize without a model, we can assure the reader that if he will actually provide himself with such slabs, strips and blocks, constructed say from pieces of cardboard fastened together with gummed tape, he will find it quite entertaining to build up the cube in some of the 154 ways that we now proceed to describe. Cf. Epling Kirk and Boyd 1972; Nerlove and Romney 1967; Kronenfeld 1974.

23.13 Calculation of the 154 cases. When the cube is built up of two slabs in any of the three possible ways; i.e. left and right, top and bottom, or front and back, each slab plays the role played up to now by a face, namely the exposed face of the slab. Similarly, when at least one strip is involved, the strip plays the role of an edge, namely the exposed edge of the strip; and a block plays the role of a vertex. So in Table 23.11 a slab is represented by a 4, a strip by a 2 and a block by a 1.

Beginning with the (4, 4)-case we must ask: in how many ways can the cube be built up from two slabs? The answer is 3, as mentioned just above, In the (4, 2, 2)-case, with one slab and two strips, the number of ways is 12, because there are six positions for the slab, for each of which the two strips can be laid parallel to each other in either of two directions.

The (4, 2, 1, 1)-case will have 24 possibilities because it arises from splitting either of the two strips into two blocks is each of the 12 possibilities of the (4, 2, 2)-case.

In the (2, 2, 2, 2)-case 3 possibilities are provided by laying all four strips parallel to one another in each of the three directions, and 6 more by laying down two strips side by side in any of the six positions available for a slab, whereupon the position of the other strips is already determined by the condition that the four strips are not all parallel to one another. So for the (2, 2, 2, 2)-case there are $3+6=9$ possibilities.

In the (4, 1, 1, 1, 1)-case, there are 12 possibilities, since the single strip may be laid along any of the twelve edges of the cube.

In the (2, 2, 2, 1, 1)-case we must distinguish three subcases:

i) the three strips are all parallel. Here there are 12 possibilities, corresponding to the twelve positions for the missing strip, i. e. the one split into two blocks.

ii) two of the strips are parallel. Here two of them must be halves of the same slab, giving 6 possibilities, for each of which the third strip can be laid in any of four positions, giving $6\times4=24$ possibilities.

iii) the three strips are mutually perpendicular. Here there are 12 possibilities for placing the first strip, for each of which the second strip can be placed in 4 ways, whereupon the position of the third strip is fixed. But these 48 cases are alike in $3!=6$, because the partition remains unaffected by the order in which the three strips are laid down. So in subcase iii) there are 8 possibilities.

Consequently, in the (2, 2, 2, 1, 1)-case there are altogether $12+24+8=44$ six possibilities.

In the (4, 1, 1, 1, 1)-case there are 6 possibilities, corresponding to the positions for the slab.

In the (2, 2, 1, 1, 1, 1)-case we must again distinguish three sub-cases:

i) the two strips are halves of a slab which may be laid in any of six positions for each of which it may then be split into the two strips in either of two directions, giving 12 possibilities.

ii) the two strips are perpendicular to each other. Here the first strip may be placed in 12 ways, each of which leaves 4 choices for the position of the second strip. But these 48 possibilities are equal in pairs because the partition remains unaffected by the order in which the two positions are chosen. So here there are 24 possibilities:

iii) the two strips are parallel but diagonally opposite, e. g. if one of them lies along the lower left edge, the other lies along the upper right. Here the first strip may be laid along any of the twelve edges of the cube, whereupon the position of the other is fixed, and again these 12 possibilities are equal in pairs. Thus there are 6 possibilities in this sub-case.

Consequently for the (2, 2, 1, 1, 1, 1)-case there are $12+24+6=42$ possibilities.

Finally, in the (2, 1, 1, 1, 1, 1, 1)-case there are 12 possibilities, since the single strip may be laid along any of the 12 edges.

23. 14 Complete table of the conjunctive cases. These 154 partitions conjunctive with respect to (P_0, P_1, P_2) are written out in full in Table 23. 14. For brevity the single vertices are omitted in each partition, since they can be immediately supplied. For example, in the partition listed as π in the (4, 1, 1, 1, 1)-case the four single vertices corresponding to the four 1's are $\chi e\mu$, $\chi e\phi$, $\chi y\mu$, $\chi y\phi$, since the π-face includes the other four vertices $\pi e\mu$, $\pi e\phi$, $\pi y\mu$ and $\pi y\phi$. Similarly, in the partition listed as πy, χy, χe in the (2, 2, 2, 1, 1)-case the two unlisted vertices are $\pi e\mu$, $\pi e\phi$, since πy includes $\pi y\mu$ and $\pi y\phi$ etc.

23. 15 Evolvable partitions. Let us now say that a conjunctive partition is **evolvable** if it can be obtained from the one-class partition represented by the Mbuti sibling terminology by a sequence of binary splits in which an already generated class is split into two classes; i. e. either the entire cube is split into two slabs, a so-called **primary** split, or a slab is split into two strips, a **secondary** split, or else a strip is split into two blocks, a **tertiary** split.

Table 23. 14 The 154 conjunctive partitions

(8) whole cube

(4,4)

$\pi, \chi;\ e, y;\ \mu, \phi$

(4,2,2)

$\pi, \chi e, \chi y;\ \pi, \chi\mu, \chi\phi$

$\chi, \pi e, \pi y;\ \chi, \pi\mu, \pi\phi$

$e, y\mu, y\phi;\ e, \pi y, \chi y$

$y, e\mu, e\phi;\ y, \pi e, \chi e$

$\mu, \pi\phi, \chi\phi;\ \mu, e\phi, y\phi$

$\phi, \pi\mu, \chi\phi;\ \phi, e\mu, y\mu$

(4,2,1,1)

$\pi, \chi e;\ \pi, \chi y;\ \pi, \chi\mu;\ \pi, \chi\phi$

$\chi, \pi e;\ \chi, \pi y;\ \chi, \pi\mu;\ \chi, \pi\phi$

$e, y\mu;\ e, y\phi;\ e, \pi y;\ e, \chi y$

$y, e\mu;\ y, e\phi;\ y, \pi e;\ y, \chi e$

$\mu, \pi\phi;\ \mu, \chi\phi;\ \mu, e\phi;\ \mu, y\phi$

$\phi, \pi\mu;\ \phi, \chi\mu;\ \phi, e\mu;\ \phi, y\mu$

(2,2,2,2)

$\pi e, \chi e, \pi y, \chi y;\ \pi\mu, \chi\mu, \pi\phi, \chi\phi$

$e\mu, e\phi, y\mu, y\phi;\ \pi e, \chi e, y\mu, y\phi$

$\pi\mu, \chi\mu, e\phi, y\phi;\ e\mu, e\phi, \pi y, \chi y$

$\pi y, \chi y, e\mu, e\phi;\ \pi\phi, \chi\phi, e\mu, y\mu$

$y\mu, y\phi, \pi e, \chi e$

(4,1,1,1,1)

$\pi;\ \chi;\ e;\ y;\ \mu;\ \phi$

(2,2,2,1,1) subcase i

$\pi y, \chi y, \chi e;\ \pi e, \chi e, \chi y;\ \pi\phi, \chi\phi, \chi\mu;$
$\pi\mu, \chi\mu, \chi\phi$

$\pi e, \pi y, \chi y;\ \pi e, \pi y, \chi e;\ \pi\mu, \pi\phi, \chi\phi;$
$\pi e, \pi\phi, \chi\mu$

$e\phi, y\mu, y\phi;\ e\mu, y\mu, y\phi;\ e\mu, e\phi, y\phi;$
$e\mu, e\phi, y\mu$

(2,2,2,1,1) subcase ii

$\chi e, ye, y\phi;\ \pi y, \chi\mu, \chi\phi;\ \chi y, e\mu, e\phi;$
$\pi e, \chi\mu, \chi\phi$

$\chi\mu, e\phi, y\phi;\ \pi\phi, \chi e, \chi y;\ \chi\phi, e\mu, y\mu;$
$\pi\mu, \chi e, \chi y$

$\pi e, y\mu, y\phi;\ \pi\mu, \pi\phi, \chi y;\ \pi y, e\mu, e\phi;$
$\pi\mu, \pi\phi, \chi e$

$\pi\mu, e\phi, y\phi;\ \pi e, \pi y, \chi\phi;\ \pi\phi, e\mu, y\mu;$
$\pi e, \pi y, \chi\mu$

$\pi y, \chi y, e\phi;\ \pi\phi, \chi\phi, y\mu;\ \pi y, \chi y, e\mu;$
$\pi\mu, \chi\mu, y\phi$

$\pi e, \chi e, y\phi;\ \pi\phi, \chi\phi, e\mu;\ \pi e, \chi e, y\mu;$
$\pi\mu, \chi\mu, e\phi$

(2,2,2,1,1) subcase iii

$\pi\phi, \chi e, y\mu;\ \pi\mu, \chi e, y\phi;\ \pi\phi, \chi y, e\mu;$
$\pi\mu, \chi y, e\phi$

$\pi y, \chi\mu, e\phi;\ \pi y, \chi\phi, e\mu;\ \pi e, \chi\mu, y\phi;$
$\pi e, \chi\phi, y\mu$

(2,2,1,1,1,1) subcase i

$\pi e, \pi y;\ \pi\mu, \pi\phi;\ \chi e, \chi y;\ \chi\mu, \chi\phi$

$\pi e, \chi e;\ e\mu, e\phi;\ \pi y, \chi y;\ e\phi, y\mu$

$\pi\mu, \phi\mu;\ e\mu, y\mu;\ \pi\phi, \chi\phi;\ e\mu, e\phi$

(2,2,1,1,1,1) subcase ii

$\pi e, \chi\mu;\ \pi e, \chi\phi;\ \pi e, y\mu;\ \pi e, y\phi$

$\pi y, \chi\mu, \pi y, \chi\phi;\ \pi y, e\mu;\ \pi y, e\phi$

$\pi\mu, \chi e;\ \pi\mu, \chi y;\ \pi\mu, e\phi;\ \pi\mu, y\phi$

$\pi\phi, \chi e;\ \pi\phi, \chi y;\ \pi\phi, e\mu;\ \pi\phi, y\mu$

$\chi e, y\mu;\ \chi e, y\phi;\ \chi y, e\mu;\ \chi y, e\phi$

$\chi\mu, e\phi; \chi\mu, y\phi;\ \chi\phi, e\mu;\ \chi\phi, y\mu$

(2,2,1,1,1,1) subcase iii

$\pi e, \chi y;\ \pi y, \chi e;\ \pi\mu, \chi\phi;\ \pi\phi, \chi\mu;$
$e\mu, y\phi;\ e\phi, y\mu$

(2,1,1,1,1,1,1)

$\pi e;\ \pi y;\ \pi\mu;\ \pi\phi$

$\chi e;\ \chi y;\ \chi\mu;\ \chi\phi$

$e\mu;\ e\phi;\ y\mu;\ y\phi$

(1,1,1,1,1,1,1,1)

eight single vertices

Then it is perhaps a plausible conjecture that the simple Mbuti system with one kinterm for all siblings is historically the earliest, and that all other evolvable terminologies have developed from it by successive binary splits. For example, the "*brother* | *sister*" system inherited by the English language may have come into existence when a desire was felt, for some social or religions reason, to distinguish male from female referent; or in our geometric terms, to split the cube vertically into two slabs, front and back. As can be seen from Table 23. 14 all the 154 conjunctive partitions are evolvable except the eight cases with three mutually perpendicular strips (sub-case iii of the 2, 2, 2, 1, 1-case), which are not evolvable because the two blocks cannot have resulted from splitting a strip nor can any of the strips have resulted from splitting a slab. Consequently, there are 146 evolvable partitions, and the fact that they include all the forty actual sibling patterns in Table 23. 16b may perhaps lend credence to the above conjecture that sibling terminologies develop by binary splits.

23. 16 Comparison of relative sex with absolute sex of speaker. Of the 4,140 theoretically possible partitions of eight types of sibling-pairs we give a complete list in Table 23. 14 of the 154 that are conjunctive with respect to the set of partitions $P_0=(\pi, \chi)$, $P_1=(e, y)$, $P_2=(\mu, \phi)$ where π and χ refer to sex of speaker relative to sex of referent. Let us now examine the situation for the set of partitions $P_0'=(m, f)$, $P_1=(e, y)$, $P_2=(\mu, \phi)$, where m and f refer to absolute sex of the speaker. Since $m=\pi\mu+\chi\phi$, $f=\pi\phi+\chi\mu$, and conversely $\pi=m\mu+f\phi$, $\chi=m\phi+f\mu$, the two partitions P_0 and P_0' are on an equal footing. In other words, there will also be 154 partitions that are conjunctive with respect to (P_0', P_1, P_2), and we see as follows that 74 of them are conjunctive for both (P_0, P_1, P_2) and (P_0', P_1, P_2).

Every vertex is conjunctive for both, e. g. $\pi e\mu=me\mu$, and similarly every strip containing both a π or χ and a μ or ϕ. So to eliminate the partitions in Table 23. 14 that are not conjunctive for (P_0', P_1, P_2) we need only strike out those that contain one of the two slabs π, χ or one of the four strips πe, πy, χe, χy. By actual count we find 80 of them, leaving 74 that are conjunctive for both (P_0, P_1, P_2) and (P_0', P_1, P_2). Thus we have the following table for the 4,140 possible sibling terminologies.

Table 23. 16a Comparison of the two sets of partitions

154 are conjunctive for	(P_0, P_1, P_2)			
154 are conjunctive for	(P_0', P_1, P_2)			
80 are conjunctive for	(P_0, P_1, P_2)	but not for	(P_0', P_1, P_2)	
80 are conjunctive for	(P_0', P_1, P_2)	but not for	(P_0, P_1, P_2)	
74 are conjunctive for	(P_0, P_1, P_2)	and	(P_0', P_1, P_2)	
3906 are disjunctive for	(P_0, P_1, P_2)	and	(P_0', P_1, P_2)	

Then it is natural to ask the same question concerning the two sets of partitions (P_0, P_1, P_2) and (P_0', P_1, P_2), interpreted now as the attributes of relative sex (P_0), absolute sex of speaker (P_0'), relative age (P_1) and sex of referent (P_2), as we asked about the balls in 23. 4 when the attributes were material, manageability, size and shape. Just as we there assumed that for most observers material would seem a more natural criterion than manageability, so we may ask which of the two criteria, relative sex of speaker and referent or absolute sex of speaker, is a more natural criterion for sibling terminologies.

To answer this question we list the fifty-two sibling terminologies, i. e. those in Figure 6. 5d, in the form of Table 23. 16b. By actual count we find that 38 are conjunctive for both (P_0, P_1, P_2) and (P_0', P_1, P_2), 14 are conjunctive for (P_0, P_1, P_2) but not for $(P_0', P_1, P_{2,})$, and none at all for (P_0', P_1, P_2) but not for (P_0, P_1, P_2). In particular, the primary split (m, f) by absolute

Table 23. 16b Fifty-two sibling patterns (cf. Figure 6.5d)

(1) j	(2) π, χ	(3) μ, ϕ	(4) e, y
(5) $\chi, \pi e, \pi y$	(6) $\chi, \pi\mu, \pi\phi$	(7) $\pi, \chi\mu, \chi\phi$	(8) $\phi, \pi\mu, \chi\mu$
(9) $\mu, e\phi, y\phi$	(10) $\phi, e\mu, y\mu$	(11) $e, y\mu, y\phi$	(12) $y, e\mu, e\phi$
(13) $y, \pi e, \chi e$	(14) $e, \mu y, \phi y$	(15) $\chi, \pi y$	(16) $\chi, \pi e$
(17) $\pi e, \pi y, \chi\mu, \chi\phi$	(18) $\chi, \pi\phi$	(19) $\pi, \chi\phi$	(20) $\pi\mu, \pi\phi, \chi\mu, \chi\phi$
(21) $\pi\mu, \chi\mu, e\phi, y\phi$	(22) $\phi, y\mu$	(23) $e\mu, y\mu, \pi\phi, \chi\phi$	(24) $e\mu, e\phi, y\mu, y\phi$
(25) $e, y\phi$	(26) $y, e\phi$	(27) $e, \phi y$	(28) $e, \mu y$
(29) $e\mu, e\phi, \mu y, \phi y$	(30) $\chi\mu, \chi\phi$	(31) χ	(32) $\pi e, \pi y, \chi\phi$
(33) $\pi\phi, \chi\mu, \chi\phi$	(34) $\pi\phi, \chi\phi, y\mu$	(35) $\pi\phi, e\mu, y\mu$	(36) $c\mu, y\mu, y\phi$
(37) $e\phi, y\mu, y\phi$	(38) $e\mu, e\phi, y\phi$	(39) $e\mu, y\mu$ $e\phi$	(40) $c\mu, e\phi, \phi\mu$
(41) $\chi\mu, \chi\phi$	(42) $\pi e, \pi y$	(43) $\chi\mu, \chi\phi$	(44) $y\mu, \pi\phi$
(45) $e\mu, y\phi$	(46) $e\phi, y\phi$	(47) $e\mu, e\phi$	(48) $\chi\mu$
(49) $y\mu$	(50) $y\phi$	(51) $e\phi$	(52) $\pi e\mu, \cdots, \chi y\phi$

sex of a speaker is not found for any tribe, although the other three primary splits: (π, χ) by relative sex, (e, y) by relative age, and (μ, ϕ) by sex of referent as in English, are all represented by many tribes. The languages of the world have shown a marked preference for distinction by the relative sex rather than absolute sex of ego, perhaps because a young child is less aware of his own absolute characteristics than of differences and similarities between himself and persons to whom he is speaking.

However, the most interesting feature of sibling terminologies is not so much this distinction between relative and absolute sex of the speaker as the fact that essentially all of them are conjunctive with respect to the three attributes of relative sex, relative age and sex of the referent. In their book *A Study of Thinking* [1956] Bruner, Goodnow and Austin eloquently emphesize the importance of partitioning in all mental activity, and they establish a general abhorrance of disjunctive concepts in social groups, in the legal profession, in the history of medicine etc. As they say: "one eventually begins to wonder whether Nature herself does not abhor disjunctive groupings." To their imposing array of examples the testimony of sibling terminology has now been added.

CHAPTER XXIV

Summary of Types and Subtypes

24. 1 The equivalence-rules. In this final chapter we summarize the equivalence-rules and string-coincidences by which kinship systems are classified into types and subtypes.

The equivalence-rules are listed in Table 24. 1 in terms of x and y, although they could equally well be listed in X and Y, since $x=y$ is synonymous with $X \sim Y$. Kinship systems involving only the first five sets of rules have non-prescriptive marriage and are therefore monoids, whereas systems with any of the last five have prescriptive marriage and are therefore groups. For prescriptive systems the four-group-rules $x\bar{x}=\bar{x}x=y\bar{y}=\bar{y}y=i$ (11.3) are tacitly understood, so that prescriptive marriage implies the merging rules $x\bar{x}=y\bar{y}=i$. The rules for such systems can also be, written in x and w, or y and $h=\bar{w}$ etc. In all cases every rule implies its inverse rule; e. g. $x=y$ implies $\bar{x}=\bar{y}$, $x\bar{y}=\bar{y}$ implies $y\bar{x}=y$, $(\bar{x}y)^q=i$ implies $(\bar{y}x)^q=1$.

Table 24. 1 Equivalence rules

1.	non-bifurcate rule: $x=y$ (5. 3)
2.	merging rule: $j=i$ (7. 2)
3.	Iroquois rules: $yx=yy$; $xx=xy$; $x\bar{y}=y\bar{x}$ (9. 3)
4.	Omaha rule: $x\bar{y}=\bar{y}$ (12. 1)
5.	Crow rule: $y\bar{x}=\bar{x}$ (12. 7)
6.	section rule: $x^m=y^n=i$ (Kariera, $m=n=2$; Karadjeri, $m=2$, $n=4$)
7.	commutative rule: $xy=yx$ (15. 1)
8.	sister-marriage rule: $\bar{x}y=i$ (11. 10)
9.	direct exchange rule: $(\bar{x}y)^2=i$ (19. 1)
10.	indirect exchange rule: $(\bar{x}y)^q=i$, $q>2$ (15. 1)

24. 2 Types of systems. The thirty-odd systems considered in this book can be classified by their sets of equivalence-rules as in Table 24. 2.

24. 3 Types and subtypes; the catalog. Finally, each of these systems is uniquely determined by its subtype, i. e. by its equivalence-rules ER and its string-coincidences SC, as listed in Table 24. 3, which would form part of our proposed catalog of all kinship systems. For non-prescriptive systems the few affinal coincidences are omitted (e. g. *hocsote* for XX and WXX in Seneca); and for non-prescriptive merging systems the regular cut-off rules $A^{2+n} \sim A^2$, $\bar{A}^{2+n} \sim \bar{A}^2$ are understood except where others are explicitly stated (e. g. Twana has $A^{4+n} \sim A$), and the merging rule $j=i$ may be followed by one or more of the lineal letters *f*, *m*, *s*, *d*,... in parentheses, indicating distinct lineal terms; e. g. Twana has $j=i$ (*f*, *m*, *c*) to mean $F \not\sim FB$, $M \not\sim MZ$, $C \not\sim JC$. The Crow-Omaha systems listed here, except Hopi, are understood to have *pf* | *pm* for grandparents and *cc* for grandchildren.

We have been guided throughout by a desire to use mathematics in such a way as to construct a concise and complete catalog of kinship systems. Unlike the natural sciences, however, with their many classifications of various kinds, the subject of kinship terminology is dominated by human variability. For our purposes the situation would be ideal if all kinterm recurrences were already accounted for by equivalence-rules, but we have seen that every system, prescriptive or non-prescriptive, requires supplementary statements. For non-prescriptive systems the example of the Hopi Indians shows that, the refractory string-coincidences may become unpleasantly numerous and should perhaps be replaced by generation patterns from Chapter Six. As for section systems, in some cases, e. g. Aranda or Dieri, the terminology fits quite well into the sections, but in other cases, e. g. Murngin or Kokata, the entries in Table 24. 3 suggest that some form of geometric diagram might be preferable, even though it would take up more space in the catalog. Also we must emphasize again (cf. 12. 8) that several possible types of systems are omitted in the above list. For example, there exist interesting Eskimo systems that resemble the English system in significant respects. We urge our readers to investigate these other systems with a view to incorporating relevant additions or changes in the proposed catalog.

Table 24. 2 Systems listed by their sets of equivalence-rules

System	Equivalence-rules	No. from Table 24. 1
MONOIDS		
English (Figure 4. 9)	$x=y$	1
Yurok (7. 3) Lower Burma (7. 7) Twana (7. 8)	$x=y,\ j=i$	1, 2
Seneca (9. 4) Hindi (9. 5) Mbuti (9. 6) Shastan Tolowa Comanche Nepal	$j=i,\ xx=xy$ $yx=yy,\ x\bar{y}=y\bar{x}$	2, 3
Fox (12. 2) Miwok (12. 5a) Tzeltal (12. 5b) Wintu (12. 5c)	$j=i,\ x\bar{y}=\bar{y}$	2, 4
Pawnee (12. 7a) Crow (12. 7b) Trobriand (12. 7c) Hopi (12. 8)	$j=i,\ y\bar{x}=\bar{x}$	2, 5
GROUPS	Name and Symbol in pure mathematics	
Kariera (13. 5) Karadjeri (15. 3) Murngin (16. 10, 16. 11, 171b)	$xy=yx,\ x^m=y^n=i$	6, 7
Tamil and Telegu (10. 2, 11. 7) Piro (11. 8)	$xy=yx,\ (\bar{x}y)^2=i$	7, 9
Taromak-Rukai (11. 11)	$\bar{x}y=i$	8
Aranda (19. 3) Dieri (19. 6) Ambrym (20. 1b) Anti-Ambrym (20. 5) Vao (20. 4) Kokata (20. 6b) Patrilateral (21. 2b)	$x^m=y^n=(\bar{x}y)^q=i$	6, 10

Table 24. 3 Types and subtypes

English	ER:	$x=y$
	SC:	$A^{p+q}J\bar{A}^{q} \sim A^{q}J\bar{A}^{p+q}$
		$\mu \sim \phi$ (ablineal), $e \sim y$, $\mu_s \sim \phi_s$
Yurok	ER:	$x=y$, $j=i$
	SC:	$\mu \sim \phi$ for $\bar{A}^2$, $e \sim y$, $\mu_s \sim \phi_s$ except J
Lower Burma	ER:	$x=y$, $j=i$ (f, m, s, d, pf, pm)
	SC:	$\mu \sim \phi$ for $\bar{A}^2$
		$e \sim y$ exc J, AJ
		$\mu_s \sim \phi_s$ exc yJ
Twana	ER:	$x=y$, $j=i$ (f, m, c)
	SC:	$A^{4+n} \sim A^4$, $\mu \sim \phi$ for A^{2+n}, $\bar{A}^{2+n}$, $\bar{A}$, $J\bar{A}$, ϕyJ
		$e \sim y$ exc J, $\mu_s \sim \phi_s$ exc $J\bar{A}$, $yJ\mu$, $\mu yZ \sim \phi yJ$
Seneca	ER:	$j=i$, $xx=xy$, $yx=yy$, $x\bar{y}=y\bar{x}$
	SC:	$XA \sim YA$, $\bar{A}\bar{X} \sim \bar{A}\bar{Y}$, $\hat{\alpha}\bar{X} \sim \breve{\alpha}\bar{Y}$
		$\mu \sim \phi$ for $\hat{A}\acute{\hat{A}}$, $e \sim y$ exc J, $\mu_s \sim \phi_s$ exc $\bar{A}$
Hindi	ER:	same as Seneca with $j=i$ (f, m)
	SC:	$\hat{A}\acute{\hat{A}} \sim J$, $e \sim y$, $\mu_s \sim \phi_s$
Mbuti	ER:	same as Seneca
	SC:	$\bar{X} \sim \bar{Y}$, $XA \sim YA$, $\bar{A}\bar{X} \sim \bar{A}\bar{Y}$
		$\mu \sim \phi$ exc A, $e \sim y$, $\mu_s \sim \phi_s$
Fox	ER:	$j=i$ (m), $x\bar{y}=\bar{y}$
	SC:	$\bar{X} \sim \bar{Y}$, $\mu \sim \phi$ for $\hat{\alpha}J\hat{\alpha}$, $\bar{A}^2$
		$e \sim y$, $\mu_s \sim \phi_s$, $\hat{\alpha}JY \sim \breve{\alpha}JX$
Southern Miwok	ER:	$j=i$, $x\bar{y}=\bar{y}$
	SC:	$\bar{X} \sim \bar{Y}$, $\mu \sim \phi$ for $\breve{J}\bar{A}$, $\bar{A}^2$
		$e \sim y$ exc J, $YyJ\phi$
		$\mu_s \sim \phi_s$, $\hat{\alpha}J\bar{Y} \sim \breve{\alpha}JX$
Tzeltal	ER:	$j=i$ (f, m), $x\bar{y}=\bar{y}$
	SC:	$\mu \sim \phi$ for yJ, $\bar{A}$, $\breve{A}^2$
		$e \sim y$ exc J, $\mu_s \sim \phi_s$ exc $eJ\mu$, $\bar{A}^2$
		$XJ\phi \sim eJ\phi$, $yJ \sim \phi\bar{X}$

Wintu	ER:	$j=i,\ x\bar{y}=\bar{y}$
	SC:	$\mu \sim \phi$ for yJ, $\bar{A}$, $\bar{A}^2$
		$e \sim y$ exc J, $\mu_s \sim \phi_s$, $XJ\phi \sim eJ\phi$
		$YJ\mu \sim YX$, $\mu J\bar{Y} \sim \bar{X}\bar{Y}$, $\phi J\bar{X} \sim yJ$
Republican Pawnee	ER:	$j=i,\ y\bar{x}=\bar{x}$
	SC:	$\bar{X} \sim \bar{Y} \sim \phi J\bar{X}$, $\mu \sim \phi$ for $\bar{A}$, $\bar{A}^2$
		$e \sim y$, $\mu_s \sim \phi_s$, $Y \sim XJ\phi$, $\mu J\mu \sim \phi J\phi$
Crow	ER:	$j=i,\ x\bar{y}=x$
	SC:	$XJ\phi \sim Y$, $\bar{X} \sim \bar{Y} \sim \mu J\bar{Y} \sim \phi J\bar{X}$
		$\mu \sim \phi$ for $\bar{A}^2$, $e \sim y$ exc J
		$\mu_s \sim \phi_s$ exc J, $\mu yJ\mu \sim \phi yJ\mu$
Trobriand	ER:	$j=i,\ x\bar{y}=x$
	SC:	$\bar{X} \sim \bar{Y}$, $XJ\phi \sim XX$, $\mu J\bar{Y} \sim \phi J\bar{X}$
		$\mu \sim \phi$ exc A, $e \sim y$ exc $\hat{\alpha}J\hat{\alpha}$, $\mu_s \sim \phi_s$
Hopi	ER:	$j=i,\ x\bar{y}=x$
	SC:	$XX \sim YX$, $\bar{X}\bar{X} \sim \bar{X}\bar{Y}$, $\bar{X} \sim \bar{Y}$
		$\phi J\bar{X} \sim \bar{X}\bar{X}$, $\mu\bar{Y}\bar{X} \sim \bar{Y}$, $\mu J\bar{Y} \sim \mu\bar{Y}\bar{Y}$
		$\phi\bar{Y}\bar{X} \sim \phi\bar{Y}\bar{Y} \sim \bar{X}\bar{X}$, $YJ\mu \sim YYJ\mu$
		$X \sim XYJ\mu$, $Y \sim XJ\mu$, $\mu_s \sim \phi_s$ for $\bar{A}$, $\bar{A}^2$
		$e \sim y$ for J, $\mu_s \sim \phi_s$ exc $yJ\phi$, $yJ\mu \sim \phi yJ\phi$
Kariera	ER:	$x^2=y^2=i,\ xy=yx$
	SC:	$\hat{A}\acute{\hat{A}} \sim \hat{\hat{A}}\breve{A}$, $\bar{X} \sim \bar{Y}$, $X\bar{X} \nsim J$, $\hat{A}\breve{A} \nsim \hat{A}\acute{\hat{A}}$
		$\mu \sim \phi$ for $\hat{\alpha}\hat{A}\acute{\hat{A}}\grave{\alpha}$ in G_0, $e \sim y$ exc J
		$\mu_{ss} \sim \phi_s$ exc $AJ\phi$, $J\bar{A}\mu$
Karadjeri	ER:	$x^2=y^4=i,\ xy=yx$
	SC:	$\mu \sim \phi$ exc J, Y, Y^2, $\bar{X}$, $\bar{X}$, Y^3
		$e \sim y$, $\mu_s \sim \phi_s$
Murngin	ER:	$x^4=(\bar{x}y)^4$ or $(\bar{x}y)^6$, $xy=yx$
	SC:	see Figure 16.3b and the remarks on periodicity in 16.3, 16.4
Tamil	ER:	$(\bar{x}y)^2=i,\ xy=yx$
	SC:	$\hat{\alpha}\bar{X} \sim \breve{\alpha}\bar{Y}$, $\mu \sim \phi$ for $\phi\hat{A}\breve{A}$
		$e \sim y$ exc J, $\mu_s \sim \phi_s$ exc $\hat{A}\acute{\hat{A}}$

Taromak-Rukai	ER: $\bar{x}y=i$ SC: $A^{2+n}\sim A^n$, $\bar{A}^{3+n}\sim\bar{A}^n$ $\mu\sim\phi$ for J, $\bar{A}$, $\bar{A}^2$ $e\sim y$ exc J, $\mu_s\sim\phi_s$
Aranda	ER: $x^2=y^4=(\bar{x}y)^2=i$ SC: $X^2\nsim J$, $X^{2n-1}\nsim\bar{X}^{2n-1}$ $\mu\sim\phi$ exc X, X^2, Y, $e\sim y$ exc J $\mu_s\sim\phi_s$
Dieri	ER: $y^2=x^4=(\bar{y}x)^2=i$ SC: $X^2\nsim J$, $\mu\sim\phi$ exc X, Y, eJ $e\sim y$ exc J, $\mu_s\sim\phi_s$
Ambrym	ER: $x^2=y^3=(\bar{x}y)^2=i$ SC: see the three "not-straight" remarks in 20.3
Vao	ER: $y^2=(\bar{y}x)^2=x^6=i$ SC: $X^2\sim Y^2$, $\bar{X}^2\sim\bar{Y}^2$, $X^3\sim\bar{X}^3\sim I$ $Y^2\sim J$, $XJ\phi\sim YJ\phi$, $\mu\sim\phi$ exc X, Y, YX^2 $e\sim y$ exc $\hat{\alpha}J\breve{\alpha}$, $\mu_s\sim\phi_s$
Kokata (Table 20.6)	ER: $x^3=(\bar{x}y)^2=y^3=i$ SC: $XX\sim YY\sim XY\sim YX\sim\bar{X}\bar{Y}\sim\bar{Y}\bar{X}$ (*bagali* | *kabili*) $\bar{X}^2\sim X^2Y\sim\bar{Y}^2\sim XYX$ (*maradu* | *waia*) $X\bar{Y}^2=\bar{Y}^2X$ (*umari* | *undal*), $Y\sim Y^2\bar{X}\phi$ (*nyundu*) $\mu\sim\phi$ for J, $Y\bar{X}$; $e\sim y$, $\mu_s\sim\phi_s$
Purum (for three clans)	ER: $(\bar{x}y)^3=i$, $xy=yx$ SG: $\bar{Y}X\sim\bar{Y}\sim\bar{Y}\bar{X}\sim\bar{X}^2$ $X^2\sim YX\mu\sim Y\mu\sim Y\bar{X}\mu\sim Y\bar{X}^2\mu$ $yJ\sim Y\bar{X}\phi$, $\mu\sim\phi$ for X^2, $\bar{X}$, $\bar{X}^2$, yJ $e\sim y$ exc J, $\mu_s\sim\phi_s$

24.4 The mathematical method in kinship study. In this final section let us consider some of the advantages of the mathematical method in addition to its practical value for the construction of a catalog of kinship systems.

Common to all mathematics is the concept of a set of elements, left undefined, and the derived concept of a structure, i. e. a set of sets of elements (1. 1). The mathematical method of studying any subject, e. g. kinship terminology, consists of listing in advance a small number of concepts, in our case the two concepts of "person" and "kinterm", which are then defined solely as having a certain small number of properties, also listed in advance as a set of axioms (1. 3). After these two lists have been decided on, every other concept must be defined as a structure on the set of concepts so defined, e. g. persons and kinterms.

A theory constructed by this method for kinship study will make predictions that can be verified (or falsified) in the field, a necessary property of any useful scientific theory. For example, our present theory has predicted the existence or four- and six-clan connubia in Murngin (16. 6), the coincidence of subsections referred to the left-hand and right-hand lines of Warner's seven-line chart (16. 2) and in the inner chart of five lines (17. 2), the existence in a six-clan connubium of exactly two twelve-generation matricycles (Figure 16. 10) and, as an implicit corollary, the practice of ZDD-exchange marriage (16. 12). In this particular case the field-investigator and the mathematical predictor were working at the same time, each without knowledge of the other.

In anthropology, in contrast e. g. to astronomy, the opportunity to test theoretical predictions may now no longer exist, through rapid attrition of aboriginal languages and customs. For example, our theory predicts that, if the four-clan connubia discovered by the field-worker have not yet completely disappeared, Murngin tribesmen can be found who will tell us that the daughter of *waku* is *kutara* under some circumstances and *mari* under others, just as the field-worker has reported (16. 1) that the daughter of *gurrong* may be *due-elker* (on the left side of Warner's chart in Figure 16. 3b) or *momo-elker* (on the right side), and we make analogous predictions for connubial complexes like Purum, Jinghpaw and Siriono. As a kind of negative counterpart to prediction the mathematical method also uncovers mistakes that otherwise would almost certainly pass unnoticed, e. g. the proposed connubium for Iatmul in 22. 6.

Other statements that resemble predictions are more in the nature of conjectures that may indicate to the field-worker about what to look for in the field. For example, our statements about possible three-clan connubia for Purum etc. (18. 7) suggest that it may be profitable or interesting to look for them, but make no prediction about the probability that they will actually be found.

A property of mathematics which, though not strictly part of its definition, is nevertheless of extreme importance is the conciseness and manipulability of its notation. For conciseness compare the statement $J\bar{X}\bar{Y}^2\phi \sim J\bar{Y}^3\phi$ with Morgan's sentence at the end of Chapter Eight, and for manipulability note the case with which our notation enables us to calculate a desired kinterm in any system, say for SWFFZ in Kariera (14. 3), either algebraically by equivalence-rules or geometrically on a kingraph. With this notation we can rapidly carry out otherwise laborious operations—reduction, expansion, substitution etc.—that add to our konwledge of a given system or to the clarity and pleasure with which we perceive what we already know. Who among us does not derive pleasure from seeing Wintu second cousins described by a simple Omaha equivalence-rule (12. 5) or the mysterious Kokata terminology explained as rotating direct-exchange marriage (20. 6)? Lévi-Strauss (1960: 53) expressed his belief that

> an algebraic treatment of, let us say, symbols for marriage rules . . . can teach us, when fitly manipulated, something about the way a given marriage system actually works, and bring out properties not immediately apparent at the empirical level.

Such is the credo of the mathematician, which we have tried to illustrate in this book.

APPENDIX ONE

Numerical Kinship Notation System

Mathematical Model of Genealogical Space

JOHN H. T. HARVEY and PIN-HSIUNG LIU

The idea on which this paper is based is the fruit of my discussions with Mr. Harvey at Harvard during summer 1965. By the end of October we presented the first draft of this paper to Professors Maybury-Lewis and White for comment. In the meantime a new category diagram was adopted, differing from the one used in the first draft, which enabled us to reach new results and to compose a second draft by the end of December. In addition to the numerical system for kinship categories, we already started to establish the basis for the numerical system of kinship types and its operational rules.

As the system opens a new field for kinship study, we also planned to set up a transformational analysis of kinship terminology, as well as a formal analysis of kin group, especially for the section system, to show the applicability of the group theory and other mathematical methods to this study. This would lead it to genuine kinship algebra (which we would like to name kinology) the usability of which has been in doubt up to now.

Due to certain deficiencies in the second draft we started to work out a third draft for clarification and addition. But through my sudden depature from Cambridge, this could not be realized and our cooperation had to be postponed. Considering, however, the possible usefulness of the study for my colleagues and the fact that the working out of the final draft will require a considerable length of time, I herewith publish the major part of the second draft in its present form.

I take the opportunity to express my gratitude to the Harvard-Yenching Institute for having received me as a visiting scholar during the years 1964–1966.

—P. H. L.

KINSHIP CATEGORIES

We define a *kinship category* as a set consisting of all egocentric relationships expressible by a given sequence of sex-generalized lineal links, i. e., in terms of parent and child.

The eight primary relationships of the traditional language-based kinship notation are not uncommonly supplemented or replaced by four without specification of sex. A notation proposed by Romney (Romney and D'Andrade 1964), which analyzes these twelve terms into relational and sexual components, provides a sex variable "*a*" in addition to sex constants "*m*" and "*f*" to the same effect, and expresses what are essentially kinship categories by sequences of the relation markers "+", parent link, "−", child link, "0", sibling link, and "=", marriage bond.

The further step of reducing to two primitive relationships is implicit in a notation suggested by Radcliffe-Brown (Radcliffe-Brown 1930), where the up-down angle for a collateral link and the down-up angle for an affinal link transparently are ordered pairs of the up-slant for an ascendent link and the down-slant for a descendent link with the intervening terms unstated.

It is important to note that, unlike generalization of sex, decomposition of non-lineal links into lineal *transitions* involves no loss of information, except where "parent's child" may have been utilized to distinguish half-sibling from full "sibling". This is because it merely exploits the redundancy in the traditional system that such transitions must be mediated by sequences of non-lineal links, minimally a collateral link between ascent and descent and an affinal link between descent and ascent, the sequences alternating unless step-relations are intended.

It is obvious that a collateral link may be replaced by ascent to and descent from *lowest common ascendents LCA*, the understood parents, and an affinal link by descent to and ascent from *highest common descendents HCD*, the actual or potential offspring. If the latter is considered an artifice, we might point out the genealogical irrelevance of marriage without issue, and the sociological implications of the linguistic phenomenon of teknonymy.

A kinship category, then, is equivalent to a kinship term compounded from the primary relationships "Parent", "Child", "Sibling", and "Spouse", with the exception that the seldom exercised option of indicating half-siblinghood is not open.

The advantage of reduction to a pair of primitive relations, particularly to a reciprocal pair with suggestive mathematical analogs, is that it opens up the possibility of applying powerful techniques to operations on complex terms.

NUMERICAL KINSHIP CATEGORIES

We pursue the mathematical analogy by giving each kinship category a numerical designation, or *numerical kinship category C.*

If we map the sequence of parent and child links defining a kinship category into a corresponding sequence of +1's and −1's, respectively, it is apparent that we may consolidate by summing subsequences of like sign, so that a *digit d* stands for *d* consecutive generations in a given direction.

Since signs now necessarily alternate, we may adopt an *alternate sign place system* which marks sign by position only, just as ordinary numerical place systems mark successive powers of the base by position only. We assign the first *place* and all subsequent odd places to positive values, or generations of ascent, the second place and all subsequent even places to negative values, or generations of descent. A negative value for an initial digit is indicated by a preposed zero, or empty first place. Similarly, for reasons that will become evident later, a final zero is written after a final positive digit.

As in other place systems, zero functions as a place-holder. We restrict it to initial and final place, with the exceptions below. Note that we define "digit" to exclude zero, $d \geq 1$. The use of zero rounds out all numerical categories to an integral number of ordered *pairs* p_i, each consisting of a *positive place* x_i followed by a *negative place* y_i, $p_i = x_i y_i$, the subscript being the ordinal number of the pair. The null category, ego, is written 00.

A numerical kinship category, then, has the canonical form

$$C = x_1 y_1,\ x_2 y_2,\ \cdots,\ x_{Np} y_{Np},$$

where the *number of pairs Np* may be one or more, $Np \geq 1$, the value of the first and last places may be zero or more, $x_1 \geq 0 \leq y_{Np}$, and the value of any intervening places must be one or more, $x_{i>1} \geq 1 \leq y_{i<Np}$.

With $d_i = 1$ and the *number of digits Nd* also one, we have the lineal primary categories:

10 = parent;
01 = child.

With $Nd = 2$, we have the non-lineal primary categories:

11 = (half-) sibling;
0110 = spouse.

With $Nd \geq 3$, however, there will be one or more 1's which are neither the initial nor the final digit, a fact which invariably signals a step-category. Thus, for three and four digits, we have the following "primary" step-categories:

1110 = step-parent;
0111 = step-child;
1111 = step-sibling;
011110 = co-spouse.

If we avoid "inside 1's", the minimal corresponding non-step-categories are:

1210 = sibling's spouse;
0121 = spouse's sibling;
1221 = sibling's spouse's sibling;
012210 = spouse's sibling's spouse.

Membership in the familiar major groupings of kin types may be determined by inspection of the overall form of a numerical kinship category, as we demonstrate by listing the following *generalized categories*, in which the digit variable $\tilde{1} \geq 1$ replaces the 1's of the previous examples:

00 = ego;
$\tilde{1}0$ = ascendent;
$0\tilde{1}$ = descendent;
$\tilde{1}\tilde{1}$ = collateral;
$0\tilde{1}\tilde{1}0$ = affinal;
$\tilde{1}\tilde{1}\tilde{1}0$ = collateral-affinal;
$0\tilde{1}\tilde{1}\tilde{1}$ = affinal-collateral;
$\tilde{1}\tilde{1}\tilde{1}\tilde{1}$ = collateral-affinal-collateral;
$0\tilde{1}\tilde{1}\tilde{1}\tilde{1}0$=affinal-collateral-affinal.

The consanguineal categories, with no affinal transitions, are the one-pair categories, if we agree that ego is reflexively consanguineal. In general, each additional pair means an affinal transition, so that the *number of affinal transitions Na* is one less than the number of pairs, $Na = Np - 1$. The *number of collateral transitions Nco* is the number of pairs less the *number of pairs with zero Nz*, $Nc = Np - Nz$.

In one-pair categories, of course, $Nz = 1$ indicates lineality, considering ego reflexively lineal, with the empty place giving the direction. In multi-pair categories, initial or final zeros, or $x_1 = 0$ and $y_{Np} = 0$, indicate initial and final affinal transitions, respectively. Conversely, $x_1 \geq 1$ and $y_{Np} \geq 1$ indicate initial and final collateral transitions.

We have already pointed out that "inside 1's" are diagnostic of step-relations. The non-step-categories of three and four digits may be represented by partially generalized categories with $\tilde{2} \geq 2$:

$\tilde{1}\tilde{2}\tilde{1}0$ = non-step-collateral-affinal;
$0\tilde{1}\tilde{2}\tilde{1}$ = non-step-affinal-collateral;
$\tilde{1}\tilde{2}\tilde{2}\tilde{1}$ = non-step-collateral-affinal-collateral;
$0\tilde{1}\tilde{2}\tilde{2}\tilde{1}0$ = non-step-affinal-collateral-affinal.

THE CATEGORY DIAGRAM

The standard *category diagram* may be read as a simple two-dimensional representation of the consanguineal categories, or all one-pair categories x_1y_1. (Figure 1)

00	10	20	30	40	50	60
01	11	21	31	41	51	61
02	12	22	32	42	52	62
03	13	23	33	43	53	63
04	14	24	34	44	54	64
05	15	25	35	45	55	65
06	16	26	36	46	56	66

Figure 1. Category diagram. (Consanguineal)

Since x is necessarily positive and y necessarily negative, we are confined to the IVth, or lower right, quadrant of the infinite Cartesian plane. The lineal categories $Nd \leq 1$ are *on the axes:* ego 00 at their intersection, the *origin*, the upper left *square*; ascendents $\tilde{1}0$ on the *x-axis*, in the x_1th square to the right along the top *row*; descendents $0\tilde{1}$ on the *y-axis*, in the y_1th square down the leftmost *column*. Collateral categories $\tilde{1}\tilde{1}$ are *in the* *quadrant*, at the intersection of x_1th column and y_1th row.

In general, a consanguineal category x_1y_1 is located in the square x_1y_1, where the value of x_1 may be read off the ascendent categories in the top row and the value of y_1 off the descendent categories in the leftmost column.

The category diagram may also be read as an n-dimensional representation of multi-pair categories of n-digits. Note that the alternate sign principle implies that we are confined to only one of the 2^n hyper-quadrants marked off by the n axes of an n-dimensional space.

In the two-dimensional case we considered the category x_1y_1 to be represented by the square x_1y_1. In the n-dimensional case we consider that it is represented by the *path* from the origin to x_1y_1: a null path for ego 00, a path to the right for ascendents $\bar{1}0$, a path down for descendents $0\bar{1}$, and a path to the right to the *lowest common ascendent LCA*, in the square x_10 followed by a path down for collaterals $\bar{1}\bar{1}$. In other words, we reinterpret the expression x_1y_1 as an ordered pair of instructions for a move x_1 squares to the right followed by a move y_1 squares down, with 0 an instruction for a *null move*, the path thus traced standing for the category.

Now, to take the simplest multi-pair categories, affinals $0\bar{1}\bar{1}0$, we may treat $0y_1x_20$ as calling for a null move to the right, then a move y_1 squares down, then a move x_2 squares to the right, then a null move down. In other words, for any given $x_1 = x_2$ and y_1, $0y_1x_20$ is the inverse of x_1y_1, the path along the other two sides of a rectangle, reaching the same square. It is, in fact, what we discuss below as the *negative reciprocal*. The point at the moment is that more than one path leads to a given square. An affinal path passes through the *highest common descendent HCD*, the implied (potential) child or children in the link, in the square $0y_1$.

00	10	20	30	40	50	60
01	**0110**	**0120**	**0130**	**0140**	**0150**	**0160**
02	**0210**	**0220**	**0230**	**0240**	**0250**	**0260**
03	**0310**	**0320**	**0330**	**0340**	**0350**	**0360**
04	**0410**	**0420**	**0430**	**0440**	**0450**	**0460**
05	**0510**	**0520**	**0530**	**0540**	**0550**	**0560**
06	**0610**	**0620**	**0630**	**0640**	**0650**	**0660**

Figure 2. Category diagram. (Affinal)

It is obvious that this procedure may be extended to cover categories of more than two digits. A collateral-affinal category $x_1y_1x_20$ calls for a path x_1 to the right, then y_1 down, then x_2 to the right. An affinal-collateral category $0y_1x_2y_2$ calls for a path y_1 down, then x_2 to the right, then y_2 down.

In general, a category $x_1y_1x_2y_2 \cdots x_{Np}y_{Np}$ is shown by the path traced by the indicated sequence of n pairs of moves x_i to the right followed by y_i down, with the value zero for a null move limited to first and last place, x_1 and y_{Np}.

If step-categories are to be excluded, the digit 1 will appear only as shown in the pairs $1y_1$, 01, 10, $x_{Np}1$, with "zero or nothing" on its outer flank.

It will be seen that there is a unique path, as well as a unique number, corresponding to every possible category, and a unique category corresponding to every possible path, as well as to every possible number.

Note that tilting the diagram $-45°$ restores the conventional semantic and visual orientation of genealogical space to the vertical component of the axes, up (and to the right) for ascent, down (and to the right) for descent.

Tilting it 45° in the opposite direction, clockwise, makes it a blueprint of the device at the IBM exhibit at the New York World's Fair that demonstrated binomial distribution, or the normal curve. Balls inserted at the origin on top and free to fall through the sides of the squares faced a succession of left-right "Choices", the random resulting paths leading to a statistically predictable distribution tapering from the center out at the bottom, approximating Pascal's triangle. This isomorphism allows simple calculation of the number of paths, and categories, of various kinds by well-known formulas, as discussed below.

All categories "in" a given square, that is, whose paths reach the square, share the same values of four properties which we now define. This convergence is thus not "noisy", in the information theory sense, but, rather, meaningful.

THE POSITIVE AND NEGATIVE SUMS

The *positive sum Sx* is the sum of all digits x_i in a category, and the *negative sum Sy* is the sum of all digits y_i. All categories in a given square

0	1	2	3	4	5	6
0	1	2	3	4	5	6
0	1	2	3	4	5	6
0	1	2	3	4	5	6
0	1	2	3	4	5	6
0	1	2	3	4	5	6
0	1	2	3	4	5	6

Figure 3. Positive sum Sx.

0	0	0	0	0	0	0
1	1	1	1	1	1	1
2	2	2	2	2	2	2
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6

Figure 4. Negative sum Sy.

have the same values of Sx and Sy, which are, of course, the values of x_1 and y_1 of the collateral category occupying the square. (All squares on the axes contain only a single lineal category.)

All categories of a given Sx are thus crossed by a vertical rook's move, all those of a given Sy by a horizontal rook's move. We thus have a coordinate system in which each square is identified by a coordinate pair $SxSy$, the values read off from the lineal categories as for collateral categories.

THE ABSOLUTE SUM AND (RELATIVE) DIFFERENCE

The *absolute sum* Sxy of a category is the sum of its posistive sum Sx and negative sum Sy, or the length of its path in one-square moves. All squares of a given Sxy are crossed by a bishop's move from one axis to the other. The value may be read off from either of the lineal categories at the ends of the diagonal, if the axes are extended sufficiently.

The absolute sum is the measure employed in the Korean "inch" system of kinship terminology, where an uncle or aunt 21 is "three inches" removed, a great-uncle or great-aunt 31 or a first cousin 22 "four inches", a first cousin once removed 32 or 23 "five inches", and so forth, the system being restricted to consanguineals and excluding affinals.

Sxy combines with the *number of digits Nd* in the formula which

0	1	2	3	4	5	6
1	2	3	4	5	6	7
2	3	4	5	6	7	8
3	4	5	6	7	8	9
4	5	6	7	8	9	10
5	6	7	8	9	10	11
6	7	8	9	10	11	12

Figure 5. Absolute sum Sxy.

0	1	2	3	4	5	6
−1	0	1	2	3	4	5
−2	−1	0	1	2	3	4
−3	−2	−1	0	1	2	3
−4	−3	−2	−1	0	1	2
−5	−4	−3	−2	−1	0	1
−6	−5	−4	−3	−2	−1	0

Figure 6. (Relative) Difference Dxy.

assigns a category to the *n*th "order" (Radcliffe-Brown 1930) or to the class of *n*-ary "relatives" (Murdock 1949), $n = Sxy - Nd + 1$. In conventional notation based on four primary relations, order is simply the number of terms. This formula corrects for the fact that our notation adds $Nd - 1$ implicit *LCA*'s and *HCD*'s, one for each sibling link and marriage link, respectively, namely the last *unit* in each digit but the last. First cousin 22 is $4 - 2 + 1 = 3$, tertiary.(1)

The absolute sum Sxy combines with the positive sum Sx and the negative sum Sy in the formula for the *number of categories Nc* in a given square, which may be computed from any category in the square by $Nc = Sxy!/Sx!Sy!$, where n factorial $n! = 1\cdot 2\cdot 3\cdot \ldots \cdot n$. The number of categories per square for $Sx \leq 6$ and $Sy \leq 6$ are shown in Figure 8.

The (*relative*) *difference Dxy* of a category is the positive sum Sx minus the negative sum Sy, $Dxy = Sx - Sy$. It is thus the sum of the digits taking account of their signs, while Sxy is the sum of their absolute values. All squares of a given Dxy are crossed by a bishop's move away from both axes, and the value, which may be negative, is given by the single lineal category at the bounded end of the diagonal. The relative

(1) It is interesting that Murdock writes "for our purposes" it will be sufficient to class all who are more remote than tertiary relatives as "*distant relatives*" (p. 95) in a work which devotes approximately two hundred pages to kinship. Consider that order mounts up so rapidly that second cousin 33 is already quinary.

0	1	2	3	4	5	6
1	0	1	2	3	4	5
2	1	0	1	2	3	4
3	2	1	0	1	2	3
4	3	2	1	0	1	2
5	4	3	2	1	0	1
6	5	4	3	2	1	0

Figure 7. Absolute difference *Dhl*.

1	1	1	1	1	1	1
1	2	3	4	5	6	7
1	3	6	10	15	21	28
1	4	10	20	35	56	84
1	5	15	35	70	126	210
1	6	21	56	126	252	462
1	7	28	84	210	462	924

Figure 8. Number of categories *Nc*.

difference corresponds, of course, to the generation with respect to ego. The *main diagonal* of the category diagram, $Dxy = 0$, or ego's generation, is important as an axis of symmetry.

Computation of this useful measure may be simplified for multi-digit categories by several readily discoverable heuristic aids such as cancellation of mirror-image symmetry *abccba*, symmetrical repetition *abcabc*, "twin" pairs *aa*, and so forth. In most practical work digits will tend to have low values, and the chances of such patterns occurring will be far higher than, say, in telephone numbers.

The absolute sum and relative difference together provide an alternate system of coordinate pairs $SxyDxy$ which is rotated 45° from the other. Conversion from $SxSy$ to $SxyDxy$ is obvious: $Sxy = Sx + Sy$ and $Dxy = Sx - Sy$. The reverse is also possible: $Sx = Sxy + Dxy/2$ and $Sy = Sxy - Dxy/2$. Note that a negative Dxy in effect inverts the operation in the numerator.

THE HIGHER AND LOWER SUMS AND ABSOLUTE DIFFERENCE

Three other measures specify properties which are symmetrical with respect to the main diagonal.

The *higher sum* Hxy is the larger of Sx and Sy, the *lower sum* Lxy the smaller. All squares of a given Hxy are crossed by horizontal and vertical moves outward from the square $Sx = Sy = Hxy$, in other words, by a right-angle parallel to that formed by the axes and Hxy squares from it. All squares of a given Lxy are crossed by horizontal and vertical rook's moves from the square $Sx = Sy = Lxy$ to the axes, in other words, by a right angle that combines with the axes to form a aquare figure.

The lower sum, or, strictly, the lower digit, is the value of n in nth *collaterality*. The higher sum seems to function as a measure of *propinquity* in certain cultures, a given number of consecutive generations of ascent or descent constituting a cut-off point for a given kind or degree of relatedness.

Subtracting Lxy from Hxy gives the *absolute difference Dhl*, the number of generations from ego's. This is, of course, the absolute value of Dxy. We may then say that English cousinship terminology is of the form $(Lxy - 1)$th cousin *Dhl* times removed.(1) Squares of a given *Dhl* naturally occupy diagonals parallel to and *Dhl* squares either side of the main diagonal (Note that in counting diagonal distance one must count stepwise.)

A coordinate pair $HxyLxy$ identifies two squares symmetrical with respect to the main diagonal and *Dhl* squares from it.

0	1	2	3	4	5	6
1	1	2	3	4	5	6
2	2	2	3	4	5	6
3	3	3	3	4	5	6
4	4	4	4	4	5	6
5	5	5	5	5	5	6
6	6	6	6	6	6	6

Figure 9. Higher sum Hxy. (Propinquity)

0	0	0	0	0	0	0
0	1	1	1	1	1	1
0	1	2	2	2	2	2
0	1	2	3	3	3	3
0	1	2	3	4	4	4
0	1	2	3	4	5	5
0	1	2	3	4	5	6

Figure 10. Lower sum Lxy. (Collaterality)

(1) Compare the simplicity of this rule, once the conceptual infrastructure has been established, with that of the rule given by Roark (1961).

CORRELATIONS

We have pointed out that, while a coordinate pair *SxSy* or *HxyDxy* identifies a single square of the category diagram, a coordinate pair *HxyLxy* or *SxyDhl* identifies two squares which are symmetrically located with respect to the main diagonal is symmetrically located with respect to itself, and is thus uniquely specified.(1)

Such a *correlation* between two squares implies two kinds of correlation, *negation* and *reciprocity* between the categories of one square and their respective *inverses* in the other, each on a one-to-one basis. When the correlation is between a main diagonal square and itself, each category finds its inverses in the same square. Every category finds its *negative reciprocal* in its own square.

The *negative* $(-1)C$ of a category C is the product of its *scalar multiplication* by -1, inverting the sign of each digit. Since our notation indicates sign value by an alternate sign place system, this simply involves the dropping or adding of initial and final zeroes:

$$(-1)d_1 \cdots\cdot d_n = 0d_1 \cdots\cdot d_n0;$$
$$(-1)0d_1 \cdots\cdot d_n0 = d_1 \cdots\cdot d_n;$$
$$(-1)d_1 \cdots\cdot d_n0 = 0d_1 \cdots\cdot d_n;$$
$$(-1)0d_1 \cdots\cdot d_n = d_1 \cdots\cdot d_n0 .$$

The negative of a collateral category $NN\cdots\cdot$ is an affinal category $0N\cdots\cdot$ and vice versa. A category C and its negative $(-1)C$ together constitute a *negative correlation* $(\pm 1)C$.

Where there is no basis of choice, we arbitrarily use the collateral term of the correlation in this expression. Of course, $(-1)(-1)C = C$. Note that only the identity element ego 00 is its own negative.

The path of a category will exactly match the path of its negative if the diagram is folded over along the main diagonal, the two paths of the correlation together forming an ink blot pattern.

The *reciprocal* C^{-1} of a category C is its right-to-left inverse, the expression read backwards:

(1) Note that coodinate pairs *HxyDxy* and *LxyDxy* also specify single squares, while *HxySxy* and *LxySxy* also specify correlations.

$$d_1 \cdots\cdot d_n^{-1} = d_n \cdots\cdot d_1;$$
$$0d_1 \cdots\cdot d_n 0^{-1} = 0d_n \cdots\cdot d_1 0;$$
$$d_1 \cdots\cdot d_n 0^{-1} = 0d_n \cdots\cdot d_1;$$
$$0d_1 \cdots\cdot d_n^{-1} = d_n \cdots\cdot d_1 0\,.$$

A *reciprocal correlation* $C^{\pm 1}$ may be written with either term of the correlation as C, since $(C^{-1})^{-1} = C$. When the choice is arbitrary, we write the term which is higher when read as a decimal fraction "C".

In our alternate sign place system, turning an expression head for tail automatically inverts all signs. With the exception that the necessary inversion of lineal links is not automatic, the same simple method of finding the reciprocal applies in the notations of Radcliffe-Brown and Romney. The operation is considerably more cumbersome in the language-based conventional notation, despite the fact that the principle is simply that of retracing one's steps.

All categories $Dhl = 0$, on the main diagonal, find their reciprocals in their own squares, with all categories of symmetrical form $x_i = y_{n-i+1}$ such as 22 or 1331 being their own reciprocals. All other categories, of course, have reciprocals in the correlated square across the main diagonal.

Note that the reciprocal of a lineal category $Sxy = Hxy$ is the same as its negative.

Limiting consideration to categories of three digits or less, exclusive of ego, we find the following generalized reciprocal correlations:

Lineal:	$10^{\pm 1} = 10$ and 01;
Collateral:	$11^{\pm 1} = 11$;
Affinal:	$0110^{\pm 1} = 0110$;
Non-lineal, $Nd = 3$:	$1110^{\pm 1} = 1110$ and 0111.

Most work on kinship restricts the last correlation to $1110^{\pm 1}$, spouses of collaterals and collaterals of spouse. Without any empirical claim as to the sociological boundedness of this correlation, we find it useful to apply the concept unrestrictedly in mathematical operations on categories.

The *Negative reciprocal* $(-1)C^{-1}$ of a category C has the order of digits reversed without inversion of signs:

$$(-1)d_1 \cdots\cdot d_n{}^{-1} = 0d_n \cdots\cdot d_1 0;$$
$$(-1)0d_1 \cdots\cdot d_n 0^{-1} = d_n \cdots\cdot d_1;$$
$$(-1)d_1 \cdots\cdot d_n 0^{-1} = d_n \cdots\cdot d_1 0;$$
$$(-1)0d_1 \cdots\cdot d_n{}^{-1} = 0d_n \cdots\cdot d_1 .$$

Two zeros are added or dropped, single zeros keep their places.

Since negation cancels the change of signs in the reciprocal, we see that $-1(-1)(C^{-1})^{-1} = C$. Actually, as this shows, taking the reciprocal is a complex operation combining inversion of the signs of all digits and reversal of their order, while taking the negative reciprocal is just the second of these simple operations.

However, since the reciprocal is of greater sociological significance and facilitates computation in our system, we prefer to consider it a simple operation, providing for it to be simply indicated and simply performed, at the slight cost of the selfcancelling negation in the artificially complex concept of negative reciprocity.

CATEGORY ADDITION

The operation of *category addition* may be approached through a reconsideration of translation from the traditional or Romney notations into numerical category notation, which involves one of its sub-operations, *concatenation.*

Given a compound term consisting of a sequence of sex-generalized primary relationships, we first substitute on a one-to-one basis from a lexicon of four entries in the form of rewrite rules, where "$f \rightarrow g$" is read "f is rewritten as g":

$+ a$, Parent $\rightarrow$ 10;
$- a$, Child $\rightarrow$ 01;
$0\ a$, Sibling $\rightarrow$ 11;
$= a$, Spouse $\rightarrow$ 0110.

After substitution, the following syntactic rewrite rules are applied to remove inside zeros (the first rule, with null effect, is included only to show all posible combinations):

$$xy \to xy\,;$$
$$x00y \to xy\,;$$
$$y0y' \to y'' = Syy'\,;$$
$$x0x' \to x'' = Sxx'\,.$$

In other words, two digits separated by no zeros or two are written together, and two digits separated by a single zero are summed. These rules follow naturally from the alternate singn principle, no zeros or two between digits indicating that they have opposite signs, a single zero that they have the same sign.

Note that *cancellation of double zero* may be considered a special case of *summing across zero*, with summing of the first digit and second zero across the first zero and of the first zero and second digit across the second zero. The same interpretation may be given to concatenation of the identity element 00 to another category or, trivially, to itself, although this is more conveniently thought of simply as a null operation.

We illustrate with a concatenation table for the primary categories, in which cancellation is shown by slashes through zeros and summing by underlining:

	10	01	11	0110
10	*1010* → 20	1ØØ1 → 11*	*1011* → 21	1ØØ110 → 1110**
01	0110*	0*101* → 02	0111**	0*101*10 → 0210
11	1110**	1*101* → 12	1111**	1*101*10 → 1210
0110	01*1010* → 0120	011ØØ1 → 0111*	01*1011* → 0121	011ØØ110 → 011110**

Categories marked with a single asterisk are, of course, themselves members of the set of primary relatives. As mentioned before, "parent's child", available in the conventional notation to represent half-sibling, is equated with full sibling in ours as so far presented. "Child's parent" can be tautological with "spouse".

Double asterisks mark step-categories. Note the redundancy in the fully exploited conventional system that both a parent's spouse other than the other parent and a sibling's parent other than ego's must be a step-parent, and both a spouse's child other than ego's and a child's sibling other than ego's child must be a step-child.

The remaining eight categories are the numerical category translations of the secondary or two-term expressions normally occurring in the traditional notation. Note that these are just the one digit categories with $Sxy = 2$ and the two digit categories with $Sxy = 3$, so that $Sxy - Nd + 1 =$ secondary. The formula does not apply to step-categories, any more than the order system does.

This process may be iterated to translate a conventional kin expression of any length, or a natural-language kin expression of any length. To take one example of each, the two happenning to be synonymous:

PaSbChSpPaSbSp:
101*1010***10101***1011*10 → 233210;

Uncle/Aunt's Child-in-law's Uncle/Aunt by marriage:
2102*102*210 → 233210.

This equivalence demonstrates that concatenation is associative, that is, that the order of concatenation is irrelevant. It is not commutative: $1\emptyset\emptyset2 \rightarrow 12 \neq 0210$.

If we signify *optional concatenation* by parenthesization, partially generalized categories may be indicated with more flexibility than by $\tilde{n} \geq n$ alone. For example:

$01(10) = 01$ or 0110;
$(10)00(01) = 00$ or 10 or 01 or $11 =$ primary consanguineal;
$00(01)(10) = 00$ or 01 or $0110 =$ ego's family of procreation;
$\tilde{1}0(11) = \tilde{1}0$ or $\tilde{2}1$;
$0110(\tilde{1}\tilde{0}) = 0110$ or $01\tilde{2}\tilde{0} =$ spouse's consanguineal other than ego's, and other than children by another spouse.

Concatenation of a sequence of categories yields a unique category which is a full interpretation only under the constraint that the sequence was intended as a minimal representation of a unique category, as in kinship notation. Otherwise, a full interpretation must be a set of categories, with a set of one merely the limiting case. Consider "parent's child", which identifies "sibling" only by notational convention, normally covering ego as well, Category addition, symbolized by the *addition sign*, generates the full set of valid solutions of a sequence of categories by combining the sub-operation of concatenation with the sub-operation of *reduction.* Addition is a binary operation, proceeding cumulatively from the left in the case of three or more summands, on an *egocentric category* E to the left and an *altercentric category* A to the right, generating a set of *displaced egocentric categories* E'_i:

$$E+A=E'_1=E'_2=\cdots=E'_{Ns},$$

where $Ns \geq 1$ is the *number of solutions.* Concatenation alone produces E'_1. This will be the unique solution if the last digit of E and the first digit of A are of the same sign, that is, if the concatenation involved summing across zero. If the innermost digits are opposite signs, further solutions are generated by successive reductions each followed by concatenation, a reduction consisting of the simultaneous subtraction of one from both innermost digits. Reduction terminates when one of the innermost digits becomes a zero and is summed across, or when no digits remain. Each stage of reduction R_i may be represented by

$$R_i = \cdots d-1+d-1\cdots \rightarrow E'_{i+1},$$

where it is understood that either both innermost digits are in the innermost places or both flank zeros in the innermost places.

Thus, to generate the two valid solutions of the example given above, "parent's child", one reduction is needed:

$$10+01\rightarrow 11\ \ (E'_1);$$
$$R_1=00+00\rightarrow 0\,0\ \ (E'_2);$$

A grandparent's grandchild may be a first cousin, a sibling, or ego, so the addition blocks after two reductions:

$$20+02\rightarrow 22\ \ (E'_1);$$
$$R_1=10+01\rightarrow 11\ \ (E'_1);$$
$$R_2=00+00\rightarrow 00\ \ (E'_3).$$

An uncle/aunt's sibling may be a step-uncle/aunt, another uncle/aunt, or a parent:

$$21 + 11 \rightarrow 2111 \quad (E_1');$$
$$R_1 = 20 + 01 \rightarrow 21 \quad (E_2');$$
$$R_2 = 10 + 00 \rightarrow 10 \quad (E_3').$$

All spouses of grandchildren are the same to ego, so no reduction is possible:

$$02 + 0110 \rightarrow 0310 \quad (E_1').$$

An uncle/aunt's great-nephew/niece may be a step-relation, a first cousin once removed (downwards), a nephew/niece, or a child:

$$21 + 13 \rightarrow 2113 \quad (E_1');$$
$$R_1 = 20 + 03 \rightarrow 23 \quad (E_2');$$
$$R_2 = 10 + 02 \rightarrow 12 \quad (E_3');$$
$$R_3 = 00 + 01 \rightarrow 01 \quad (E_4').$$

We may, of course, if we choose, disregard solutions which are step-categories, or those beyond a certain number of digits, or any others of no immediate interest.(1) We must, however, discard as invalid all solutions concatenated from reductions which have removed both innermost pairs, that is, which have produced self-cacelling double zeros on both sides of the addition sign. The necessity for this may be seen in the simplest case, spouse's spouse:

$$0110 + 0110 \rightarrow 011110 \quad (E_1');$$
$$R_1 = 01 \quad + \quad 10 \rightarrow 0110;$$
$$R_2 = 00 \quad + \quad 00 \rightarrow 00 \quad (E_2').$$

A spouse's spouse may be a co-spouse or ego, but cannot be another spouse. Note that ego 00 is not a self-cancelling double zero, and that the pair of the one-pair category from which it has been reduced has not been dropped. 00 is a category, while 0100 can only be the category 01. 00 is dropped, in effect, in concatenation, but not in reduction. Note also that subsequent reductions may give valid solutions.

(1) When only the solutions nearer ego are wanted, or only the fully reduced solution, reduction may be speeded up cancelling symmetrical sequences from the addition sign outwards and by adding the difference of unequal innermost digits to the next place on the side of the smaller.

Hereafter we simplify the representation of addition by reverting to the form $E + A = E'_1 = E'_2 = \cdots = E'_{Ns}$. For example, addition of sibling's spouse's parnet and grandchild:

$$1220 + 02 = 122.2 = 121.1 = 12\,,$$

where the period is simply a temporary juncture marker to facilitate reduction. The equivalences are between $E + A$ on the one hand and each E'_1 on the other. E'_i and E'_j are equivalent only in the sense that both contain instances of $E + A$, and are not, for instance, substitutable for one another elsewhere.

Note that addition is not commutative. A sibling's spouse is not a spouse's sibling:

$$11 + 0110 = 1210 \neq 0110 + 11 = 0121\,.$$

Addition is, however, associative. Consider the three-term addition "child's parent's sibling". We normally proceed from the left, first adding child and parent:

$$01 + 10 = 01.10 = 0.0;$$

then adding the remaining summand to each solution:

$$0110 + 11 = 0121;$$
$$00 + 11 = \mathbf{11}\,.$$

We may also, though, add the second and third terms first, temporarily taking the second term as a (shifted) egocentric category:

$$10 + 11 = 21;$$

If this smaller innermost digit happens to occupy the outermost place, it is perhaps simplest to consider that the difference is summed with the inner zero of an added outer pair of zeros, all other pairs cancelling themselves out. For example:

$$4232+2322=\cdots=4.2=\cdots=2.0 \rightarrow 20;$$

or

$$3423+3251=\cdots=34.51=\cdots=30.11 \rightarrow 41.$$

The second process, of course, includes summing across zero, and thus terminates reduction. We do not normally indicate the juncture point after it has been summed across, but do so here and then rewrite to show how the place assignments have been made.

and then add the result to the first term:

$$01 + 21 = 01.21 = \mathbf{11}\,.$$

By either method:

$$01 + 10 + 11 = 0121 = \mathbf{11}\,.$$

Again, consider "second cousin's grandfather's great-grandchild":

$$33 + 20 = 33.20 = 32.10 = 31; \qquad (E + A_1)$$
$$3320 + 03 = 332.3 = 331.2 = \mathbf{34};$$
$$3210 + 03 = 321.3 = \mathbf{34};$$
$$31 + 03 = \mathbf{34};$$

or:

$$20 + 03 = 2.3 = 1.2 = 0.1; \qquad (A_1 + A_2)$$
$$33 + 23 = 33.23 = 32.13 = \mathbf{34};$$
$$33 + 12 = 33.12 = \mathbf{34};$$
$$33 + 01 = \mathbf{34}\,.$$

In both cases:

$$33 + 20 + 03 = 3323 = 3312 = \mathbf{34}\,.$$

Traffic rules have been given for tracing a path on the category diagram from ego 00 to an egocentric category E: a numerical category is interpreted as a sequence of instructions, each odd, or positive, place x_i calling for a move x_i squares to the right, each even, or negative, place y_i for a move y_i squares down.

In tracing a path corresponding to an altercentric category A from E to E', however, that is, in representing addition of categories, these rules remain in full force only for the first concatenation, or unreduced addition. The graphic analog of reduction reverses these rules for the first i squares of A in the ith reduction, each *unit* of a positive place calling for a move one square to the left, each unit of a negative place for a move one square up. Reduction continues only as far as these re-readings of A double back along the path of E towards ego 00.

Since 1 is subtracted from both sides in each reduction, the absolute sum of each E'_i will be 2 less than that of its predecessor. Since the subtraction is from digits of opposite sign, the relative difference will be unchanged. This means that the set of solutions E_i' will occupy a diagonal parallel to the main diagonal, each solution one diagonal square closer to the axes, that is, one square up and one to the left, or towards ego. If the first solution is in the square $SxSy$, the ith reduction will be in the square $S_{x-i}S_{y-i}$. In the case of the addition of reciprocals, $Sx = Sy = i$: the first solution will be on the main diagonal at $SxSy$, the last at ego 00.

Step-categories may be avoided in addition on the category diagram by abandoning A paths which revert to movement away from ego one square short of a transition square in the retraced E path.

TRANSPOSITIONS OF CATEGORY ADDITION

Addition of categories generates the set of categories represented by the unknown in equations of the form $a + b = x$, such as "Who are my uncle's first cousins to me?" But we would also like to be able to determine the values of the unknowns satisfying equations of the forms $a + x = b$ and $x + a = b$, such as "What are my first cousins to my uncle?" and "Whose uncle is my first cousin?"

We found our rules for *transposition* of category additions anticipated in group theory, and so will first point out in what respects the set of all numerical kinship categories constitutes a *group* as that term is understood in abstract algebra.

> *A group is a set G and a binary operation ⊗ on G such that the following axioms are satisfied:*
>
> **Axiom 1** (*Associativity*). *For any elements r, s, t of G,*
>
> $$r \otimes (s \otimes t) = (r \otimes s) \otimes t.$$
>
> **Axiom 2** (*Identity*). *There is a unique element I in G such that, for every element r of G,*
>
> $$r \otimes I = I \otimes r = r.$$
>
> **Axiom 3** (*Inverses*). *For any element r of G, there exists a unique element r^{-1} of G such that*
>
> $$r \otimes r^{-1} = r^{-1} \otimes r = I.$$
>
> (Grossman and Magnus 1964: 13)

> A *binary operation on a set* is a *correspondence* that assigns to each ordered *pair* of element of the set a uniquely determined element of the set. [Italics in text]
>
> (Grossman and Magnus 1964: 4)

We have seen that addition of categories is associative. We have also seen that it has an identity element, ego 00. But, while addition of elements of the set of categories produces other elements of the set, it does not qualify as a binary operation under the definition quoted because it assigns not a unique element but a set of elements to each ordered pair of elements. Moreover, Axiom 3 holds only for *fully reduced addition*, in which concatenation takes place only after the last possible reduction. For example:

$$21 + 12 = 21.12 = 2.2 = 1.1 = 0.0.$$

You are not your uncle's only nephew. But, in terms of fully reduced addition:

$$21 + 12 = \cdots = 00;$$

that is, addition of reciprocals reduces to ego. This constraint on addition also resolves the difficulty in meeting the group theory definition of binary operation, since there is now a unique solution for each addition. We may say, then, that the set of all categories constitutes a group under the binary operation of fully reduced addition.

Note, in connection with fully reduced addition, that the simple concatenation of primitive terms that forms the basis of all kinship notations, including ours, may be termed *unreduced addition.*

As we have seen, addition is a directed operation, even fully reduced addition, so the set of categories is not a commutative, or Abelian, group. There are, however, unobvious cases of partial commutativity, such as

$$21 + 11 = 21.11 = 21;$$
$$11 + 21 = 11.21 = 21\,.$$

The brothers of some of your uncles are the uncles of some of your brothers, the only exceptions, in fact, involving half-uncles or half-brothers. But such cases must be considered accidental.

The transposition rules for group theory equations, with the binary operation arbitrarily represented in terms of "group multiplication", are as follows:

> To "solve" $ax=b$, multiply on the *left* by a^{-1} to find $x=a^{-1}b$; to "solve" $xa=b$, multiply on the *right* by a^{-1} to find $x=b\,a^{-1}$. [Italics in text]
>
> (Grossman and Magnus 1964: 36)

Since the binary operation on categories is obviously closer to addition than to multiplication, it would be more natural to employ the additive inverse, the negative, rather than the multiplicative inverse, the reciprocal. Precedent for treating head-to-tail inversion as negation may be found in vector theory, where the negative of a vector is one of equal magnitude but opposite direction. We prefer the mathematically inappropriate term "reciprocal" because of its currency in anthropological work, and the negative unit exponent because the minus sign would invite confusion with negative places and with scalar multiplication by -1. There is no such danger in the use of the plus sign for addition, since it accomodates itself naturally to our alternate sign convension. It would be possible to consider the binary operation on categories to be multiplication if the digits were defined as the exponents of sex variables rather than, in effect, as their coefficients. Romney and D'Andrade, for example, indicate "expansions" by superscripts. This would seem, however, to lead to unnecessary complication, either notational, if the redundant variables are retained, or conceptual, if they are suppressed.

We thus prefer to state these transposition rules in the following hybrid form, with apologies to any mathematicians they may offend:

If $a + x = b$, then $a^{-1} + b = x$;
If $x + a = b$, then $b + a^{-1} = x$.

To rephrase these transposed equations in the terms used for the original category addition equation:

If $E + A = E'$;
then $E' + A^{-1} = E$;
and $E^{-1} + E' = A$.

For mnemonic purposes, it is useful to note that the unknown in a transposed equation has switched placed with the unknown of the original, while the remaining term, the one that is literally not displaced, has been inverted. Note also that the equation for E simply states the obvious fact that the inverse of a relation is its reciprocal.

Once the indicated reciprocation has been made in a transposed equation, it constitutes a perfectly valid new "original" equation and may be relabelled accordingly. This holds equally in the less obvious case of the equation for A.

Consider, however, that E' in the original equation actually represents a set of solutions E'_i, each of which must be substituted in the transposed equations. With superscripts indicating the value of E' substituted, we thus have:

If	$E + A = E'_i$;
then	$E'_i + A^{-1} = E^i_j$;
and	$E^{-1} + E'_i = A^i_j$.

The original values of E and A will be the *intersections* of the set E^i_j and A^i_j respectively.

A more practical method for evaluating E and A through transposition is to employ fully reduced addition throughout:

If	$E + A = \cdots = E'_{Ns}$;
then	$E'_{Ns} + A^{-1} = \cdots = E^{Ns}_{Ns}$;
and	$E^{-1} + E' = \cdots = A^{Ns}_{Ns}$;

where E^{Ns}_{Ns} and A^{Ns}_{Ns} and the original E and A.

In the following example, the original values of E and A are underlined wherever they appear, and the equations using E'_{Ns}, the shortcut transpositions solving for E and A, are marked with asterisks:

$E + A = E'_i$:

$\underline{31} + \underline{12} = 31.12 = 3.2 = 2.1 = 1.0$;

$E'_i + A^{-1} = E^i_j$:

$3112 + 21 = 3112.21 = 3111.11 = 311.1 = \underline{31}$;

$32 + 21 = 32.21 = 31.11 = \underline{3.1} = 2.0$;

$21 + 21 = 21.21 = \underline{31}$;

*$10 + 21 = \underline{31}$;

$E^{-1} + E'_i = A^i_j$:

$13 + 3112 = 13.3112 = 12.2112 = 11.1112 = 1.112 = \underline{12}$;

$13 + 32 = 13.32 = 12.22 = 11.12 = \underline{1.2}$;

$13 + 21 = 13.21 = 12.11 = \underline{12}$;

*$13 + 10 = 13.10 = \underline{12}$.

It would be even more tedious to demonstrate the fact that resubstitution of any value E^i_j or A^i_j in the original formula will produce the appropriate value E'_i through fully reduced addition, or the fact that resubstitution of any set E^i or A^i will do the same in terms of intersection. Resubstitution of equivalents may also be made in the transposed equations.

APPENDIX TWO

Mathematical Analysis of Genealogical Spaces

S. H. Gould and Pin-hsiung Liu

INTRODUCTION

Genealogical theory may be illustrated by two basic problems.
First: Under what circumstances does one person address two others by the same kinship term?

This first problem is particularly interesting in segmented societies, i. e. societies partitioned into segments such that kinship terms depend almost solely on the respective segments to which the individual persons belong. For example, a Murngin tribesman in northern Australia will address his father and his greatgrandson by the same term *bapa*, but his grandfather and his son by the distinct terms *marikmo* and *gatu*, an apparently bizarre practice that receives its natural explanation in the theory of segments developed below.

Second Problem ii: How are kinship terms combined?

This question takes three (essentially equivalent) forms; e. g. for the relations "grandparent", "grandchild" and "parent":

iia) My grandparent't grandchild refers to me as what?
iib) I refer to what relative of my grandparent as parent?
iic) As what do I refer to my grandparent's parent?

Here the interest lies not only in calculating the answers themselves, but also in predicting how many of them there will be: namely, three for iia (self, sibling and cousin), two for iib (child and child-in-law), and two for iic (great grandparent).

To solve these problems rapidly and systematically, we develop a concise numerical notation, first for "non-sexdistinguishing" societies, then for societies with a sex-distinction, and finally for segmented societies. Our method is based on the fact that all relations can be expressed in "child-parent" terms; e. g. "ancestor" $= PP\cdots P$ (parent's parent's$\cdots$parent), "sibling" $=$ PC (parent's child), "cousin" $= PPCC$ (grandparent's grandchild).

1. NON-SEXDISTINGUISHING SPACES

1.1 Definition and notation

A *space* consists of a *basic set* B of persons $a, b, c, \cdots$, together with one or more *structures* on B, where by a structure we mean a set of subsets of B; e. g. a *family structure* consists of a set of families, a *husband-wife structure* consists of a set of married pairs.

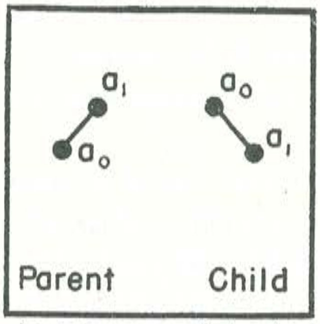
A *relation* is a structure whose subsets are pairs.

By the word "pair" we mean an "ordered pair", i. e. a pair with a first element and a second, so that e. g. the "husband-wife" relation is different from the "wife-husband"; and for brevity we shall often refer to the pair only by its second element; e. g. by the "wife-relation" we mean the "husband-wife" relation. In non-mathematical speech a relation (more precisely, a binary relation) is defined in some such way as "a quality which can be predicated only of a pair of entities". The mathematical definition—which like all definitions in mathematics is in terms of "sets of sets"—avoids vagueness by abstracting from the non-mathematical relation its one essential feature, namely the set of pairs by which it is exemplified.

The set $\{(b, a), (d, c)\cdots\}$ formed by inverting each of the pairs in $P = \{(a, b), (c, d)\cdots\}$ is called the *inverse* of P, and is denoted by P^{-1} or, if P is a child-parent relation (see below), by C.

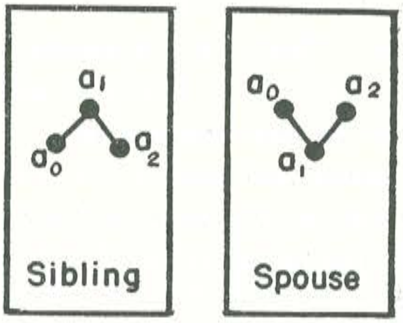
By the *product* $Q \cdot R$ of two relations Q, R we mean the relation consisting of the set of pairs (a, c) for which there exists a b such that (a, b) is in Q and (b, c) is in R. For example, if Q is "father" and R is "brother", the product $Q \cdot R$ contains all pairs (a, c) such that some b is father to a and brother to c; in other words, the statement "(a, c) is in $Q \cdot R$" means that c is uncle to a. It is clear that $(Q \cdot R)^{-1} = R^{-1} Q^{-1}$.

We denote PP by P^2, $P{\cdot}P{\cdot}P = P{\cdot}PP$ by P^3, $\cdots$, $C{\cdot}C$ by $C^2 = (P^{-1})^2 = P^{-2}\cdots$, and the *identity* (or *self*) relation consisting of all pairs of the form (a, a), (b, b), $\cdots$ by $I = P^0 \cdot C^0 = P^0 \cdot P^0 = C^0 \cdot C^0$. All these relations are called *powers* of P, or of C.

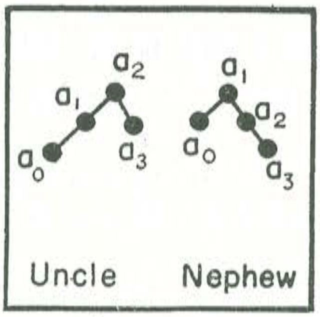


Inverses and duals

a

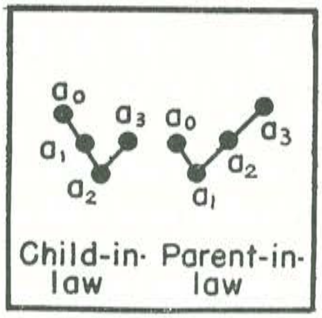


b



Inverses

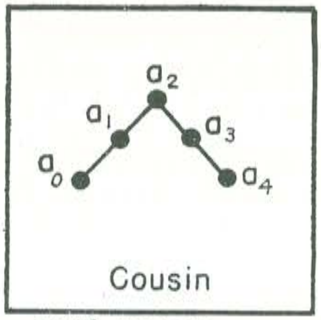
c



Inverses

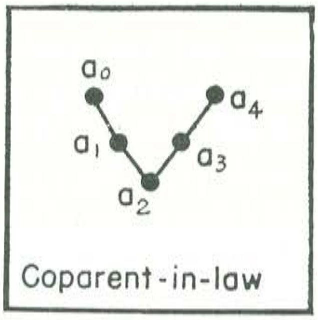
d

c and d are duals



Self-inverse

e



Self-inverse

f

e and f are duals

A relation P is called *stratifying* if no two powers of P have a pair in common. Clearly, if P is stratifying, then so also is its inverse C. The powers of P or of C determine distinct strata, called *generations*, i. e. no person is his own ancestor, etc.

A *genealogical space* G is a space such that at least one of its structures is a stratifying relation P, called its child-parent relation. Since all statements about the space G are based solely on the stratifying property of the relation P, and since C is also stratifying, any true statement about G will be changed into a true statement, called the *dual* of the original statement, if C is substituted for P, and P for C. For example, the true statement "sibling (PC) is *symmetric*" (i. e. is its own inverse; namely, if a is sibling to b, then b is sibling to a) becomes the dual (and therefore likewise true) statement "spouse (CP) is symmetric." We shall find below that this *principle of duality* holds not only for child and parent, but also for male and female.

If P is the only structure on G, then G is said to be *non-sexdistinguishing*. Genealogical spaces with two structures, parentage and sex, are considered in the next section.

In giving examples for non-sexdistinguishing spaces it is convenient to write "uncle" for "uncle-or-aunt", and "nephew"for "nephew-or-niece".

1.2 Graphs. Inverse and dual paths

The various relations can be helpfully visualized as graphs, in which the individual persons are represented by dots, with each child lower on the page than his parent, and each child-parent pair joined by a line-segment. Every possible relation between two persons a_0 and a_n can then be unambiguously defined by a *path* π from a_0 to a_n (see the sketches); i. e. by a sequence of distinct elements $(a_0, a_1, \cdots, a_n)$ such that each of the successive pairs (a_0, a_1), $(a_1, a_2)\cdots(a_{n-1}, a_n)$ is either *a* child-parent pair P or else a parent-child pair C.

The sequence of P's and C's in the path *dual* to π is obtained by substituting P for C, and C for P, whereas the sequence in the inverse path $\pi^{-1} = (a_n, a_{n-1}, \cdots, a_0)$ is obtained by first inverting the order of the P's and C's in π and then making the substitution of P for C, and C for P. In the sketches, each path π is drawn on the same sketch as its inverse, and dual sketches are placed side by side.

The path π is said to be of *length* n, or to have n *steps*. If all the pairs (a_0, a_1), (a_1, a_2), $\cdots$ are in P (resp. in C), the path is called an *ascent* (resp. a *descent*). If p of the steps are in P and the other $q = n - p$ are in C, the path π is of *height* $h = p - q = n - 2q$ (positive, negative or zero) and a_n is h *generations* above a_0.

It is important to note that these sketches do not represent an entire relation, but only one pair in it; the sketch labeled "uncle" (more precisely, nephew-uncle) represents only one nephew, often called *ego* but here called a_0, and only one of his uncles, here called a_3. The entire nephew-uncle relation would be represented by an unintelligible maze of lines running out from the various points.

On the other hand, mathematical discussion of a relation becomes much simpler and more intelligible if it is based on the entire relation, not just on the relatives of one person.

1.3 Kinship types

Any sequence Q of P's and C's, say $Q = CPPCCP$ (spouse's sibling's spouse), will define a set of paths, joining each point a_0 to various other points a_n. We shall say that Q is the *kinship type* denoting the relation that consists of all such pairs (a_0, a_n), and for convenience we shall sometimes say that (a_0, a_n) is in Q, with the meaning that (a_0, a_n) is in the relation denoted by Q. Similarly, we shall speak of the product $Q_1 \cdot Q_2$ of two kinship types, meaning the product of the corresponding relations. To say that some pair (a, b) is in Q is clearly equivalent to saying that (b, a) is in Q^{-1}.

Some of these kinship types will have corresponding kinspip "terms" in English: e. g. $P^2C =$ uncle, $P^4C^6 =$ third-cousin-twice-removed; but most of them, e. g. $P^7C^5P^3C^2$, will not correspond to any familiar English name.

1.4 Reduced forms

The product $A \cdot B$ of two kinship terms A and B may include one kinship term, or more than one. For example,

$P \cdot PC$ (parent's sibling) includes only PPC (uncle)

$PP \cdot C$ (grandparent's child) includes PPC, P (uncle, parent)

$P \cdot PCC$ (parent's nephew) includes only $PPCC$ (cousin)

$PP \cdot CC$ (grandparent's grandchild) includes $PPCC$, PC, I (cousin, sibling, self)

$PPC \cdot C$ (uncle's child) includes only $PPCC$ (cousin),

and similarly for the dual products $C \cdot CP$, $CC \cdot P, \cdots CCP \cdot P$.

Multiple inclusions occur only when the dot appears between a P and a C, in either order, and are always due to the fact that PC (sibling) and CP (spouse) are defined by pairs (a_0, a_1), (a_1, a_2) with distinct a_2 and a_0, whereas the products $P \cdot C$ and $C \cdot P$ (parent's child and child's parent), also include the possibility that $a_2 = a_0$, in which case $P \cdot C = C \cdot P = I$. Then in a product like $PP \cdot CC$ (grandparent's grandchild), whenever the inner product $P \cdot C$ represents I, this inner $P \cdot C$ can be deleted to obtain a subset of the pairs denoted by $PP \cdot CC$. In other words, $PP \cdot CC$ can be *reduced* to $P \cdot C$, and this *first reduced form* $P \cdot C$ (since again the dot occurs between *a* P and *a* C) can be further reduced to I.

The general rule is: a product $K \cdot L$ of two kinship terms K and L is *reducible* if the last step in K and the first step in L are dual to each other; i. e., if one of them is P and the other C; and the first reduced form thus obtained will be reducible on the same condition, and so on, down to a completely reduced form in which the inner terms, one on each side of the dot, are either both P or else also both C.

An equivalent statement is: the product $K \cdot L$ will be q times reducible if the first q steps in K^{-1} are identical with the first q steps in L.

Then the various kinship terms included in $K \cdot L$ will be obtained by omitting the dot in the unreduced product $K \cdot L$ and in each of its reduced forms.

1.5 Solutions of the second basic problem

If we regard M, L and K respectively as unknowns X, Y, Z, then for each of the three parts a), b), c) of the second basic problem we may write $I \subset K \cdot L \cdot M$, where the the symbol $\subset$ means "is included by"; e. g. in part iia, K takes me to my grandparent, L to my grandparent's grandchild, and

X back to myself. Then $I \subset K \cdot L \cdot M$ implies $X \subset L^{-1}K^{-1}$, $Y \subset K^{-1}M^{-1}$, $Z \subset M^{-1}L^{-1}$, so that in the particular case $K = PP$, $K^{-1} = CC$, $L = CC$, $L^{-1} = PP$, $M = P$, $M^{-1} = C$ we have

$X \subset L^{-1} \cdot K^{-1} = PP \cdot CC$, with reduced forms $P \cdot C$, I,
$Y \subset K^{-1} \cdot M^{-1} = CC \cdot C$, with no reduced form,
$Z \subset M^{-1} \cdot L^{-1} = C \cdot PP$, with the reduced form P.

Omitting the dots gives:

i) $PPCC$ (cousin), PC = sibling, I = self,
ii) CCC (great grandchild),
iii) CPP (parent-in-law), P (parent), as stated in the Introduction.

1.6 The numerical notation

For a kinship type like P^2C^2 (cousin), or CP^2C^2P (spouse's sibling's spouse), it is convenient to write merely the sequence of exponents $P^2C^2 = 22$, $CP^2C^2P = 012210 = P^0CP^2C^2PC^0$, where the initial zero is necessary to show that the sequence begins with a C, and the final zero is convenient (for the reasons given just below) to show that the sequence ends with a P.

In this new notation, which means that the length of every kinship type is now even, the familiar English names will appear as follows:

$10 = P =$ parent,
$m0 = P^m = m$th ancestor,
$11 = PC =$ sibling,
$21 = P^2C =$ uncle,
$0210 = C^2P =$ child-in-law,
$22 = P^2C^2 =$ cousin,
$m(m+k) = P^mC^{m+k} = m$th cousin k-times-removed,
$01 = C =$ child,
$0m = C^m = m$th descendant,
$0110 = CP =$ spouse,
$12 = PC^2 =$ nephew,
$0120 = CP^2 =$ parent-in-law,
$0220 = C^2P^2 =$ cograndparent,

$0m(m+k)0 = C^m P^{m+k} = (m+k)$th ancestor of mth descendant through distinct intermediate relatives (no common name in English).

The convention of suffixing a zero to a sequence ending in a P is convenient for at least three reasons:

i) the inverse of a kinship type is now obtained by merely inverting the order of its constituent P's and C's. Thus $21 = P^2C =$ uncle is inverse to $12 = PC^2 =$ nephew; $0110 =$ spouse is self-inverse, etc;

ii) the dual is obtained by adding or canceling an initial or final zero; thus $0220 = C^2P^2 =$ cograndparent is dual to $22 = P^2C^2 =$ cousin;

iii) the reduced forms of a product $A \cdot B$ are quickly obtained, as follows:

a) $A \cdot B$ will be reducible if and only if the last term in A and the first term in B are both non-zero. (If exactly one of them is zero, the product is already in completely reduced form. If both are zero, the double zero is canceled and reduction proceeds in the usual way). The number of reduced forms will be equal to the smaller of these non-zero terms (if they are equal to each other, the number of reduced forms will be equal to either of them increased by the smaller of the immediately adjacent terms), and the successive reduced form will be obtained by subtracting unity from each of these non-zero terms until one of them becomes equal to zero. (If they become equal to zero simultaneously, the reduction continues on the next adjacent terms.)

The kinship term corresponding to an incompletely reduced form is obtained by omitting the dot, and the term corresponding to the completely reduced form is obtained by "adding across the internal zero" and omitting the zero and the dot. Thus $22 \cdot 12$ reduces to $21 \cdot 02 = 23$ (cousin's nephew$=22 \cdot 12$ reduces to first-cousin-once-removed $= 23$). Let us illustrate from Problem *ii* in the Introduction, where we have: $K = 20$, $K^{-1} = 02$, $L = 02$, $L^{-1} = 20$, $M = 10$, $M^{-1} = 01$, which implies

$X \subset L^{-1} \cdot K^{-1} = 20 \cdot 02 = 2 \cdot 2$, with the reduced forms $1 \cdot 1$ and I;

$Y \subset K^{-1} \cdot M^{-1} = 02 \cdot 01$ with no reduced form

$Z \subset M^{-1} \cdot L^{-1} = 01 \cdot 20$, with the reduced form $00 \cdot 10$, so that, as stated in the Introduction, $X = 22$ (cousin), 11 (sibling) or I (self);

$Y = 03$ (where $3 = 2 + 1$ by addition across the single zero and subsequent omission of the zero and the dot) = great-grandchild.

$Z = 0120$ (parent-in-law), or 10 (parent).

As a final example, consider "cousin's cousin". Here $X \subset 22 \cdot 22$, with reduced forms $21 \cdot 12$, $20 \cdot 02 = 10 \cdot 01$, I, so that $X = 2222$ (no one-word name in English), 2112 (again no one-word name), 22 (cousin), 11 (sibling), self.

2. SEX-DISTINGUISHING SPACES

2.1 Sex-distinction

Up to now, our space has had only one structure, the child-parent relation. We now consider genealogical spaces with a second structure as well, namely a sex-distinction.

A *k-sex-distinction* on a basic set B is a structure S consisting of $K \geq 2$ exclusive and exhaustive subsets of B, called respectively the S_1-sex, the S_2-sex, $\cdots$ the S_k-sex. If $K = 2$, the S_1-sex will be called *male*, and the S_2-sex *female*. For $K > 2$, the word "sex" is used in a generalized sense. For example, in the terminology of certain Christian churches we may take $K = 4$ in view of the fact that, in addition to his two biological parents, a child is given two "god-parents". A notation like ${}_aS_i$ will mean that ${}_aS_i$ is in the S_i-sex. For $k = 2$, we write a^f to mean that a^f is female, and a^m to mean that a^m is male.

In spaces with one sex (i. e. the non-sexdistinguishing spaces of Chapter One) the child-parent relation was required to be stratifying with respect to that one sex. Similarly, in spaces with k sexes ($k \geq 2$) the child-parent relation is required to be *stratifying with respect to each sex*; i. e. If we define an S_i-ascent (resp. an S_i-descent) as an ascent (resp. descent) a_0, a_1^{Si}, a_2^{Si}, $\cdots$, a_n^{Si} in which all the elements, except possibly the first, are in S_i, and define the nth positive S_i-power (resp. nth negative power) of P (resp. of C) in S as the set of pairs (a_0, a_n) joined by an S_i-ascent (resp.

by an S_t-descent) of length n, then no two S_t-powers of P have a pair in common.

Consequently, we can define a difference in generations along any given sex. But generations across sex cannot be satisfactorily defined. For example, in some societies (see Chapter Three) uncle-niece marriages are the general rule, which means that the child of such a marriage has the same person for his grandfather along the male ascent and for his great-grand-father along a mixed ascent through his mother.

Since the definition of a sex-distinction is symmetric with respect to male and female, the *principle of male-female duality* will hold, i. e. any true statement will be transformed into a true statement by interchange of the terms "male" and "female" (compare the child-parent duality in Section One). This principle will be particularly valuable for the segmented (m, n)-spaces in Section Three (spaces with m-patrilines and n-matrilines, since our results for spaces with $m \geq n$ can be immediately transferred to spaces with $n \geq m$.

2. 2 Numerical notation

In sex-distinguishing spaces (not including those in which kinship terms depend on the sex of the speaker; to be treated later) there will be two terms for "parent", i. e. "father" = F and "mother" = M, and similarly for "sibling" (brother = B, Sister = Z) and child (son = S, daughter = D) etc., and for "cousin" there will be sixteen: MMDD, MMDS, ···, FFSS; so that the notation of Chapter One 10 = darent, 11 = sibling etc. is no longer sufficient. In such a space we shall write

$1_0 0$ = mother, $1_1 0$ = father, 01_0 = daughter, 01_1 = son,
$2_{00}2_{00}$ = MMDD, $2_{00}2_{01}$ = MMDS, ···, $2_{11}2_{11}$ = FFSS,

and for 34 = second-cousin-once-removed, e. g. $3_{101}4_{1001}$ = FMFSDDS, where it is to be noted that the length of each subscript is given by the number to which the subscript is attached; e. g. 3 has a subscript of length three, 4 of length four, etc. In order to include those kinship terminologies (as e. g. in the Fox branch of the Algonquin Indians) which distinguish the sex of the speaker, it will only be necessary to prefix a zero or a one to the subscript, e. g. $1_{00}0$ would mean "mother of a daughter" etc., and to make corresponding changes in the rules for reduction of a product given below.

These subscripts may be shortened, at the cost of perspicuity, by considering them as numbers in scale two, and then converting them to scale ten. E. g. $0101 = 0 \cdot 2^3 + 1 \cdot 2^2 + 0 \cdot 2 + 1 = 5$, so that second-cousin-once-removed $= 3_{011}4_{0101} =$ MFFDSDS becomes $3^3 4^5$, with superscripts to indicate the new notation.

In many kinship terminologies the sex of several of the persons in the chain will be immaterial; e. g. in English "granpmother" stands equally well for MM and FM. Thus, using 2 to mean "of either sex" we may write

grandmother $= 2_{20}0$,

and now the notation may be shortened by using scale-three; i. e.

grandmother $= 2^6$,

where $6 = 2 \cdot 3 + 0$ is the scale-ten equivalent of 20 in scale-three.

This use of subscripts can be generalized in an obvious way to a space with k sexes, in which we may wish to give information about the various sexes to which a given kinship term allows given persons to belong.

2. 3 Reduction

The kinship terms resulting from the product $A \cdot B$ of two given kinship terms A and B will now be found as follows:

1) for addition across a single internal zero, the subscripts are juxtaposed (concatenated); e. g. if $A =$ mother's father $= 2_{01}0$ and $B =$ mother $= 1_0 0$, we write $2_{01}0 \cdot 1_0 0$, add across the internal zero, juxtapose the subscripts and omit the dot and the internal zero, to obtain $3_{010}0 =$ MFM.

2) reduction of a product $A_{a \ldots ij} B_{k \ldots pq}$ can take place only if $i = k$ (if the second-to-last subscript numeral i on A and the first subscript numeral k on B are either both zero or both one) in which case j and k are deleted (where k is the last numeral on A).

Thus $2_{01} \cdot 1_0$ can be reduced to $1_0 \cdot 0$ (my MFD can be either my aunt or my mother), but $2_{01} \cdot 1_1$ can not be reduced (my MFS can only be my uncle).

2.4 Cousins

The "cousin"-relation $= 22$ ($= a_0, a_1, a_2, a_3, a_4$) will occur frequently in the description of segmented societies of the next chapter. We shall find that of the 32 possibilities only the sex of a_0, a_1, and a_3 will be important. Writing $\sim$ (resp. $\nsim$) to mean "of the same sex" (res. "not of the same sex") we have the four kinds of cousinship:

parallel-parallel	if	$a_0 \sim a_1$,	$a_1 \sim a_3$,
cross-parallel	if	$a_0 \nsim a_1$,	$a_1 \sim a_3$,
parallel-cross	if	$a_0 \sim a_1$,	$a_1 \nsim a_3$,
cross-cross	if	$a_0 \nsim a_1$,	$a_1 \nsim a_3$;

the usual terms "patrilateral cross-cousin" for "parallel-cross" and "matrilateral cross-cousin" for "cross-cross" are unfortunate, since they give preferential treatment to a male-speaker and thus destroy sex-duality.

2.5 Patrilineage and matrilineage

An S_i-line σ_i is a set of elements, at least one of which is in S_i, such that

i) if a is in σ_i, then σ_i includes every element in every S_i-ascent and every S_i-descent from a;

ii) σ_i is *minimal*; i.e. omission of any set of elements from σ_i would destroy property i).

For $k = 2$, an S_1-line (resp. S_2-line) is called a *patrilineage* (resp. *matrilineage*). It is obvious that no two lines of the same sex can intersect without coinciding completely.

3. SEGMENTED SPACES

3.1 Definitions

A space with m patrilineages and n matrilineages is called an (m, n)-space. The intersection of a patrilineage and a matrilineage is a *segment*. An m, n-space in which every patrilineage has a non-empty intersection with every matrilineage is called a (marriage-) alliance, which therefore has mn

segments. In view of male-female duality, we may assume $m \geq n$. From now on, we shall use the word "space" to mean "alliance".

A *sociological K-relative*, where K is a kinship term, is defined as any person who is in the same segment and of the same sex as the corresponding biological K-relative; e. g. a "sibling" of a_0 is any person in the same segment as a biological sibling of a_0.

A marriage-rule is a pair of segments $\sum_1$, $\sum_2$ such that the no male in $\sum_1$ can have a child in common with a female in $\sum_2$.

A *segmented space* is a space with $m \geq 2$ with the marriage rule (S_i, S_i) for all i; i. e. no two persens in the same segment have children in common. In other words, marriage is "cross-patrilineage" and "cross-matrilineage." A 1, 1 space is said to be *trivially segmented.*

By this definition a marriage rule is "restrictive" e. g., a_0 cannot marry in $\sum_1$. For convenience, most of the marriage rules stated below will be in "prescriptive" form (the form commonly used by the native speakers themselves); e. g. a_0 must marry in $\sum_j$. But any prescriptive rule can be stated as a set of restrictive rules; i. e. if a_0 must marry in S_1, then a_0 cannot marry in $S_2, S_3, \cdots, S_{mn}$.

3. 2 The (1, 1) space

The simplest (set-distinguishing) space is the (1, 1) space, in which the two lines (patri- and matri-) obviously coincide, so that there is only one segment and therefore no marriage rule. Since other systems prohibit sibling-marriage, the (1, 1) space is sometimes called "sibling-space". The system appears to have been practiced, at least in part, by certain noble families in Europe, and by the family of Cleopatra in Egypt.

3. 3 The Kariera (2, 2)-space

The (2, 2) and (4, 4) spaces are represented by well-known examples, e. g. the Kariera tribe in the western part of Australia for the (2, 2), and the Murngin tribe in the northern part for the (4, 4).

The Kariera tribe, occupying a territory of about 3500 square miles, consists of ten hordes (though the exact number appears to be uncertain). The horde, averaging about 50 individuals, is the basic unit of economic and religious organization, centered on one or more waterholes, around which it leads a hunting and gathering life. The horde is descendent, patrilineal, exogamous, patrilocal and virilocal: namely, it claims descent from a single pair of (perhaps mythical) eponymous ancestors; every parson belongs permanently to his or her father's horde (i. e. a horde is a patrilineage); marriage is cross-horde; and a male remains permanently in the territory of his own horde, while a female moves, after marriage, from her father's territory to the territory of her husband. The ten hordes are divided into two moieties (i. e. halves) of five hordes each (though, unlike many other Australian aborigines, the Kariera tribesmen have no definity term for "moiety"). Each of the hordes in each moiety is divided into two parts, which in one of the moieties are called "Banaka" and "Palyeri", and in the other "Karimera" and "Burung". A marriage alliance consists of two hordes, one from each moiety. The horde from the Banaka-Palyeri moiety will here be denoted by H_0, and from the Karimera-Burung moiety by H_1.

The marriage rules, as stated by the natives, are "Banaka must marry Burung" and "Palyeri must marry Karimera". The children of a Banaka-father (resp. Karimera-father) are in Palyeri (resp. Burung) and conversely; and therefore, as a result of the marriage rules, the children of a Banaka-mother (resp. Palyeri-mother) are in Karimera (resp. Burung), and conversely.

So in the square array

$$\begin{pmatrix} \text{Banaka} & \text{Palyeri} \\ \text{Karimera} & \text{Burung} \end{pmatrix}$$

The horizontal rows are the two patrilineages (i. e. hordes) H_0 and H_1 and the two vertical columns are the *zero*th matrilineage and the first matrilineage. Thus the four parts Banaka, Palyeri, Karimera and Burung are in fact segments, in the sense defined above. In each of the two hordes, the even-numbered generations form one segment and the odd-numbered the other. Denoting the four segments by

$$\begin{matrix} 00 & 01 \\ 10 & 11 \end{matrix}$$

where the choice of Banaka for 00 is arbitrary but already determines all the other symbols (if patrilineages are to be horizontal, and matrilineages vertical), we see that the marriage rules can be restated as:

00 marries 11, and 01 marries 10,

so that the diagonal lines indicate the two *marriage-aggregates*, call them M_0 and M_1, i. e. the two sets of segments such that no marriage is cross-aggregate. If we choose an arbitrary generation in Banaka to be called the *zceroth generation*, then M_0 contains all the even-numbered generations, and M_1 all the odd-numbered, which means that a may marry b if and only if they are an even number (including zero) of generations apart.

Since a (sociological) brother-sister pair—i. e. a male and a female from the same segment, say Banaka—marry a (sociological) sister-brother pair in Palyeri, the system is called "direct-sibling-exchange". It is also called "cross-cousin marriage", in view of the fact that a male *m*, say in Banaka, marries his first-cousin any even number of times removed, since his wife comes from Palyeri and so do his cousins, who are not only his cross-cross cousins, i. e.,

*m*M, *m*MB and *m*MBD are in Palyeri,

but also his parallel-cross cousins, i. e.,

*m*F and *m*FZ are in Banaka, and therefore *m*FZD is in Palyeri.

On the other hand, neither the Kariera system nor any other system except the (1, 1) can be "parallel-cousin", neither parallel-parallel nor cross-parallel, since

*m*F, *m*FB, and *m*FBD are in Banaka, and

*m*M and *m*MZ are in Palyeri, so that *m*MZD is in Banaka, and therefore parallel-cousin marriage would involve the forbidden sibling marriage.

3. 4 Origin of the (2, 2) system

We can see how the system may have arisen in actual practice if we imagine that at some period in their early history the various hordes of the Kariera tribe had drawn apart from one another to such an extent that their contact was chiefly in the form of warfare, and that for mutual defense two hordes, H_0 and H_1, found it convenient to make a political alliance, which they then strengthened by intermarriage, after the fashion of the royal houses of Europe. Let us suppose that the alliance began with a mass-marriage of members of the "*zero*th generation" P_0^m, P_0^f, P_1^m, P_1^f. These *zero*th-round marriages will be of the form

$$P_0^m \leftrightarrow P_1^f, \qquad P_1^m \leftrightarrow P_0^f$$

and their (first generation) children will be

$$c_{01}^m,\ c_{01}^f,\ \text{(in Palyeri), and } c_{10}^m,\ c_{10}^f \text{ (in Karimera)},$$

were patrilineage is indicated by the first index and matrilineage by the second; e. g. c_{01}^m denotes a male child patrilineally descended from the eponymous male ancestor of H_0 and matrilineally descended from the eponymous ancestress of H_1. The first-round marriages of these first-generation persons will be

$$c_{01}^m \leftrightarrow c_{10}^f, \qquad c_{10}^m \leftrightarrow c_{01}^f,$$

with second-generation children

$$c_{00}^m,\ c_{00}^f \text{ (Banaka), and } c_{11}^m,\ c_{11}^f \text{ (Burung)},$$

who in turn may marry, in the second round of marriages, either into their own generation or, in case some of the progenitors have remained unmarried, into the *zero*th generation; and third generation children may marry either into their own generation or into the first generation, and so forth.

3. 5 The Murngin (4, 4) space; circulating counnubium

An example of a (4, 4) space is provided by the Murngin tribe in northern Australia, which consists of 60 hordes (again the number is not precisely determined) divided into two moieties of 30 hordes each, which the natives call the *Dua* moiety and the *Yiritcha* moiety. Each horde is divided into four parts, which in a Dua-horde are called Buralang, Warmut, Balang and Karmarung; and in a Yiritcha-horde Bulain, Kaijark, Ngarit, and Bangardi.

Although direct evidence is incomplete, it appears from observation of the use of kinspip terms that the standard marriage alliance consists of four hordes, two from each moiety, which we may call H_0, H_2 (from the Dua moiety) and H_1, H_3 (from the Yiritcha). Again using subscripts to distinguish hordes, we may write the names of the 16 segments in a square array:

Generation / Horde		G_0	G_1	G_2	G_3
Dua	H_0	Bur_0	War_0	Bal_0	Kar_0
Yiritcha	H_1	Ban_1	Bul_1	Kai_1	Nga_1
Dua	H_2	Bal_2	Kar_2	Bur_2	War_2
Yiritcha	H_3	Kai_3	Nga_3	Ban_3	Bul_3

The marriage rules, which are stated by the natives in the form: "Buralang sends wives to Bulain", etc., can be expressed in our notation by

$$(M_0):\ 00 \to 31 \to 22 \to 13 \to 00, \qquad (M_1):\ 10 \to 01 \to 32 \to 23 \to 10,$$
$$(M_2):\ 20 \to 11 \to 02 \to 33 \to 20, \qquad (M_3):\ 30 \to 21 \to 12 \to 03 \to 30,$$

so that there are four marriage-aggregates.

All members of a given horde come from the same, perhaps by now forgotten, eponymous male ancestor and all members of the same segment share the same eponymous ancestress as well. So if we regard sociological kinship terms, not as expressions of biological relationship (though they originated in that way) but as part of the ceremonial behavior expected from one person toward another, and if this behavior is based on both patrilineal and matrilineal descent, then it is natural for a Murngin tribesman to call his father and his greatgrandson by the same name *bapa*, as was mentioned in the Introduction, since the two of them are in the same segment, but to call his grandfather (*maraitcha*) and his son (*gatu*) by distinct names, since they are in distinct matrilineages; and similarly for cross-horde kinship terms.

3.6 Origin of the (4, 4)-circulating connubium

In our quasihistorical account of the origin of this (4, 4)-system, each of the participating hordes H_0, H_1, H_2, H_3 will furnish zero-generation males m_0, m_1, m_2, m_3, and females f_0, f_1, f_2, f_3. The marriages in the *zero*th round will be of the form

$$m_0 \leftarrow f_1,\ m_1 \leftarrow f_2,\ m_2 \leftarrow f_3,\ m_3 \leftarrow f_0, \text{ etc.}$$

with first- (and similarly fifth-, ninth, ···) generation children.

$$m_{01},\ f_{01};\ m_{12},\ f_{12};\ m_{23},\ f_{23};\ m_{30},\ f_{30};\ \text{etc.},$$

where, as before, patriline is indicated by the first index and matriline by the second.

It is easy to verify that in this so-called "regular" (4, 4)-marriage system (i. e. circulating connubium) every person marries a cross-cross cousin (who is not, however, as in the Kariera (2, 2)-system, also a parallel-cross cousin).

3.7 Larger alliances

In larger alliances, of 6, 8, 10, ··· hordes (the existence of two moieties means that the number must be be even), the principle of one name for one segment is blurred. We have seen that in a (4, 4) alliance the four names Buralang, Warmut, Balang and Karmarung (for a Dua-horde) are given to successive generations; e. g. Buralang to the segment consisting of the 0th, 4th, 8th, ··· generations, Warmut to the 1st, 5th, 9th, ··· generations etc. But these same names continue to be used for the successive generations in larger alliances as well, where the number of segments in each horde, e. g. 8 in an (8, 8) alliance, is too large to be accommodated by four names. Thus the same name, e. g. Buralang, is now given not only to the 0, 8, 16, ··· generations, belonging to the 0th matrilineage, but also to the 4, 12, 20, ··· generations, belonging to the 4th matrilineage; and the name Warmut is given to the 1st and 5th matrilineages etc. In a (6, 6) alliance, with six matrilineages, the name Buralang in given to the 0th, 4th, 8th, 12th, 16th, 20th, ··· generations, which belong respectively to the 0th, 4th, 2nd, 0th, 4th, 2nd, ··· matrilineages, the name Warmut is given to the 1st, 5th, 9th, 13th, 17th, 21st ··· generations, belonging respectively to the 1st, 5th, 3rd, 1st, 5th, 3rd ··· matrilineages, etc. In each horde the origin of the names, namely the distinct matrilineages in a (4, 4) alliance, is now forgotten, and they are regarded as names, not for matrilineages, but for generations.

3.8 The general (m, n)-space

The (2, 1)-space, with two patrilines (i. e. hordes H_0, H_1, each consisting of one segment) may be pictured as having arisen in the following way. A horde H_0, in which the females f_0 outnumbered the males m_0, and the males were relatively young, formed an alliance with a horde H_1, in which the males m_1 outnumbered the females, so that H_1 provided only males for the alliance. The *zero*th-round marriages were of the form $m_1 \leftrightarrow f_0$, with children m_{10}, f_{10}, while the males m_0 waited for one generation. The first-round marriages were $m_0 \leftrightarrow f_{10}$ with children m_{00} and f_{00}, while the m_{10} waited; the second-round marriages were $m_{10} \leftrightarrow f_{00}$, while the m_{00} waited, and so on. The marriages are all of the form "(sociological) uncle-niece", and sibling marriages are prohibited,

In the (3, 3)-space the alliance was formed by a horde H_0, with zero-generation persons m_0, f_0; a horde H_1 with m_1, f_1; and a horde H_2 with m_2, f_2. The discussion is similar for the other spaces, (3, 1) (3, 2) etc.

3.9 Composition of kinship terms

In the general (m, n)-space we will have mn segments:

$$\begin{array}{cccc} 00 & 01 & 02 \cdots & 0n \\ 10 & 11 & 12 \cdots & 1n \\ \vdots & \vdots & \vdots \; \ddots & \vdots \\ m0 & m1 & m2 & mn, \end{array}$$

where, as always, patrilineage is indicated by the first index, and matrilineage by the second. All calculations for the first index will be carried out modulo m (e. g. if $m = 4$, then $2 + 3 = 1$, etc.) and for the second index modulo n and, in general, the kinship term by which a addresses b (for convenience, we assume that b is male) depends only on the number p of patri-generations and the number m of matri-generations by which b is above a. Thus there will be mn such kinship terms in all.

Let us illustrate for the Murngin (4, 4) system. Here the corresponding 16 terms (we give only masculine terms and neglect certain variants) are:

00 *wawa*,	01 *gatu*,	02 *maraitcha*,	03 *bapa*,
10 *waku*,	11 *kaminyer*,	12 *waku*,	13 *due*,
20 *kutara*,	21 *gurrong*,	22 *kutara*,	23 *gurrong*,
30 *gawel*,	31 *galle*,	32 *gawel*,	33 *nati*.

Thus a person a_0 in segment 21 (i. e. Kar_2) will call a person a_1 in 13 (i. e. Kai_1), who is therefore $(1-2, 3-1)=(3,2)$ generations above him, by the $(3,2)$ term, namely *gawel.*

Consequently, the composition of terms proceeds according to the simple rule:

If a_1 is (i, j)-generations above a_0, and a_2 is (k, l)-generations above a_1, then a_2 is $(i+k, j+1)$-generations above a_0.

Thus in the Murngin $(4,4)$-space, if a_2 is $(3,1)$ generations above a_1 and a_1 is $(3,2)$-generations above a_0, then a_2 will be $(3+3, 1+2)=(2,3)$-generations above a_0. In other words a_0 will address his *gawel*'s *galle* as *gurrong.*

Similarly, in the Kariera $(2,2)$-space we will have the "multiplication" table for the composition of kinship terms:

00	01	10	11
01	00	11	10
10	11	00	01
11	10	01	00,

e. g. if a_0 is in Palyeri, a_1 is in Karimera, and a_2 is in Burung, then a_2 is $(1,0)$ generations above a_1, who is $(1,1)$-generations above a_0, and is therefore $(1+1, 0+1)=(0,1)$ generations above a_0, so that for the product or composition of Kariera terms we have the following "multiplication" table (table for addition of parti- and matri-lineages):

00	01	10	11		0	1	2	3
01	00	11	10		1	2	3	0
10	11	00	01		2	3	0	1
11	10	01	00,		3	0	1	2,

where on the right the four entries are indexed from 0 to 3.

This table is the Cayley multiplication table for the Abelian (i. e. commutative) Klein four-group, which is the direct product of two cyclic groups, each of order two. Similarly, the corresponding genealogical group for the general (m, n)-space is the direct product of two cyclic groups on in a space with k sexes, of k cyclic groups. Consequently, by a basic theorem in group theory every finite Abelian group is the genealogical for some (m, n)-space.

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劉 斌 雄

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