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KINSHIP, MARRIAGE AND AGE IN ABORIGINAL AUSTRALIA

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Abstract: McConnell (1930) first described and attempted to explain an "age spiral" in Australian Aboriginal systems of descent, marriage and kinship over eighty years ago. Since then, ethnographic and theoretical research concerning this matter has been sporadic and inconclusive, with societies that display this feature most often being treated as anomalous, transitional, hybrid or aberrant. Atkins (1981) attributed the failure to understand these societies to a lack of realism in the models; specifically to the widely accepted supposition that any 'normal' kinship system must entail an infinite or open series of successive genealogical generations each of which is both discrete and closed. Since that supposition can apply only to societies in which mean husband-wife age differences are zero or negligibly small, he suggested that the age spiral, reported in Australian Aboriginal societies where husband-wife age differences generally exceed 14 years, rests on a finite set of open generations rather than an infinite set of closed generations. His proposal means that the concept of generations as an infinite series of discrete, closed strata may not reflect a human universal, but rather may be an example of European ethnocentrism and over-simplification being interpreted mistakenly as self-evident scientific truth.

This paper compares models of Australian Aboriginal kinship based on traditional generational closure with models based on generational openness as embedded in age spirals or, more accurately, age biased helices. The objective is to salvage generational openness if it has any merit and to reject it if it does not. The research is based on my own and others' fieldwork as well as archival research and comparative studies of Aboriginal societies in Central Australia, Cape York Peninsula, Arnhem Land and Western Australia. Analytical methods include formal mathematical models; mechanical, statistical and network models; and computer simulations. The approach is primarily nonverbal, demographic and quantitative rather than verbal and cognitive.

The findings show that open and closed models entail radically different expectations about the structure and operation of Aboriginal societies in areas including but not limited to: genealogical frameworks, language group endogamy and exogamy, inbreeding coefficients, MBD vs. FZD marriage, prescriptive vs. proscriptive marriage rules, directed marriage cycles and classificatory kinship. In addition to comparing the strengths and weaknesses of open and closed models, the paper also evaluates the strengths and weaknesses of open models by themselves, in search of deficiencies that might justify their rejection. Several significant problems are introduced and discussed, but seem not to constitute fatal flaws.

The findings are likely to be of greater interest to scientists who are concerned with the survival of Aboriginal societies over the last 50 millennia and of lesser interest to those who focus exclusively on structures of systems of kin classification. The impact of these findings on the broad study of Dravidian and Dravidian-like kinship terminologies may be significant, but I am not qualified to investigate that issue and leave it to others. An extended and detailed analysis of relationships between openness and language group exogamy is in preparation.

KINSHIP, MARRIAGE AND AGE IN ABORIGINAL AUSTRALIA

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KINSHIP, MARRIAGE AND AGE IN ABORIGINAL AUSTRALIA[1]

1. Preliminaries

1.1. Objectives

This paper is an attempt to make sense of what have been called, among other things, aberrant, asymmetric or age biased systems of descent, marriage and kinship in Australian Aboriginal societies. It is an exercise in pattern detection whose objective is to describe the structure and operation of these systems. It examines how they work locally and speculates on their history. A second paper, in preparation, deals with their operation regionally, and possibly continent wide. My work focuses primarily on the Alyawarra with whom I conducted fieldwork in 1971, and secondarily on the Northern and Eastern Aranda of Central Australia, the Kariera of Western Australia, the Wanindiljaugwa of Groote Eylandt, and the Wikmunkan of Cape York Peninsula (see Appendix for alternate spellings and locations). By exploring an anomaly that has lurked in the shadows of Australian Aboriginal kinship research for eighty years, I attack and defend vertically asymmetric marriage and kinship systems, seeking to vindicate or bury them, whichever they deserve.

Twentieth century anthropologists with interests in Aboriginal kinship focused largely but not exclusively on "structures of systems of kin classification" (Scheffler 1981:167) and related topics; i.e., on the rules or logic underlying Aboriginal kinship terminologies. This traditional concern with language-based kinship terminologies, which by definition emphasizes named categories of kin relations, needlessly hampers systematic analysis of implicit or unnamed relationships. Here I focus more on what people do than on what they say they do, exploring nonverbal behavior, unnamed implicit relationships, things people take for granted, things often subsumed under the expression "it goes without saying …".

The point of view is biobehavioral, exploring generational structures and age relations mainly through data on biological descent, demography and marriage practices. It employs mechanical, statistical, and multi-dimensional network or reticular (White and Houseman, n.d.) approaches to kinship while touching only briefly on linguistic, terminological, algebraic, componential and related cognitive matters. Generally the statistics are not confirmatory but

[1] **Acknowledgements**: I am especially grateful to John R. Atkins and Douglas R. White. John Atkins' fascination with ball-and-stick models and Ursula McConnel's Wikmunkan data primed him to see and immediately state the central problem of this paper when I told him I had "found" an age biased helix in my Alyawarra data. On the other hand, Doug White has been the Devil's Advocate for a decade, challenging, guiding, and assisting me as I have struggled with these and related ideas. Without either of them this paper would not have happened. Next I thank the Alyawarra speaking people of Central Australia for their remarkable adherence to the wisdom of the Dreamings that epitomizes "abidingness", for their wonderful sense of humor, and for their enthusiastic participation in my efforts to record a vast amount of data that I hoped would be of value to them as well as to the study of human societies. I gratefully acknowledge the many contributions of electronic resources including: Google Earth; Wolfram Demonstration Projects; Wikimedia Commons; KinSources Kinship Data Repository; Michael Fischer's *KinshipEditor 3031*; and Pajek, pgraph and PUCK software. Finally, I thank the many scholars, cited and uncited, whose data and interpretations shaped the work. Of course I am fully responsible for all of its deficiencies

rather are in the tradition of pattern detection and exploratory data analysis inspired by Tukey (1977). Alternative, classic approaches to the study of familial generations and related topics appear in the works of Radcliffe-Brown (1931), Evans-Pritchard (1940), Levi-Strauss (1949/1969), Murdock (1949), Leach (1954), Lounsbury (1964), Bohannan and Middleton (1968), Barnes (1968, 1971), Denham (2011) and many others.

Part 1 introduces the paper from several perspectives. Part 2 examines a hypothetical mechanical model of a "generic" horizontally and vertically asymmetric Australian Aboriginal marriage system. Part 3 tests that model with statistical and network analyses of ethnographic data, mainly from the Alyawarra language group in 1971.

In Alyawarra-English, "proper" means consanguineal or actual, "tribal" means classificatory, and "skin" means section or subsection.

1.2. Atkins' statement of the problem

John R. Atkins (1981) stated the problem very clearly:

> "Without exception [kinship models] conform to a hoary old anthropological assumption that I'll call The Axiom of Generational Closure. By this I mean the tacit but widely accepted supposition that any "normal" kinship system - or at least every proper model of such a system - must entail an infinite or open series of successive genealogical generations each of which is not only discrete but also closed. Models that embody this supposition apply only to societies in which the average or expected F-M age difference (and therefore normally also the average H-W age difference) is zero or negligibly small. But most real societies are characterized by systematic H>W and F>M age differences which often are sizeable. For example, the 14-year F>M age disparity recently reported for the Alyawarra (Denham, McDaniel, and Atkins 1979) cannot be dismissed as atypical for Australian systems, and it certainly is too large to be neglected by the kinship theorist. The model that we proposed for the Alyawarra incorporates a finite set of open generations rather than the reverse."

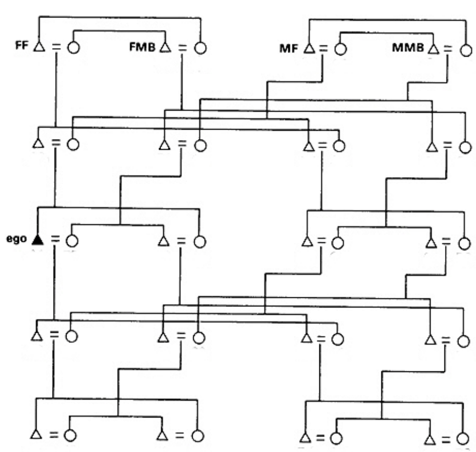


Figure 1-1. Symmetric Aranda diagram.

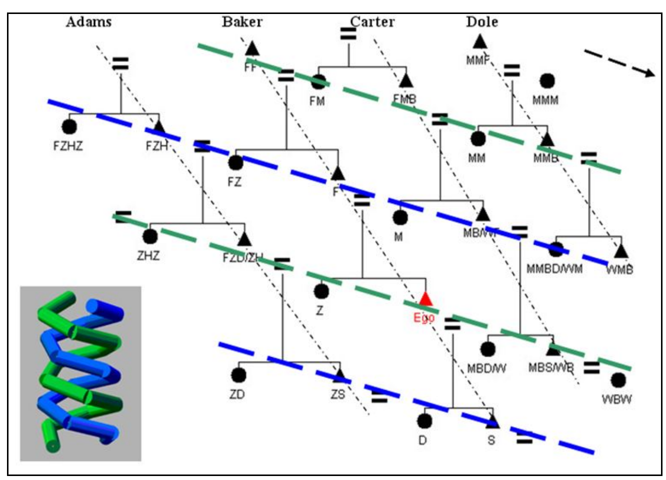


Figure 1-2. Part of asymmetric Alyawarra diagram.

The contrast that Atkins makes is depicted somewhat impressionistically in Figures 1-1 and 1-2. The traditional Aranda model is based on horizontal, closed generations stacked endlessly on top of each other, while the age biased Alyawarra model is based on exactly two endless, diagonal, open generations that may, under some conditions, form a helix. The key contrasts here are between symmetric and asymmetric and between closed and open. I explore these contrasts in detail below. These are normative models that can incorporate language, rules, normative data, and ideal genealogical relationships as well as kinship and section terms. Each contains genealogically based kinship "positions" that correspond to kinship terms, but the positions are equivalence classes that categorize genealogical relatives, not actual genealogical relatives.

The principal problem with bilaterally symmetric Australian Aboriginal kinship models, such as those for Kariera and Aranda (Figure 1-1), is that while they might fairly represent Aboriginal ideologies, they tell us nothing about actual, physical, biological descent and marriage. Their lack of realism in this regard is reminiscent of model ships that will not float and model airplanes that will not fly.

When we disregard age relations, we simply gloss over one of the most conspicuous facts of life in most Australian Aboriginal societies. When we pretend that the societies are closed and the descent relations are indeed consanguineal as they appear to be, we immediately encounter lethal inbreeding coefficients. After 10 iterations, the youngest people in a classic Kariera diagram have an inbreeding coefficient of F=0.508; in a classic Aranda model it is F=0.245. That means that the Kariera inbreeding coefficient is more than twice that for parent-child and sibling incest (F=0.250), while the Aranda value is only 0.005 less than that for parent-child and sibling incest. As has long been known, these values simply are not sustainable in human societies.

The only ways to make them work with regard to actual human reproduction are to: a) incorporate the W<H 14+ year age bias that yields significant changes in the structure of the model, and either b) define descent relationships as primarily classificatory rather than consanguineal, thereby negating the genealogical linkages that give the models their structure, thus converting the diagram to a metaphor, or c) permit intermarriage between exogamous societies, thereby violating the model's endogamous closure, or both b) and c). The helical model in Figure 1-2 incorporates the age bias and has a modestly lower inbreeding coefficient (F=.230 after 10 iterations) in its endogamous form, but by far its most important feature it that it is intrinsically open to intermarriage among exogamous societies.

I do not argue that the age biased model Atkins advocated is the only way to proceed, but rather that it is one viable option for simultaneously accommodating the age bias, eliminating societal closure, and facilitating a significant reduction in inbreeding coefficients while still accommodating key features of Aboriginal ideology. It is quite consciously an attempt to "save" the traditional models by bringing them into better conformity with reality while demonstrating both their strengths and their weaknesses.

A better way to proceed might be to throw out the traditional models altogether and replace them using a totally different approach. I expect that will happen, but that is not my objective here.

1.3. A dismal history of age biased marriage systems

During the 20th century, the matter of age biased generations was addressed repeatedly in terms of social structure and kin terminology but not in terms of biology, and was dismissed each time with no clear resolution.

McConnel's (1930, 1939-40, 1950, 1951) early series of ethnographic reports from several societies in Cape York Peninsula concerning senior-junior marriages explicitly discussed an "age spiral" as a defining feature of the Wikmunkan marriage system. Having worked on this matter over a period of decades, her later work published in 1950 is related to, but is distinctly different from, her earlier work from the 1930s. I focus on her report from 1950.

Warner (1938) reported an asymmetric marriage system from Arnhem Land, and the resulting Murngin Controversy finally was more-or-less abandoned following publications by Bohannan and Middleton (1968) and Barnes (1968).

Levi-Strauss (1949/1969:214), after struggling with reports such as McConnel's, metaphorically threw up his hands and concluded that they were "aberrant", meaning "anomalous" with a negative connotation.

Leach (1951), B.S. Lane (1961) and others who wrote on asymmetric marriage systems at mid-century focused on the flow of spouses unidirectionally but horizontally within generations that conformed to Atkins' Axiom of Generational Closure, although symbolic attributes such as wealth or status gave a metaphorically vertical aspect to the asymmetry. Following in this tradition, Needham (1962, 1971) and McKnight (1971) rejected McConnel's arguments concerning a non-metaphorical age-based vertical asymmetry.

Rose (1960), on the basis of detailed, quantitative fieldwork on Groote Eylandt, concluded that systems like those in Figure 1-1 simply would not work in societies with large wife-husband age differences that characterize many Australian Aboriginal societies. His work on Groote Eylandt often has been cited for its great merit (De Josselin de Jong 1962), but his rejection of traditional Kariera and Aranda system models has been consistently forgotten or ignored.

Guhr (1963) did a masterful evaluation and integration of 100 years of Aranda kinship data, and produced detailed diagrams of asymmetric 4-section and 8-subsection systems in Central Australia that correspond precisely to statements by Spencer and Gillen (1899:558-9, 1927) and many others. To the best of my knowledge, his monograph featuring a kind of early meta-analysis (Glass 1999) has been cited in only one subsequent publication.

Hammel (1976a) demonstrated that it is logically impossible for a generation to form a closed loop when men systematically marry younger women and their sisters systematically marry older men. He argued further that age biases in *either* direction (wife younger *or older* than husband) predispose a society toward marriage with MBD and away from marriage with FZD, and cited a brief letter by Rose (1965) to the same effect. In a sad commentary on this issue, Hammel (1976a:157) says: "Leach (1957, 1965), confronted with evidence of unilateral exchange behavior by Salisbury (1956) and Rose (1960, 1965), stubbornly contended that that was not what he and Levi-Strauss were talking about. He is correct. That is not what they were talking about. My suggestion is that they should have been …". And there the matter seems to have rested.

Blundell and Layton (1978) and Keen (2004:199) reported asymmetric generations among the Ngarinyin and Worora in the Kimberleys, and Keen (1982) came close to depicting age biased generations among the Yolngu / Murngin in Arnhem Land.

Denham, McDaniel, and Atkins (1979) argued that age biased generations and Omaha skewed kinship terms were present among the Alyawarra of Central Australia. The argument stimulated considerable controversy but Scheffler (1982) and others rejected the work and it suffered the predictable fate of (near) oblivion.

Tjon Sie Fat (1983a, 1983b), responding to Denham et al. (1979), devoted two theoretical articles to mathematical interpretations of helical structures and circulating connubia. Working from first principles rather than from data, he constructed a family of mathematical models of age biased systems focusing on MBD marriages, relative ages of spouses, generation moieties, number of descent lines required for closure, and other defining features of age biased marriage systems.

Jorion (1993:143) quotes the Murngin ethnographer, Warner (1931:172), who says: "The two main elements in Murngin kinship are the patrilineal lines and their lateral connections through the intermarriage of the five generations of the seven lines of descent." Jorion notes that "this piece of information has been regarded at best as anomalous and at worst as mistaken by all authors who have worked on the Murngin puzzle: there seemed no way in which one could match the eight subsection system with Warner's claim of seven patrilines with patricycles of five generations." Jorion then uses a helical model to demonstrate how age biased generations might contribute to solving this aspect of a problem that for half a century was not amenable to analyses using the standard Aranda model as a prototype.

Allen (1998:321) fleetingly mentions using a double helix as a diagrammatic device for representing a combination of linear and circular time in his tetradic model, one helix for each generation moiety. But he holds fast to an open set of finite generations upon which the helix would be superimposed for illustrative purposes, he seems to be unaware of the age bias that would be integral to such a device, and he does not mention the device a few years later (Allen 2007) in a summary statement of his work on the tetradic model.

McConvell and Alper (2002) and McConvell (2010) analyze optional and obligatory asymmetric Omaha skewing in kinship terminologies from the perspective of skewed terminologies rather than age biases. The apparently closely related topics of age bias and Omaha skew in Aboriginal Australia are better documented now than half a century ago, but much remains to be done.

Perhaps the naysayers have it right; perhaps this motley collection of "aberrant" phenomena truly deserves the obscurity in which it has languished for nearly a century. But it seems to be one of those anomalies that won't go away, challenging to those who have sought to understand it, threatening to those who have sought to dismiss it, responding gradually to theoretical efforts to make it respectable. Its nagging persistence suggests that its intractability may lie not in the phenomenon itself, but in the congeries of assumptions and attitudes that interfere with our getting a firm grasp of it. Kuhn (1962:77) was concerned about the impact of "severe and prolonged anomalies" on the history of science. Since McConnel's first report on the Wikmunkan appeared 80 years ago, this anomaly qualifies as prolonged, but is it severe enough to be important? Perhaps my efforts will answer this question.

The transition from a closed world to an infinite universe (Koyré 1957) was not easy for Medieval and Renaissance cosmologists. It did not happen in a single leap or in a gradualistic evolutionary straight line. Rather, it advanced on many fronts as multiple working hypotheses (Chamberlain 1890) were offered competitively to escape the limits of earlier theories. Such is the spirit in which I offer these ideas concerning age biased generations, one of many possible ways to escape the long tradition of building closed models of open Australian Aboriginal systems of descent, marriage and kinship.

As Gould and Lewontin (1979:586) note, "[P]lausible stories can always be told. The key to historical research lies in devising criteria to identify proper explanations among the substantial set of plausible pathways to any modern result".

1.4. Generation intervals

The duration of a generation interval, defined as the age difference between a parent and a child, is a major determinant of the age structure of populations and is a key parameter when using genetics to date population divergence events such as mutations and migrations (Weiss 1973). However, no consensus exists regarding the length of human generation intervals, and a wide variety of interval lengths have been used. For example, in 26 recent studies, 8 used 20 years, 13 used 25-29 and 5 used 30-35 years (Fenner 2005) and only one distinguished between male and female generation intervals. This lack of precision and/or standardization makes comparison between studies difficult, questions the accuracy of divergent date estimations and generally weakens research into human evolution. Methods used to compute individual parent-child generation intervals and mean or aggregate societal generation intervals are described in works such as Tremblay and Ve´zina (2000), Lancaster (2007) and Fenner (2005).

All approaches are problematic for obtaining accurate, complete data on parent-child and parent-parent age differences in non-literate, non-numerate societies with no birth records as was traditionally universal in Aboriginal Australia. A relatively strong approach focuses exclusively on generation intervals based on birth dates (where obtainable) of living children and their living parents, and yields potentially verifiable parent-child and wife-husband age differences. A weaker first proxy uses wife-husband age differences, perhaps estimated, when data on parent-child differences are missing. An even weaker second proxy uses data on age at first marriage for husbands and wives which, like data concerning deceased people and any events that occurred in earlier years or decades, may pose intractable problems due to accidental and deliberate data distortions. Thus we can very cautiously approach the problems at hand by way of mean parental generation intervals, mean wife-husband age differences and mean ages at first marriage.

	Maternal (MC) Generation Interval	**Paternal (FC) Generation Interval**	**Wife-Husband (WH) Age Difference**	**Number of Cases**
More Developed Countries	27.3	30.8	3.5	151
Less Developed Countries	28.3	31.8	3.5	40
Non-Australian Hunter-Gatherers	28.0	33.4	5.4	132
Australian Aboriginal Hunter Gatherers	28.0	42.6	**14.6**	25

Table 1-1. Mean MC and FC generation intervals and mean W-H age difference.
Approximate values based on data from 191 nations (Fenner 2005) and
157 hunter-gatherer societies (Binford 2001, Table 4.07).

Table 1-1 summarizes recent data concerning parent-child generation intervals and wife-husband age differences in 151 More Developed Countries (MDC), 40 Less Developed Countries (LDC), 132 non-Australian hunter-gatherer societies and 25 Australian Aboriginal hunter-gatherer societies (UN 2000, Binford 2001, Helgason et al. 2003, Tremblay and Ve´zina 2000, Fenner 2005).

Recent genealogy-based research shows Icelandic female/male/aggregate generation intervals to be 28.7/31.9/30.3 years (Helgason, et al. 2003) and French Canadian intervals to be 28.9/34.5/31.7 (Tremblay and Ve´zina 2000), both of which are greater than values commonly used in genetics studies. Expanding on the detailed Icelandic and French Canadian studies by using data from World Marriage Patterns (UN 2000) for 191 nation-states, Fenner (2005) shows that mean female/male generation intervals for less developed countries (LDC) are 28.3/31.8 years and for more developed countries (MDC) are 27.3/30.8 years.

Mean wife-husband age difference varies across societies and may be anywhere from -2 years (wives on average 2 years older than husbands) to +28 years (husbands on average 28 years older than wives) (UN2000). Fenner's (2005) analysis of Binford's (2001) data on mean wife-husband age differences at first marriage in 157 hunter-gatherer/forager societies shows husbands on average to be 5.35 years older than their wives worldwide (n=132) outside of Aboriginal Australia, but within Aboriginal Australia (n=25) the mean wife-husband age difference is 14.64 years (approximately 14 years, depending on which data are used). Their very large wife-husband age difference, combined with a mean maternal generation interval of approximately 28 years, yields a paternal generation interval of about 42 years. In other words, Australian Aboriginal female/male/aggregate generation intervals are approximately 28/42/35 years. These computations include unknown and variable numbers of married women both below and above reproductive ages (i.e., infant bestowals and elderly widow remarriages) whose impact on mean generation intervals is unknown but probably negligible.

Only 2 of 348 societies considered here show a negative wife-husband mean age difference (UN2000, Fenner 2005). Thus the positive age difference is almost universal in human societies, but is highly variable and seems to be most extreme among the Aboriginal societies of Australia.

Fenner (2005) notes that asymmetric generation intervals have obvious and unavoidable implications for studies of human origins and migrations focusing independently on the descent of females (mtDNA) and males (Y-chromosome). The present article argues that this striking sexually based difference, wherein the female generation interval is approximately .667% of the male generation interval in Australian Aboriginal societies, has had major implications for the structure and operation of those societies in the ancient and recent past and into the present.

This sexually dimorphic behavior (Gay and McEwen 1980), which is manifested in a sex based mean difference in generation intervals and is virtually universal in human societies, appears to be maximized in Australian Aboriginal societies by cultural factors that sharply delay the onset of socially recognized mating by men. I suggest that this sexual dimorphism combined with the matrilateral bias that derives from any asymmetric distribution of heritable features (Hammel 1976a) underlie a "package" of puzzling phenomena including a) the W<H age bias combined with MBD marriage that are so conspicuous in Australian Aboriginal societies, and b) the worldwide rarity of W>H age biases and FZD marriage. Specifically these factors together suggest that MBD marriage is common and FZD marriage is rare for reasons of biology and logic. Functionalist arguments concerning their strengths and weaknesses in integrating societies may be reasonable with regard to their effects but may have little or nothing to do with their causes.

1.5. Descent and generation moieties

Moieties are ubiquitous if not universal in Australian Aboriginal societies. Here I briefly introduce this fundamental and complex set of relationships.

A moiety system divides an entire society into two linked groups of people that assume complementary positions and functions relative to each other. The two groups may be thought of as "halves" of a society. There are several ways to divide a society into halves. For example, patrilineal descent moieties (patrimoieties) and matrilineal descent moieties (matrimoieties) divide societies into two different "vertical" sets of halves on the basis of sex/gender and descent linkages. Both are present simultaneously in most Australian Aboriginal societies, either explicitly (named) or implicitly (unnamed); if unnamed, the two divisions may be more appropriately called "sides" (Houseman 1997; Houseman and White 1998). Both are exogamous, taking husbands and wives exclusively from the opposite group in the same moiety pair.

Generation moieties, unlike descent moieties, divide a society into halves based on "horizontal" layers defined in terms of marital linkages in the form of sibling-in-law chains. They too are present in almost all Australian Aboriginal societies (White, I.M. 1981), often are unnamed and typically are endogamous; i.e., people generally take husbands and wives from within their own generation moieties.

All three forms of moieties tend to be implicit (i.e., unnamed) rather than explicit. Patrimoieties often are easier to detect because of the named clans or Countries that constitute them and the named sections that occur at the intersections of patrimoieties and generation moieties.

Figure 1-3 is a simple 3-dimensional representation of the tripartite moiety structure that characterizes so many Australian Aboriginal societies. It has 6 moieties (patridescent P1+P2, matridescent M1+M2, generation G1+G2) and 4 nodes (sections) where moieties intersect. Arrows with points (P1+P2; M1+M2) represent patri- and matri-descent respectively; lines without points (G1+G2) represent marriage. The number of descent lines within each descent moiety is variable, as is the number of sibling-in-law chains within each generation moiety.

These generation moieties, sometimes known as merged alternating generation levels, can be viewed both horizontally and vertically. Horizontally, Ego's own generation moiety consists of himself, his brothers, sisters and cousins in G.0, **plus** his grandparents and their siblings and cousins in G+2, **plus** his grandchildren and their siblings and cousins in G-2, yielding a single "composite generation" or "super generation" consisting of even numbered generation levels (…, G+4, G+2, G0, G-2, G-4, …). The other generation moiety consists of his parents and their siblings and cousins in G+1 and his children and their siblings and cousins in G-1, yielding another composite generation that includes an extended series of odd numbered generation levels. Marriage within a generation moiety generally is prescribed while marriage with members of the opposite generation moiety generally is proscribed (Tonkinson 1979; White, I.M. 1981; Dousset 2005).

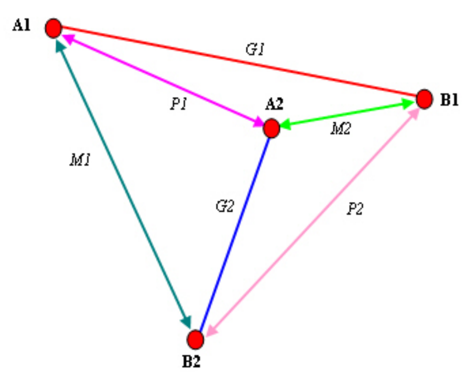


Figure 1-3. Tetrahedral moiety structure.

This representation was inspired in part by Allen's (1998, 2007) tetradic model.
Thanks to D.R. White for the diagram.

Viewed vertically, a man in section A1 has children in A2 in accordance with P1 patridescent moiety membership. His sons' children are in A1, his sons' son's children are in A2, and so on, back and forth, through the descending generation levels *via* P1. It follows, in ascending generation levels, that A1's father is in A2, his FF is in A1, and his FFF is in A2. The same man in section A1 finds his M and MB and their multi-generational patriline in section B2, and finds his W and her multi-generational patriline in section B1. In other words, each section contains a specific set of kin, spanning multiple generation levels, who are related to each other in specific ways through descent and marriage.

Isobel White (1981) suggests that dividing societies into two generation moieties or "super generations" (mine and not-mine) is just as obvious as dividing them into two patrilineal descent moieties (mine and not-mine) or two matrilineal descent moieties (mine and not-mine). In fact, virtually all Australian Aboriginal societies have all of these kinds of moieties, often unnamed, with two endogamous alternating generation levels as the most widespread system of explicit societal divisions (see Radcliffe-Brown in Levi-Strauss 1949/1969, p.499).

I have paid special attention to generation moieties here because of their importance throughout the remainder of this paper.

2. Mechanical approaches to asymmetric generations

2.1. Circulating connubia

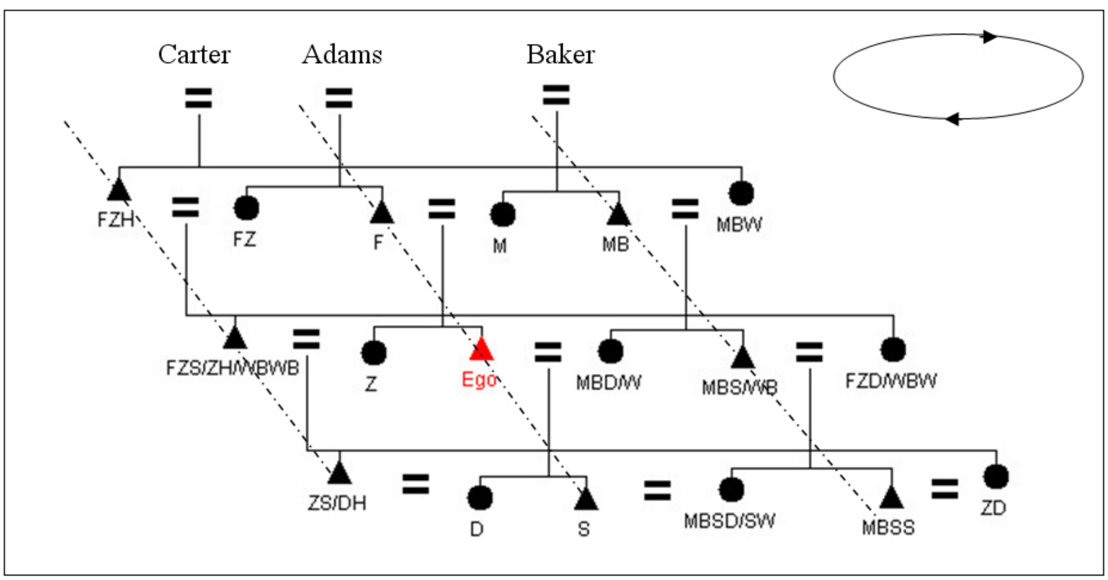


Figure 2-1. Circulating connubium.

A circulating connubium is an arrangement in which women move sequentially from one family to another in a circle as in Figure 2.1, where Adams men marry Baker women, Baker men marry Carter women, and Carter men marry Adams women. The form generally occurs when marriages are restricted to matrilateral cross cousins (MBD). If the society is small and endogamous, and everybody consistently follows the same MBD marriage rule, the sibling-in-law chain that constitutes each marital generation forms a closed unidirectional loop as shown in the upper right corner of the diagram. Women (or men) flow horizontally from family to family in one direction or the other (Tjon Sie Fat 1983a; Shapiro 1969).

This diagram represents an endogamous society with husbands and wives of approximately the same age yielding an indefinite number of stacked age constant circular generations. The light dashed lines identify Carter, Adams and Baker patrilineal descent lines. Adams men marry Baker women, Baker men marry Carter women, Carter men marry Adams women. The sibling-in-law chain that forms each marital generation is a closed loop in which women flow horizontally in one direction from family to family.

Figure 2-1, by disregarding relative ages of wife and husband, implies that marriages occur with spouses of approximately one's own age, so the pattern is incompatible with the 14.6 year mean wife-husband age difference. The default option is societal endogamy, but exogamy that does not appear in the diagram is possible and, at least in principle, the structure itself can expand to accommodate more descent lines. Furthermore the degree of inbreeding declines when classificatory kin substitute for consanguineal kin. The pattern is widespread throughout East and South Asia (Levi-Strauss 1949/1969) and the Murngin Yolngu (Warner 1937/1958) may be a classic example in Australia.

2.2. Horizontally and vertically asymmetric generations

Age biased generations occur when a unidirectional, generally MBD, marriage rule is combined with mean female and male generation intervals that are significantly different from each other as in so-called "May-December marriages". Australian Aboriginal descent and marriage systems that are both horizontally and vertically asymmetric have unidirectional flows that characterize circulating connubia combined with traditional and significant differences in mean maternal and paternal generation intervals.

In societies such as the Wikmunkan (McConnel 1950) with senior/junior marriage systems, the age bias is explicitly acknowledged in the kinship terminology. In societies such as the Wanindiljaugwa (Rose 1960), Northern Aranda (Guhr 1963) and Alyawarra (Denham and White 2005), the age bias is not explicitly acknowledged by the Aboriginal people but is clearly detectable in demographic and behavioral data. In the following paragraphs I briefly introduce each of these as diverse representatives of societies with horizontally and vertically asymmetric marriage systems so that I can refer to them throughout the remainder of the paper. For extended discussions of generations and age relations in Aboriginal Australia, see Denham (2010c, 2011).

2.3. McConnel's Wikmunkan

Senior/junior marriage systems introduce systematic spousal age differences into some Australian Aboriginal societies by distinguishing between older and younger siblings of oneself or one's parents (McConnel 1950; McConvell and Alper 2002). In circulating connubia husbands and their wives (MBD) are presumed to be of approximately the same mean age so that sibling-in-law chains form closed loops. But if men in Figure 2-2 are forbidden to marry mother's elder (e) brother's daughter (MeBD) but permitted or expected to marry mother's younger (y) brother's daughter (MyBD), generations based on the resulting sibling-in-law chains become age biased.

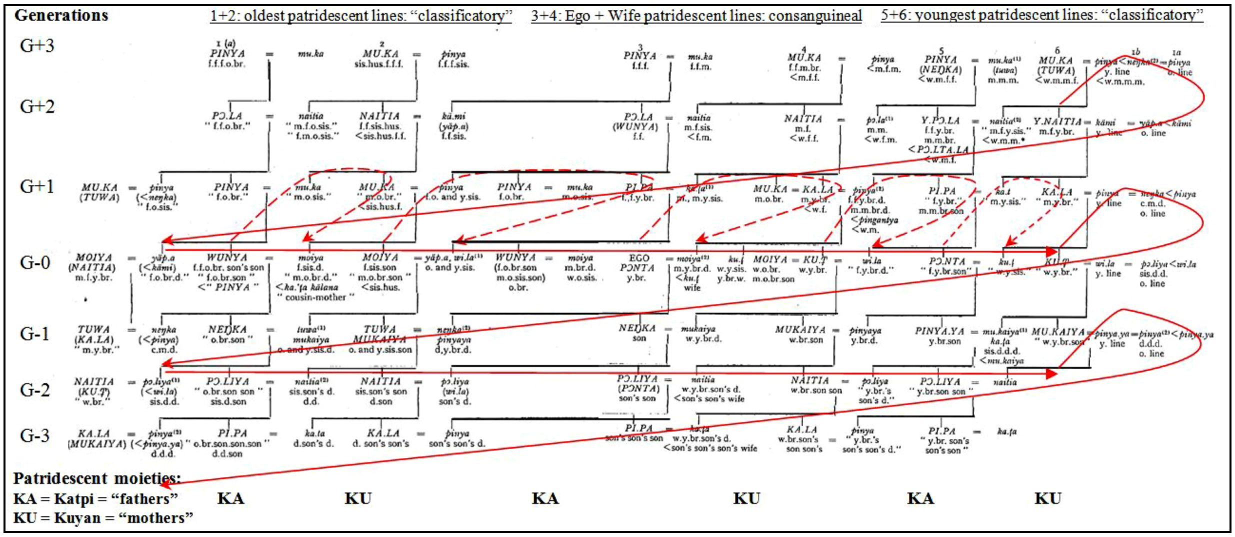


Figure 2-2. Relabeled version of McConnel's (1950) Wikmunkan double helix.
Sibling-in-law chains: red = generation moiety A (G+2,0,-2,-4); unmarked = generation moiety B (G+3,+1,-1,-3). No numerical age data available. This structure is equivalent to the Alyawarra structure in Figure 2-4. (Please enlarge the image by 250% to view details.)

Figure 2-2 is an extensively relabeled copy of McConnel's (1950:121-122) Diagram I, not her original effort from 1930, but her significantly different final version from 1950. In it men marry their MyBD who tend to be considerably younger than the men, and women marry their FeZS who tend to be considerably older than the women. The distinction between MyBD and MeBD is coded into the kinship terminology with separate kinship terms for the two kin types (Read 2004).

Restricting marriage to MyBD disrupts the circular flow of women that characterizes circulating connubia. While women continue to flow in one direction, the loop no longer closes. As illustrated in Figure 2-2, the flow is not horizontal but is inclined diagonally so that older men "reach downward" and to the right to recruit younger women as wives. This pattern supports Hammel's (1976a) theoretical argument that it is logically impossible for a generation to form a closed loop when men systematically marry younger women and their sisters systematically marry older men.

Since McConnel's diagram uses a traditional infinite or open series of successive genealogical descent and marriage generations each of which appears to be not only discrete but also closed, the continuous sibling-in-law chains that form endogamous generation moieties are obscured in the original and are only slightly more visible in the copy when the red line is added to accent the connections.

2.4. Rose's Wanindiljaugwa

Rose's (1960) extensive quantitative data on extreme wife-husband age differences and MBD marriages among the Wanindiljaugwa of Groote Eylandt reveals an 8-subsection system and a kinship terminology compatible with bilateral sibling exchange marriage. However his analysis of marriages and genealogies reveals a predominance of MMBDD marriage combined with implicit age biased generations that preclude systematic bilateral sibling exchange marriage. He concludes that the system resembles both the so-called Murngin from adjacent parts of Arnhem Land and the Aranda from Central Australia.

On the basis of his work on Groote Eylandt, combined with Radcliffe-Brown's (1931) and Spencer and Gillen's (1899/1968, 1927) frequent emphases on strong preferences for MBD marriage among Kariera and MMBDD marriage among Aranda, Rose explicitly rejects symmetric representations of these systems on the grounds that they simply cannot work in real Australian Aboriginal societies. The problems associated with diagramming the Wanindiljaugwa system were such that his monograph does not include a diagram of it.

In this context, Rose (1960:170) focuses on the possible contradiction between Spencer and Gillen's (1927) symmetric model of Aranda kinship and their "categorical" statement that "a man marries his MMBDD". Likewise he urges us to reconsider the traditional symmetric Kariera model in light of Radcliffe-Brown's frequent statement that the Kariera system shows a marked preference for matrilateral marriage (Radcliffe-Brown 1913:156, Levi-Strauss 1949/1969:219, Rose 1960:170, De Josselin de Jong 1962).

Keen (1982:637, Figure 3), working in Arnhem Land several decades later, almost captures the age biased generational structure described here in reporting an interesting variation on the age biased theme, perhaps midway between senior-junior and generic age biased systems, among the Murngin Yolngu:

> "The Yolngu sort all those women likely to be younger than a man from those likely to be older, classifiying MBD, MMBDD, and MMMBDD (matrilateral cross cousins) as *galay*, but FZD, MFZDD, FFFZDDD (patrilateral cross cousins) as *dhuway*. Yolngu marriage rules therefore consistently specify marriage with a woman likely to be younger, optimizing conditions for age-related polygynous marriages" (Keen 1982:640).

2.5. Guhr's Northern Aranda

Following immediately on publication of Rose's (1960) Groote Eylandt monograph, Gunter Guhr (1963) published a remarkable dissertation on Aranda kinship that has been ignored for half a century. His meta-analysis of almost 100 sources dealing with Aranda kinship published prior to 1963 strongly supports Rose's rejection of Radcliffe-Brown's symmetric model of Aranda kinship.

Guhr worked first and foremost with Spencer and Gillen's (1899) detailed explanation of the *tualcha mura* (proper mother-in-law) custom in which two young children, one a boy and the other a girl his own age, enter into a ceremonial relationship whereby the boy has a right to marry the girl's first daughter when that daughter reaches marriageable age. If, for example, the boy and girl are three years old at the time of the ceremony, then the girl must continue to mature until she is about 15 years old before she can marry and begin to reproduce, and her own first daughter must mature for about 15 years before she becomes marriageable. The result is that the boy will be about 30 years old when his promised wife reaches age 15, yielding an expected W<H age difference at first marriage of approximately 15 years.

To accommodate the age difference, Guhr splits each of Radcliffe-Brown's bilaterally symmetric generations into a pair of adjacent generations that are 15 years apart, and postulates unilateral marriage between those age off-set generations, His graphic representation of the W<H age difference based on *tualcha mura* appears in Figure 2-3. The members of each pair of generation moiety lines are slightly separated from each other to enhance legibility.

Amidst the complexities of this Northern Aranda 8-class system, Guhr places H and his siblings (B and Si) in the left-most descent line in G0, and his W (MMBDD = M^2BD^2) and her siblings in the right-most descent line in G1; that is, H and W and their sibling sets are in adjacent generations but on opposite sides of the diagram with W being one generation younger than H. At the level of the marital family, this distinction means that the generations in wife's descent line are desynchronized from those in husband's descent line. At the level of the society, it means that one-half of the intermarrying pairs of classes is off-set from the other half by an amount equal to the W-H age difference. The Figure clearly indicates that the age off-set is not just a marital family matter, but rather is a systemic difference that simultaneously defines age relations among all of the marriage classes. Marriages are aligned in conformity with descent generations rather than marital generations or sibling-in-law chains.

Guhr's use of an age off-set foreshadows Allen's (1998:323) use of "generation semimoieties" to make sense of subsection systems such as that of the Aranda. But both Guhr's age off-set generations and Allen's generation semimoieties introduce additional complexity into an already astonishingly complex situation to save the appearance of horizontally stratified, closed generations. The process used here is reminiscent of the Ptolemaic tradition of adding more epicycles or eccentrics to the cosmological chart in order to "save the appearance" (Grant 1978:280-284) of perfect circles, in both cases yielding end products that run afoul of Occam's razor. Nevertheless Guhr's age off-set proposal for the Northern Aranda is an elegant alternative to my age biased proposal for the Alyawarra whose territory adjoins that of the Northern Aranda.

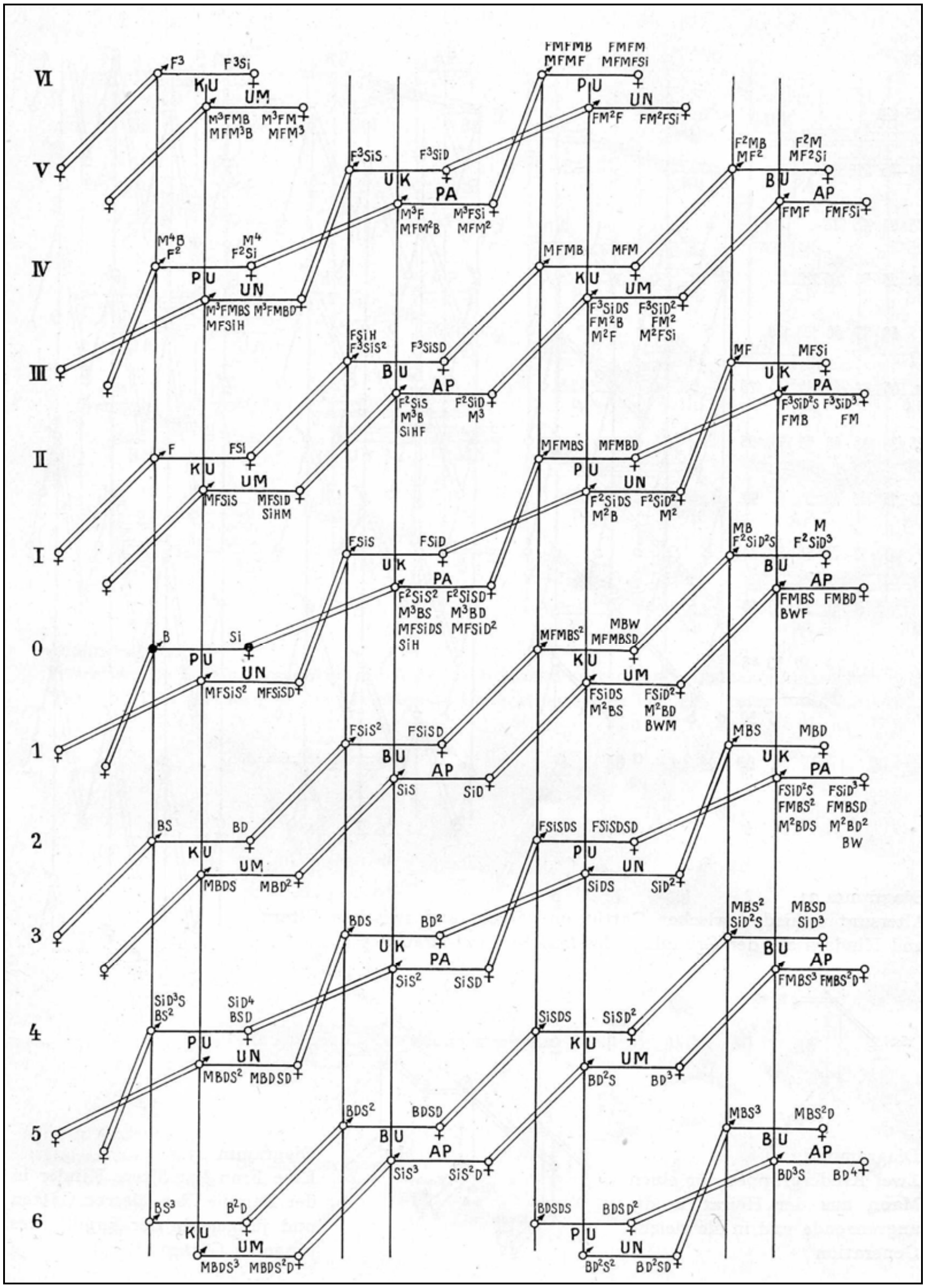


Figure 2-3. A quadruple helical structure for the 8-class Northern Aranda.
Enhanced version of Guhr's (1963) meta-analysis of 19th and 20th century Aranda data.

2.6. Denham's Alyawarra

The helix in the blue-and-green inset of Figure 2-4 appears much more clearly than in Figures 2-2 and 2-3, but it is the same helix. The diagonal generation moieties based on sibling-in-law chains in Figures 2-3 and 2-4 appear to have opposite inclinations, but that is an illusion due to the position of H to the left of W in Figure 2-3 and to the right of W in Figure 2-4.

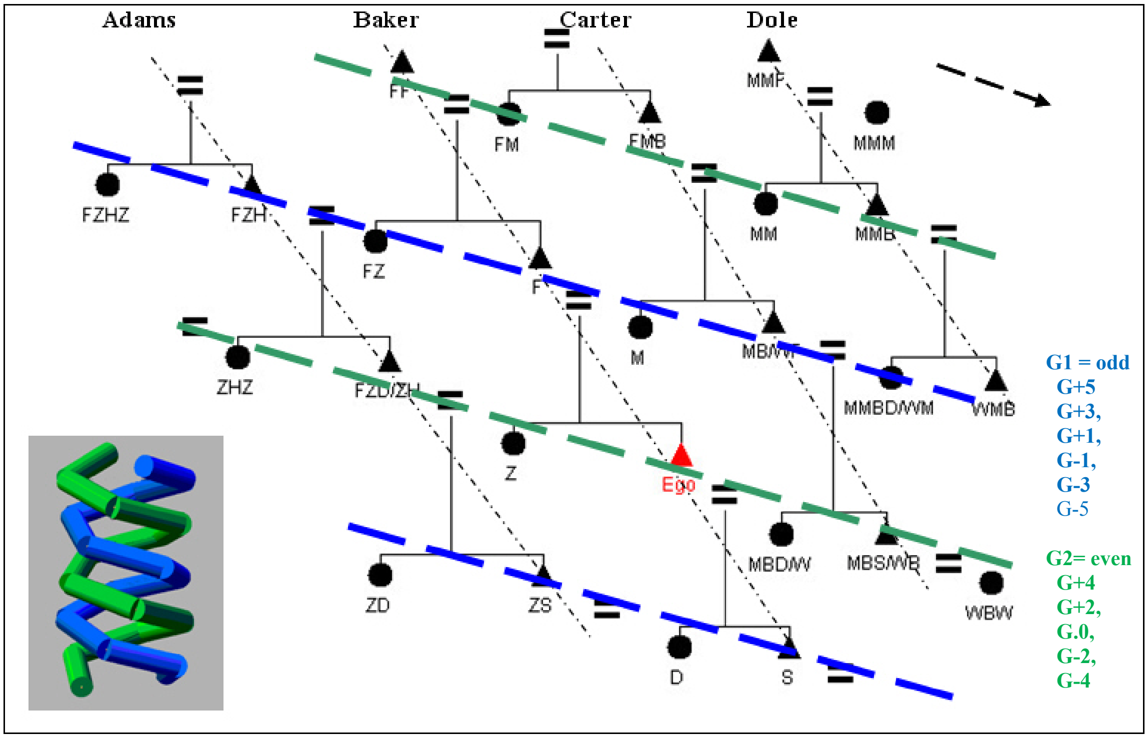


Figure 2-4. Generic age biased generations.

Generations such as this occur with senior/junior marriage systems that prohibit marriage with MeBD (e=elder) and encourage it with MyBD (y=younger), and with systematic marriage with any MBD combined with the ubiquitous 14+ year difference between female and male generation intervals. This diagram shows only a portion of the 6-patriline lattice for the Alyawarra language group, and with appropriate modifications it accommodates Wikmunkan (McConnel 1930), Aranda (Guhr 1963), Wanindiljaugwa (Rose 1960) and possibly others. Dashed gray lines identify Adams, Baker, Carter and Dole patrilines or families. Ego, in the Baker family, marries a woman in the Carter family who is his MBD. The 14+ year age bias means that generations, and generation moieties, indicated by heavy blue and green dashed lines, no longer form closed loops in horizontal strata, but instead are biased (inclined or tilted) downward toward the future as shown by the single-headed arrow at top right. Women and men at the edges of the 6-line lattice may marry each other, in which case the diagram rolls around on itself to form a closed three-dimensional helix as shown at bottom left, or they may marry into a potentially endless series of additional families that reach beyond the edges of the lattice. Both options seem to be possible in Australian Aboriginal societies. ("Double Helix" image from Sandor Kabai 2010. The Wolfram Demonstrations Project).

A major difference between Figures 2-3 and 2-4 is that Figure 2-3 forms a quadruple helix with four strands in 8-subsections corresponding to Northern Aranda, Southern Aranda and Wanindiluagua systems, while Figure 2-4 has a double helix with two strands in 4-sections corresponding to Wikmunkan, Alyawarra and Eastern Aranda systems. Furthermore, Figure 2-3 employs twice as many generations as Radcliffe-Brown used (compare Figure 1-1 with Figure 2-4) and retains "an infinite or open series of successive genealogical generations each of which is not only discrete but also closed" (Atkins 1981), whereas the Alyawarra diagram in Figure 2-4 employs only two generations both of which are open.

In part the double helix in Figure 2-4 is an idealized representation of social relations embedded in kinship terminologies and marriage preferences among societies such as the Wikmunkan. In part it is an idealized representation of logical and demographic relationships based on the *tuelcha mura* custom as embedded in kinship terminology and marriage practices among the Northern Aranda. In part it is an idealized representation or mechanical model of kinship terminology, marriage preferences, genealogical relationships and a great deal of statistical data on actual marriage practices and kinship term applications among the Alyawarra and, indirectly, the Wanindiluagua.

2.7. Wraparound

In Figures 2-2 through 2-4, women and men on the left and right margins of the diagram have a problem that is missing from circulating connubia in Figure 2-1. The lattice formed by descent lines and generations, implicit in Figures 2-2 and 2-3 and explicit in Figure 2-4, may remain open, flat and two dimensional, in which case women and men on the margins of the diagrams may marry into families that lie beyond the edges of the diagram; i.e., marrying exogamously into neighboring societies. Alternatively they may marry each other, in which case the diagram must roll around on itself to form an endogamous helix with the strands extending downward through time, displaced by an amount determined by the number of descent lines and the difference between female and male generation intervals. The example at the lower left corner of Figure 2-4 has 2 strands, blue and green, but it could have anywhere from 1 to 8. Also it reflects a 14 year difference between parental generation intervals, but that difference could be anywhere from -2 to +28 years.

The three-dimensional helical structure is similar to but quite different from the stacks of two dimensional circles that are associated with two-way and one-way circular flows of women in previous diagrams (Tjon Sie Fat 1983a). Both options, lattices and helices, are logical possibilities in Aboriginal Australia (Denham, McDaniel, Atkins 1979; Denham and White 2005), but their absolute and relative frequencies of occurrence are unknown. If helical closure is rare, as it probably is, then this structure tends to foster societal exogamy rather than endogamy as in the previous diagrams.

Figures 2-2 through 2-4 refuse to close upon themselves to form neatly stacked circles that characterize endogamous societies. Indeed the lattice can roll up in three dimensions to form a highly complex multi-stranded helix with each complete endogamous cycle spanning as much as 250 years, or it can remain open and reach outward to attach exogamously to similar structures in adjacent societies. It seems to default to exogamy and probable survival rather than endogamy and possible extinction for very small societies. And it rejects Atkins' (1981) "hoary old anthropological assumption that … any "normal" kinship system - or at least every proper model of such a system - must entail an infinite or open series of successive genealogical generations each of which is not only discrete but also closed."

2.8. Hammel's mechanical model of asymmetric cross-cousin marriage

Hammel (1976a) argues that a wide variety of nonkinship biases in the selection of mates have implications for the relative proportions of types of consanguineal relationships between mates. Although the biases that he considers include systematic differences in heritable traits such as height, weight, skin color, wealth, prestige and age, he develops his argument specifically around the relationship between a) systematic wife-husband age differences and b) their implications for the relative frequency of occurrence of MBD and FZD marriages. He uses a mechanical model to explain how this proposition works, and a stochastic simulation to demonstrate it in action. Here I attempt in 3 paragraphs to summarize and expand upon the mechanical model that he explains in a very tightly structured 15 page article. I discuss his stochastic model below.

Hammel's mechanical model requires that: a) everyone must have an age, b) the mean age difference between mates must not be zero, c) the attribute (age) must be heritable by offspring of both sexes from both parents, and d) the age difference between mates is a constant proportion. It follows that Ego, his siblings (B and Z) and parallel first cousins (FBC and MZC) all have the same mean age, so the mean age difference between them is zero and they are not eligible to marry each other. On the other hand, MBD's age differs from Ego's in the same direction that Ego's M's age differed from Ego's F's age, while the age of FZD differs in the opposite direction; i.e., if Ego's F is older than Ego's M, then Ego will be older than MBD and younger than FZD. "The bias in mating thus distinguishes parallel cousins from cross [cousins] and subdivides [cross cousins] without reference to the reckoning of kinship" (Hammel 1976a:147). For the purposes of this model, Hammel sets M's age at -2 units (years) relative to F's age, so ages relative to a male Ego's are: MZD=FBD=0, FZD=+2 and MBD=-2; thus, among his cousins, MBD is Ego's only acceptable mate.

Hammel then considers consistency of the bias across generations. He reaches three conclusions: a) if the direction of the bias is consistent across generations, the proportion of MBD marriages will increase at the expense of FZD marriages (#MBD>#FZD); b) if the direction of the bias reverses from one generation to the next, the proportion of FZD marriages will increase at the expense of MBD marriages (#MBD<#FZD); and c) if the direction of the bias changes randomly from one generation to the next, the bias will assume an intermediate value (#MBD≈#FZD).

Finally if we reverse all of the signs, thereby setting F's age at -2 years relative to M's, and changing FZD's and MBD's ages accordingly, we see that the appropriate mate for Ego still is MBD. Thus consistency in the bias regardless of its direction (or amount) yields an increase in MBD marriage. It makes no difference whether W is younger or older than H, or by how much; so long as the bias is consistent in either direction, the proportion of MBD marriages will increase at the expense of FZD marriages. Sexually dimorphic behavior manifested in a sex based mean difference in generation intervals that is virtually universal among humans suggests that societies with systematic and consistent FZD marriage and/or negative age biases (W older than H) will be rare.

Hammel extends his argument, examines its applications to other biases, and speculates about its relevance to sexual dimorphism, inbreeding avoidance and interfaces between exogamous societies that have conflicting cognitive or value systems. The stochastic simulation of his mechanical model in action is of singular importance below.

Hammel (1976a:159-160) concludes that "genealogy and demography are not the motor of the social universe, … but to ignore them for descriptive and analytical purposes would be unwise."

2.9. Ethnographic determinants of age and matrilateral biases

The factors that Hammel considers in his mechanical model tell us that the matrilateral bias will develop if the ages of W and H are systematically different, but they tell us nothing about the magnitude of the asymmetry. What makes it 14+ years in Aboriginal Australia?

The 14+ year age bias seems to derive from a striking constellation of factors including, but not limited to, *tualcha mura* or similar customs. Among the Alyawarra in 1971 essentially the same *tualcha mura* mother-in-law relationship was established as that described by Spencer and Gillen for the Aranda. But among the Alyawarra, it occurred when the boy was initiated at age 14 or 15 and the woman who became his *tualcha mura* was a young adult or soon would become one, thereby reducing much of the uncertainty associated with infant mortality among 19th century Aranda.

At least among the Alyawarra, related contributing factors include: male initiation at puberty followed by 15 years of intensive religious training that results in delayed onset of marriage by men; marriage at puberty by women; and sororal polygyny in which mature men often marry two or more full or half-sisters who are significantly younger than the men, thereby insuring that the women are married during their early reproductive years when men of their own age are not allowed to marry. Among North Coast societies such as the Tiwi, where mandatory infant bestowal combined with mandatory widow remarriage make it impossible for any female to be unmarried (Hart et al. 1988:16), the range of age differences between W and H may be exaggerated but the mean difference is unaffected. Thus the magnitude of the W<H age difference may be determined by ethnographic factors that are similar across many Australian societies.

No doubt the factors that Hammel discusses generate a matrilateral bias, but in Australian Aboriginal societies, there are other, ethnographically specific factors at work as well.

Assume that Ego is a member of a society with 4 sections as described above.

First, everyone belongs to one exogamous patrimoiety and one exogamous matrimoiety, called sides if unnamed. Concomitantly, everyone belongs to one endogamous generation moiety, generally but not always unnamed. All three of these elements are knowable nonverbally as well as verbally as "own" and "other" or "mine" and "not mine". The fact that descent moieties are exogamous and generation moieties are endogamous means that Ego's spouse can come from only one of the 4 sections in the society; viz., the section to which belong his cross-cousins (MBD and FZD).

The exclusion of marriage with female siblings and parallel cousins on the basis of tripartite moiety memberships is strongly augmented by biological inbreeding avoidance. According to the Westermarck hypothesis (Westermarck 1891/2010, Wolf and Durham 2005, Pusey 2005), inbreeding avoidance develops among siblings and parallel cousins as they grow up together in face-to-face groups, in this case living throughout childhood in the same nomadic camps with fathers who tend to be brothers and mothers who tend to be sisters, thereby biologically reducing the likelihood of mating and intermarriage among them. In other words, although a man, his sisters and his female parallel cousins are members of the same endogamous generation moiety, proscription of marriage among them is overdetermined by two rules of descent moiety exogamy, the biology of inbreeding avoidance, and a presumptive incest taboo; i.e., the rule favoring generation endogamy is overruled by the other factors.

Early association that inhibits sexual attraction among siblings and parallel cousins according to the Westermarck hypothesis is absent between cross cousins who grow up in different camps with their own siblings and parallel cousins. Thus cross cousins (MBD and FZD) are potential spouses not only because of their membership in the right descent lines and generation level, but also because inbreeding avoidance is minimized.

The W<H 14 year mean age difference yields a strong matrilateral bias that operates through genealogies and demography to encourage men to marry MBD, MMBDD or MBDDD who are 14 years younger than the men, while discouraging marriage with FZD and FZDDD who are 14 years older than the men. The age bias does not proscribe marriage with FZD, but sharply curtails it.

The network of proscriptions yields the result that Levi-Strauss attributed to prescription, but does so non-teleologically and independently of kinship terms. In effect the kinship term for MBD, which may appear to entail prescription, is a "shorthand" term that subsumes the congeries of proscriptions and serves as the basis for further verbal elaborations. At least in principle, this mating pattern could have predated the emergence of language (Allen 1998, 2007).

Hence the age bias and the matrilateral bias are not coincidental or arbitrary, but rather seem to be multiply overdetermined by an interlocking set of structural and biological factors.

2.10. Possible invisibility of age biased marriage systems

Cognitive aspects of age biased systems may appear to be symmetric when Aboriginal people describe them to European anthropologists, but behavioral aspects may seem to be asymmetric when statistical data on marriage practices are considered. For example, kinship terminologies from Groote Eylandt (Rose 1960), Northern Aranda (Guhr 1963) and Alyawarra (Denham, McDaniel and Atkins 1979; Denham and White 2005) appear to be symmetric thereby permitting or encouraging sibling exchange marriages, but in fact all of these societies have approximately 14 year age biases.

Hammel (1976a:159-60) specifically addresses this point:

> "The problem I have raised … by employing an analytical demographic and genealogically oriented approach is … [that] of the relationship between ideology and behavior. It has been obvious … that men whose culture prescribes marriage with MBD … may be bedded with very different ones. What has not been clear is how very startling the contrast between behavior and ideology is in quite the opposite direction. I have shown that natural, empirically observable behavior that forms a perfect substructure for the emergence of a symbolic system is not a sufficient condition for the emergence of an ideology and occurs more often in the absence of an ideology than in its presence."

In other words, from Hammel's perspective societies that practice asymmetric marriages stemming from age-based matrilateral biases generally do NOT acknowledge that asymmetry in their kinship terminologies. Similarly Rose (1960:168) argues that vertical asymmetry may be concealed, from oneself and others, by what he calls "the fiction of sister exchange marriage".

Does that mean that the asymmetry is unknown or not salient to the informants, or that it might be well known and important to them but they fail to mention it to anthropologists who do not specifically ask about it since to the informants it seems to be a self-evident truth ("It goes without saying …")? For example, Bell (1993:19), speaking of the Alyawarra at Warrabri Settlement in the late 1970s, ambiguously says: "At [times] they would speak of their siblings, cousins, grandparents and grandchildren as belonging to the same generation level." But what does she mean by generation levels? Perhaps she is referring to generation moieties in the traditional stratified "alternating generation" format in Figure 1-1, or perhaps she is independently confirming that two helical generations, corresponding precisely to the double helix format in Figure 1-2, informed their world view. Among the Alyawarra at MacDonald Downs Station in 1970-71, stratified generation moieties were apparent, but age biased generations were never discussed by informants although they were implicit in numerical genealogical, demographic and kinship data (Denham and White 2005).

In other words, the age bias is present willy-nilly if the factors that produce it are present. This of courses raises serious questions concerning unreported vertically asymmetric systems of descent, marriage and kinship among all or many Australian Aboriginal societies characterized by male initiations at puberty, protracted religious training, delayed onset of marriage by men, frequent sororal polygyny, possibly infant bestowal, and *tualcha mura* or similar customs.

Failing to see vertically asymmetric systems of descent, marriage and kinship in a great many Australian Aboriginal societies in the past may be due to the possible rarity of the phenomenon, the possible failure of Aboriginal people to call attention to what they consider to be a self-evident truth, or the possible failure of outside observers to search for them or to notice them because of their own assumptions about the nature of generations in European societies.

Thus Wikmunkan, Alyawarra, Wanindiljaugwa, Murngin Yolngu, Aranda and perhaps Kariera may not be aberrant or anomalous but rather may represent many societies whose symmetric ideologies are contradicted by their asymmetric descent, marriage and kinship practices. So long as we focus on verbal behavior to the exclusion of nonverbal, we get a half-truth at best.

2.11. Tjon Sie Fat's family of age biased helical structures

If there is any merit at all in the argument (or assumption) that vertically asymmetric generations characterize some, most or all Australian Aboriginal systems of descent, marriage and kinship, then it is reasonable to speculate on the possible characteristics, dimensions, parameters of mechanical models of these systems. Such is my objective in the remainder of this Section. However, should you prefer to skip these speculative theoretical details, it is entirely reasonable to go directly to Section 3 to examine statistical, topographic and network data that yield an alternative ethnographic view of these societies.

The right side of Figure 2-5, from Tjon Sie Fat (1983a:586), is a three-dimensional representation of matrilateral cross-cousin marriage with no systematic mean age difference between H and W ($\Delta_{FC}=\Delta_{MC}$). Each circle represents one of "an infinite number of closed exchange circuits and discrete generations". It is vertically symmetric but horizontally asymmetric.

This diagram incorporates only horizontally asymmetric matrilateral cross-cousin marriages, but it could just as easily incorporate symmetric bilateral cross cousin marriages with sibling exchanges. Simply making the arrows double ended would indicate this bilaterality. In other words, a decision to preclude bilateral cross-cousin marriage is a cultural feature or rule that could be reversed at any time.

Closure of each generational circle shows that the marriage system of which it is a part is endogamous. The transfer of spouses within each generation forms a loop with no formal provision for exogamous marriages to other such closed structures.

Figure 2-5 corresponds to the limiting case in which the ratio of Mother-Child/Father-Child age differences is exactly 1 (MC/FC = 1); i.e., Mother and Father are the same age. Figure 2-6 is a more general case, based on MC/FC < 1. The most general case, not included here diagramatically, occurs when MC/FC ≠ 1, which, following Hammel's (1976a) argument, would encompass those rare situations in which women on average are older than their husbands, perhaps including the Hill Madia of South India whose kinship has been proffered (Vaz 2011) as one of the oldest and most basic of the Dravidian systems. I suggest that societies having horizontally stratified generations with MC/FC = 1.0 are special, and probably rare, exceptions to the general case in which MC/FC ≠ 1 and generations are age biased.

The right side of Figure 2-6 is a three-dimensional representation of matrilateral cross-cousin marriage with an unspecified but systematic mean age difference between H and W. It is asymmetric both horizontally and vertically. As in Figure 2-5, this diagram incorporates only matrilateral cross-cousin marriages, but because of the MC/FC < 1 age bias, systematic symmetric bilateral consanguineal cross cousin marriage and sibling exchange are impossible, not cultural features or human rules, but simply biological and logical properties of the relationships. They are possible, of course, among classificatory kin.

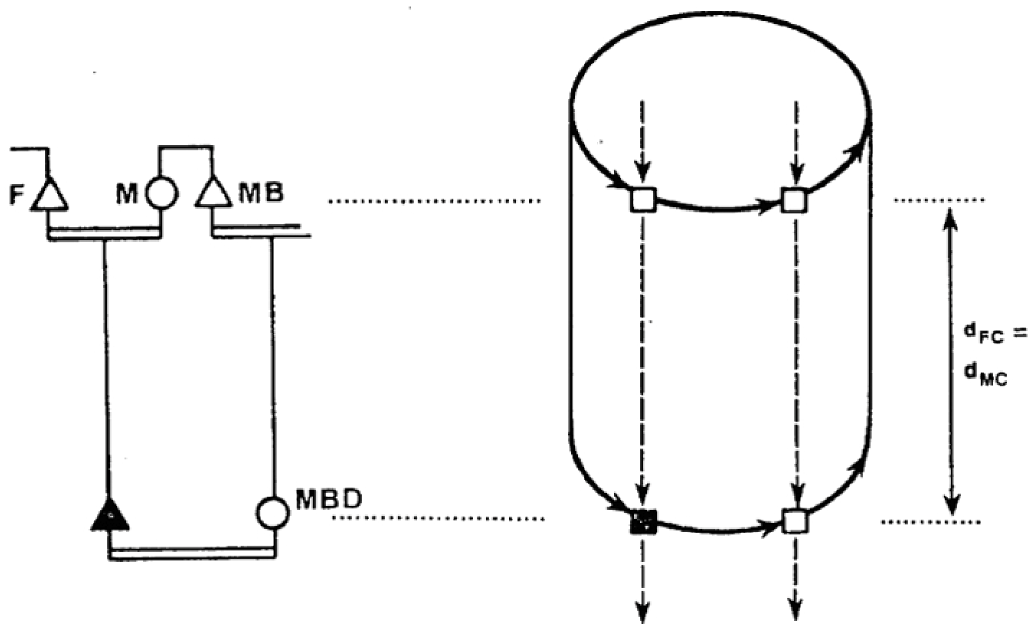


Figure 2-5. Matrilateral cross-cousin marriage with age constant generations.
Endogamous society with an indefinite number of age constant circular generations ($\Delta_{MC}/\Delta_{FC} = 1$).
(From Tjon Sie Fat 1983:588).

As in Figure 2-5, the cylinder on which the helix is drawn in Figure 2-6 indicates that the marriage system of which it is a part is endogamous. The transfer of spouses along the diagonal generations forms endless helices with no formal provision for exogamous marriages to other such helices. But here the generations are not closed, self-contained strata in a potentially endless series of such isolated layers; rather if we extend the helix vertically in both directions we see that the two generations depicted on this short segment of the cylinder are themselves endless. Figure 2-5 is radically different from the finite set of (two) temporally open, continuous, asymmetric age biased generations in Figure 2-6.

Table 2-1 represents a family of helical kinship models developed by Tjon Sie Fat (1983a), based on Figure 2-6, which shows that the helical structure can accommodate diverse "packages" of patrilines, matrilines, age biased generations and MC/FC age ratios.

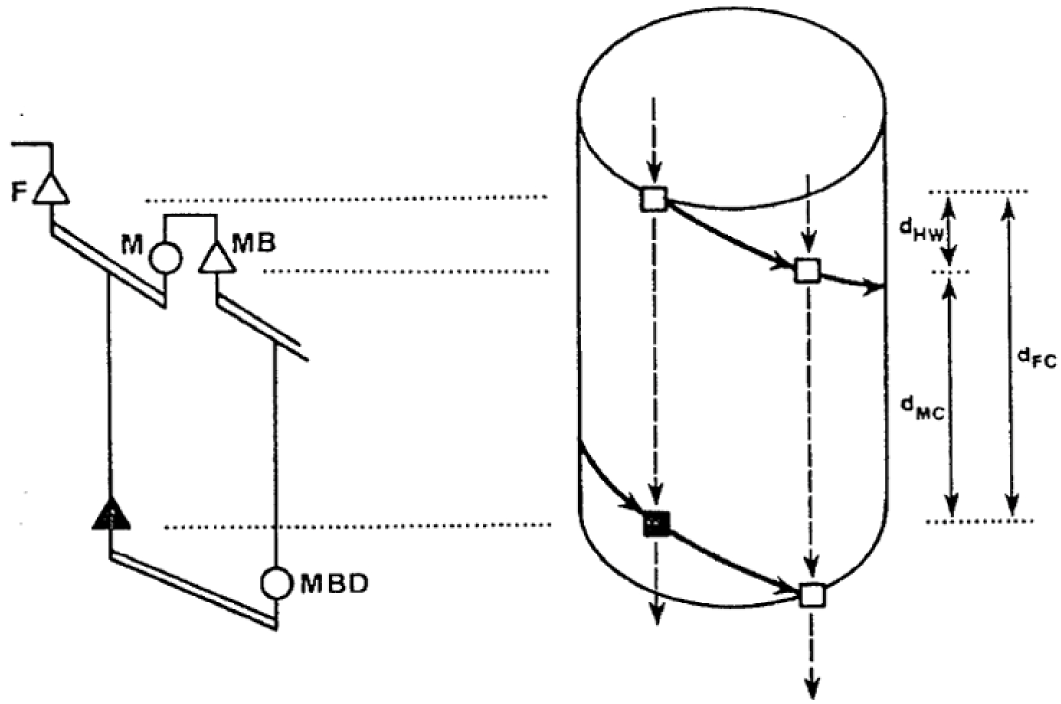


Figure 2-6. Matrilateral cross-cousin marriage with age biased generations.
Endogamous society with exactly two age biased helical generations ($\Delta_{MC}/\Delta_{FC} < 1$).
(From Tjon Sie Fat 1983:589).

Tjon Sie Fat's (1983a) formal mathematical model of all simple endogamous helical structures with age-biased matrilateral cross-cousin marriage is derived not from field data but rather from a basic set of structural axioms that he developed in response to a suggestion that John Atkins (1981) made to him concerning the possibility of constructing helical models. Thus the fact that specific mechanical models within the family perfectly fit designated ethnographic cases in Table 2-1 is not due to a circular argument. The model, based on logic rather than data, predicts that certain nontrivial and counterintuitive structures will be found among Australian Aboriginal societies, and in fact a lot of puzzling field data matches the prediction. Although these societies most often have been treated as "anomalous, transitional, hybrid or aberrant" (Tjon Sie Fat 1983a:601), I suggest that they may be a key to understanding Australian Aboriginal social organization generally. Notice that some of the societies in Table 2-1 belong to the Pama-Nyungan language family while others do not. Implications of this fascinating linguistic issue require further exploration.

The segment of a helical model in Figure 2-4 is representative of a family of twenty-seven simple helical structures with 1 to 14 patrilines, 1 to 13 matrilines, and 1 to 7 helices generated by Tjon Sie Fat (1983:592). In Table 2-1 parameters for seven of those twenty-seven models for which ethnographic examples are available are highlighted in yellow. Table 2-2 below lists a modified and expanded set of these parameters.

# Patri-lines P	# Matri-lines M	# Helices H	Age Ratio MC/FC	Ethnographic Examples (sources)	Australian Language Family
2	1	1	0.5	**Oblique** marriages	n/a
3	2	1	0.667	**Oblique** marriages Ambrym (Lane & Lane 1956)	n/a n/a
4	2	2	0.5	Maybe **Murngin** (Levi-Strauss 1969) Maybe **Karadjari** (Elkin 1954)	PN Non-PN
4	3	1	0.75		
5	4	1	0.8		
6	3	3	0.5	**Wikmunkan** (McConnel 1940 original)	PN
6	4	2	0.667	**Wikmunkan** (McConnel 1950-51 revised) **Alyawarra** (Denham et al 1979) Possible transform of **Ambrym** (Lane & Lane 1956)	PN PN n/a
6	5	1	0.833		
7	6	1	0.857		
8	4	4	0.5	**Murngin** (Warner 1937, Shapiro 1969, Keen 2004) **Karadjari** (Elkin 1954) Maybe **Wanindiljaugwa** (Rose 1960, De Josselin de Jong 1962) Maybe **Ngarinyin** (Elkin 1954, Blundell & Layton 1978, Keen 2004)	PN Non-PN Non-PN Non-PN
8	6	2	0.75	**Murngin** (Warner 1937, Shapiro 1969) **Karadjari** (Elkin 1954)	PN Non-PN
8	7	1	0.875		
9	6	3	0.667		
9	8	1	0.889		
10	5	5	0.5		
10	8	2	0.8		
10	9	1	0.9		
11	10	1	0.909		
12	6	6	0.5		
12	8	4	0.667		
12	9	3	0.75		
12	10	2	0.833		
12	11	1	0.917		
13	12	1	0.923		
14	7	7	0.5		
14	12	2	0.857		
14	13	1	0.929		

Table 2-1. Parameters of helical models with corresponding ethnographic examples.
Language family: PN=Pama-Nyungan, non-PN=non-Pama-Nyungan (based on Tjon Sie Fat 1983a, Table 2 and Figures 3-9, and sources cited in the Ethnographic Examples column of this table).

In Table 2-1, the MC/FC age ratio does not specify ages but can accommodate any pair of ages that yield the correct ratio. The minimum MC/FC age ratio used in generating the family of helical models was 0.500, where the mean MC age difference is half of the mean FC difference, and the maximum was 0.929, where the mean MC age difference is almost but not quite equal to the mean FC difference. These 27 structures have among them thirteen discrete MC/FC age ratios, viz., 0.5, .667, .75, .8, .833, .857, .875, .889, .9, .909, .917, .923 and .929. The values are intuitively easy to read: MC/FC = .5 means that wives on average are one-half the age of their husbands. Values missing from this series do not correspond to any possible structures with 1 to 14 patrilines, 1 to 13 matrilines, and 1 to 7 helices. All seven of the ethnographic examples in Table 2-1 have MC/FC age ratios at which wives on average are one-half to three-quarters the age of their husbands. Ethnographic examples of MC/FC between 0.76 and 0.99 have not been reported, perhaps because they are rare or absent, but more likely because they are more difficult to distinguish from cases in which MC/FC = 1.

Within these limits, the mean FC age difference is highly adjustable, but the mean MC age difference is much more tightly constrained by biological limits on female reproduction; e.g., age at onset of menstruation, age at first marriage, age at menopause, variable effects of infant mortality and lactational amenorrhea on birth spacing, and so on. The result is that the mean MC age difference generally is limited to somewhere around 28 years as in the Alyawarra case, but the mean FC difference may range from about 28 years to more than 56 years in societies where men begin to reproduce very late in their lives (Tremblay and Vezina 2000; Bodmer and Cavalli-Sforza 1971).

As the mean MC/FC age ratio deviates from 1 in a symmetric structure, the system reaches a phase boundary where horizontal closure of each stratum through endogamous bilateral cross-cousin marriage with or without sibling exchange becomes impossible, and the structure transforms itself in a single step from the closed, stratified form in Figure 2-5 to a closed age biased helical form such as that in Figure 2-6, with the number of helices and their slopes determined by the number of patrilines and matrilines in the system.

Is it plausible that Tjon Sie Fat's family of helical structures might be thought of as constituting a set of evolutionarily stable states that are to some extent analogous with atoms and their isotopes, or genes and their alleles? For example, in the Alyawarra case the mean parent-child age differences are MC=28 and FC=42 years, and the MC/FC ratio is 28/42=.667, yielding an actual WH age difference is 14 years, all of which are precisely what the model predicts for a system with 6P (patrilines), 4M (matrilines) and 2H (helices), and a mean MC age difference of approximately 28 years that is fixed biologically. Although the Wikmunkan diagram in Figure 2-2 looks rather different from the Alyawarra diagram in Figure 2-4, they are strikingly similar in that both contain 6 patrilines, 4 matrilines and 2 generation moieties, and both have MC/FC age ratios of 0.667.

These structures are not eternally immutable, but when they move into stable configurations in some parameters, they resist changing to other configurations. For example, in an ideal endogamous society the number of patrilines, matrilines and generations cannot simply "drift off" toward different values (e.g., add or subtract a descent line or a generational helix here or there) without significantly altering the structure or destroying it. While the structures do not seem to add or subtract components piecemeal, they do seem to be more amenable to multiplying and dividing, by which I mean that the Northern Aranda 8-subsection system with a quadruple helix core may be a transform of the Alyawarra (and probably Eastern Aranda) 4-section systems with double helix cores. Similarly, Tjon Sie Fat (1983a) suggests that Wikmunkan and Alyawarra structures may be transforms of the Ambrym pattern (Lane and Lane 1956). Furthermore, since the flow of spouses is predominantly unidirectional, the structure in one such society is "preadapted" to linking with comparable (4-section to 4-section) or compatible (4-section to 8-subsection) structures in neighboring societies to form a linked chain of exogamous societies as possibly was occurring among the Aranda and their neighbors more than a century ago (Spencer and Gillen 1899:421-22) and clearly appears in the Alyawarra network visualization in Figure 3-15 below.

2.12. Internal flexibility

Just as rigidity is a characteristic of closure, flexibility and elasticity seem to be characteristics of openness. Consider the following aspects of structural flexibility with regard to the range of values that parameters can assume within the framework of the mechanical model.

If the MC and FC age differences co-vary upward or downward in a rather narrow range {26/39, 27/40.5, 28/42, 29/43.5, 30/45} the model retains the same MC/FC ratio of 0.667, and the structure literally "expands" or "contracts" without altering its form. In these five cases, the mean age difference between FF and SS increases from 39x4=156 years to 45x4=180 years.

In the real world the MC/FC ratio necessarily is approximate as age relations within each family move nearer to or farther from the ideal, either stochastically due to random variations in birth spacing, etc., or directionally in response to cumulative changes in the habitat. Thus the helical structure is highly stable but is flexible enough to operate effectively in the "rough terrain" among and between optimal values.

Some ethnographic cases in Table 2-1 appear to approximate two different configurations. Murngin and Karadjari cases look like a 4P-2M-2H model in some ways, but in other ways they look like an 8P-4M-4H model. Similarly McConnel's early Wikmunkan data look like a peculiar 6P-3M-3H model, but her later, revised data clearly match a 6P-4M-2H model like that of the Alyawarra. The Alyawarra in 1971 had a 4-section system like that of the Eastern Aranda and a kinship terminology that was like the 8-subsection form used by the Northern Aranda. Was the system a static hybrid in a field of discrete and isolated systems? Was it in an "inward" or "outward" transition between 4 sections and 8 subsections with a corresponding shift in kinship terms that fit the old or new condition? Or were both the Alyawarra and the Wikmunkan cases transforms of the Ambrym 3P-2M-1H model into the 6P-4M-2H model resulting from the fission of 3 patrilines into 6 patrilines, as Tjon Sie Fat speculates?

From this perspective, documented shifts into and out of specific configurations are not remarkable. Lane and Lane's (1958:132) report of the historical transition from 4 sections to 6 sections among the Ambrym, with a concomitant change from sibling exchange to MBD marriage, expands the scope of inbreeding avoidance. The famous "discussions" recorded among the Aranda about whether to change from 4 sections to 8 subsections (Spencer and Gillen 1899:421-22) may reflect decisions about whether to change the rules internally or to accept an innovation from outside, thereby pushing marriages outward to more remote kin. These and similar cases suggest that adjusting the parameters may be conscious and deliberate examples of social engineering, or may be unplanned behavioral variants that have a positive selection value after they occur.

2.13. Slope and chirality

Finally, continuing to assume that the notion of age biased generations has some merit, it is appropriate to examine both the slope of the age bias and the direction of its rotation if the structure closes to form a helix. There is a distinct risk of reification in the following paragraphs.

Table 2-2 summarizes earlier comments on the geometry of the structure and adds remaining parameters that are necessary for a more complete specification. Tjon Sie Fat computed his family of helical structures for a range of values that might reasonably apply to human societies (realistic range), with extensions to that range to include some possible but implausible examples (broad range). Figure 2-7 uses a specific set of values from the right-most column in Table 2-2.

Features	**Broad range**	**Realistic Range**	**Value used in Figure 2-4**
Patrilines	1-13	1-8	6
Matrilines	1-12	1-7	4
Generations	1-7	1-4	2
Δ_{MC}	14-50	28 years	28 years (constant)
Δ_{FC}	14-80	28-56 years	42 years
$\Delta_{MC} / \Delta_{FC}$ 28/56 = 0.500 28/42 = 0.667 28/37.3 = 0.750 28/35 = 0.800 28/28 = 1.000	0.5-1.0	0.5-0.8, 1.0	0.667
Angle of generational slope = pitch of helix	0-30°	19-30°, 0°	25°
Angle of patriline separation	180-27.7°	180-45°	60°
Temporal span of one helical cycle	0-224	28-224, 0 years	84 years

Table 2-2. Full specifications of lattices / helices.

Figure 2-7 uses Δ_{FC} as the metric. Patrilines constitute the vertical dimension, so the vertical spacing between Ego and his Father equals $\Delta_{FC.}$ Hence the spacing between Ego's Father and Ego's Sister, and between Ego's Wife and Ego's Wife's Father both equal Δ_{FC} as well. These relationships, in conjunction with the nearly constant Δ_{MC}=28 are especially important because they determine the slope of the generation moiety, and generate the lattices (and the helices as well) in their proper and complete form. In Figure 2-7, I am concerned only with realistic values of Δ_{FC} and Δ_{MC}. I could have drawn a physically different but logically equivalent Figure with matrilines rather than patrilines constituting the vertical dimension.

The single vertical line at the left represents Ego's and his Father's patriline. Key points on it are Ego's age set at 0, the intersection with the dashed horizontal line at 28 years corresponding to the nearly constant value of Δ_{MC}, and several realistic values of Δ_{FC} in the range of 28 to 56 years. The scale measures ages upwards from Ego.

The vertical lines to the right represent four possible positions of the patriline to which Ego's Mother and Wife might belong, depending on the total number of patrilines (P=4…P=10) in the system. Here I use a range of 4 to 10 possible patrilines in an endogamous system that could be represented by the cylinder in Figure 2-6. Four patrilines on that cylinder are positioned 90º apart, 6 are then 60º apart, and so on.

Since Δ_{FC} can vary discontinuously from 28 to 56 years while Δ_{MC} remains approximately fixed at 28, $\Delta_{MC/}\Delta_{FC}$ varies from 1 to 0.5. If Δ_{MC}/Δ_{FC}=1 (i.e., $\Delta_{MC}=\Delta_{FC}$=28 years), the lattice has no age bias and assumes a symmetric appearance; if $\Delta_{MC}/\Delta_{FC} < 1$ (i.e, $\Delta_{FC} > 28$ years), a phase transition occurs and the lattice assumes an age biased asymmetric appearance. Three of the four values of $\Delta_{MC}/\Delta_{FC} < 1$ with which we are concerned here are documented in the Ethnographic Examples in Table 2-1; viz., Δ_{MC}/Δ_{FC} = 0.5 (56 years), 0.667 (42 years) and 0.75 (37.3) years, while one lies just outside the documented range at 0.8 (35 years).

The heavy solid line in Figure 2-7 depicts the structure of the Alyawarra system. The ages are Ego=0, M=28 and F=42, and the system has 6 patrilines spaced at 60º degree intervals. So Ego's M/MB/WF are located horizontally in the patriline 2nd from the right and vertically 14 years younger than F. Line F-M is the age biased generation containing FZ, F, M, MB, while the parallel line Ego-WB is the age biased generation containing Z, Ego, W, WB. To represent alternate values of Δ_{FC} and P, select alternate vertical and horizontal spacing, and connect the points to yield new generation lines.

Explanation of Figure 2-7. Knowing ΔFC, ΔMC=28 and P (# patrilines in a system) enables us to diagram all relations. The following examples apply to endogamous societies.
Father-Ego patriline (1 vertical line on the left): Ego's age = 0, Δ_{MC} = 28 years fixed, Δ_{FC} = 28 to 56+ years variable discontinuously, $\Delta_{MC/}\Delta_{FC}$ = 1.0 to 0.5.
Mother-Wife patrilines (4 vertical lines to the right): select one depending on total number of patrilines (P=4…P=10) in system; e.g., if P=6, Ego's M+W belong to 2nd patriline from right.
Heavy solid line example: Ego=0, Δ_{MC}=28 fixed, Δ_{FC}=42; P=6, patriline spacing = 60º (6x60º=360º); ages of M/MB/WF = 14<F (measured vertically), 42>W (measured diagonally); line F-M is age biased gener-ation containing FZ, F, M, MB; parallel line Ego-WB is age biased generation containing Z, Ego, W, WB.
Dashed-dotted examples: For alternate values of Δ_{FC} and P, select alternate vertical and horizontal spacing, and connect the points to yield new generation lines.

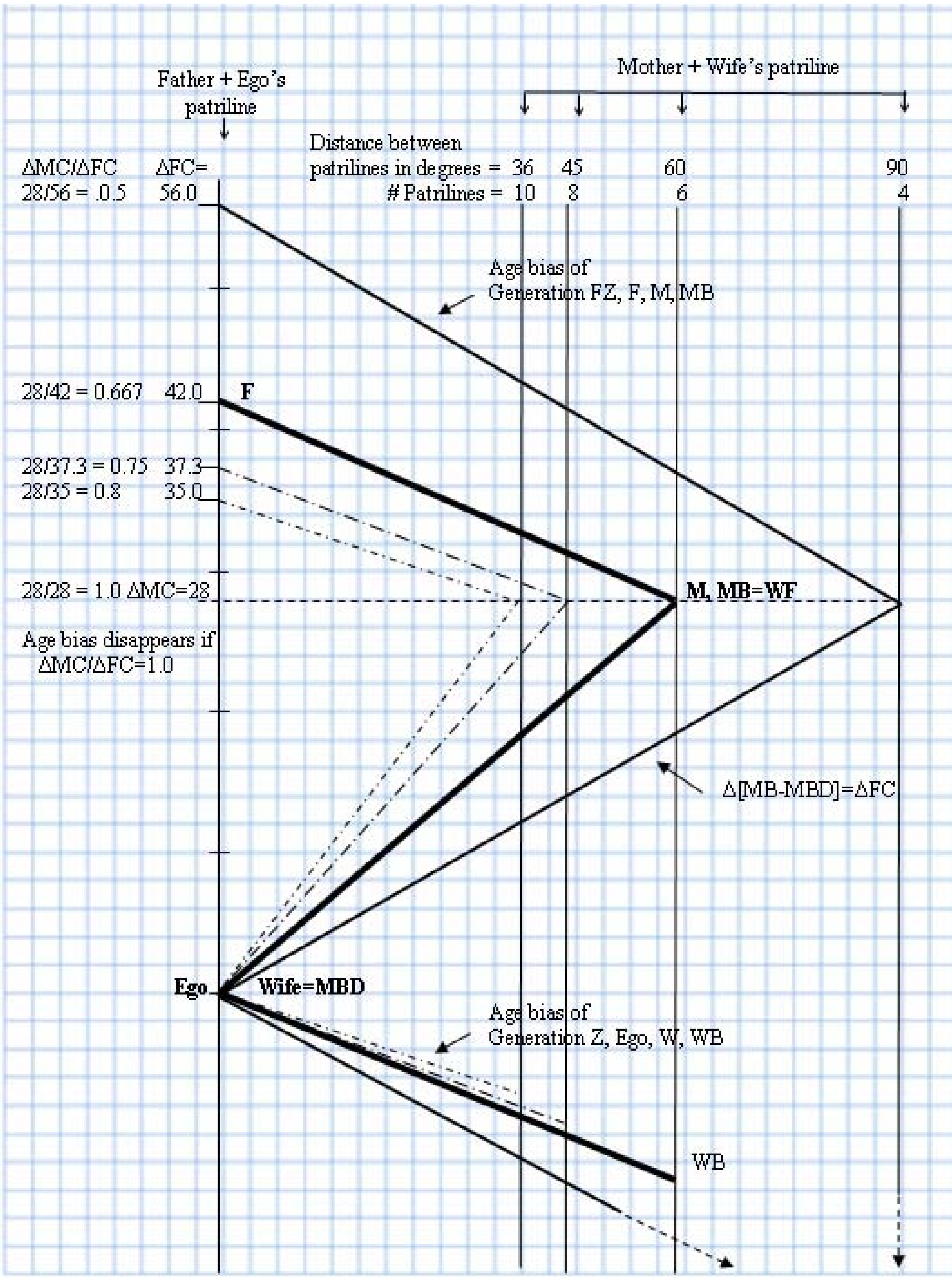


Figure 2-7. Ascertaining the slopes of age biased generations.

Now complete the diagram by drawing the correct number of patrilines through the points where they would intersect with extensions of the generation moiety lines.

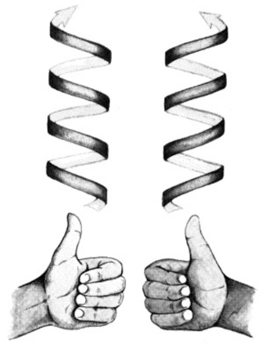


Figure 2-8. Chirality.
(From Wikimedia Commons)

Chirality or handedness as shown in Figure 2-8 is one of many defining features of a helix. Does it coil to the left or right? The question pertains to the nature of the helix, not to the perspective of the viewer. In Figure 2-8, the thumbs are parallel with the axes of both coils, both thumbs point upward in the same direction, and the two sets of fingers coil in opposite directions. If we invert one hand, the fingers on both hands coil in the same direction, but the axes point in opposite directions. The two hands really are different.

In nature, the handedness displayed by organic and inorganic substances generally is determined by their physics, chemistry and genetics and is ascertained experimentally or observationally. But in the case of Figures 2-2 through 2-4, chirality is imposed rather than discovered. By this I mean that the vertical axes are based on time with the axes arbitrarily pointing downward – past at the top, future at the bottom – and the handedness of the helices depends solely upon the authors' arbitrary decisions to place Ego's wife to his right (left-handed) or left (right-handed). It so happens that the helices in Figures 2-2 (Wikmunkan) and 2-4 (Alyawarra) are left-handed and the one in Figure 2-3 (Aranda) is right-handed, but they could have been different.

So what if anything is the significance of the direction of the coils in the kinship diagrams? Perhaps in some sense it does not matter, but if diagrams and societies are to work together properly, standardization is an asset. It may be that the diagrams in Figures 2-2 through 2-4 are acceptable individually but should be standardized one way or the other to facilitate comparisons. Even more importantly, understanding how they work "naturally" seems to be a precondition for using the Figures as steppingstones toward understanding language group exogamy. If chirality within these social structures is a characteristic of nature rather than an arbitrary imposition by authors, figuring out precisely which way these helices coil remains a major open question.

Thus the specification of parameters for the 2- and 3-dimensional vertically asymmetric structures suggests that the graph in Figure 2-7 is not an "artists' impression" as schematic kinship diagrams ordinarily are. Rather, it seems to approximate a preliminary engineering drawing of a statistical social geometry.

3. Statistical and network approaches to asymmetric generations

The model introduced above deliberately and systematically bypasses most of the blooming buzzing confusion that characterizes the real world. On the one hand such a model displays ideal relationships with little or no regard to variability and minutiae, somewhat resembling Platonic forms and type specimens. On the other hand it subsumes a vast amount of variability and minutiae by reducing all of it to an "average" such as a nonexistent "average family" with 2.3 children. Both processes obscure variations that occur in highly variable societies. Thus the next logical step in the methodological progression used here is to focus more closely on the details of what people do in one particular society, the Alyawarra speaking people of Central Australia who seem to have a marriage system that is both horizontally and vertically asymmetric. This calls for statistical and network analyses that emphasize variability and uniqueness while deemphasizing types and averages.

3.1. Alyawarra fieldwork

During an 11-month period in 1971-72, I conducted fieldwork with Alyawarra speaking people at MacDonald Downs and Derry Downs Stations about 250 km northeast of Alice Springs in Australia's Northern Territory. The Chalmers family, who operated these and adjacent cattle stations, were highly sympathetic to the Aboriginal people, whom they had known intimately since homesteading there in 1923. The Chalmers served as a buffer against the encroaching White world.

The total Alyawarra population in 1971 was about 470. The 264 members of my research population lived in four semi-permanent camps spread over a road distance of 85 km. The camp where I lived had a typical population of about 100 and was the most isolated. The people were not nomadic in the traditional sense but remained highly mobile within the cluster of four camps and between the cluster and other camps, cattle stations, and towns in the region. They hunted kangaroos for most of their meat but also received rations of flour, sugar, tea, bread, and fruit. Under conditions of semi-provisioning, they maintained much of their traditional lifestyle with little interference from Whites or "detribalized" Aboriginal people. Alcohol was prohibited.

The availability of secure water supplies, part time employment and rations enabled the Alyawarra in 1971 to live in more-aggregated / less-dispersed groups and to devote much of their time and effort to Alyawarra traditions based on their knowledge system often called the Dreamtime. Here I am concerned, at the most superficial level, with aspects of the Dreamtime known as Ancestors, Dreaming sites and Countries. These concepts are dealt with in diverse ways by Spencer and Gillen (1899, 1927), Strehlow (1947), Elkin (1954), Stanner (1965), Denham (2001) and many others.

Ancestors, known as *angerdelungwa* (Alyawarra: Moyle 1986, Yallop 1969), *tchuringa* (Aranda: Spencer and Gillen 1899), *tjurunga* (Aranda: Strehlow 1947), or other such terms, constitute the idiom in which the primordial Aboriginal Law is expressed. As something vaguely resembling highly active Platonic Forms, the Ancestors and their traditions embody the history, geography, social order, ethics and art of the Aboriginal people. Ancestors may relate to people in several ways, such as "conception totems" that define individuals and as "clan totems" that define descent groups, with clan totems being particularly important among the Alyawarra. They underlie descent, marriage and kinship relations within each language group, and interconnect people who belong to different dialect or language groups thereby yielding regional or transcontinental networks of relationships that are fundamental to exogamous marriages.

The locations at which Ancestors as clan totems performed specific actions may be known as Dreaming sites, and the area surrounding a Dreaming site may be known as a Country. The named patrilineal descent group that belongs to and is responsible for a Dreaming site also is known as a Country and generally has the same name as the Dreaming site with which it is affiliated. I introduce these concepts here because a) Ancestors as clan totems, serving as apical ancestors who unite otherwise unrelated clans, ultimately lie at the heart of the classificatory kinship systems that are just about universal in Australian Aboriginal societies, and b) Countries in the sense of named patrilineal descent groups or clans ultimately lie at the heart of the endogamous and exogamous marriage networks that integrate Aboriginal societies continent-wide.

In 1971, traditional Alyawarra physical residency patterns had been distorted by 50 years of colonialism, but traditional conceptual ties to Ancestors, Dreaming sites and Countries seemed to be fully intact. In fact, although their physical ties to the land may have been weakened by colonialism, their conceptual ties to it perhaps had been strengthened.

In the remainder of this paper, I deal with a) vital statistics, demographic, genealogical and census data, and b) kinship data.

My Alyawarra vital statistics, demographic, genealogical and census data appear in two separate but overlapping datasets holding the same kinds of data with only slight differences. The AU01 Alyawarra 1971 (Denham 2010a) dataset, with 377 records, contains data I collected during my fieldwork in 1971-72. The AU10 Alyawarra 1817-1979 (Denham 2010b) dataset, with 1460 records, contains a greatly expanded collection of the same kinds of data. They come in large part from the Australian National Archives and span the period from 1817 to 1979. In this paper I rely almost exclusively on the AU01 dataset, but briefly introduce the AU10 dataset near the end.

The AU01 vital statistics, demographic, genealogical and census dataset contains one record for each of the 264 living people and 113 of their deceased ancestors. Each record contains values for 53 variables including sex, age, marital status, language group, Country, section, personal Identification Numbers of parents and spouses, and 32 pieces of census data. Of particular importance here is the code for the Country to which each person belonged, selected from a list of 27 populated Countries with whom living members of the research population were known to be affiliated.

The second type of data that I use here pertains specifically to kinship terms. During my field research (Denham and White 2005), I worked closely with selected, well-known, and well-documented pairs of people to elicit kinship terms and their relational *significata* in strict accordance with Tax's ([1937] 1955) six rules or principles that serve as structural features of kinship terminologies (Scheffler 1982); i.e., I used Rivers' (1900) genealogical method to learn the Alyawarra kinship vocabulary and to define the normative kinship data relationally. This process yielded 22 basic Alyawarra kinship reference terms, the same number that appears in Spencer and Gillen's (1899) famous Northern Aranda vocabulary. Seventeen of the Alyawarra terms are clear cognates of those used by the Northern Aranda.

Using field methods and analytical procedures described in detail in Denham and White (2005), I compiled a file of kinship term applications that shows one of many possible ways in which those 22 kinship reference terms could be used by the Alyawarra. I asked 104 people to apply one of those 22 terms to each of 225 members of the research population. All 104 people who served as Ego also served as Alter, so the kinship dataset contains 10,816 terms in 104 pairs of reciprocals (i.e., the term with which Ego referred to Alter plus the term with which Alter referred to Ego), plus 104 x 121=12,584 terms used by Ego but not reciprocated by Alter. Thus the data file as a whole contains a total of 23,400 kinship term applications.

The AU01 data files introduced here, plus manuals describing their structure, content and operation, are downloadable from KinSources: Kinship Data Repository, under Dataset Components near the bottom of the page, at:
http://kinsource.tge-adonis.fr/kinsource/bin/view/KinSources/AU01Alyawarra1971.
The relevant files are as follows:

- Alyawarra1971ManualREADFIRST.pdf
- Alyawarra1971data.txt
- Alyawarra1971KinDataKey.pdf
- Alyawarra1971KinData.xls

3.2. Scattergrams

The 14+ year age bias shows up clearly in Figures 3-1 and 3-2, scattergrams of relationships between the ages of husbands and their wives among the Alyawarra of Central Australia in 1971 (Denham 1975) and in directly comparable data for the Wanindiljaugwa of Groote Eylandt in 1941 (Rose 1960). Together these Figures show that the regularities described above "are not absolute but rather are statistical preferences that appear most of the time" (Wiener 1954:61). These diagrams suggest some of the common features of age biased generations and some of the many ways in which variations or deviations can occur.

Figure 3-1 (based on Denham 1975) shows 53 H-W pairs for whom actual ages are known. Among the Alyawarra, infant bestowal and widow remarriage are rare. The solid diagonal line

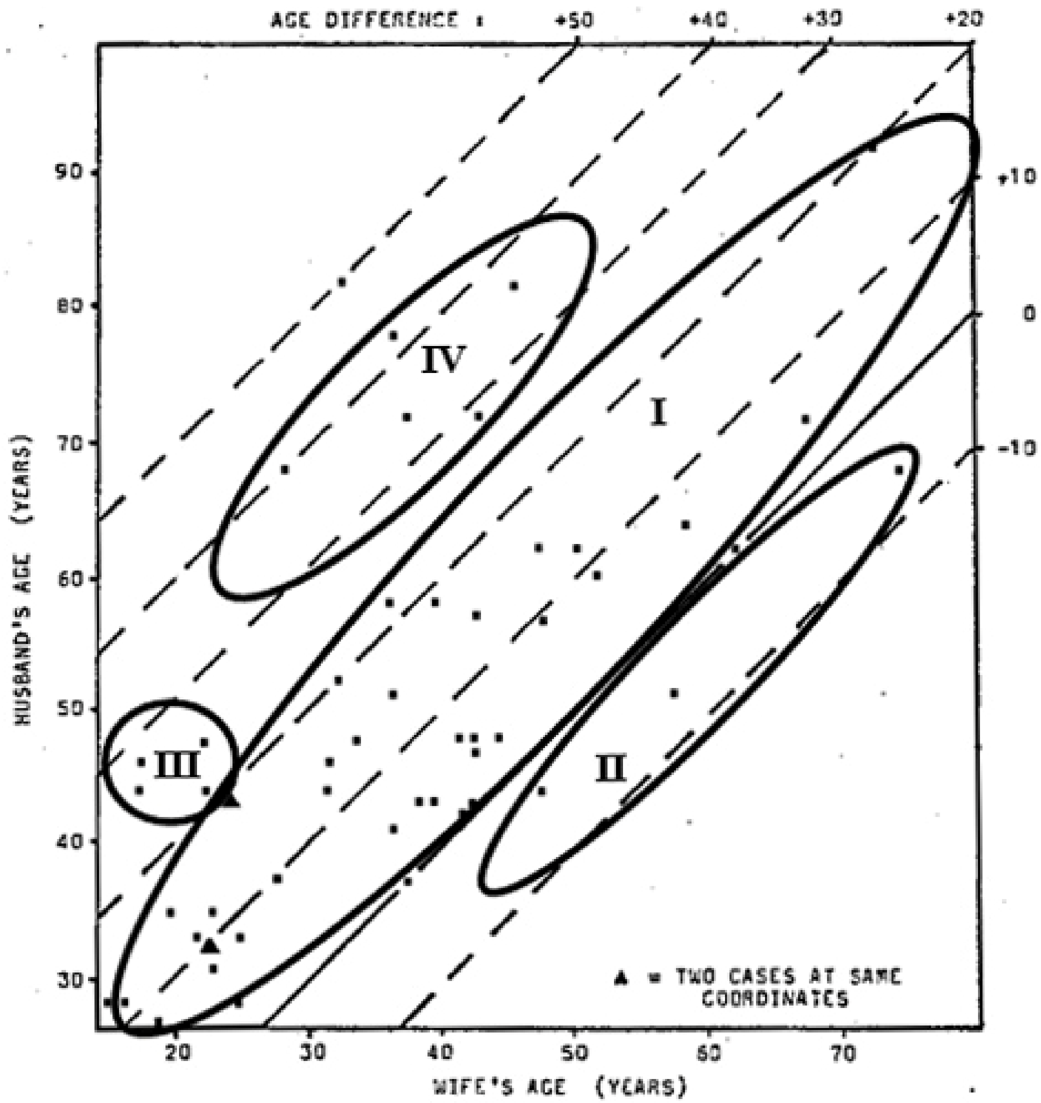


Figure 3-1. Relationships between ages of Alyawarra husband-wife pairs.

Heavy diagonal line with 0 age difference: husband and wife are the same age (H=W).
Dashed lines above H=W demarcate marriages with husbands older than their wives.
Dashed line below H=W demarcates marriages with wives older than their husbands.
I. The "main sequence" of husbands 1 to 20 years older than their wives.
II. A small group of marriages of mature men 1 to 6 years younger than their wives.
III. A small group of marriages of mature men having wives near or below the age of 20 years.
IV. A small group of marriages of elderly men (>65) having wives in the 25-40 year age range.
(From Denham 1975)

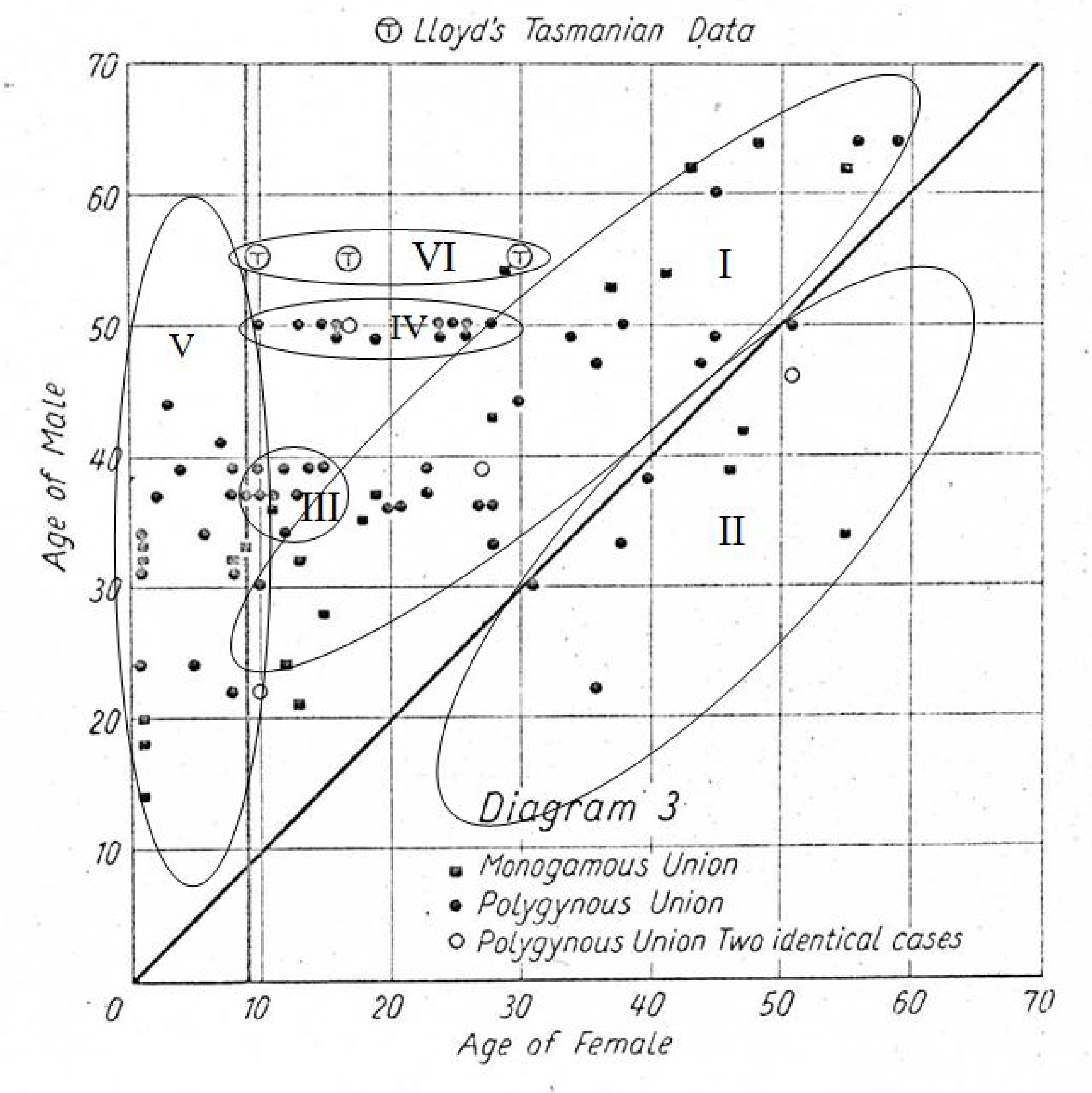


Figure 3-2. Relationships between ages of Wanindiljaugwa husband-wife pairs.

Heavy diagonal line with 0 age difference: husband and wife are same age (H=W).
I. The "main sequence" of husbands 1 to 20 years older than their adult wives.
II. A moderate group of marriages of mature men who are 1 to 20 years younger than their wives.
III. A small group of marriages of mature men having wives in the 10-15 year age range.
IV. A small group of marriages of elderly men (>50) having wives in the 10-30 year age range.
V. Infant bestowals in which husbands from 15 to 45 years old have wives below the age of 10 years.
VI. Three cases from Tasmania added by Rose (probably from G. T. Lloyd 1862).
(From Rose 1960:67).

labeled "0" is the locus of points at which husband and wife are the same age. The diagonal dashed lines represent age differences of ±10, 20, 30, 40 and 50 years. Age differences between spouses ranged from +50 years (husband 50 years older than wife) to -6 years (wife 6 years older than husband).

Cluster I holds the great majority of these marriages, in which men are 1-20 years older than their wives. Mean, median and modal differences all fall in Cluster I, in the interval of 11-15 years; mean is approximately +14 years and standard deviation is 11.8.

Cluster II is a very small group of marriages between mature men and women who are 1 to 6 years their senior.

Clusters III and IV show the kinds of marriages that give rise to notions of gerontocratic polygyny in Australian Aboriginal societies. Cluster III holds a small group of marriages in which men between 40 and 50 years old have wives who are under 20 years old; Cluster IV holds a small group of marriages between elderly men (> 65 years old) with wives in the 25-40 year age range. Together Clusters III and IV hold less than 20% of the Alyawarra marriages.

Figure 3-2 (Rose 1960:67) shows approximately 80 H-W pairs for whom good or at least acceptable age estimates are available among the Wanindiljaugwa of Groote Eylandt. The solid diagonal line labeled "0" is the locus of points at which husband and wife are the same age. Here infant bestowal and widow remarriage are common occurrences, and differences between spouses' ages ranged from +40 years to -20 years. Clusters I – IV are comparable in Figures 3-1 and 3-2, but Cluster V, which is missing from Figure 3-1, holds many marriages in Figure 3-2.

Again Cluster I holds the great majority of marriages, in which men are 1-20 years older than their adult (>10 years old) wives. Mean, median and modal differences all fall in Cluster I, in the interval of 11-15 years, and the mean is approximately +14 years.

Again Cluster II holds marriages between mature men and older women. Here the age difference is somewhat larger (1 to 20 years) and the number of W>H marriages is larger than among the Alyawarra. Presumably these differences reflect widow remarriage with younger men on Groote Eylandt.

Clusters III and IV are similar in Figures 3-1 and 3-2, but the differences are clear. In Cluster III women on Groote Eylandt tend to be a few years younger than those among the Alyawarra. In Cluster IV, age estimates for men are truncated at 50 years and again ages of women tend to be somewhat younger than among the Alyawarra.

Cluster V, which is absent among the Alyawarra but conspicuous among the Wanindiljaugwa, greatly amplifies on the (perhaps misguided) notion of gerontocratic polygyny on the North Coast of Australia. It holds about 20 marriages between men from 15 to 30 years old with girls under the age of 10 years. Presumably a large number of these marriages with subadult females are based on infant bestowal.

Cluster VI is irrelevant here. It holds three cases from Tasmania added by Rose, probably from G. T. Lloyd (1862).

In Figures 3-1 and 3-2, Cluster II holds marriages in which wives are older than their husbands. These negative age relations reduce the overall mean W<H age difference for each population, but their presence would not affect the proclivity for MBD marriage since, according to Rose (1965) and Hammel (1976a), any consistent bias in either direction increases the likelihood of MBD marriage.

3.3. Sibling-in-law chains

From a slightly different but closely related perspective, we can examine the same data in detail by extracting sequences of individual marriages linking specific pairs of people, Countries and patrimoieties. The resulting data sequences enable us to display flows of women and men that can be represented, in one form, by reconstructing actual sibling-in-law chains that follow the schematic diagram in Figure 3-3, approximately centered on Ego.

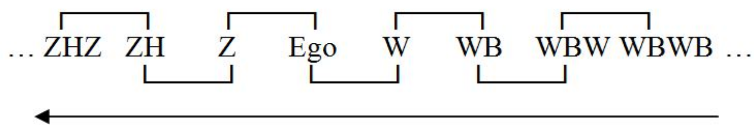


Figure 3-3. Sibling-in-law chains defined.

Symbols: ┌──┐ = siblings, └──┘ = spouses
Abbreviations: Z=sister, H=husband, W=wife, B=brother
To the left of Ego: Ego's sister, sister's husband, sister's husband's sister, and so on …
To the right of Ego: Ego's wife, wife's brother, wife's brother's wife, and so on …
The arrow shows that the direction of flow of women is from right to left.

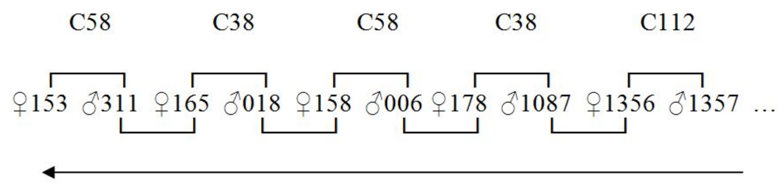


Figure 3-4. Sibling-in-law chain for ♀158.

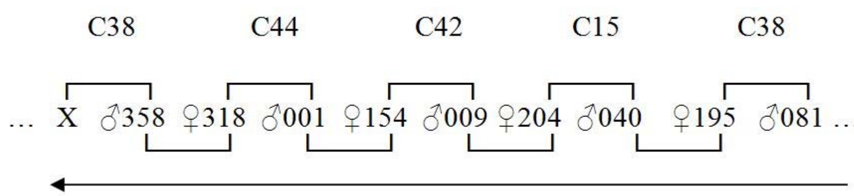


Figure 3-5. Sibling-in-law chain for ♂009.

Figure 3-4 and 3-5 are stripped-down views of two sibling-in-law chains based strictly on a small sample of consanguineal kin taken directly from the Alyawarra genealogies. The map in Figure 3-6 shows that the Countries whose codes appear at the top of Figure 3-5 are located between the Sandover and Bundey Rivers, very near the center of Alyawarra territory and adjacent to Gurlanda Camp where I lived and worked in 1971-72. The arrows illustrate the flow of women among the Countries as indicated in Figure 3-5.

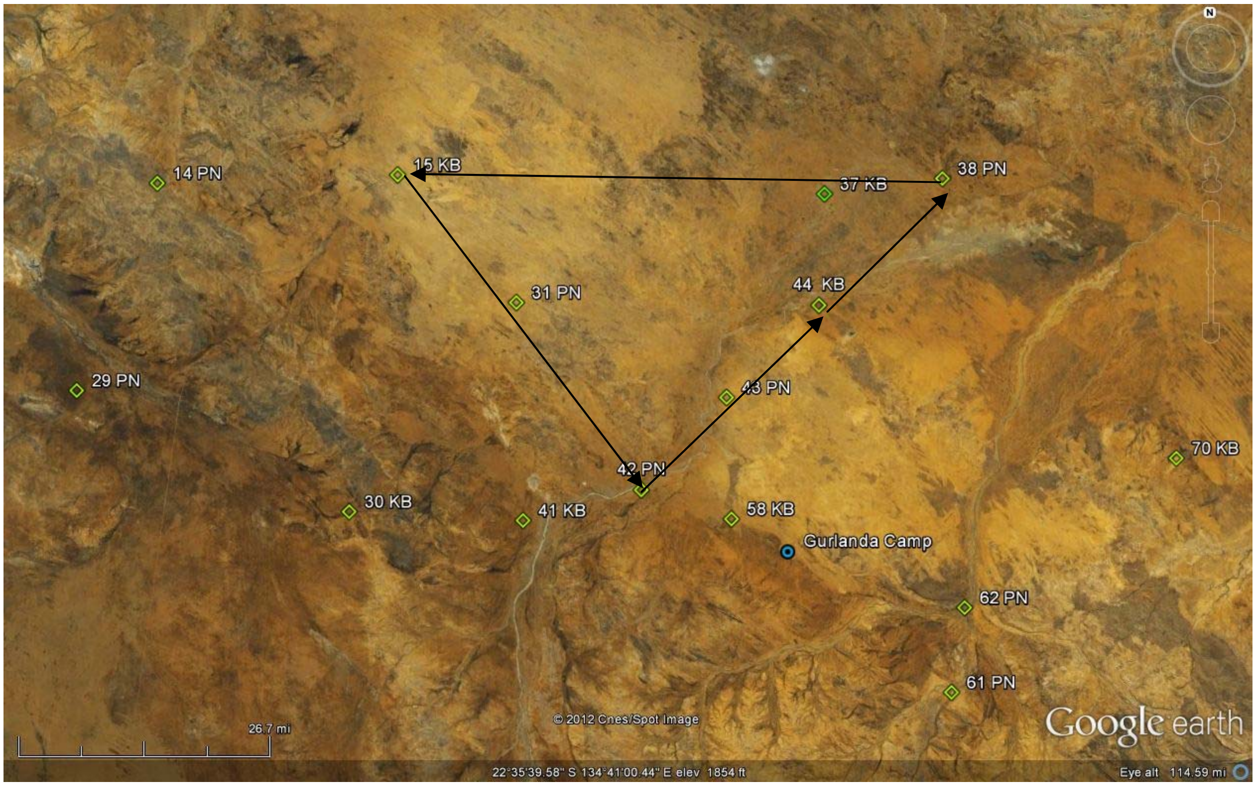


Figure 3-6. Map of sibling-in-law chain for ♂009 in Figure 3-5.

The sibling-in-law chains connecting Countries in Figure 3-6 are displayed horizontally, in effect lying flat on the surface of the Australian desert landscape, but that horizontal orientation is a misleading simplification that conceals the significant difference between the ages of wives and husbands. In Figure 3-7, the same chains are plotted against absolute or estimated years of birth on the vertical axis, with youngest people at the bottom of the chains and oldest people at the top. The red line represents the mean wife-husband age difference of approximately 14 years, which corresponds closely to the mean W<H age difference of 14.6 years in Australian Aboriginal societies overall (Binford 2001 and Fenner 2005). In fact, the slopes of both of the sample chains shown here are characteristic of Alyawarra sibling-in-law chains and closely approximate the Alyawarra and Australian Aboriginal means. The ubiquitous age bias gives the sibling-in-law chains a time dimension that is not reflected in Figures 3-4 through 3-6.

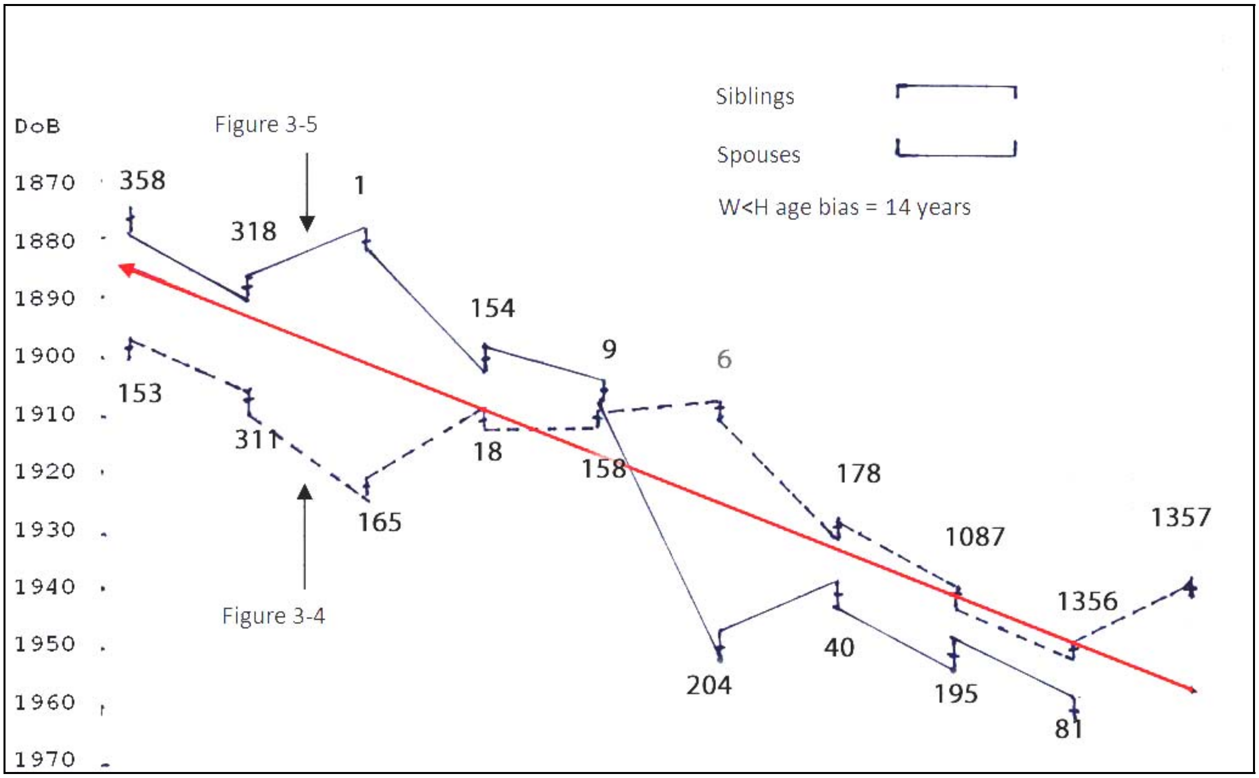


Figure 3-7. Sibling-in-law chains with systematic age bias.
Based on Alyawarra data from Figures 3-4 and 3-5.

As a statistical representation of marital behavior, it is not surprising that, in the plot taken from Figure 3-4, the age bias reverses itself briefly at the marriage between ♂18 and ♀158. The disruption is not enough to interfere with the systematic flow from one end of the chain to the other, but enough to suggest that something exceptional has happened. The fact that ♂18 and ♀158 appear side by side in Figure 3-7 is a subtle symptom of a temporary "reversal" of the flow of women associated with a "kink" in the chain. Specifically, each chain as a whole is based on consistent MBD marriages in which wives on average are 14 years younger than husbands, but the "kink" derives from a FZD marriage in which the W<H age difference is 0.

Each sibling-in-law chain constitutes a portion - perhaps a segment or a filament - of a generation moiety. Since marriages generally occur between Ego and members of the same generation level within the same generation moiety (even: 0,2,4,…), the parents and children of members of this sibling-in-law chain are in two different levels in the opposite (odd: 1,3,…) generation moiety (parents in G+1 and children in G-1). Ego's grandparents and grandchildren are in Ego's own generation moiety but in different generation levels (grandparents in G+2 and grandchildren in G-2). It follows that a reasonable representation of these relationships would utilize an array or lattice of diagonal lines as in Figure 3-8, each of the red and blue lines being parallel with the sibling-in-law chains in Figure 3-7, each forming a generation level in either the even or the odd generation moiety. Statistical irregularities would appear whenever a FZD marriage (e.g., ♂18 and ♀158) occurred instead of a MBD marriage, and whenever a "proper" alternate marriage occurred between a man and a woman in different levels of the same generation moiety; e.g., the marriage between ♂9 and ♀204, she being his consanguineal MBDDD rather than his MBD. It goes without saying that Ego can be placed in any node, and all of the ego-centric kin types will automatically reposition themselves accordingly. Not all Australian Aboriginal systems will fit such a lattice with suitably adjusted parameters, but those that do should have kinship terms that correspond roughly to the relational labels in the lattice, as do Alyawarra terms.

Rose's (1960) data contains precisely the same kind of chains as in Figure 3-7, but they are somewhat harder to extract due to the more fragmentary nature of his data.

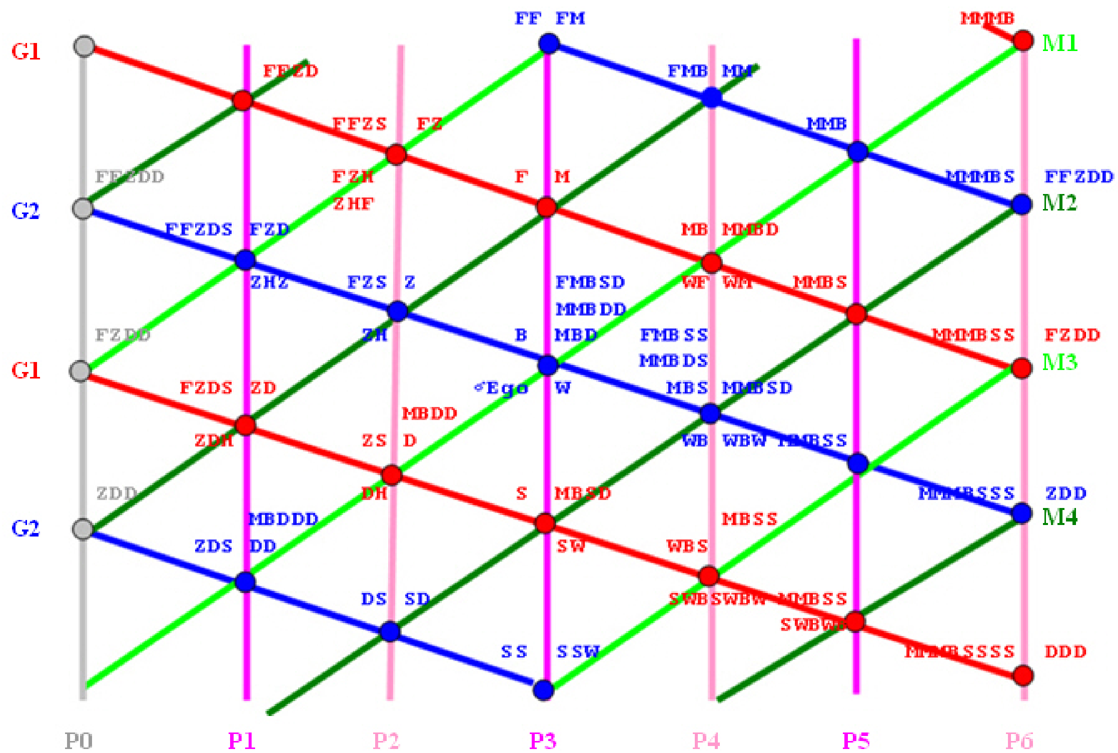


Figure 3-8. Two-dimensional age biased lattice based on sibling-in-law chains.

Generations G1-G2 (labels at left), Patrilines P1-P6 (labels at bottom), Matrilines M1-M3-M2-M4 (labels at right). Inclination of the age biased generations is based on Δ_{MC}/Δ_{FC} = .667. P0 is identical with P6 and has been included to show where closure would occur if the Figure were optionally rolled to form a cylinder. Standard kin type abbreviations are used.

3.4. Directed marriage cycles

Here I am deeply grateful to DR White for using pgraph software and Klaus Hamberger for using PUCK software to identify more than 650 directed cycles consisting of as many as 18 links – including many with 2 affinal links - among the 114 marriages in the AU01 Alyawarra dataset.

We can expand upon this small sample of sibling-in-law chains to examine the actual frequency of occurrence of marriages between men and women of various kin types. For example, according to Birdsell (1985, 1993), we should see no marriages between consanguines; rather all marriages should be between classificatory kin. And according to Radcliffe-Brown (1931), Levi-Strauss (1949/1969) and a host of others who assume that bilateral sibling exchange marriages occur in accordance with traditional models of Kariera and Aranda kinship terminologies, we should see no significant difference in the distributions of MBD and FZD marriages. Together they lead us to expect no marriages between consanguines and some significant number of bilateral sibling exchanges.

The sibling-in-law chains introduced above are "surface" phenomena that show relationships between individuals and between Countries without taking into consideration historical or genealogical relationships that necessarily impart yet another significant kind of time depth to the data. But we can go beyond that by focusing on directed marriage cycles (DMC), i.e., marriages in which husbands and their wives are linked to each other not only by their own marriages but also by consanguineal and affinal linkages among their relatives whose marriages might reveal bilateral sibling exchange, systematic differences between frequencies of MBD and MMBDD marriage, or the presence or absence of other patterns diagnostic of Dravidian or Dravidian-like kinship systems of Aboriginal Australia.

If a man marries his MBD, then the directed marriage cycle that links the couple through their ancestors also links their Countries in both social and topographic senses of that term. The example in Figure 3-9, taken from Figure 3-4, includes three consecutive links that are DMC. Here I consider two of them.

In the first, Ego is ♂6 and his W is ♀178; she is his MBD as labeled in the space between Ego and his wife. Here Ego belongs to C58, while his M, MB and MBD/W all belong to C38. In this MBD marriage, Ego was born in 1908 and his wife in 1930 as shown in Figure 3-7, yielding a 22 year age difference. Two of the linking relatives are deceased.

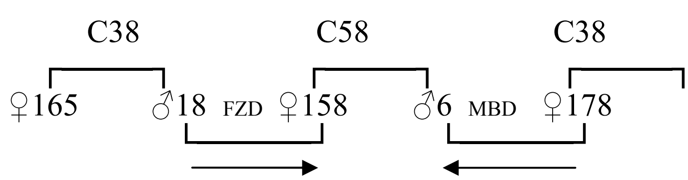


Figure 3-9. Directed marriage cycles from Figure 3-4 (see text).

In the second, Ego is ♂18 and his W is ♀158; she is his FZD. Ego, his F and his FZ all belong to C38, while his FZH/WF and FZD/W both belong to C58. In this FZD marriage, Ego and his wife are the same age, both having been born in 1910. One of the linking relatives is deceased.

Both of these DMC are simple in every sense. There are only four people in each cycle including Ego and his W, the cycles are based on exclusively consanguineal relations with no intervening ½ sibling or classificatory relations, the only affinal relation is that between H and W, and each cycle links only two Countries.

The links in these cycles appear to be entirely straightforward, from Ego to F to FZ to FZD on the left, and from Ego to M to MB to MBD on the right. Notice, however, that in the MBD marriage between ♂6 and ♀178, the woman flows matrilaterally from right to left in agreement with earlier sibling-in-law chain diagrams, but in the FZD marriage between ♂18 and ♀158, the woman flows patrilaterally from left to right. When ego marries MBD, he almost invariably marries a woman who is considerably younger than himself, but when he marries FZD, he generally marries someone whose age is much closer to – or even greater than - his own. Differences in ages and directions of flow between MBD and FZD marriages yield “kinks” in the chains.

Figure 3-10 shows a more complex cycle in which the links are less obvious. On the surface they look like those in Figure 3-9, but the abbreviation of linking kin types suggests their underlying complexity. Ego is ♂40 (C15) and his wife is ♀211 (C42). She is his close classificatory MMBDD*. The asterisk indicates that a classificatory link joins them, in addition to the single affinal link between H and W.

♂40 MMBDD* ♀211

Figure 3-10. A more complex marriage cycle.

The cycle in Figure 3-10 has eight links joining four different Countries. ♂40 Ego (C15), his M ♀157 (C38) and his MMBDD/W ♀211(C42) are living, but the other five people, all members of C58, are deceased; viz., Ego’s MM, MMF, MMFB, MM*FBS* including a pair of close classificatory brothers, and MM*FBS*D. The classificatory link at MMFBS reflects the fact that two men – close classificatory (or perhaps ½) brothers, one about 20 years older than the other - at different times were husbands of 211’s MM.

The complexity accelerates rapidly when we extract cycles containing 2 affinal links between H and W. If three or more affinal links are accepted, the complexity continues to increase exponentially.

Directed marriage cycles present I am concerned next with tabular data pertaining to age bias and inbreeding in the context of directed marriage cycles as addressed by Tables 3-1 through 3-3 below.

Among the 114 marriages in this dataset, 58 (50.9%) show no directed marriage cycles while 56 (49.1%) are characterized by directed marriage cycles. Among those that are characterized by directed marriage cycles, all close with 1 H-W affinal link and include other kinds of linkages. 17 have consanguineal links only, 18 have consanguineal plus one close classificatory link, and 21 have consanguineal plus 2 affinal links. The 17+18=35 that have only 1 affinal link plus consanguineal and close classificatory links may be thought of as the structural core of this Alyawarra population.

The Alyawarra DMC are situated in genealogies with depths as great as 6 generations. A 6-generation patriline with a mean male generation interval of 42 years has an actual time depth of 210 years; i.e., the birth of its earliest members occurred in 1760, about 28 years before the British founded the first European settlement in Australia. Phrased more conservatively, a 60 year old man who was living in 1971 and was married to his MMBDD could trace that relationship through his MMB who was born in approximately 1840. Although the marriages themselves were current in 1971, the DMCs discussed here were not recent events. Since the earliest pastoral properties in the Sandover-Bundey River drainage basin were established near 1920, the deepest directly linking marriages among these living Alyawarra occurred perhaps half a century before the "official" onset of European colonization in Alyawarra territory.

Each consanguineal (or consanguineal-plus-close classificatory) cycle is accompanied by as many as 81 longer parallel affinal cycles that are reducible to the consanguineal kin types in Table 3-1. For example, in a Dravidian-like MFBSD cycle, MFBS reduces to classificatory MB, so the MFBSD cycle as a whole reduces to MBD*.

Kin Type	Number	Percent
Matrilateral cross-cousin marriages		
MBD	18	51.4
MMBDD	7	20.0
MBDDD	1	2.9
Subtotal	26	74.3
Patrilateral cross-cousin marriages		
FZD	7	20.0
FZDDD	2	5.7
Subtotal	9	25.7
Total	**35**	**100.0**

Table 3-1. Frequencies of DMC by kin types in the structural core.
Each cycle may include a close classificatory kinship link.

♂ Ego's Country Code	Consanguineal					Row Total
	Matrilateral cross-cousins			Patrilateral cross-cousins		
	MBD	MMBDD	MBDDD	FZD	FZDDD	
3	4	2	0	3	0	9
58	4	1	0	1	2	8
38	4	0	0	1	0	5
15	0	4	0	0	0	4
31	3	0	0	0	0	3
44	3	0	0	0	0	3
42	0	0	1	0	0	1
62	0	0	0	1	0	1
81	0	0	0	1	0	1
Col Total	**18**	**7**	**1**	**7**	**2**	**35**

Table 3-2. Distribution of core DMC by ♂Ego's Country.
Cycles may include a close classificatory kinship link.

	First Cousin	Second Cousin	Other Consanguine	Non-Consanguine	Row Total
Number of marriages	25	7	3	79	114
Percentage of total (n=114)	22.1	6.2	2.7	69.0	100.0
Percentage of core (n=35)	71.4	20.0	8.6	-n/a-	100.0

Table 3-3. Relative frequency of occurrence of cousin marriages.
Comparison of first and second cousins, other consanguines and non-consanguines
in DMC core marriages (n=35) and all marriages (n=114).

All 35 core DMC comply fully with Alyawarra expectations concerning moiety and section memberships, so we cannot omit any of them as being "defective" or "wrong marriages". Since all are acceptable but have different frequencies of occurrence, diagramming any one of them as an ideal or preferred type on the basis of these behavioral data would be inappropriate. Hence we address a statistical problem rather than a question of approximations to ideal types.

Table 3-2 shows that core DMC are concentrated among men from 9 of the 27 populated Countries, with all of these Countries except 62 and 81 showing a preponderance of matrilateral cross-cousin marriages. The first 6 Countries constitute the most densely interconnected part of the core, while marriages in the last 3 Countries, plus the 21 marriages that are not members of DMC, are only loosely attached to the core Countries. They constitute a kind of "halo" of affiliated outlying Countries, some unambiguously Alyawarra but some attached more strongly to language groups other than the Alyawarra.

The age bias makes matrilateral marriages more common than patrilateral, and all of the matrilateral forms together constitute a large majority (26 of 35). The mean age difference does not absolutely preclude marriage with FZD, but among the Alyawarra, a man on average has a 74% chance of marrying a matrilateral cross-cousin, and a 26% chance of marrying a patrilateral cross-cousin, even though both cousins are in his own generation moiety and generation level, and both are marriageable.

The distinction between marriage between first cousins and more remote consanguineal kin is sharp. Marriages with first cousins (MBD and FZD) constitute 25/35 = 71.4 % of the core marriages, marriages with second cousins (MMBDD) constitute 7/35 = 20%, and marriage with other consanguineal kin constitute only 3/35 = 8.6%.

Table 3-4 summarizes age differences between spouses within directed marriage cycles. The difference is clearest in the contrast between MBD (12.4 years) and FZD (1.3 years). Both MBDDD and FZDDD are exaggerated by small sample size, and possibly by marriage between different generation levels within the same generation moiety.

	Matrilateral cross-cousins			Patrilateral cross-cousins	
Directed marriage cycles	MBD	MMBDD	MBDDD	FZD	FZDDD
Number of cases	18	7	1	7	2
W<H mean age difference	12.4	8.7	44.0	1.3	12.0
Weighted mean age difference	12.6			7.0	

Table 3-4. Mean age difference between married cross-cousins within DMCs.

Directed marriage cycles absent Among the 114 marriages in this dataset, 58 (50.9%) are not characterized by directed marriage cycles. These cases are by no means irrelevant to this analysis, and in fact they are more challenging to understand because biological linkages are missing from them.

The absence of DMC can be due to at least three important factors. Missing data with which to reconstruct existing relationships is an obvious possibility. Second, there may be a genuine absence of linkages of any kind, in the most extreme case because the spouses belong to two different language groups between whom no earlier marriages are known.

Third, relevant linkages between spouses may be classificatory rather than biological, hence are invisible when we search the genealogical data. Yet classificatory relationships are crucial to the operation of Australian Aboriginal societies. For example, genealogical relations underlying the organization of Alyawarra residential groups such as camps tend to show a strong if somewhat unusual kind of matrilocality, while Alyawarra men argue for patrilocality. The contradiction disappears when we realize that both are right: the biological data show matrilocality, while the indigenous cognitive model of patrilocality is based specifically on relations between men who are classificatory, not genealogical, brothers (Denham n.d.).

Table 3-3 shows that first cousin marriages strongly predominate in the DMC core (71.4%), but at the same time are in a minority (21.1%) across the population as a whole. Thus the Alyawarra engage in consanguineal marriages at a rate that is high enough to maintain the spirit of the Law and low enough to avoid the harmful consequences of inbreeding that are implicit and unavoidable in tightly compacted traditional structures of Kariera and Aranda kinship as depicted in Figure 1-1.

From an Alyawarra perspective, classificatory linkages that are invisible in the biological data are fully equivalent to biological linkages as bases for forming marriages and organizing camps, and the rules that apply to them, when suitably modified to accommodate classificatory rather than genealogical relations, are identical so far as I know with the rules that regulate marriage with close biological kin.

Omitting consideration of classificatory linkages at this point is expedient, but we must devise computational procedures for identifying specific classificatory linkages between specific pairs of people, just as we can identify biological linkages from genealogies, or we simply lose a lot of "hidden" relational data that would be valuable for the analysis of descent, marriage and kinship in the Alyawarra dataset and most likely in all classificatory kinship systems.

My attempts to reliably identify and interpret marriages based exclusively on close, distant and remote classificatory linkages, therefore lying outside the scope of software that focuses on genealogical relationships, have not yet succeeded. At the point in my fieldwork when I should have systematically recorded every person's relationships to his/her clan, conception and other Dreamings, I did not know enough about Alyawarra kinship, Dreamings or language to do that job effectively. I consider that to be the single greatest omission from my fieldwork.

3.5. Generation moieties and Directed Marriage Cycles

Figure 3-11 shows that the 35 core DMC discussed above are not freestanding, isolated units as they appear to be in Figures 3-9 and 3-10. Rather, they occur as a dense cluster spanning more than 5 traditional generations occupying multiple levels in each of the two generation moieties.

As labeled in the Figure, red bands correspond to levels in the even numbered generation moiety and blue bands to levels in the odd numbered. Each DMC is marked with the abbreviation of the links between H on the left and W on his right. Interrelations among generation moieties and directed marriage cycles appear clearly.

Each horizontal sibling-in-law chain, beginning at the left with ♂1, the oldest man, and continuing to the right in decreasing age order, embodies the age bias just as it appears in Figure 3-7. Likewise of course, G+3 at the top of Figure 3-11 and G-1 at the bottom are respectively the oldest and youngest represented levels in the generation moieties.

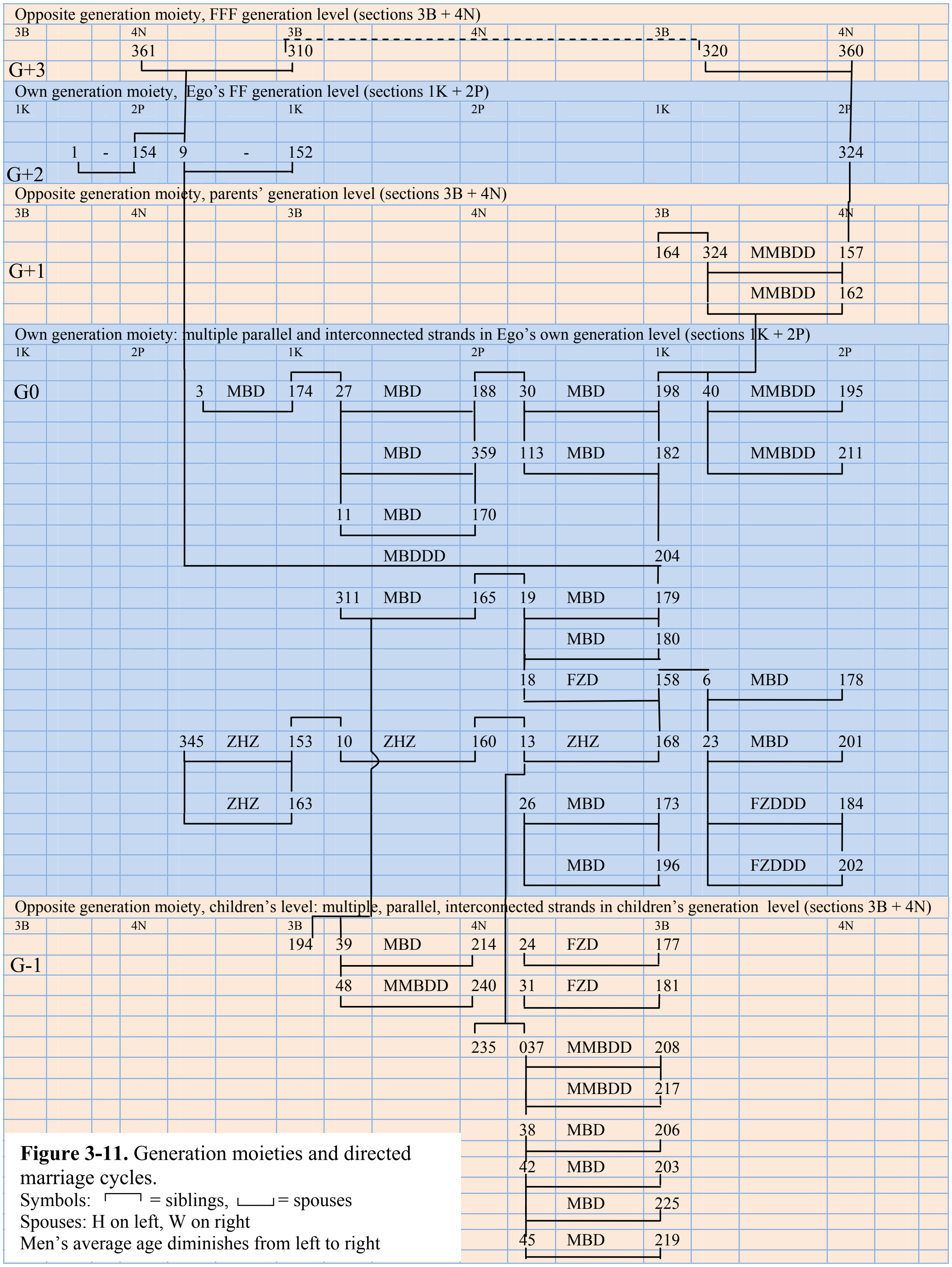


Figure 3-11. Generation moieties and directed marriage cycles.
Symbols: ⌐¬ = siblings, └┘ = spouses
Spouses: H on left, W on right
Men's average age diminishes from left to right

For example, in Figure 3-11, in the blue "own generation moiety" band, the top row of entries says:

- ♂3 (a very old man) has one W, ♀174, who is his MBD
- ♀174's Bs are ♂27 and ♂11 (somewhat younger than ♂3)
    - ♂27 has two W, ♀188 and ♀359, both of whom are his MBD
    - ♂11 has one W, ♀170, who is his MBD
        - The three W of ♂27 and ♂11 are full Z of each other
- ♀188, ♀359 and ♀170 have two full B, ♂30 and ♂113
    - ♂30 and ♂113 (mature men) have one W each, ♀198 and ♀182 who are full Z
        - ♀198 and ♀182 have one B, ♂40, (a young mature man) who has two W, ♀195 and ♀211, both of whom are his MMBDD. Those women have no married B, so the chain ends with them.
    - ♀198 and ♀182 have three other full Z, ♀204, ♀179 and ♀180
        - ♀204 is a W of ♂9 who appears two generation levels above her. She is his MBDDD.
        - ♀179 and ♀180 are W of ♂19 and are his MBD

And so on through a remarkable intertwining of relationships at the core of the society. And a great many valid interconnections that reduce legibility are omitted from this diagram.

Thus we see the structural core of Alyawarra society embedded in the 1971 research population.

3.6. Kunstadter's cross-cousin marriage simulations

Together Birdsell and Tindale predict no marriages between consanguines, while the traditional models advocated by Levi-Strauss et al. lead us to expect some significant but unspecified number of bilateral sibling exchanges. In fact, we find just the opposite: a significant number of marriages between consanguines but no bilateral sibling exchanges.

The argument against bilateral sibling exchange has been made. But with regard to inbreeding, Birdsell (1985, 1993) argued that, "Very few individuals in [an Australian Aboriginal] population are affected [by inbreeding] and the impact is negligible", and attributed to Tindale the statement that, "in arranging marriages great efforts are made to assure that the candidates have no known biological relationship to each other." All of the data presented in Figures 3-9 through 3-11 and Tables 3-2 through 3-4 are incompatible with Birdsell's argument. Tables 3-2 and 3-3 show that 1st cousin marriages account for 21% of all known Alyawarra marriages and 1st and 2nd cousin marriages together account for 28.3%. These numbers show inbreeding to be a solid reality in 1971, and the historical depth of the relations suggest that it probably was a reality in earlier decades.

In this regard, an early computer simulation by Kunstadter, et al. (1963) shows the following estimates of cross-cousin marriage rates in societies that seek to maximize MBD marriage by using preferential or prescriptive rules. In societies such as the Alyawarra with population sizes in the 200-300 range:

> "… over three quarters of all observations [of MBD marriage fall] in the 20 to 35% range and over nine out of ten in the 15 to 40% range. … The average proportion of matrilateral cross-cousin marriages is calculated to lie between 27 and 28%. … marriages which conform to the ideal merely by accident appear to be between 1 and 2%. … We are reasonably convinced that the estimates of cross-cousin marriage rates … are sufficiently reliable to permit theoretical inferences about the viability of prescriptive marriage norms in a social system with normal demographic variability."

Although the Alyawarra data are not directly comparable to those of Kundstadter's simulated populations, the similarities are great enough to suggest that their 1st and 2nd cross-cousin marriages, which account for 28.3% of the total, lie remarkably close to Kunstadter's prediction and quite far from Birdsell's.

How can we account for the disagreement between Birdsell and Tindale on the one hand, and the Alyawarra data on the other?

It is at least conceivable that Birdsell's (1993) and Tindale's (1953) informants, many or most of whom married in the 19th century and were not members of the Alyawarra language group, were scrupulously careful to avoid inbreeding by marrying classificatory kin only, while Alyawarra-speaking people in the 19th and 20th centuries failed to exercise due caution. This interpretation implies that the traditional rule for maximizing MBD marriage was partially negated by a traditional rule excluding consanguineal MBD. It appears then that the Alyawarra adhered to the traditional maximization rule while disregarding the partial negation rule. This argument implies that the explicit structural core of Alyawarra society, which is so clearly visible here, was missing at other times and places in Australia. But is it really plausible that colonialism and genocide contributed to the emergence, rather than to the disruption, of such a remarkable pattern? That may be conceivable, but at the very least it is profoundly counterintuitive.

An alternative interpretation of these data is the ancient truism that says "what you see depends upon where and how you look", also known as "the story of the blind men and an elephant". I do not doubt the veracity of Birdsell and Tindale, but I seriously doubt that their broad generalizations are valid. My objectives, field methods and working assumptions were different from theirs, so it is not surprising that the data I collected was different from theirs.

3.7. Hammel's stochastic model of asymmetric cross-cousin marriage

Deterministic mechanical models ignore variations in the occurrence of events, thereby failing to mirror the real world acceptably. Certainly they are important, but they are limited in what they can do. Much stronger approaches to understanding relationships between ideology and behavior include computer-based stochastic simulations and extensive observation of naturally occurring events, especially when those two approaches can be used together. Hammel's (1976a:161-168) stochastic model of age biased marriages, mentioned above in my discussion of his mechanical model, offers a highly effective way to situate the observed statistics on Alyawarra directed marriage cycles in a broader context.

Hammel's simulation, using the SOCSIM program (Hammel 1976b), began by establishing a test population and simulating its reproductive behavior and mortality for multiple generations to establish a stationary population with a genealogy of sufficient depth. After running for 150 years, the test population had 132 members. The test population was run 33 separate times, each time with a different starting number to obtain independent trials. A run was terminated when the population had run for 400 years, or had exceeded 400 people, or had declined to 10 people. For each marriage, all first- and second-cousin relationships between H and W were tabulated. Each run was set to achieve a different mean age bias between H and W, extending about a dozen years on both sides of zero bias.

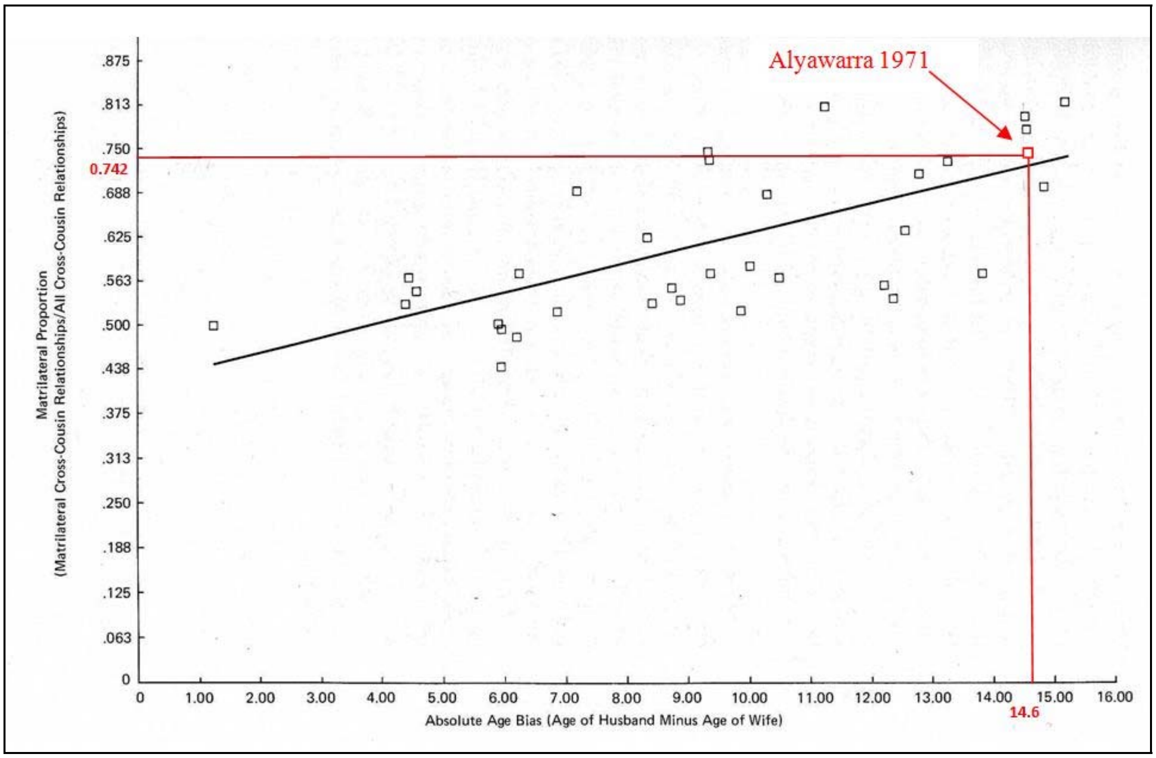


Figure 3-12. Data plot and regression of absolute age bias and consanguineal bias.
Figure from Hammel (1976a:165), plus Alyawarra data in red.

The results of the tests were unambiguous. Consider the example in Figure 3-12. Although the mechanical model said nothing about the relationship between the strength of the age bias and the strength of the matrilateral bias, this Figure displays that relationship. The absolute age bias ranged from 1.25 to 15.27 years (signed values -14.6 years to +15.27 years) shown on the x-axis. The matrilateral bias, defined as the number of MBD and MMBDD marriages divided by the total number of 1st and 2nd cross-cousin marriages, ranged from .441 to .816 (.5 = random distribution, 1.0 = perfect correlation) shown on the y-axis. The correlation between matrilateral bias and absolute age bias, which at .778 is highly significant statistically, means that the matrilateral bias increases as the absolute value of the age bias increases as shown by the diagonal line from lower-left to upper-right.

The SOCSIM test population was exactly half the size of the 264 living members of the Alyawarra research population, so the small size of the Alyawarra population does not present a problem here. The absolute age bias within 114 Alyawarra marriages was 14.6 years. Tables 3-1 and 3-2 show 26 matrilateral marriages out of a total of 35 cross-cousin marriages, hence the matrilateral bias is 26/35 = .743. The Alyawarra data, when fitted to the SOCSIM distribution, lies almost exactly at the end of the diagonal, meaning that its position in the distribution is precisely what SOCSIM would have predicted.

3.8. Kinship terms and helices

In addition to focusing primarily on marriage, we can focus equally well on kinship terminology.

The Northern Aranda have an 8-subsection system, and their kinship terms have fit - traditionally and by default - onto a hypothetical 4-patriline Radcliffe-Brownian descent structure with bilaterally symmetric sibling exchange marriages between 2^{nd} cross-cousins (e.g., MMBDD). Each generation is discrete, horizontally closed on itself, and perpendicular to the vertical axis of the structure as in Figure 1.1.

The Alyawarra kinship terms, which can be superimposed on the Northern Aranda structure, seem to correspond to the Northern Aranda subsection system. But if we conceptualize the situation that way, we are dealing with an implicit Alyawarra 8-subsection system when in fact the Alyawarra use an explicit 4-section system in the manner of the Kariera and Eastern Aranda. Since wives on average are 14+ years younger than their husbands, the bilaterally symmetric sibling exchange marriages that have been taken for granted among the Northern Aranda and Kariera are clearly impossible to sustain among the Alyawarra.

A series of 8 Figures and 6 Tables in Denham, McDaniel and Atkins (1979) expands on these problems. A clue to their solution appears in Table 3-5, where we see 173 cases in which women are related to Ego as a consanguineal MBD and 119 cases in which they are related to him as a consanguineal FZD.

Since both MBD and FZD are female cross-cousins, Ego's "default" reference term for both of them is *algyeliya* in the Alyawarra language (*ilchella* in the Northern Aranda). However, Ego uses *algyeliya* to refer to 77.3% of his FZD and to only 30% of his MBD. Why is the term not used consistently for both as we might intuitively expect it to be?

A. RELATION: Mother's brother's daughter		
TERM	**NUMBER OF CASES**	**PERCENTAGE OF CASES**
algyeliya	**52**	**30.0**
anowadya	**51**	**29.5**
amaidya	**42**	**24.3**
andungiya	**15**	**8.7**
adardiya	**13**	**7.5**
TOTAL	**173**	**100.0**
B. RELATION: Father's sister's daughter		
TERM	**NUMBER OF CASES**	**PERCENTAGE OF CASES**
algyeliya	**92**	**77.3**
adardiya	**9**	**7.5**
anowadya	**8**	**6.7**
andungiya	**6**	**5.0**
Misc. (4 terms)	**4**	**3.5**
TOTAL	**119**	**100**

Table 3-5. How ego refers to MBD and FZD.

In keeping with the difference in his usage of *algyeliya*, Ego refers to 29.5% of his MBD as *anowadya* (wife) but only 6.7% of his FZD by that term. One obvious interpretation of this contrast is that Ego may be much more likely to marry his MBD than his FZD.

An even greater contrast appears when Ego refers to 24.3% of his MBD as *amaidya* (mother) but none of his FZD by that term. This optional usage of a Crow kinship skew transforms a MBD into a "classificatory mother", an action that in effect "pushes" an otherwise marriageable woman into an unmarriageable category, thereby increasing the likelihood that Ego will marry more remote kin. The fact that Ego never invokes that option with regard to FZD suggests that women in that category may be unmarriageable by default.

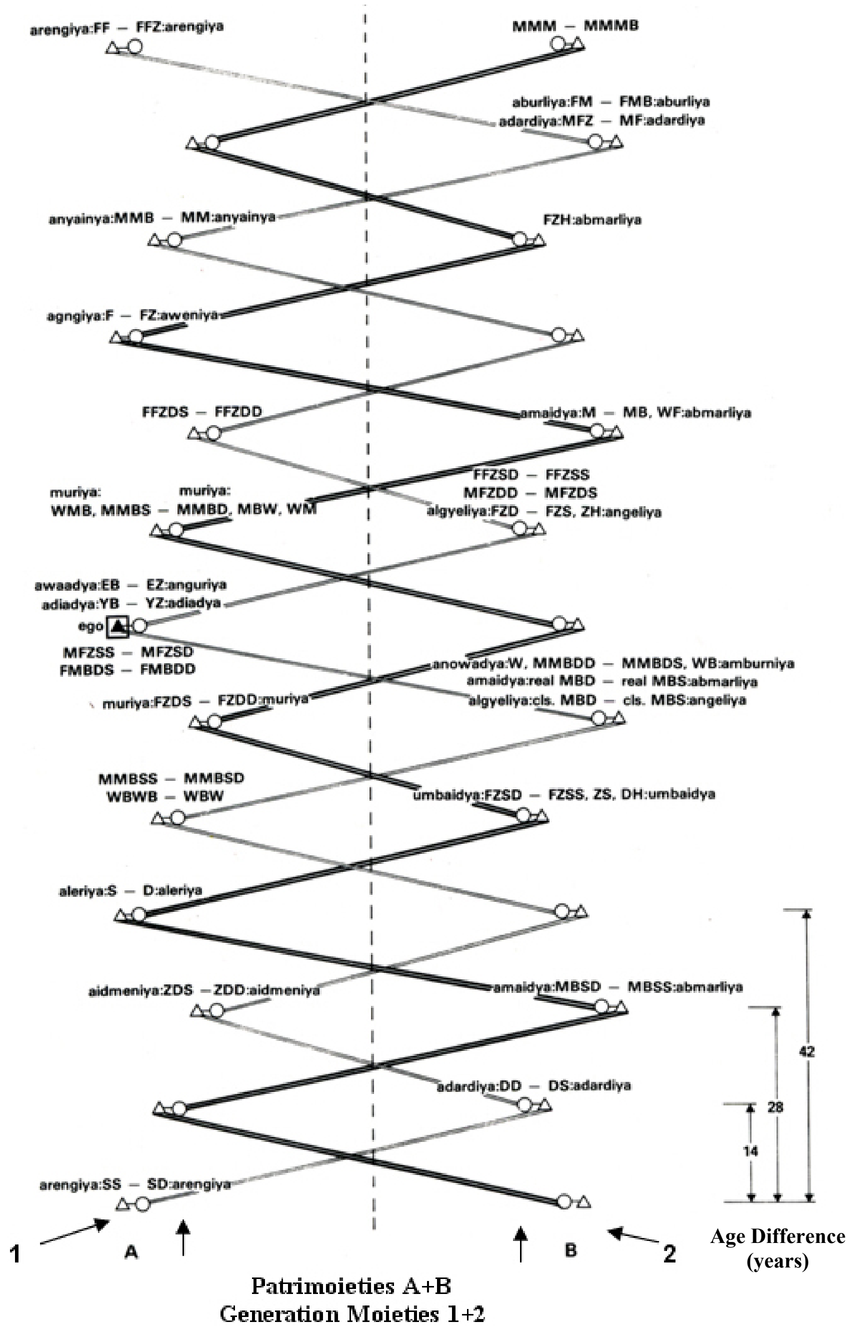


Figure 3-13. 2-dimensional Alyawarra endogamous helix with kinship terms.
Closed endogamous structure equivalent to Figure 3-8, with 14 year age bias and Dravidian kinship terms from the Alyawarra dataset. Generation form: ←*past* … ZHZHZHZJZHZ ♂ego WBWBWBW… *future* →

In the presence of these large and significant differences, it is interesting to note that Ego uses *adardiya* (MFZ or DD) to refer to exactly the same percentage, viz., 7.5%, of both MBD and FZD. As members of G+2 and G-2, women in both of these categories are members of Ego's generation moiety, so would be proper but less likely wives for Ego.

Finally in 5% to 8.7% of the cases Ego used the uninformative affinal term *andungiya* (BW) to refer to MBD and FZD.

To accommodate these features, and many related anomalies omitted here, the helical structure that appears in Figure 3-13 is explicitly age biased in favor of matrilateral cross-cousin marriage (toward MBD or MMBDD and away from FZD or FFZDD) and displays all of the primary Alyawarra kinship terms along with their kin types. In this structure, the section terms, kinship terms and age relations all conform to a hypothetical 6-patriline, 4 matriline structure that is unlike the 2-patriline Eastern Aranda and 4-patriline Northern Aranda structures. But in order to work, the generations must cease to be discrete, horizontally closed and perpendicular to the vertical axis, and instead must transform themselves into endless sibling-in-law coils, stretching from past to future, that wrap around the vertical axis at an angle determined in part by the number of hypothetical patrilines, 6 in the Alyawarra case. The intertwined helical generations are based on a pair of sibling-in-law chains that can be represented from a male ego's perspective as:

←*past* … ZHZHZHZJZHZ ♂**ego** WBWBWBW… *future* →

The vertical dashed line in the Figure represents the axis of the helix. A complete wrap goes from FF to F to Ego to S to SS, spanning 4 male generation intervals and 6 female generation intervals, with a total elapsed time of 168 years on average.

Figure 3-14 shows a simplified version of Figure 3-13, labeled generically with kin types instead of Alyawarra kinship terms, therefore potentially compatible with a broader range of kinship systems.

The helical structure in Figure 3-14 represents an attempt to construct an ideal 3-D representation of the abstract Alyawarra structure with 6 patrilines, 4 matrilines, 2 helical generations, Δ_{MC}=28 years, Δ_{FC}=42 years and MC/FC=.667 (additional parameters appear below).

In Figure 3-14, each node occurs at the intersection of a patrimoiety, a matrimoiety and a generation moiety, and contains a H-W marital pair, along with a corresponding set of classificatory kin for each member of the pair. Each of the two exogamous patrimoieties contains 3 classificatory descent lines represented as dotted lines 1-3-5 and 2-4-6. Each of the two exogamous matrimoieties contains 2 classificatory descent lines that have been omitted for clarity. Each of the two endogamous generation moieties contains a pair of classificatory "alternating generations", also omitted here. Each classificatory line contains a corresponding set of consanguineal or affinal lines that constitute the fine structure of the Alyawarra system of descent, marriage and kinship.

The ♂Ego located at the center of Patriline 3 in the blue generation moiety is the reference point for all of the relationships shown on the diagram. His wife is in the same node with him, but his sister (in the same blue generation moiety) is in the left adjacent node 14 years older than he is. His father and mother are in the node directly above him in Patriline 3, while his son and son's wife are in the node directly below him in Patriline 3. All other relations can be identified following these examples.

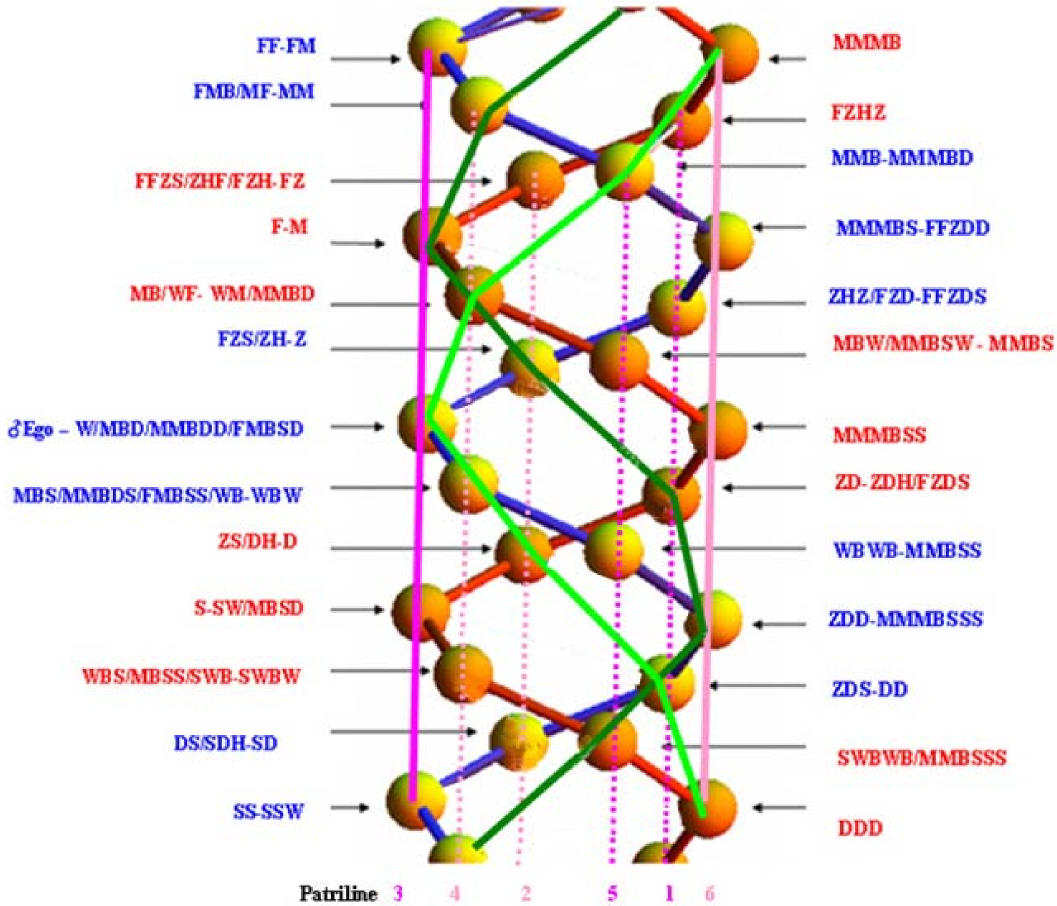


Figure 3-14. 3-dimensional Alyawarra helix; kin types without kin terms.
Nodes are marital pairs. Kin type abbreviations as above. Two exogamous patrimoieties (**Purple** and Pink), two exogamous matrimoieties (**DarkGreen** and LightGreen), and two endogamous generation moieties (Red and Blue). Patrimoieties show finer details (dotted lines 1-3-5 and 2-4-6) of patridescent in six separate classificatory descent lines. ("Double Helix" image from Sándor Kabai, Wolfram Demonstrations Project, retrieved 2010.)

In this format, it is clear that the even numbered generation moiety containing levels G+4, G+2, G0, G-2, G-4, and so on, is a continuous coil, and that the "levels" (+4, +2, etc.) are contiguous segments in the same endless generation moiety, not discrete segments stacked on top of each other. So when Ego refers to his FF, he simply refers to someone at a different point in his own generation moiety. It follows of course that polygyny does not reflect gerontocratic competition between older men and younger men. Rather, men flow through a) a youthful period in their lives when they do not marry because of the 15 years of intensive training they receive in the Dreamings, then through b) a period of early adulthood when they establish their reputations and positions in society with one wife and their children, then c) through a terminal period of maturity during which they are expected to accept additional responsibilities including additional wives in polygynous households. Think of it as a kind of transitional sequence through which most men flow, not on the basis of competition but rather as a performance of their "civic duty".

There is a strong temptation to stretch the visual analogy of the double helix by treating the two pairs of intermarrying Alyawarra sections (K ↔ P, B ↔ N) as if they were comparable to the two base pairs (A ↔ T, G ↔ C) in DNA. Likewise, self-replication of the Dreamings through "reincarnation" and intensive training strengthen that temptation. But pushing that analogy too far may be unwise.

3.9. White's network diagram

A significant problem – some might say a fatal flaw – in the argument presented to this point is that the six patrilines in Figures 3-13 through 3-15 are not named by me or the Alyawarra, and in fact, I have said nothing to this point about their membership. Although they are key constituents of a helical structure that provide its "vertical" orientation and determine its slope, I never heard the Alyawarra talk about those 6 patrilines. They are implicit, perhaps unknown, certainly unlabeled by the Alyawarra. I could never ask an Alyawarra which of those lines he belongs to for he would not have a clue what I was talking about. Some might argue that Figure 3-15, attractive and stimulating though it may be, is "nothing but" a concatenation of metaphors. Perhaps that judgment has some merit, but perhaps it is misguided.

As mentioned earlier, the 377 members of the AU01 Alyawarra 1971 dataset belong to 27 named patriclans, called Countries in Alyawarra-English. Each Country has a topographic aspect as a physical location containing Dreaming sites, and a sociological aspect as the patrilineally related group of people who belong to and are responsible for the Dreaming sites at that physical location. The problem then is to concatenate 27 named patriclans that the Alyawarra know well into 6 unnamed classificatory patrilines that are essential to the construction of the helix but seem to be unknown to the Alyawarra.

Doug White devised Figure 3-15 as a way to extract information about patriline membership on the basis of marriage behavior. He physically positioned the genealogy of each patriclan between a) the clan from which it receives most of its wives and b) the clan to which it gives most of its women as wives. The horizontally asymmetric flow is based on the predominance of MBD and MMBDD marriage among the Alyawarra, and is combined with a vertically asymmetric flow based on the age bias, thereby yielding the diagonal blue dotted lines reaching from upper-left to lower-right. The Figure is an empirical exemplar of well known algorithms for equivalence structures pioneered by Lorrain and White (1971).

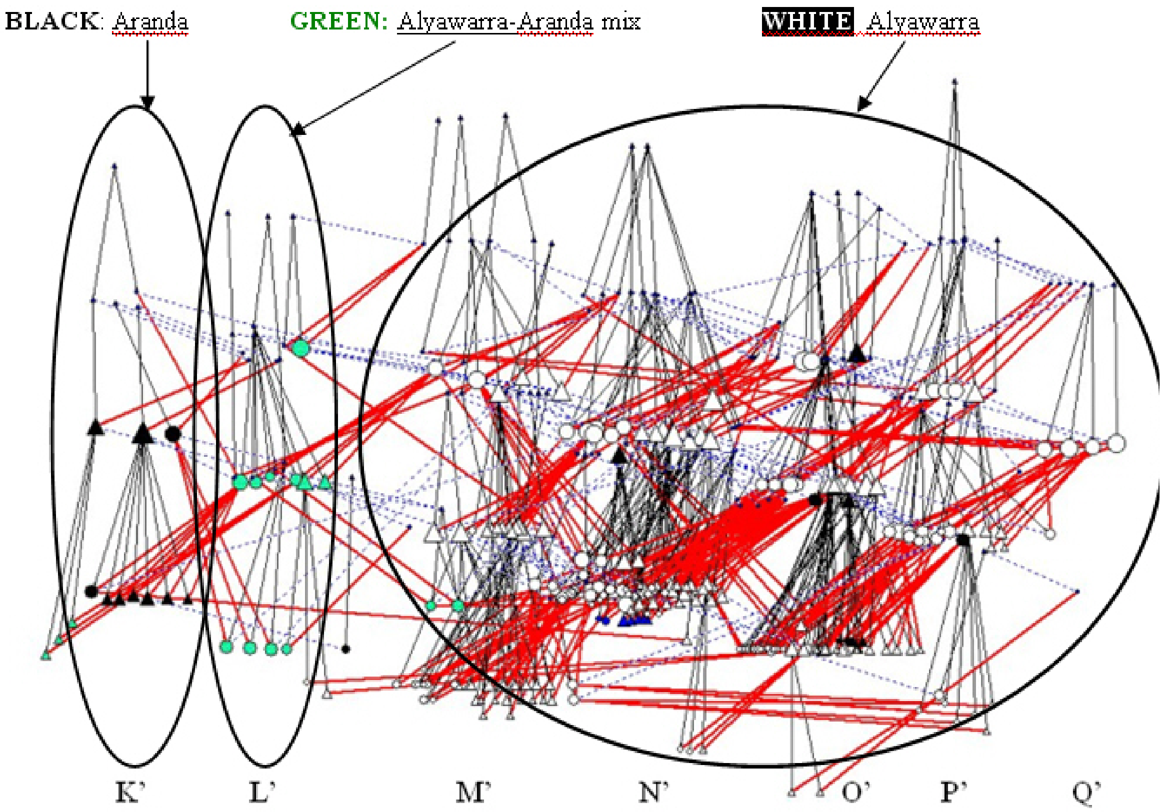


Figure 3-15. Network patterns in Alyawarra marriage data.
People: Δ = male, O = female; *Language group membership of each person:* white = Alyawarra, green = Alyawarra-Aranda mix, black = Aranda, blue = informants disagreed on language group affiliation; *Linkages*: solid black lines = father-child links (patridescent), solid red lines = mother-child links (matridescent), dotted blue lines = husband-wife links (generation moieties); *Vertical descent groups:* K' = Aranda, L' = part-Alyawarra, M' through Q' = full-Alyawarra (alternate descent group codes 1-6, 0 explained in text). *Network* based on data from Denham (1971/2007), prepared by D.R. White (Denham and White 2005), featuring sibling sets generated with Pajek network analysis software (Batagelj & Mrvar 1998; de Nooy, Mrvar & Batagelj 2005).

Specifically, to order the structure, White (Denham and White 2005) took M and N as the two most densely connected "seed" lineages out of the total of 27 lineages defined by patrilineal descent from a common (known) apical ancestor. Next, all other lineages that are predominantly wife-givers to M are added to a superclass of lineages that contains N, and now designated as a classificatory patriline, N'. Next, all other lineages that are predominantly wife-takers from lineages in N' are added to a new classificatory patriline, M', that contains M. This process is now repeated to identify potential classificatory patrilines. To the right of N' are added successive wife-givers O', P', Q', etc., until no more can be added. To the left of M' are added successive wife-takers L', K', J', etc., until no more can be added. At each stage the relative age cohorts are adjusted so that they are uniform across the diagram in the sense that the average age of each cohort for each classificatory patriline follows a regular progression. Classificatory patrilineages K', M', O' and Q' belong to Kamara and Burla sections, while L', N', and P' belong to Pityara and Ngwariya (to improve clarity, section membership is omitted). The Figure shows six classificatory Alyawarra or part-Alyawarra patrilines and one Aranda patriline, plus a pair of generations based on sibling-in-law marriage sequences.

The following features stand out in Figure 3-15 and in other views of the same network:

- 7 classificatory patrilines, the number determined empirically: 5 exclusively Alyawarra, 1 bridging between Alyawarra and Aranda, and 1 primarily Aranda. (Here I group the 6 Alyawarra and part-Alyawarra lines, and temporarily disregard the very important Aranda line.)
- 98% of the marriages are consistent with "correct" section memberships
- 74% are consistent with the 14 year mean age bias
- Sororal polygyny is pervasive
- Alyawarra patrilines link seamlessly to part-Aranda and Aranda patrilines

The blue dotted lines representing marriages in the Figure show that men generally marry cross-cousins (MBD frequently; FZD rarely) and there are no cases of direct sibling exchange marriage. Since on average Alyawarra men marry women who are about 14 years younger than they are, sister's husband is on average 28 years older than her brother's wife. With an average age difference of 28 years between ZH and BW, it is biologically impossible to engage in systematic direct sibling exchange marriages.

Figure 3-15 is a 2-dimensional horizontal view of descent and marriage relationships in the research population to a depth of 5 to 6 generations from top to bottom. As a network visualization of genealogies, Figure 3-15 clusters a great many Countries in 7 descent lines each of which shows the same or very similar patterns in the flow of spouses from one particular set of Countries in one direction, to another particular set of Countries in the opposite direction.

Figure 3-15 raises serious questions about three important issues; viz., reification, missing links and exogamy. I address them separately below.

3.10. Reification

In Figure 3-15, the 27 cognitive Countries are disengaged from the topographic Countries with which they are affiliated in Figure 3-16, and are brought together in classificatory descent lines, K' through Q'. Individually, the vertical patrilines (Countries) and the diagonal generation moieties are fair approximations to reality, but the analytically imposed horizontal grouping of descent lines is problematic. Each of the patrilines is a theoretical construct, an implicit structure like unnamed moieties, that reflects some aspects of Alyawarra descent and marriage practices, section and kinship terminologies, and rules that underlie all of them. But since the groups are not recognized by the Alyawarra, White could have constructed them somewhat differently, using slightly different criteria for positioning a patriclan here or there, and the end product would differ accordingly. It probably still would have 6 exclusively or primarily Alyawarra patrilines, and 1 primarily Aranda patriline, but the constituent patriclans might differ here and there.

So we have 6 patrilines, but we do not know just whose they are or how real they are. Certainly they don't correspond to anything we know about in the cognitive world of the Alyawarra. Not to put too fine a point on it, I believe the Alyawarra could talk forever about the 27 discrete patriclans and the 4-section 2-patrimoiety structure of which they are members without ever concatenating them into 6 patrilines or 4 matrilines.

Together the patrilines and other elements in these Figures constitute a hypothetical construct based on kinship terms, kin types that underlie them, marriage rules built on top of them and a great deal of statistical data that makes more sense when observed through the "lens" provided by the construct. When we act "as if" the 6 patrilines exist even though the Alyawarra are unaware of them, does that constitute a violation of Whitehead's (1925:51) Fallacy of Misplaced Concreteness? If so, does that mean that a structure that incorporates those lines is "nothing but" a reification, an abstraction treated as if it were a concrete physical entity?

More broadly, does the status of helical marriage structures as hypothetical constructs make them somehow unreal? As MacCorquodale and Meehl (1948:106) point out: "It is naive to object to … formulations simply on the ground that they refer to unobservables, or are 'hypothetical'… None of these objections is a crucial one for any scientific construct, and if such criteria were applied a large and useful amount of modern science would have to be abandoned" including the long sought and hugely expensive Higgs boson. Since I am entirely comfortable in dealing with implicit moieties, I am strongly inclined to accept implicit helices which, after all, are implicit moieties with implicit twists.

3.11. Missing links

Figure 3-15 is only one of many 2-dimensional views of the Alyawarra marriage network. In principle, when marriage chains reach the left or right edge of the network, they can cross to the opposite edge of the Figure and connect with the descent line that superficially appears to be most remote from them. This results in the uninterrupted continuation of the WBWBWB sibling-in-law chain from ego upward to and beyond his FF and FFFF, and downward to and beyond his SS and SSSS.

Quantitative data that insures the continuity of genealogical chains connecting left to right margins of the network in Figure 3-15 is suggestive but hardly overwhelming and unambiguous. More links at these weakest points in the chains would be helpful. Where are the "missing links"?

First, among the Alyawarra and many other Australian Aboriginal societies, there is a systematic bias in favor of recalling ancestors in named descent lines and against recalling ancestors in unnamed descent lines, and a systematic proscription against speaking the names of deceased individuals. These constraints make it difficult to identify specific deceased ancestors and the problem becomes more difficult and more biased against females with increasing generational depth. In the Alyawarra case, male lines are named (Countries), and female lines are not. At a depth of 5 to 6 F-S generations (150-180 years) recall of specific ancestors is minimal;

only a few males can be recalled as individuals and the identities of virtually all remote female links have been lost.

But from an Aboriginal perspective, the absence of a specific identity of a specific individual who died over a century ago is far less problematic than it would be for a person of European ancestry who must recall GreatGrandPa's name and other particulars in order to construct his genealogy. The Alyawarra strategy is to deliberately forget (erase) the person's name the moment he dies but to remember a critical set of relational data for him including his clan totem a.k.a. Ancestor a.k.a. Dreaming, his Country, his generation, his section or subsection, his position in the network of proper and classificatory kin relations, and anything peculiar (like a wrong marriage) that would disturb the ancestor's "fit" into this multidimensional web of relationships. By using all of this extraordinarily redundant information, in conjunction with similar information about his known living descendants, an ancient ancestor can be pinpointed and identified with amazing precision and speed from an Aboriginal perspective even when nobody knows or cares what the old one's name might have been. This multilevel reticular strategy doesn't mean that everybody who ever lived can be retrieved from memory instantly, but it does mean that these intellectual and social networks are astonishingly resilient and contribute greatly to the abidingness (Stanner 1958/1965) of Australian Aboriginal culture. But alas, if a person is really marginal, lying far from the center at the very edge of Figure 3-15, he still might get lost.

Second, stochasticity of the kind that could destroy very small endogamous populations may be a factor here. The Alyawarra language group in 1971 had a total population of approximately 470 people (Denham 1975:114) and most of the 264 members of the research population were members of that language group. So we are working with a sample from a very small population. Since random fluctuations in age, sex ratio, membership in moieties and sections, and so on, are expected to produce missing links such as these in small endogamous populations, they present obvious problems for the survival of Aboriginal societies but do not pose theoretical problems here. In other words, I speculate that if the research population had been larger by a factor of two, three or four, the closure would have been much more certain.

The second point gives rise to the third; viz., if the Alyawarra in 1971 had been a truly endogamous language group, marriages would have had to wrap around in Figure 3-15 to accommodate all who married within the system, but as the small size of the population requires for its survival and as Figure 3-15 shows, this is an exogamous language group. In this case out-marriages between Alyawarra classificatory patrilineage L' and Aranda classificatory patrilineage K' occur where the weakest link in the wrap-around would have occurred if the society had been endogamous; i.e., between Alyawarra classificatory patrilineages L' and Q'. So in this case, exogamy plus generational openness seem to have replaced endogamy plus generational closure, thereby replacing some of the connective data that I seek.

In other words, for proper helical closure to occur reliably, a society must have a population whose size is large enough to ensure endogamous survival; in a sense, the wraparound is the *sine qua non* of endogamous survival. The exogamous linkages in Figure 3-15 suggest, and I explore very briefly below, what I think happens when population size and stochasticity preclude endogamous survival.

Fourth, the stated preference for marrying classificatory rather than proper kin means that our view of the data is itself part of the problem. Pajek software extracted linkages based on genealogical (consanguineal and affinal) relations but not on classificatory kinship relations that are superimposed on the enormously complex genealogical grid, are not isometric with it, and are used optionally and opportunistically by each individual.

It is easy to extract lowest order genealogical relations but virtually impossible to extract classificatory relations after marriages have occurred. This means that the network visualization is based on marriages that are acceptable genealogical relations but not on preferred classificatory kinship relations. Had I been able to extract classificatory (especially distant and remote) kinship linkages in addition to proper genealogical linkages, the pattern might have been more complete. Because of small population size combined with multigenerational intermarriage, almost everybody is related biologically to almost everybody else *via* multiple genealogical pathways. Specifically, approximately 240,000 non-redundant genealogical pathways are known to interconnect the 377 members of this Alyawarra population.

Within the Alyawarra system of descent, marriage and kinship with its hypothetical 6 patrilines, 4 matrilines, 2 helical generations, Δ_{MC}=28 years, Δ_{FC}=42 years, and MC/FC=.667, if each man marries a woman who is his own MBD, his Son marries a woman who is his own MBD, his SS marries his own MBD, and so on through the generations to his SSSSSSS who marries a woman who is his own MBD, the graphic representation of the ancestry of SSSSSSS and his wife will form the helix in Figure 7-7 independently of whether SSSSSSS and his wife aim to generate it, or care about it, or even know about it. The division of a society into unnamed sides may follow from local egocentric decision making, not necessarily from long range systematic planning. Likewise with the formation of helical structures: nobody has to "think globally" in order to "act locally". Each member of the population simply thinks and acts locally – but consistently and accurately according to the traditions or rules – and in time the helix emerges automatically. Birdsell (1993) similarly argues that the geometric form of language group territories in Aboriginal Australia is basically hexagonal, as are honeycombs (D'Arcy Thompson 1917), but he does not argue that they are planned that way from the top down.

Since people sometimes have no "proper" MBD to marry, they can substitute a close classificatory MBD as needed and the system continues to operate properly, but reconstructing the relations becomes a bit more difficult because classificatory links do not leave "biological trails". And if people sometimes have no proper OR close classificatory MBD, they can substitute a distant classificatory MBD, or a proper or classificatory MMBDD, or some other functionally equivalent member of the population such as FMBSD, MMMBDDD, FFMBSSD, or many others all of whom are congruent with W=MBD, and still maintain the same structure but produce considerably more difficulty in reconstructing it as time goes by.

Long relational chains between spouses (e.g., MMMBDDD) sometimes appear in discussions of models of Aboriginal kinship. No doubt they are logically possible, but their relevance to behavior in the real world is at best questionable. Practically speaking it might make no sense for a man to marry his MMMBDDD since his MMMB almost certainly would be long since dead by the time he married, and several of the actual genealogical links to such a distant kinswoman across that long chain probably would be missing or imprecisely defined. A more realistic hypothesis is that marriages are established primarily if not almost exclusively on the shortest practicable consanguineal and classificatory chains (MBD, MMBDD), and that the activation of long consanguineal chains such as MMMBDDD might occur only rarely. In fact, if everyone were to "act locally" by marrying a consanguineal or close / distant / remote classificatory MBD or MMBDD in accordance with a common Aboriginal injunction to that effect, making no reference whatsoever to extended kinship chains, the end product over a period of several ordinary generations would be a perfectly shaped emergent asymmetric geometric structure that would look as if it had been planned from the top down even though it had not been planned at all. But because of reliance on marriage with classificatory kin, its details could be unclear – even implicit - when examined from the perspective of traditional biologically based genealogies. An alternative approach assumes that important patterns detectable in the domains of descent, marriage and kinship derive primarily from distributed cognition, individual responsibility and emergence rather than from micromanagement by a few indigenous kinship experts who navigate through the intricate and extensive genealogical linkages that so often fascinate anthropologists.

I suggest that one of the most intriguing features of network diagrams such as the one in Figure 3-15 is not that the data is sparse in some places, but rather that any intimation or evidence of helices shows up despite the operation of so many factors that could obscure it.

3.12. Exogamy

Except in dealing with Figure 3-15, everything I have said to this point in the paper has dealt with endogamous societies. Traditionally, models of Australian Aboriginal kinship have been designed exclusively to fit endogamous societies. But that is needlessly limiting.

With regard to the Alyawarra and almost every other Australian Aboriginal society, the presumption of endogamy does violence to the actual structure and operation of marriage relations among any focal society and all of the neighboring societies with which it intermarries. On rare occasions, there may be some merit in using the simplifying assumption or convenient fiction of endogamous closure, but in fact the Alyawarra and most societies for which appropriate data exist are unambiguously exogamous. The uninterrupted tradition of building endogamous models of exogamous societies is flawed, and this paper, if it were to stop here, would suffer from that flaw.

The closed 3-dimensional helix in Figure 3-14 is maximally endogamous, the open 2-dimensional lattice in Figure 3-8 is maximally exogamous, and the network in Figure 3-15 is mixed, thus perhaps is closer to reality than either of the extremes. The exogamous bridge between Alyawarra and Aranda in Figure 3-15 has major implications for the overall structure of both societies. For example, if the Alyawarra were strictly endogamous, much greater wraparound would be necessary in order for the society to maintain its social and biological integrity without literally falling apart at its boundaries, regardless of whether the boundaries might be defined endogamously, genetically, linguistically or territorially.

Figures 3-16 and 3-17 amplify on the data displayed in Figure 3-15. Figures 3-15 and 3-16 are based solely on the 377 person AU01 dataset, while Figure 3-17 is based on the expanded 1460 person AU10 dataset.

The evidence of exogamy discussed above in conjunction with Figure 3-15 is only the tip of the iceberg. For example, the seamless integration depicted there between full Aranda (line K' black), part Aranda (line L' green) and Alyawarra (lines M' through Q' white) obscures complexity that derives from the fact that some of the Aranda who married into the research population were Northern Aranda from Utopia Station and points west who used an 8-subsection system, and some were Eastern Aranda from Plenty River and points south who used a 4-section system. Similarly, a few full and part Aranda (black and green symbols) appear in lines M' through P', and a small cluster of blue symbols representing people whose language group membership was disputed appears in Line N'. Since these non-Alyawarra people were included in the research population only if they were directly related to Alyawarra by marriage or descent, all of them are living evidence of language group exogamy.

Figure 3-16 is a 2-dimensional vertical view of the Alyawarra marriage network that appeared in Figure 3-15 in a horizontal view. It shows linkages among all known intermarrying Countries as they are located physically "on the ground" in and near Alyawarra territory. Marriages entirely within the inner A ring (the core) are exclusively between Alyawarra, while marriages in which one spouse belongs to a Country outside the A ring but within the B ring (the penumbra) represent language group exogamy.

The AU10 Alyawarra dataset (Denham 2010b) based on census data and other records from the Australian National Archive provided in raw form by Paul Mackett (2005) contains records for 1460 people born between 1817 and 1979, living throughout much of the southeastern quadrant of the Northern Territory. Disregarding 272 people for whom language group affiliation was not available, the dataset shows that about 80% of the remaining 1188 people were identified as Alyawarra; about 12% were identified as Aranda but the Northern/Eastern/Western distinction was missing in many cases; Kaiditch and Walbiri constituted nearly 3% each; and the remaining 2% were distributed over 5 other language groups. Again, non-Alyawarra included here were spouses or children of Alyawarra.

Table 3-6 and Figure 3-17 present a preliminary estimate of the frequency and spatial distribution of Alyawarra exogamy between 1817 and 1979. Of approximately 207 Alyawarra marriages for which language group membership is known for both partners, approximate numbers of endogamous and exogamous marriages appear in Table 3-6. Somewhat counterintuitively, the AU10 dataset with greater time depth, depicted in Figure 3-17, shows more extensive language group exogamy than does the more recent AU01 dataset, depicted in Figure 3-16. All numbers here are subject to revision.

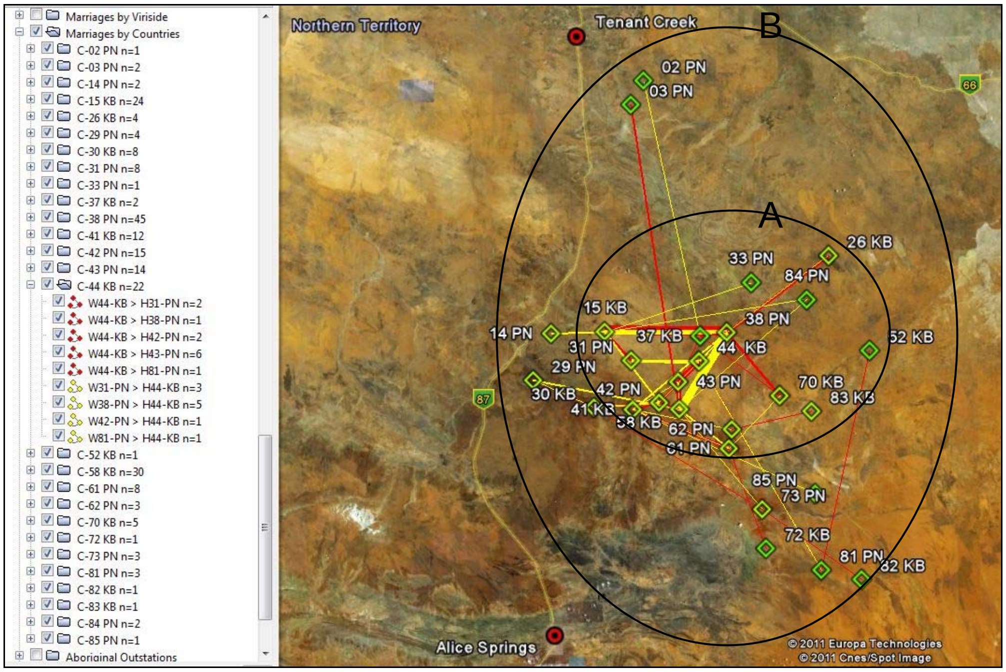


Figure 3-16. Marriages between Countries, AU01 Dataset.
114 marriages; Country# with patrimoiety code (KB, PN); color code: red=men, yellow=women.
Within Ring A = generally endogamous core; between Rings A and B = exogamous periphery.

One Spouse	Other spouse	Number of Cases	Percentage of Cases
Alyawarra	Alyawarra	160	77.3
Alyawarra	Aranda, Eastern	10	} 9.7
Alyawarra	Aranda, Northern	7	
Alyawarra	Aranda, Western	3	
Alyawarra	Wailbri	10	4.8
Alyawarra	Kaititja	9	4.3
Alyawarra	Warramunga	5	2.4
Alyawarra	Anmatjerra	1	0.5
Alyawarra	Wakaya	1	0.5
Alyawarra	Yanyula	1	0.5
	Total	**207**	**100.0**

Table 3-6. Cases of Alyawarra endogamy and exogamy in the AU10 dataset.
Numbers subject to revision.

In each case of language group exogamy, the interface between Alyawarra and non-Alyawarra terminologies, rules, structures and practices must be negotiated. Just how age biased generations with their intrinsic openness to exogamy may contribute to the smooth flow of men and women among these disparate societies remains unanswered. The societies are open exogamously, genetically, linguistically, territorially. But constructing models that accommodate the openness rather than accidentally ignoring or deliberately excluding it is a topic that I address in a separate paper.

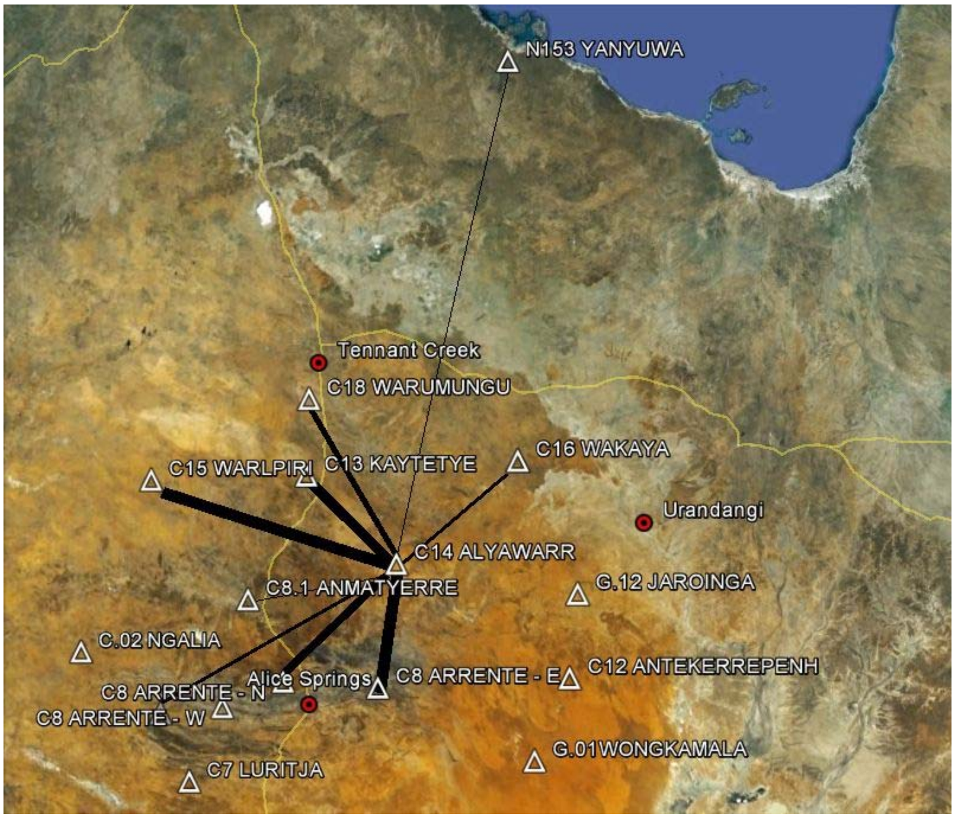


Figure 3-17. Alyawarra intersocietal exogamy 1817-1979, AU10 Dataset.
White triangles denote language groups; red dots are towns; roads are Stuart Highway from Alice Springs to Tennant Creek and Barkley Highway from Tennant Creek to Queensland. Black line width represents the relative frequency of Alyawarra intermarriages with other language groups. See Table 3-6 for numerical values and Appendix for alternate spellings.

4. Conclusion

In writing this paper, I accepted John Atkins' challenge to go beyond the "hoary old anthropological assumption" that he called "The Axiom of Generational Closure", thereby attempting to demonstrate the viability of using a radically different set of assumptions, based on conceptual, social and biological openness, with which to explore Australian Aboriginal systems of descent, marriage and kinship. The methodological experiment seems to have worked, but its value has yet to be determined.

I have distinguished between two types of human generations; viz., the traditional type that complies with the axiom of generational closure, and the alternative age biased type that does not. This fact seems to have major implications for the analysis of Australian Aboriginal systems of descent, marriage and kinship, but its implications for the analysis of other human kinship systems with greater or lesser degrees of age bias are unknown. I suggest that exploring those implications might be productive.

I set out to "save the appearances" of earlier research by introducing a significant degree of additional realism – both substantive and methodological - into an area of inquiry that sometimes tenaciously hangs onto traditions and preconceived notions lacking in realism. In my opinion, the enhanced realism is an asset.

I reached beyond the traditional emphasis on language-based kinship terminologies by deliberately focusing on implicit relationships that may underlie those that are explicit. Examples include but are not limited to implicit descent and generation moieties and the near-universal species-specific marital age asymmetry that people may take for granted, act on almost "instinctively", and describe by saying "it goes without saying" in any number of human languages. I conclude that much remains to be learned about implicit, nonverbal or unverbalized aspects of human descent, marriage and kinship, and that the assumptions, methods and findings reported here may be of some use in that regard.

I set out to defend and attack horizontally and vertically asymmetric marriage systems, seeking either to vindicate and salvage 80 years of inconclusive research on the topic, or to demonstrate that the prolonged anomaly of age biased generations really is an intellectual dead end. Data and models introduced above are compatible with an interpretation based on Atkins' "finite set of open generations rather than the reverse," and that plausibility is heartening.

But plausibility is not the issue. The real issue is validity, and serious questions about validity derive specifically from the network diagram in Figure 3-15; viz., a) the Alyawarra helix works "as if" it were based on a 6-patriline hypothetical construct of which the Alyawarra themselves are unaware, and, b) even though the small number of direct marital linkages between the patrilines on the margins of the network is not surprising, their paucity is at best suggestive rather than persuasive. I conclude that the mechanical, statistical and network approaches used to analyze these behavioral and cognitive patterns are fruitful enough to warrant further research, but suggest that dealing with the questions raised by Figure 3-15 should receive a high priority.

The paper raises other questions, both implicitly and explicitly, about a number of problems that it does not even attempt to solve, including but not limited to the following:

- Possible systematic impacts of an age bias on global rather than local models of present day Dravidian and Dravidian-like kinship terminologies (Tjon Sie Fat 1998; Trautmann 1998; Barbosa De Almeida 2011).
- Possible significance of age biased generations in *both* Pama-Nyungen speaking societies with predominantly Dravidian-like kinship terminologies in the southern two-thirds of

Australia, *and* non-Pama-Nyungen societies with predominantly Iroquois-like terminologies in the northern third of Australia (McConvell 2010).
- Possible connections between present day Australian Aboriginal systems of descent, marriage and kinship that seem to display age biases, and early human kinship systems such as those of special interest to Allen (1998, 2007), Vaz (2011) and others.
- Possible relations between age biases and Omaha-Crow skews, both of which reduce the marriagability of otherwise marriageable people.
- Possible importance of chirality in helical social structures.

When I began the paper, I was optimistic about using it to deal with ways in which structures introduced above operate in the continent-wide field of exogamous societies as displayed in Figures 3-15 through 3-17. But that topic is far too large and complex to address here, and calls for a separate paper.

In conclusion I paraphrase Hammel (1976a:157). People who focus exclusively or primarily on structures of systems of kin classification may contend that biology is not what they are talking about. That is correct. That is not what they are talking about. My suggestion is that it should be an important part of what they are talking about.

WWD
Franconia, NH, USA
5/27/2012

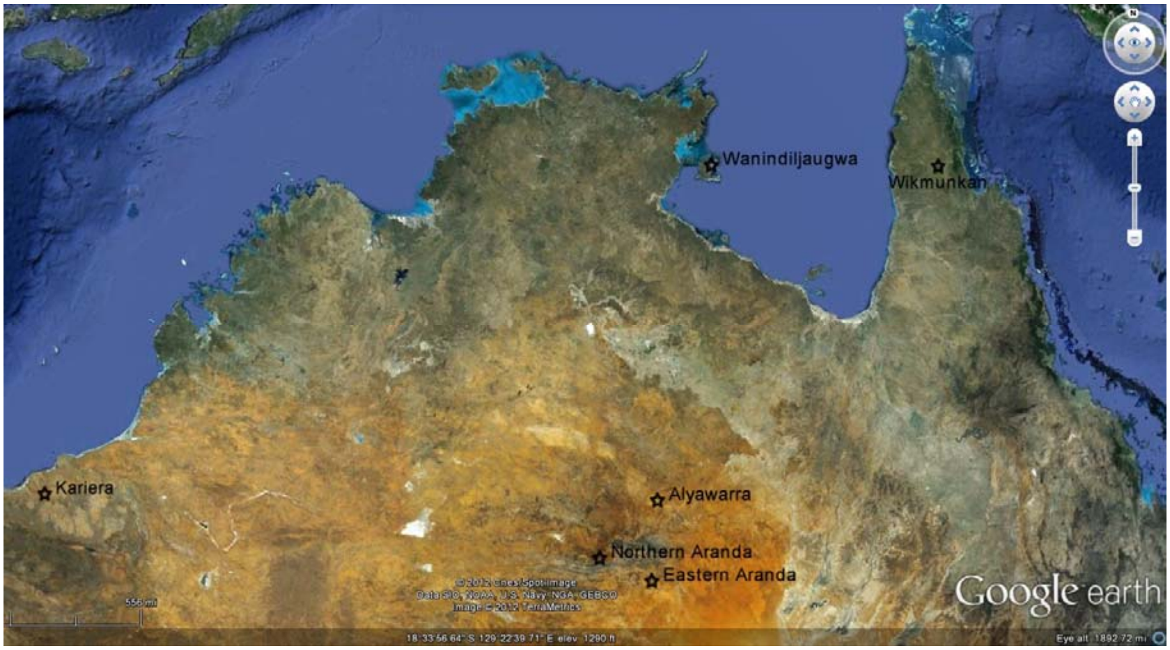
Appendix. Alternate spellings with locations

Some traditional spellings

AIATSIS Language codes and preferred spellings
http://www1.aiatsis.gov.au/thesaurus/language/language.asp

*Alyawarra	C.14	Alyawarre
Anmatjera	C8.1	Anmatyerre
*Aranda	C.08	Arrernte
Jaroinga	G.12	Jaroinga
*Kariera	W.39	Kariyarra
Kaititja	C.13	Katetye
Kukatja	C.7	Kukatja
Murngin	N.116	Murngin Yolngu
Ngalia	C.02	Ngalia
Ngarinjin	K.18	Ngarinyin
*Wanindiljaugwa	N.151	Anindilyakwa
Wagaya	C.16	Wakaya
Wailbri	C.15	Warlpiri
Warramunga	C.18	Warrumungu
*Wikmunkan	Y.57	Wik-Mungkan
Yanyula	N.153	Yanyuwa
Yolngu	N.116	Murngin Yolngu

*Principal language groups discussed in the text appear in the following map.



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