WHAT IS KINSHIP?

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INTRODUCTION

At the heart of David Schneider's rejection of the assertion that "kinship … has to do with reproduction" (Schneider 1984:198) along with its corollary, the "Doctrine of the Genealogical Unity of Mankind," is his deep-seated conviction regarding the need to understand cultural phenomena using their own terms, meanings, and references. Schneider comments that "(t)he first task of anthropology, **prerequisite to all others**, is to understand and formulate the symbols and meanings and their configuration that a particular culture consists of" (Schneider 1984:196, emphasis and bold in the original). Kinship, Schneider argues, has not been approached from this perspective, and so "kinship . . . is essentially undefined and vacuous: it is an analytic construct which seems to have little justification even as an analytic construct" (Schneider 1984:185) and hence "`kinship' … is a non-subject" (Schneider 1972:51; see also Needham 1971).

More than a half century earlier, when W. H. R. Rivers considered four modes by which kinship might be defined, he began in a similar vein by asserting that blood relationship (consanguinity) is inadequate for a definition of kinship as it would not account for the practice of adoption and other practices which make it evident that "fatherhood and motherhood depend, not on procreation and parturition, but on social convention" (Rivers 1924 [1968]:52). The second mode for defining kinship – the one he decided upon—was through genealogy which, though it might be determined through blood relationship, could also be determined through some other

social procedure. Next he considered the possibility that kinship is defined through the terms of relationship, but found this lacking as he considered that pedigree and genealogy determine the terms of relationship and not the reverse. His fourth mode was by social function, whereby "(p)ersons are regarded as kin of one another if their duties and privileges in relation to one another are those otherwise determined by consanguinity" (Rivers 1924 [1968]:53). But Rivers' notion of genealogy reintroduced the consanguinity he initially had rejected for, as Schneider has pointed out, in his genealogical method he made sure to limit the genealogical terms father, mother, child, husband and wife to "their English sense" (Rivers 1900:75). Schneider comments "All Rivers really does, then, is to say that kinship is in the first instance defined in terms of consanguinity . . . and that sometimes social convention alone may confirm a kinship relationship even in the absence of a relationship of consanguinity but that, when it does, it is created in the image of a consanguineal tie" (Schneider 1972:54).

This insistence on a consanguineal tie has led Schneider to reject kinship as a domain of study. He asserts that "the way in which kinship has been studied does not make good sense" (Schneider 1984:201) since "[i]t exists in the minds of anthropologists but not in the cultures they study" (Schneider 1972:51). What Schneider rejects is not the possibility of there being culturally identified relationships of one person to another, but the presumption that these relationships, if they are to be called "kinship relationships," are biological/reproductive, with its attendant universal genealogical grid, allegedly relevant to all cultures.[1] The presumed biological/reproductive basis has been introduced, he suggests, since "kinship has been defined by European social scientists, and European social scientists use their own folk culture as the source of many, if not all, of their ways of formulating and understanding the world about them" (Schneider 1984:193, emphasis added). Schneider does not question the existence of a

citamangen-fak relationship among the Yapese, with whom he did his fieldwork, but only whether it is meaningful to consider it to be a father-son relationship as would be done under the "received view" of what is meant by kinship. Hence he questions whether it is a kinship relationship "within the framework of the conventional kinship theory" (Schneider 1984:67, emphasis added) for, as he argues, "the Yapese definition of the relationship between citamangen and fak remains radically different from the European cultural conception of kinship" (Schneider 1984:73), which presumes that reproduction is the critical defining property. That the relationship is neither genealogically construed nor arrived at through reproduction is evidenced, according to Schneider, by the fact that the "rights of the fak in the citamangen's land … [is not] based on their kinship or genealogical connection," but "is based largely on the interaction, the doing, of the exchange and less on the state of being, of having some substance, quality, or attribute." (Schneider 1984:75). To put it simply: what constitutes being a fak is by cultural specification (what I call "rules of instantiation" below), not by satisfaction of a universal genealogical relationship.

What would make concepts such as citamangen or fak kinship terms in view of the analysis to be discussed here is neither any purported genealogical property they may be said to satisfy nor how they relate to a genealogical grid. Rather, it would stem from their inclusion as symbols within a system of symbols that has abstract structure of a particular kind, namely a structure that is generative and based on an abstractly definable reciprocity property that links one symbol to another as reciprocal symbols.[2] In this analytic framework, kinship as a system of relationships is freed from presuming that the relationships are first of all genealogical and reproductive and, instead, considers the relationships as they are culturally specified, both in terms of the structural form of the system of symbols through which the relationships are expressed and

the "meaning" of those symbols. In other words, we must rethink at the most basic level, what is kinship.

Schneider's comments contrast strongly with Ward Goodenough's observation made about the same time:

> We anthropologists have assumed that kinship is universal, that all societies have kinship systems. If we are correct in this assumption, if every society does have some set of relationships whose definition involves genealogical considerations of some kind, then genealogical space must be constructed of things that are common to all mankind. These, we have seen, are parenthood and socially recognized sexual unions in which women are eligible to bear and from which women and especially men derive rights in children and thus establish parent-child relationships. (Goodenough 1970:97, emphasis added).

Goodenough, following in the footsteps of Rivers, takes as self-evident that kinship relations are to be defined using genealogical criteria.

Subsequently, with the formal approach to the study of kinship terminologies introduced by Lounsbury, the assumption of genealogy as the basis of kinship took on the aura of definition. Thus Scheffler and Lounsbury equated kinship and genealogy in comments such as "Relations of genealogical connection, or kinship proper…" and "Where the distributional criteria are genealogical and egocentric, we speak of relations of kinship" (Scheffler and Lounsbury 1971:38). But Schneider had noted that:

> the genealogically defined grid is the only analytic device that has been applied to most of the systems which anthropologists have studied. There has been almost no systematic attempt to study the question without employing this device. To put it simply, it is about time that we tested some other hypotheses. (Schneider 1972:49)

Although Schneider never made it clear what would constitute these other hypotheses, another hypothesis about the source of the structuring of kinship terminologies – the subject of this paper – has, in fact, been tested and verified through its application to the analysis of three very different terminologies, namely the American-English (AKT), the Shipibo of Peru, and the Trobriand Islander terminologies. The hypothesis upon which these analyses are based asserts that the set of kin terms for a particular terminology constitutes a structured system of symbols, with that structure definable without reference to a genealogical grid. Further, it is demonstrated through mathematical analysis that the kin term structure may be generated from a few symbols taken as generating symbols, and from certain structural equations. In brief, these analyses provide strong evidence for a claim that terminological structures are cultural constructs whose structural features are explicable through the logic governing their generation as abstract structures separate from reference to a genealogical grid. In addition, linkage between the terminological space and a genealogical grid is elucidated by analytically mapping the terminological space onto the genealogical grid. That mapping, then, determines for each of the abstract symbols in the terminological structure its definition as a class of associated kin types. Contrary to Rivers' argument that kin terms are defined through genealogical relationships, the mapping going from the structure of kin terms to the genealogical grid establishes the independence of the definition of the kin term structure from the genealogical grid. Rather than viewing either the terminological space or the genealogical grid as primary and the other as secondary, the results of the analysis argue for viewing the genealogical and the terminological spaces as co-existing conceptual structures with overlap arising through application of the symbols from these two conceptual structures to the same domain of persons. Distinguishing

these cultural constructs is the degree of abstraction involved in their definition as conceptual structures.

The analysis also makes evident the way rules of instantiation of abstract symbols in concrete terms may provide a means whereby static structure takes on dynamic and malleable properties. There must be transition from the abstract domain of culture at the ideational level to the more concrete level of individuals and their social relationships. It is in that transition where modification, change and redefinition of the instantiation of abstract symbols can take place without altering the underlying conceptual structure, namely the terminological space. I hypothesize that the terminological space, contrary to Rivers' argument, provides a framework for defining the world of kin for egos and alters through mapping of kin terms onto concrete alters and egos. This provides a way to define a kinship world without presupposing the basis for that kinship world to be genealogical as defined by the genealogical grid, in accord with Schneider's argument quoted above. By recognizing that there are rules of instantiation that give abstract symbols concrete reference, and that the content of these rules is culturally defined, the problem of presuming parenthood defined via reproduction -- or alternatively, parenthood as a cultural interpretation of biological parenthood (Keesing and Keesing 1971:157) -- as a universal basis for kinship is circumvented. The terminological space is constrained by general, structural properties that make it a "kinship space" and structural equations that give it its particular form. The instantiation of the symbols can, but need not, be framed in terms of parenthood modeled on reproduction. But even if the instantiation is not culturally based on reproduction, it is still possible to construct a mapping from the terminological space to the genealogical grid under a straightforward mapping of the generating symbols of the terminological structure onto the primary kin types.[3] This implies that it will be possible to provide a genealogical "meaning" of the

kin terms regardless of whatever may be the culturally formulated meaning of the generating symbols. Whether the genealogical "meaning" so constructed has cultural salience is, of course, at the heart of Schneider's critique of kinship based on a presumed universal genealogical grid.

DEFINITION OF KIN

The argument that reproduction – a universal – is the basis upon which kinship relations are defined via the parent-child relationship is appealing in its simplicity. Biologically for each person there must be a genetic father and a genetic mother.[4] If it is the case that all persons everywhere recognize at least a physical father and a physical mother (genitor and genetrix) modeled upon biological reproduction, then the genetic connections (via genetic father and genetic mother) can be replaced by genitor and genetrix and kinship can then be viewed as modeled upon biological reproduction but freed from the requirement that one know the identity of the genetic father and the genetic mother. Presumably, the genitor and the genetrix are those persons posited by the local theory of reproduction to be the basis upon which reproduction takes place. Then, the relation, parent of, along with the reciprocal relationship, child of, permits genealogical tracing through repeated use of these two relationships. From this vantage point, the genealogical method pioneered by Rivers is but a small, additional step and has the seeming implication that kin terms can be considered as cover terms for sets of genealogical positions as argued by Rivers and others. But all of this presumes, as Schneider has detailed, the universality of the relation, parent of, as the cultural "interpretation" of the biological fact that there must be a male and a female involved in procreation.

Schneider used his ethnographic work among the Yapese to illustrate that, at least for them, coitus is not culturally recognized as relevant to reproduction; hence, in their conceptual

framework it would appear to be erroneous, as noted above, to assert that they have a concept of kinship modeled on biological reproduction. However, it might be asserted that even if reproduction is removed from the argument, as long as the Yapese have a concept that can be reasonably translated as 'parent of' and 'child of' in a genealogical sense, then the key aspect of the genealogical grid is still present. It simply would not be founded upon a local theory of biological reproduction. Of course, Schneider's point is precisely that: Do the Yapese have a term that can be reasonably translated as 'father', in a genealogical sense? His answer is that they do not have such a term:"… the relationship between citamangen and fak may not properly be translated as `father' and `child,' and is indeed not even a kinship relationship according to certain [genealogical] definitions of that term … "(Schneider 1984:78).

The problem with trying to maintain the genealogical grid as a primary referent for kinship in the absence of a local theory of biological reproduction based on coitus, hence the problem with trying to define kinship in terms of a genealogical grid, is also highlighted in other ethnographic accounts. For example, Goodale in her comments about the Tiwi concept of 'mother' notes that the Tiwi, like other Australian groups, attribute pregnancy to a dreaming on the part of her husband. The dreaming is crucial, as it is the means by which the social identity of a pitapitui, the unborn child, becomes established. The dreaming act identifies for a pitapitui its maternal social identity and through the dreaming act his wife becomes pregnant. While the Tiwi, like the Yapese, deny that reproduction is simply a matter of coitus, they are perfectly well aware of the biological basis of reproduction. As Goodale puts it, for the Tiwi coitus is the basis upon which humans are made, but while this is a necessary, it is not a sufficient, condition for the reproduction of a Tiwi child: "Although the Tiwi recognize that either a husband or a lover can make a baby by having sexual intercourse with its mother, they also assert that such activity

cannot alone create a Tiwi child. A Tiwi must be dreamed by its father, the man to whom its mother is married, before it can be conceived by its mother" (Goodale 1994 [1971]:138, emphasis in the original). An unborn Tiwi must be dreamed as otherwise it would not know the maternal social identity that it must have to be fully part of the social world of the Tiwi:"Pitapitui do not know which woman in their sib is their particular mother and can only obtain this information from their father, whose identity they do know" (Goodale 1994[1971]:139). Interestingly, there is a parallel here between the Yapese notion that it is by doing work that a Yapese is formed and the Tiwi idea that it is by dreaming that a Tiwi is formed. For both groups, what it means to be a 'child' does not derive so much from a local theory of biological reproduction as from a cultural concept of what is required to make a Tiwi or Yapese child as opposed to making another instance of Homo sapiens.

Goodale makes it clear that the Tiwi term, innari, which we might translate as 'mother', does not easily lend itself to serve in the formation of a genealogical grid as the term refers not to a single person, but to a category of which any one of several women can be the occupant, without making a distinction as to which woman from the category is the topic of a conversation. She comments: "I am fairly certain that it is completely unnecessary for Tiwi to make such [genealogical] discrimination, which is one that they not only do not, but also cannot, ordinarily conceptualize" (Goodale 1994[1971]:73, emphasis added). If the Tiwi do not make a distinction among these women in terms of their different genealogical relationships to ego, then it is difficult to see the basis upon which it can be argued that their kinship concepts are first of all grounded in genealogical relationships.

It does not require a group that excludes coitus in their concept of reproduction to find problems with the assumption that the persons identified by the same kin term have a prior

genealogical identification. In her discussion of !Kung san kin terms, Lorna Marshall observes that trying to fit their kin terms into a genealogical framework does not match their conceptualization of the kin terms. She comments:

> The !Kung were apparently not always assiduous in teaching their children the exact biological position of their kinsmen (whether a given man was FaBr or MoBr, for instance), and a person would not always know why he applied a certain term to someone, but he would know that the term he used was proper, and he would know the proper joking status to observe; that would have been well taught him by his parents. (Marshall 1976:204, emphasis in the original)

She goes on to say

> !Kung informants showed no interest in generation as such. What a !Kung says, when he associates his relatives with each other in the pattern I have called generational, is that they are `like' each other. . . . That they are alike because they occupy the same `step or stage in the succession of natural descent' (as Webster defines `generation') apparently does not concern the !Kung. Instead it was the joking relationship they spoke of, and they pointed out the parallel position of their kin in its terms. (Marshall 1976:208, emphasis added)

While Marshall found it convenient to describe their kinship system in generational terms, it is evident from her comments that this is not part of their conceptualization. And with their naming system the whole system of terms of reference and address can change, regardless of genealogical relationship, merely by changing one's name: "Names may be changed, and, when they are, the person is reclassified and the kin terms applied to him or her are changed accordingly" (Marshall 1976:236). When !Kung san who do not know each other meet, they establish their kinship

relationship not by tracing their respective genealogies until they find a relative in common, but by determining a third person to whom each has a kinship relationship by virtue of a term of reference:

> Gao [a Nyae Nyae !Kung] had never been to Khadum [to the north of the Nyae Nyae region] before. The !Kung who lived there at once called him ju dole [dole: 'bad', 'worthless', 'potentially harmful']. He was in haste to say that he had heard that the father of one of the people at Khadum had the same name as his father and that another had a brother named Gao. `Oh,' said the Khadum people in effect, `so you are Gao's !gun!a . . .. (Marshall 1976:242)

In effect, they determined a kinship relationship, !gun!a, (a person in the name giver/name receiver relationship with ego) through a kin term calculus that does not depend upon a genealogical grid for its computation.

Ethnographers working in New Guinea have also noted problems with assuming that kinship is first of all genealogical. Langness comments

> …a man might hold rights in the group into which he was born, equivalent rights in a group in which he was raised, the same rights in a group in which his father was raised, his mother's group (either her natal group or one she happened to be raised in), and so on … the sheer fact of residence in a … group can and does determine kinship. (1964:170, 172, emphasis in the original)

Similarly, Lowman-Vayda notes for the Maring that

> First-generation non-agnates in residence are usually considered members of other clans. Their children, however, appear to be considered members of the clan with which their father resides. The rationalization of this is that these children have been nourished by and

> grown on the products of local land and therefore may be claimed as members of the clan. (1971:322, emphasis added)

More recently, and in a similar vein, Zimmer-Tamakoshi has noted that for the Gende,

> … the acquisition of ancestors through funeral payments (*kwiagi*) and pig feasts, is an old Gende custom. Contributors to a *kwiagi* are often biological descendents of the deceased, but affines and unrelated persons may also contribute with the idea of obtaining the deceased's land rights as well as ancestral protection and other benefits the deceased may bestow. Though the rhetoric surrounding these rites makes use of reciprocal kin terms … the meanings of the terms are not focused on biological relationships. Rather, the stress is on the actual (or alleged) caring and exchange that existed (or exists) between the two reciprocals, without which - and biology notwithstanding - there could be no viable or positive relationship. (this volume, Chapter 00, emphasis added)

Interestingly, Rivers also noted that the users of a classificatory kinship terminology might not be able to justify the application of a term to particular persons on the basis of blood or marriage but apparently failed to see the contradiction between this and his conviction that genealogy is the basis of kinship. He observed that while the use of a classificatory term was often justified by its users in terms of "blood or marriage ties," this was not always the case and "in other cases in which the terms were used they denoted merely membership of the same social group and [the correct usage] could not be justified by distinct ties of blood or marriage relationship" (Rivers 1924 [1968]:191, emphasis added).

Although a genealogical basis does not appear to be crucial to the meaning and definition of terms in these examples, some theorists such as Scheffler and Lounsbury have, nonetheless, argued otherwise. For example they consider neither the !Kung terminology nor other

terminologies that use a name-giver-name-receiver relationship as a basis for determining kin term usage to be counterexamples to their thesis that genealogy is the basis of kinship. Instead, they argue that "the system of name sharing and all it implies about social relations and the extended use of kinship terms is founded quite simply on the (presumed) `biological' (genealogical) facts" (Scheffler and Lounsbury 1971:59) as evidenced by the presence of core terms in the !Kung san terminology that, they argue, can be reasonably glossed as parent, child and sibling. But if a collection of persons can take on kinship status vis-à-vis ego without knowing any genealogical relationship, as occurred in Marshall's example of Gao, then it is difficult to see in what sense a !Kung san term "is the `name' of a genealogically established category" (Scheffler and Lounsbury 1971:13, emphasis added), as they assert must be the case for a kin term. Merely to assert that the terminology has a "core" term that allegedly meets this criterion hardly suffices to justify the claim that all "kin terms" are names for "genealogically established categories."

Yet another means used to maintain the purported primacy of genealogy as the basis of kinship in the face of the so-called classificatory terminologies that seem to deny a special position for genitor and genetrix has been to maintain that even if the term glossed as 'mother' is also properly applicable to females who are not in a reproductive relationship with ego, nonetheless the female who gave birth to ego is distinguished through reference to "true mother, genetrix" (Scheffler and Lounsbury 1971:44). Such writers, however, make the unwarranted assumption that a linguistic form that might be translated as "true mother" necessarily refers to genetrix. While the Siriono may use the expression ezi te to mean 'proper mother' in the sense of genetrix, as claimed by Scheffler and Lounsbury, other groups do not make the same association between 'true' and genitor and genetrix. For the South Fore of New Guinea, Glasse comments

> …when the genealogies were assembled it became apparent that classificatory and kagisa (`fictive') kin were often listed as true MBD…. Even the daughters of MB's age-mates were sometimes counted this way … their distinction [between `true' and `tenuous' relationships] refers to the importance and solidarity of the bond and not necessarily to its genealogical closeness. (1969:33, emphasis added)

Similarly, Zimmer-Tamakoshi comments for the Gende of New Guinea that

> Regardless of who an individual's biological parents are … whoever is/are significantly more nurturing assumes the role of 'true parent' in an individual's life. The reverse is also true, with a 'true child' being one who does what is expected for his or her 'parents' (biological or otherwise). (this volume, Chapter 00)

However, to remove genealogy as the necessary basis for "kinship" immediately poses the problem addressed by Rivers: Upon what basis is kinship defined or definable? Schneider avoids this question by rejecting kinship, but he is rejecting a particular construal of kinship based upon what he calls the Doctrine of the Genealogical Unity of Mankind. Whether or not we call it kinship, it is evident that all cultural systems have a culturally constructed means by which relationships between pairs of individuals are defined in a manner that not only defines a relationship between pairs of individuals, but allows for calculation of a system of relationships through recursive use of a few relationships. The genealogical method "works" as a means of eliciting a corpus of terms that are used for reference and for address because the set of persons who can be considered with regard to genealogy and the set of persons who are identified with regard to terms of reference and address are overlapping sets. But the fact that the terms of reference and address can be elicited through the genealogical method does not establish the priority of genealogy as the basis for kinship. It is certainly possible to have more than one

conceptual structure, each with its own definition as a structure that can be applied to the same domain. The problem is: If genealogy is not the conceptual basis upon which our idea of kinship is based, then what is its basis?

To address this question, we first need to make it clear that genealogical reckoning involves more than simple replacement of genetic father and genetic mother by genitor and genetrix, since genealogical tracing occurs even when genitor and/or genetrix are not given cultural recognition. Underlying the difference is a shift from the phenomenological domain of empirical structures to the ideational domain of structures built out of abstract relations. Genetic father and genetic mother refer to empirical individuals (whether we can actually identify them or not) who must have existed as the source of the spermatozoon and ovum that are genetically responsible for a biological person. Genealogical tracing only requires that to each person there be linked a single male person, whom we can call, following Lehman (n.d.) the genealogical father of ego, and a single female person, whom we can call the genealogical mother (see also Figure 2 below). [5]

In this shift from the phenomenological to the ideational domain also lies the basis for considering the terminological structure to be a cultural construct distinct from the genealogical grid. To see this, we need first to make evident the structure entailed by genealogical father and genealogical mother, and to see how the shift from genetic father and genetic mother to genealogical father and genealogical mother provides a basis for the widely occurring, if not universal, practice of genealogical tracing. Secondly, we will see that the genealogical grid involves yet another shift to a cultural construct formulated in accordance with an underlying logic. This shift involves more than a simple extension of the idea of genealogical tracing. The genealogical grid involves a different kind of structure than is produced through genealogical

tracing, namely a structure defined through equations that provide the structure with its particular form. Universality of the genealogical grid depends, then, upon the universality of the structural equations, and not just the presumed universality of genealogical father and genealogical mother as the basis for genealogical tracing. Thirdly, further abstraction leads us to the terminological space as a system of abstract symbols constrained only by structural properties that are to be satisfied, rather than properties exhibited by the generating symbols. That the terminological space no longer needs be considered as modeled directly on genealogical or biological relationships will become evident.

BIOLOGICAL MODEL

We can model the relationships determined by genetic father and genetic mother by specifying that genetic father and genetic mother define a local structure that can be extended recursively. Locally it is defined by the fact that biological reproduction links one person (a node in the structure) with two persons (two other nodes in the structure), with the stipulation that the two persons represented by the two nodes have opposite sex and each is directly a contributor to the genetic makeup of the focal person (see Figure 1).

/insert figure 1 about here/

We can represent these two biological properties of sex difference and contributor of genetic material formally as follows. Let $\underline{S}$ be a set of persons. Let $\{\underline{m}, \underline{f}\}$ be a set with two symbols that we interpret as “male” and “female” respectively. We stipulate that there is a mapping, σ, from $\underline{S}$ to the set $\{\underline{m}, \underline{f}\}$ (that is, a rule that specifies for a person, $\underline{s}$, in $\underline{S}$ whether the

person should be linked to m (male) or to f (female)) which we write symbolically as:σ:S $\rightarrow$ {m, f} (read:"σ maps each element in the set S to the set {m, f}") for the set, S, taken as a whole, and as σ(s) = m (or σ(s) = f) (read:"σ maps s to m" or "σ maps s to f") for an element s in S. Let S_m be the subset of S such that if s $\in$ S (read: "s is a member of the set S") then σ(s) = m. The set S_m consists of those members of S linked to the "male" symbol, m. Similarly, let S_f be the subset of S such that if s $\in$ S then σ(s) = f. Now suppose there are two mappings, G (for genetic father) and g (for genetic mother) with G: S $\rightarrow$ S_m and g: S $\rightarrow$ S_f. Then for each s $\in$ S, G(s) is a male person and for each s $\in$ S, g(s) is a female person. We will call G the genetic father mapping and g the genetic mother mapping in the case where S is a set of actual persons and G and g are defined empirically for any person s in S by the fact of who in S (if anyone) is the genetic father of s and who in S (if anyone) is the genetic mother of s.

While the mappings G and g can be applied recursively (e.g., we can compute G(g(s)), or the genetic father of the genetic mother of person, s) there is no structural restriction on such computations beyond the definition of G and of g – only the restriction imposed by the empirical facts regarding who copulated with whom and thereby led to a pregnancy and a birth. Other than the local structure shown in Figure 1, the structure determined by repeated application of genetic father and genetic mother (a family pedigree) has form dependent upon the facts of who impregnated whom and cannot be specified in advance of knowing those empirical facts.

The structure provided in Figure 1 is what Read (1992) calls a $Model_D$ (data model), that is, it is a model of empirical reality and encompasses the biological fact of sex difference at the chromosomal level and the respective roles of each sex in providing a gamete with the haploid number of chromosomes so that when a pair of gametes unite, usually via coitus, the resulting zygote now has the diploid number of chromosomes. Other biological facts about biological

reproduction (e.g., that the woman who conceives the child need not be the woman who produced the ovum) are not included; hence it plays the role of a model as simplifying reality. The validity of a $Model_D$ rests in its congruence with empirical facts and not with regard to its relationship to some theory about those empirical facts. For example, the assumption that all persons can be neatly divided into either biological males or biological females is a valid assumption only to the extent that it is in accord with biological facts. In actuality, it is not consistent with the biological fact that there are persons with extra X or Y chromosomes, which affects their phenotypic, sexual characteristics, nor with the fact that there are individuals lacking alleles responsible for full sexual development as males, or individuals who may even have an apparent shift in the sexual phenotype of the "male" person. We accept the simplification that all persons are either biologically male or biologically female in the model on the grounds that the biological exceptions are relatively unusual cases and so can be ignored for a model representing the majority of cases. In contrast, the genealogical grid posits symbols that are marked male or female regardless of the degree of concordance with the biological reality. In the genealogical grid, kin types are labeled male or female not as a simplification of the biological complexity of biological sex, but as a fundamental aspect of the conceptual framework that is being expressed through the genealogical grid. In our $Model_D$ we change our definition of what is a biological male or a biological female in accordance with the biological facts. Assertions such as reproduction requires a biological male and a biological female are valid only to the extent to which it factually does require a gamete from a male and a gamete from a female to produce a viable zygote. But once we shift to culturally based definitions, we no longer use congruence with empirical evidence as the arbiter of the validity of a definition.

The assertion that the model shown in Figure 1 can be applied to any person implies that we can construct, from an initial person, a "tree," possibly with intersecting "branches" as we move upward in the tree, by applying the model recursively to each person identified in a prior application of the model. Thus, if we begin with person A, we know that there are persons B and C who are the genetic father and genetic mother of A, respectively, so that G(A) = B and g(A) = C. But B and C are persons to whom we can apply the model and so there must be persons D and E who are the genetic father and genetic mother of B, respectively, and persons F and G who must be the genetic father and genetic mother of C, respectively. While we know that B ≠ C, D ≠ E and F ≠ G, it is possible, however that D = F. This implies that while we can link each of A, B, C, D, E, F and G via recursive application of the model in Figure 1, we only know some aspects of the resulting structure in advance (e.g., a genetic father cannot equal a genetic mother) and other aspects (such as possibly the fact that D = F) can only be determined from the empirical facts of who beget whom.

A second aspect of Figure 1 is that recursiveness is not indefinite as the recursive argument is also a historical argument of what happened evolutionarily as we trace back through our ancestry. If we insist that the genetic father and genetic mother be members of the species, Homo sapiens, we know that should we apply the recursive property enough times, we would arrive at biological "ancestors" who would not be classified as members of the species Homo sapiens. Further, even if we had the factual information on ancestral entities evolutionarily prior to Homo sapiens, we would also find indeterminacy as to the time frame when we make the shift from ancestors who are Homo sapiens to ancestors who are not. While a species such as Homo sapiens has a well defined biological boundary at a point in time through the criterion of being able to produce fertile offspring, the evolutionary boundary for Homo sapiens is arbitrary in that it

does not refer to an event at a single point in time, but to change taking place over a period of time.

While the problem of establishing biological boundaries may seem remote from the question, Who is a kin?, it has the following important implication. The biological model given in Figure 1, even with recursion, does not model the facts of ancestry once we provide our categorizations of who are the A, B, C, etc. identified by the model in Figure 1. Once we specify the set of persons of interest, then the set S will not be closed under the genetic father and genetic mother mappings for the reasons specified above. There must be a person s in S for whom g(s) or G(s) is not in the set S. This is evident if we think of S as the set of persons that might be obtained, say, through collecting the genealogies of persons in a village. However exhaustive our attempts, there will be persons in our genealogy for whom the genealogical father and genealogical mother are not known, hence there surely must be persons for whom the genetic father and genetic mother biologically existed but are not in our set S of persons identified through the genealogies. Nor can we correct this limitation by defining S to be the set of all Homo sapiens. Even if we define S to be the set of all Homo sapiens, recursive sequences of the form, say, g(g … (g (s) …)), must eventually arrive at ancestors who are not members of the species Homo sapiens and so are not in the set S.

The genealogical grid has no such limitation. The genealogical grid, built upon the ideas of genealogical father and genealogical mother, can be extended back indefinitely without running into boundary problems because it is not a Model_D, but a Model_T; that is, it is a model for a theory (see D'Andrade 1970:90 for an elaboration of this theory in terms of "a set of imaginary persons plus a number of genealogical relations"). Further, the genealogical grid will have properties, such as indefinite extension of kin type products, that do not correspond to biological reality.

That is, the rationale for the genealogical grid lies not in its ability to serve as a $Model_D$ for the empirical reality of relationships defined through the biological relationships of genetic father and genetic mother, but as a $Model_T$ for a theory of genealogical relationships.

We can identify that theory in two ways. One is via the concepts that are part of a cultural system and the relations among those concepts. The second is to identify the elements needed to make the transition from the biological tree as a $Model_D$ to a theory that would have the genealogical grid as a $Model_T$. We will follow the second method here.

GENEALOGICAL STRUCTURE

The distinction between genetic father and genetic mother versus genealogical father and genealogical mother refers to a shift in the definition of the mappings, G and g. Suppose we now drop the genetically defined mappings, G and g, and substitute in their place culturally defined mappings, m and f, in their place where we define m(s) = t if, and only if, t satisfies an appropriate cultural criterion for t to be recognized as the genealogical mother of S and f(s) = u if, and only if, u satisfies an appropriate cultural criterion for u to be recognized as the genealogical father of S, but we leave unspecified the specific cultural criterion. Similar to the genetic tree that can, in principle, be constructed from a focal person by tracing out along paths of genetic fathers and genetic mothers, is the familiar genealogical tree showing the parent/child paths formed from the focal individual by tracing along paths of genealogical fathers and genealogical mothers. As with the genetic tree, the particular form taken on by the genealogical tree depends upon the fact of who is identified as genealogical father and who is identified as genealogical mother to whom. That identification is the basis upon which a conceptual system expressed in terms of symbols and relationships among symbols is given instantiation.

While at first glance it may appear that the shift from the mappings, G and g, to the mappings, m and f, is simply a substitution of a cultural definition for a biologically based one, the shift is more profound than merely the substitution of one definition for another. As mentioned above, the shift is from the phenomenological domain to the ideational domain. Consider a focal individual, s, and two other individuals, t and u, from the set S of persons. Even if it should be the case that g(s) = g(t) = g(u) and G(s) = G(t) = G(u), that is, s, t and u each have the same genetic mother and the same genetic father, t and u are still genetically distinct and cannot be equated genetically with one another in terms of their relationship to s. Each of t and u will be genetically distinct from each other and from s, regardless of sharing the same genetic mother and the same genetic father. In contrast, if m(s) = m(t) = m(u) and f(s) = f(t) = f(u), that is t and u have the same genealogical mother and the same genealogical father as does s, then from a genealogical perspective t and u are genealogical siblings with respect to s and are not distinguished in terms of genealogical specification. From a genealogical viewpoint, t and u are genealogically identical with respect to s and each is a genealogical sibling of s. The biological distinctiveness of t and u is "erased" when a shift is made to the genealogical domain. The "erasure" of the distinctiveness of the persons t and u is conceptual rather than empirical and follows from creating a structure – the genealogical grid—in which it is the kind of relationship one person may have with another that is represented. In this structure the logic asserts that when the relationship of person s to person t is the same as the relationship of person s to person u, then s and t are simply instances of that relationship regardless of their distinctiveness in a genealogical tree. Or, to put it another way, the genealogical grid is a conceptual construct with structure determined by its underlying logic and not by the empirical facts of how particular individuals are linked via genealogical father and genealogical mother. As Lehman and Witz have commented

> There is abundant motivation . . . to hold not only that people do their kinship reckoning by a process that can be described as composition of relations, but also that they are able to generate an abstract, free floating positional schema which can be imposed on any given kinship situation and on which kinship reckoning is carried out. (Lehman and Witz 1974:127)

The positional schema can be taken to be the usual genealogical diagram.

Now let f, m, s and d be kin type symbols that are to be interpreted as representing genealogical father, genealogical mother, genealogical son and genealogical daughter, respectively. We may express the relationship of person t to person s when both are persons in the same genealogical tree in the usual manner through taking appropriate kin type products of these four symbols; e.g., t might be s's genealogical father's genealogical son. Let u be the genealogical father of s. Whereas genealogical father presumably refers to a single person, u, with respect to s, genealogical son of u is any male for whom u is the genealogical father. More formally, if we think of each of f, m, s and d as a mapping of the set S of persons into the set S of persons, then f and m are 1-to-1 mappings whereas s and d may possibly be 1-to-many mappings. That is, if s is a male person, then s is a son of u and so the expression "s's genealogical father's genealogical son" could be used for s or for t. The ambiguity is resolved in the genealogical grid through the sibling kin types, genealogical brother (b) and genealogical sister (z) since t can be called the genealogical brother of s but s cannot refer to himself as a "genealogical brother." Of course, genealogical brother (genealogical sister) may still be a 1-to-many mapping and so the kin type, genealogical brother, will still group together under the same term more than one person should u have more than one son.

In terms of persons, distinctiveness as persons is not at issue. Rather, the ambiguity arises from the application of a conceptual structure (the genealogical grid) whose rationale lies not in its ability to model the actual genealogical pattern for a group of persons, but instead in it serving as a conceptual structure that can be mapped onto a set of persons and thereby used to calculate (genealogical) relationships among those persons. It is not a Model_D, but a Model_T.

We may formally construct the consanguineal genealogical grid as a Model_T by taking the set of symbols, {f, m, s, d, b, z}, to be interpreted as the kin types, genealogical father, genealogical mother, genealogical son, genealogical daughter, genealogical brother, and genealogical sister,[6] along with a special symbol, ego, and use the concatenation operation to construct strings of symbols that will be interpreted as representing kin type products. (That is, we would read the symbol string, fmf, as genealogical father's genealogical mother's genealogical father.) We stipulate that ego is a right-identity with respect to concatenation; that is, we have the equation

(x) (ego) = x, for all x ∈ {ego, f, m, s, d, b, z}. (1)

For example, (m) (ego) = m indicates that genealogical mother's ego is genealogical mother. Equation (1) ensures that the symbol, ego, will neither be embedded within a symbol string nor be the terminal symbol in a symbol string. Now let G be the set of all symbol strings that begin with the symbol, ego. The set G is closed under concatenation; that is, if ego (xy…z) ∈ G (read: "ego (xy…z) is a symbol string in G") and ego (st … u) ∈ G, then the concatenation of these two symbol strings, namely ego(xy… z) ego(st…u), reduces to the symbol string, ego(xy…zst…u) (since ego is a right identity and so z ego = z) and the latter symbol string is an element of G as it begins with the symbol, ego. More precisely, the set G of all symbol strings that begin with ego

forms what algebraically is known as a semigroup under the concatenation operation since the concatenation operation is a closed, associative[7] operation over the set S.

We now introduce the equations

fs = ms = b (2)

fd = md = z[8] (3)

sf = df (4)

sm = dm (5)

bz = z (6)

zb = b (7)

sb = s = db and reciprocally, bf = f = zf (8)

and

sz = d = dz and reciprocally, bm = m = zm.[9] (9)

We use these equations to reduce symbol strings in G that contain the symbol strings on the left side of these equations by replacing any such embedded symbol string with the symbol appearing on the right side of the equation. For example, we would reduce the symbol string, ego fsmd, to ego z via: ego fsmd = ego bz = ego z. The interpretation of each of these equations in the form of kin type products should be evident.

Equations (1) – (9) are needed to ensure that the structure imposed on the set, G, of symbol strings by these equations is isomorphic to the genealogical grid expressed in the form of the standard genealogical chart. In that diagram, implicit assumptions are made about genealogical calculations in order that the positions displayed in the diagram be the positions obtained through kin type products that make up the genealogical grid. For example, in the genealogical chart, ego's genealogical father's genealogical son has the same position as ego's

genealogical mother's genealogical son and, in both cases, is ego's genealogical brother, which presumes that Equation (2) is valid.[10] When a genealogical tree is constructed for a set of individuals, the resulting, empirical structure need not be consistent with the genealogical grid, as individuals divorce, remarry, have offspring outside of marriage, and so on, all of which contribute to the features of the empirically constructed structure that need not be part of the genealogical grid. The empirical structure thus may contain relationships that, while describable in genealogical terms, are not consistent with those displayed in a diagram for the genealogical grid. The "discrepancy" arises from the fact that the former uses a Model_D for its formulation and the latter is a Model_T; that is, the former has structural properties that arise from empirical events whereas the latter has structural properties as a consequence of the logic upon which it is constructed.

/insert figure 2 about here/

The genealogical domain has, then, two levels that we, as culture-bearers, easily shift between. One is the level that arises from substitution of genealogical father and genealogical mother for genetic father and genetic mother (see Figure 2) and is concerned with the structure determined empirically by repeated application of genealogical father and genealogical mother (and their reciprocal relations) to the empirical facts of reproduction in the form they are given cultural interpretation. Let us call this genealogical kinship. This level is characterized by genealogical tracing using the concepts of genealogical father and genealogical mother and leads to the usual genealogical diagrams that show how the individuals in a set of persons, such as an extended family, are linked via genealogical connections. The second level is the conceptual

structure that is constructed at a symbolic level by symbols normally given interpretation in terms of genealogical relationships (kin types), where the structure arises not from empirical context but from an underlying theory that specifies which kin type products define new genealogical positions and which kin type products can be reduced to already-defined genealogical positions as expressed in certain equations (e.g., Equations (2) - (9)). The second level is where there is a shift from the phenomenological (genealogical tree) to the ideational (genealogical grid) domain.

It is possible for the structure so generated to have its constituent elements interpreted in a manner other than as kin types presumed to be the cultural interpretation of the underlying biological system of reproduction. The linkage between a symbol and a kin type is, as Schneider so forcefully argued, by cultural specification, not by necessity, and serves as a means to map the structure with its symbolic elements onto actual persons in a manner consistent with the structure given in Figure 2. Thus, if the genealogical symbol, ego, maps to the focal person, then so long as the genealogical symbol, f, is mapped to that person's genealogical father, and genealogical m maps to that person's genealogical mother, then the genealogical grid is consistent with Figure 2 no matter how genealogical father and genealogical mother might be defined. Whether or not the kin types genealogical father and genealogical mother constitute "biology interpreted through culture" (Vivelo 1978:150, emphasis in the original), as one introductory text on kinship phrases it, is not crucial for this process of mapping to individual persons. All that is needed is a way to link the symbols via cultural constructs that identify the interpretation of the symbols to actual individuals in a manner consistent with the structure given in Figure 2. In other words, from a formal perspective the "genealogical grid" does not contain within it the necessity that it be genealogy taken to represent actual or putative biological parent/child links. Rather, it represents

genealogy in this sense only to the extent that genealogical father and genealogical mother are culturally modeled on biological parent/child links.

It should be noted that genealogical tracing exists without formulating the genealogical grid. Genealogical tracing through repeated use of genealogical father and genealogical mother does not require that the logic of a genealogical grid should also be part of the cultural repertoire. Further, unless there is a group that truly is unaware of the biological basis of procreation, genealogical tracing may very well be universal, as Lehman (Lehman 1992:98) has argued. If so, then genealogical kinship defined as the set of relationships determined through genealogical tracing would also be universal. But unless the further step of constructing a genealogical grid as a conceptual structure has also had cultural recognition, then there is no reason to assume that a genealogical grid, as opposed to genealogical tracing, is universal. Schneider's objection to the "genealogical grid" as universal appears to be an objection to assuming that the culturally defined genealogical grid is universal. Not considered by Schneider is the possibility that genealogical tracing may be universal when it is separated from genitor and genetrix as its basis.

We can summarize the consanguineal genealogical grid as a cultural construct that can be modeled through:(1) a set of symbols {f, m, s, d, b, z} along with a special symbol, ego, (2) a concatenation operation for forming symbol strings, (3) definition of ego as a right identity with respect to the concatenation operation, (4) identification of a set, G, of symbol strings that commence with the symbol, ego, and (5) stipulation of certain equations (e.g., Equations (2) – (9)) that specify which symbol strings can be reduced to other symbols. The genealogical grid is the structure that arises from the application of those equations to the symbol strings in G. The resulting structure is a Model_T, hence its validity for a particular culture is ascertained not by reference to empirical data in the form of genealogical tracings, but through identification of

cultural constructs that can be abstracted as the symbols required for constructing the genealogical grid along with cultural recognition of the equations that provide the space with its structure.

The structure so determined uses two abstractions from the empirical structures produced through genetic father and genetic mother. These are (1) the replacement of genetic father and genetic mother by genealogical father and genealogical mother along with abstraction of genealogical father and genealogical mother to the symbols, f and m, and (2) abstraction of the recursive application of the structure shown in Figure 2 to the concatenation operation on symbol strings to produce new symbol strings from whatever is the set of symbols used in the construction. The first abstraction also requires that there be a rule that stipulates how the symbols shall be given instantiation when the structure is to be mapped onto a set of persons. While it might appear evident that f maps to father, m maps to mother, and so on (with father, mother, etc. referring to genealogical relations), given the intent that the structure defined conceptually should serve to determine the genealogical grid, this is not a formal necessity. We could, in the case of the Yapese for example, map f to citamangen and construct a structure that would be based on "products" of the term, citamangen; e.g., alter could be referred to as ego's citamangen's citamangen. Whether the structure so produced is a genealogical structure lies at the heart of Schneider's critique of the use of genealogy as universally determining what constitutes kinship relationships.

TERMINOLOGICAL STRUCTURE

The assertion that a structure based on constructs such as ego's citamangen's citamangen would be a genealogical structure rests on the claim that what we call kin terms are labels for sets

of kin types. This claim implies that what we consider to be kin terms should be defined through their constituent kin types. The most developed, formal account based on taking genealogy as the means for defining kinship has been the rewrite/extension methodology introduced by Lounsbury (Lounsbury 1964). Briefly, in a rewrite analysis the first step is to identify the kin types associated with each kin term. The next step is to reduce the set of kin types for a kin term to the focal kin type(s) for that set. Next, the kin types in the reduced set of kin types are given componential definitions (see Kronenfeld 1996). Lastly, rewrite rules are formulated that reconstruct the full range of kin types for the kin terms from the focal kin types for a kin term.

Insofar as the rewrite rules are not theoretically constrained, the last step can always be completed, regardless of the validity of the assumptions underlying the methodology, by adding whatever rewrite rule is needed to achieve closure. In this sense, it is too powerful a methodology as it can be carried out on any collection of sets of kin types, no matter how constructed. More problematic, though, is that the procedure must begin with a structure – the kin terms reduced to focal kin types – that has no a priori definition. The methodology has circularity as it is assumed that terms are defined via kin types, but the structure from which the analysis begins relies upon the kin terms for its specification. The circularity can be seen in the rewrite rule analysis of the Sirionó kinship terminology. The Sirionó are a group from northeastern Bolivia, originally studied by Holmberg (Holmberg 1948; Holmberg 1950) and whose terminology was the subject of an extensive analysis by Scheffler and Lounsbury using rewrite rules (Scheffler and Lounsbury 1971). In their analysis, the structure to which the rewrite rules apply consists of the 12 terms in the terminology with their focal kin types as shown in Table 1.

/insert table 1 about here/

The list of sets of focal kin types (the second column in Table 1) requires first knowing the specification of the kin terms as sets of kin type products in order to derive the focal kin types, hence the recovery of the full range of kin types for each kin term from this list via rewrite rules does not fully establish the basis upon which the kin terms are defined as sets of kin type products. Left silent is the basis for the list of focal kin types. Unless we can specify why, for example, a female's fzs should be a focal kin type other than by appeal to the term yande and the range of kin types to which this term can be applied, the analysis has not succeeded in showing the basis upon which kin terms are associated with sets of kin types.

Although Woolford (Woolford 1984) asserts that a grammar based on the five kin types, parent, nuncle (sibling of Parent), grandparent, sibling and cousin, a fixed set of rewrite rules, reciprocity of kin types, and a partition operation (e.g., rewriting parent as mother and father) suffice for generating all kin classification systems, it does so only by using rules whose form is merely a restatement of kin term properties. For example, in her analysis of a Turkish terminology, rules such as "Divide by relative age of ego versus alter: Sibling" and "Divide by sex of relative: Parent, Nuncle, Grandparent, Elder Sibling, Child" (Woolford 1984:779) are introduced. These rules are not given any rationale other than the fact that they are necessary as the terminology has terms that distinguish between older and younger sibling and the kin types listed in the second rule correspond to terms that are sex marked. These ad hoc rules merely identify the ways in which the terminology differs from the purportedly universal analytic framework for all terminologies and use the properties of the kin terms to establish the rules.

If the assertion that a kin term "is the `name' of a genealogically established category" (Scheffler and Lounsbury 1971:13) is valid, then it must be possible to begin with the genealogical grid and next determine those categories of kin types for which the kin term is the "name" without appealing to properties derived from the names. Otherwise, we are implicitly recognizing that it is the terms that carry the information load regarding how the genealogical grid is subdivided into categories of kin types, hence the terms are not simply the names for already determined categories but the means by which those categories are defined. Either we should consider the possibility that the kinship terminology has embedded in it the basis upon which the kin types categories are constructed (the cultural rules, or what Fortes has called "a distinctive set of customary axioms" [Fortes 1969:53]), or we must identify the cultural "rules" that have led to the categorization of kin types. In either case, the rewrite rule analysis has had to use the kin terms as the means to identify the consequences of those cultural rules when applied to the genealogical grid in order to form the categories of kin types allegedly "named" by the kin terms.

If it is the kin terms, along with their structural relations as kin terms, that carries the cultural informational load about categorization of kin types, then we no longer need to assume that kinship is genealogy. Rivers rejected the possibility that kinship might be defined via the kin terms on the grounds that kin terms are defined through use of genealogy. But if that assumption is incorrect and it is the kin terms that determine the genealogical categories – as I (Read 1998) have demonstrated to be the case for the AKT and the Shipibo terminology—then it also follows that kinship may be defined by mapping the terminology onto a collection of persons without necessarily making reference to genealogical claims. As the examples from Marshall and Goodale given above illustrate, in fact calculations are made to establish kinship without reference to genealogical claims through a kind of kin term product.

Scheffler and Lounsbury call this "pragmatic kin-class reckoning" (Scheffler and Lounsbury 1971:142, n.3) but claim that it is based on genealogical reckoning as they assert that "the relations between kin categories (narrow and broad) are such that partial genealogical knowledge suffices for their proper use" (Scheffler and Lounsbury 1971:142, n. 3). Yet they also recognize that "the users of the system may not be accustomed to speaking or `thinking' in the abstract of lengthy genealogical chains, e.g., of father's father's brother's son's sons…"(Scheffler and Lounsbury 1971:142, n. 3). But if the user of the term is not thinking in terms of lengthy genealogical chains then it is not clear how the user would know the genealogical relationship of one term to another unless this relationship was learned for every pair of terms – a daunting prospect to say the least. By their argument, a user of the AKT presumably would know that if alter is a person related to ego and referred to by ego's cousin as Grandfather, then ego would also know to use the kin term, Grandfather, to refer to alter by virtue of the calculation that a cousin's father's father or a cousin's mother's father is a grandfather when both ego and ego's cousin recognize alter as a kin person and even if ego does not know the genealogical kin type product strings that "define" who is a Cousin.[11] But the calculation that a cousin's father's father or cousin's mother's father is a grandfather is not self-evident from the consanguineal kin type definition for Grandfather, namely {ff, mf}, in the absence of knowledge about the kin type definition for Cousin, hence the genealogical calculation that links the kin term, Cousin, to the kin term, Grandfather, would have to be learned for this pair of terms, and similarly for other pairs of terms. It seems more plausible that by experience ego is likely to know that a person that one's cousin calls Grandfather is a person that ego also calls Grandfather when both ego and ego's cousin recognize that person as a kin person, hence a Grandfather of a Cousin is a Grandfather as a kin term product (see below). In his critique of the assumption that kin terms first of all have

reference to genealogically related individuals, Hirschfeld (1986:271) makes a similar observation: "It simply seems to be empirically the case that establishing the appropriate use of kinship terms involves reference to how the individuals use other kinship terms . . . not how those individuals are genealogically related." Observe that in this kind of learning through experience, ego knows the correct term to use to refer to alter without having to know the genealogical relationship of (to continue the example) ego to ego's cousin or of ego's cousin to ego's grandfather, or even of ego's genealogical relationship to grandfather. Let us refer to this kind of calculation that only uses kin terms and does not refer to genealogical relationships a kin term product.

> More precisely, I (Read 1984:422; 1998:10) have defined the kin term product as follows: Let K and L be kin terms in a given kinship terminology, **T**. Let ego, $alter_1$ and $alter_2$ refer to three arbitrary persons each of whose cultural repertoire includes the kinship terminology, **T**. The kin term product of K and L, denoted K o L, is a kin term, M, if any, that ego may (properly) use to refer to $alter_2$ when ego (properly) uses the kin term L to refer to $alter_1$ and $alter_2$ (properly) uses the kin term K to refer to $alter_2$.[12]

For example, in the AKT, if K is the kin term, Father, and L is the kin term Mother, then M = Father o Mother is the kin term, Grandmother.

The kin term product is not dependent upon genealogical relations for its computation and instead, unlike kin type products that are assumed to be universal, depends upon informant knowledge for its calculation. Kin term products are thus culturally specific and convey cultural concepts about how the kinship relations identified by the terms in the terminology may form a system of relationships.

If the cultural information load is embedded in the kin term products, then it follows that a means to display that informational load directly rather than indirectly through mapping kin terms

onto the genealogical grid is needed. The means for so doing was originated by Leaf and was illustrated by him with two terminologies, the American/English kinship terminology and the Punjabi kinship terminology (Leaf 1971; Leaf, this volume). The kin term map has been modified by Read (Read 1984) in order to make it consistent with graphs that show the consequence of taking symbolic products through use of arrows that are labeled in accordance with the symbol represented by the arrow. Construction of kin term maps has been implemented in the software program, Kinship Algebraic Expert System (KAES) (Read and Behrens 1990; Read 1998).

The basic idea underlying the kin term map is to display each kin term as a single node in a graph (mathematical sense) with arrows connecting the nodes representing the result of taking products of the kin terms with a small set of kin terms (one term for each kind of arrow) from which all other kin terms can be computed through the kin term product. For the AKT, the terms Self, Parent, Child and Spouse are the kin terms that suffice to generate all other kin terms in the AKT (Read 1984). The kin term map for the AKT constructed with the software program, KAES, is shown in Figure 3. The upward arrows show the consequence of taking kin term products with the kin term, Parent. The downward arrows show the consequence of taking kin term products with the reciprocal kin term, Child. The kin term products with the kin term, Spouse, are shown with an equal sign. The kin term map is a Model_D as it represents informant information about kin term products. Leaf's Punjabi example is of particular interest in this regard as it was elicited directly through informants and displays a structure that his informants found satisfactory as a map of their kinship world.

/insert figure 3 about here/

That it is possible to display the relationships among kin terms by means of products with the use of but a few kin terms suggests that the terminology structure may have an internal logic that gives it its form and that it can be generated through repeated application of the kin term product in a logically consistent and exhaustive manner. More precisely, it may be possible to model the kin term map abstractly as a structure that can be generated from a set of symbols (the generating elements) via a binary product defined over the set of symbols, using equations to determine the form of the structure. Unlike the situation with rewrite rules, this claim about the kin term map is falsifiable as it is quite easy to draw a structure that cannot be generated in this way. Contrariwise, success in generating the structure argues strongly for the claim that the terminology structure is the locus of cultural concepts about kin relations, as it is unlikely that the terminology structure would be logically consistent were this not the case.

The generative approach to analysis of kinship terminology structure is formally related to the conceptual basis for the genealogical grid in the following way. Recall that the genealogical grid is formally based upon (1) a set of symbols, (2) the concatenation operation on symbol strings, and (3) certain equations that give the genealogical grid its particular structure. For the genealogical grid the set of symbols includes a special symbol, ego, that acts as a right identity element with respect to the concatenation operation and the other symbols are interpreted as kin types. Determining the equations that are needed to ensure that the distinct symbol strings in the formal model will have 1-to-1 correspondence with the distinct kin type products represented in the genealogical grid can formally generate the genealogical grid. In order to generate the terminological space we need the following changes. First, we note that the concatenation operation for the genealogical grid is a binary product on the set, $\underline{G}$, of symbol strings that begin with the symbol, $\underline{ego}$. That is, given a symbol string that we symbolically denote by $\underline{x}$, and a

second symbol string that we denote symbolically by y, we can think of the concatenation operation as acting on the two symbol strings denoted by x and y to form the new symbol string, xy, which is also a member of the set, G. Thus, if we let o represent the concatenation operation, then we have x o y = xy and o maps a pair of symbols from G to a symbol in G (more formally, o: G x G → G). For the terminological space, instead of the concatenation operation and a set of symbol strings, G, that begin with the symbol ego, we now only assume we have a set of symbols, S, and a binary operation, o, defined over S so that o maps any pair of symbols from S to a symbol in S. The interpretation of o with respect to kin terms will be the kin term product. We can think of the kin term product, then, as based on the idea of a binary product. The idea of a binary product is already utilized with kin type products, but the binary product for kin terms differs by replacing the definition of the binary product as the concatenation operation on symbol strings with a binary product defined over the symbols in the set S. In this respect, the kin term product is a further abstraction on the idea of recursive application of genealogical father and genealogical mother (or of genetic father and genetic mother). Secondly, we do not specify in advance what should be the set of symbols to be used as generating elements, but derive these from the kin term map via identification of kin terms that are atomic; i.e., cannot be expressed as the kin term product of other kin terms. No universal set of atomic terms is postulated and the atomic terms will be terminology specific. For example, the atomic kin terms in the AKT are found to be Self, Parent, Child, and Spouse (Read 1984; 1998), whereas the atomic kin terms in the Shipibo terminology (Behrens 1984:139-147) are found to be Ea ('Self'), Papa ('Father'), Tita ('Mother'), Bakë ('Child'), Ahuiín ('Wife') and Bënë ('Husband') (Read and Behrens 1990; Read 1998). Nor is it the case that the atomic consanguineal kin terms must have transliteration as one of 'Parent,' 'Child,' 'Mother,' 'Daughter,' 'Father' or 'Son' as the atomic terms for the

Trobriand terminology are Tama (‘Father’) and Tuwa (‘Elder Brother’) (Read and Behrens 1990; Read 1998).[13] Further, no assumption is made that a terminology will have a term that can be transliterated as ‘Self,’ and some terminologies, such as the Trobriand terminology, lack such a term. Thus, whereas the symbols used in generating the genealogical grid are based on the structure shown in Figure 2, the generating symbols for the terminological space drop the a priori specification of the structural properties to be exhibited by the generating symbols (i.e., the structure shown in Figure 2) and instead have terminologically specific specification of those structural properties. Third, the structural equations that give the structure being generated its particular form depend upon the structural properties of the terminology as displayed in the kin term map and will be terminology specific rather than universal, as is assumed for the equations underlying the structure of the genealogical grid. For the AKT, the relevant equations are:

Parent of Child = Self (consanguineal structure) (10)

Spouse of Spouse = Self (11)

Spouse of Parent = Parent and reciprocally, Child of Spouse = Child (12)

Parent of Parent of Spouse = 0[14] and reciprocally, Spouse of Child of Child = 0 (13)

Parent of Spouse of Child = 0 (14)

and

Spouse of (Child of Parent) = (Child of Parent) of Spouse. (15)

For example, by Equation 10 is meant that if ego refers to $alter_1$ as Child, and $alter_1$ refers to $alter_2$ as Parent, and if ego, $alter_1$, and $alter_2$ are consanguineally related, then $alter_2$ must be ego and so ego refers to $alter_2$ (= ego) by the term Self, hence Parent of Child = Self.

These equations, along with a rule for assigning sex marking of symbols based on whether or not products with the Spouse term yield kin terms in the algebraic model, and a rule for

equating Cousin symbols so that an “Ith Cousin J Times Removed” is a self-reciprocal kin term, suffice to generate a symbolic (algebraic) structure isomorphic to the kin term map for the AKT (Read 1984; 1998, see Figure 4). The fact that a structure is generated also makes it possible to identify structural properties arising from the logic of the structure’s generation as opposed to these properties originating for reasons extrinsic to the logic of the structure.

/insert figure 4 about here/

One such property for the AKT is the lack of the “-in-law” suffix and the use of Uncle and Aunt for Spouse of Aunt and Spouse of Uncle, respectively. Schneider (1980:107, n.7) asserted “. . . it is clearly inconsistent for them [husband of aunt and wife of uncle] to be uncle and aunt when cousin’s spouse is not cousin and son’s spouse is not daughter” and suggested as an explanation that “. . . Uncle’s wife is accorded aunt as a form of respect, aunt’s husband is accorded uncle as a form of respect ….” (emphasis added). However, the algebraic model demonstrates (1) that the equations, Spouse of Aunt = Uncle and Spouse of Uncle = Aunt; are a consequence of the logic of the structure (see Figure 4, where the Nuncle node is bifurcated via the sex marking rule into the pair of nodes, Aunt and Uncle, and the arrows between these two nodes indicate that Spouse of Aunt = Uncle and Spouse of Uncle = Aunt), hence the lack of terms such as Aunt-in-law or Uncle-in-law demonstrates consistency between the logic of the structure and the semantic form of kin terms, (2) that the kin term product, Spouse of Cousin, does not yield a kin term is consistent with the logic of the structure, and (3) that all of the terms marked with the -in-law suffix correspond precisely to those nodes in the structure introduced by taking products with the spouse term, Spouse.

Finally, the mappings Self → {ego}, Parent → {m, f} (and reciprocally, Child → {d, s}) and Spouse → {w, h} from the terminological structure to classes of primary kin types, in conjunction with the algebraic model for the kin term structure, suffices to predict, with complete accuracy, the kin types included in the range of each kin term (see Figure 5). (The prediction is verified empirically through

/insert figure 5 about here/

mapping kin terms to the genealogical grid using Rivers' genealogical method.) Whereas the rewrite rule analysis is predicated on the assumption that the linkage between the genealogical grid and the set of kin terms is via a mapping from kin types to kin terms, this result demonstrates the reverse, namely that the mapping can be defined from the terminological space to the genealogical grid, and the use of kin terms as labels for classes of kin types derives from this mapping rather than serving as a basis for defining the meaning of kin terms.

CONCLUSION

A comparison of the four structures that have been discussed is provided in Table 2. As one goes across the table from left to right, each of the subsequent structures can be considered as produced by a

/insert table 2 about here/

relaxation/abstraction of a property or properties of the previous structure. Thus the genealogical tree is more abstract than the genetic tree by virtue of genealogical father and genealogical mother being symbols that have rules of instantiation that are not constrained by biological facts, whereas genetic father and genetic mother refer to persons with a specified biological relationship to the focal person.

Next, whereas the genealogical tree uses the more concrete notion of recursion as a way to construct an empirically based structure, the genealogical grid abstracts from this a binary product in the form of concatenation of symbol strings (i.e., kin type products) and abstracts from genealogical father and genealogical mother the kin type symbols, f and m, and the latter is extended to include the other elementary kin types via reciprocity and the definition of the kin type symbols, b and z.[14] By shifting to the symbolic/ideational level, these symbols, in conjunction with the concatenation operation and the equations satisfied by the concatenation operation, suffice to generate the genealogical grid. Unlike the genealogical tree or the genetic tree, the form of the structure derives from the logic of its generation and not from empirical events. The shift to abstract symbols also requires that there be more explicit rules of instantiation.

Finally, the terminology space does not require instantiation of the generating symbols in terms of genealogical father, genealogical mother, etc., thereby making the structural elements of the terminological space into symbols whose identification and instantiation becomes culturally specific. Similarly, the specification of the binary operation as the concatenation operation is relaxed and its replacement, the kin term product, depends upon cultural knowledge for its implementation. Also, the equations that give the terminological space its particular structural form depend upon cultural specification. Instantiation is also generalized. While it is possible to map the abstract symbols used to construct a generative model for the kin term map to the

genealogical grid (see "(1) AKT", in Table 2, bottom and Figure 5), this is not necessary. Instead, the kin terms, taken as abstract symbols, can have cultural specification for their instantiation (see "(2) AKT" in Table 2, bottom and Figure 6) which need not be identical to the way the kin terms might be mapped to the genealogical grid. For example, Parent in the AKT might include "adopted parent" as part of its cultural specification.

/insert figure 6 about here/

Whereas the genealogical grid is supposedly universal and, hence, uses concepts that are presumably shared by all cultures, the terminological space has a priori specification only through general structural properties such as (1) the structure must have a focal element; that is, a kin term from which all other kin terms can be reached via kin term products, and (2) the structure preserves reciprocity; that is, for each term there is a reciprocal term and the reciprocal form of an equation is also valid in the structure. Whereas the presumed universality of the genealogical grid determined by the elementary kin types and Equations (2) – (9) has been challenged by Schneider as assumed rather than demonstrated, the terminological space is consistent with his concern that the first task is to "understand and formulate the symbols and meanings and their configuration that a particular culture consists of" (Schneider 1984:196). The algebraic analysis that I introduced (Read 1984) and implemented in the form of a computer program (Read and Behrens 1990; Read 1998) elucidates the symbols and their configuration. The structure in which the kin terms are embedded is part of understanding their meanings. But their meanings are more fully elaborated via the rules of instantiation; e.g., Who is a Parent in American culture? Who is a Spouse? The answers are culturally constructed and are not fixed but changeable as illustrated by

the way the first question has had its answer revised as a consequence of the introduction of surrogate “mothers,” artificial insemination, and the like. The second question may have its answer revised through the debate on whether or not same-sex marriage should be legally recognized.

Meanings are not only changeable, but may also vary depending upon which structure (genealogical tree, genealogical grid, or terminological space) has cultural salience in a particular instance. While Schneider argued against the universality of the genealogical grid as representing what constitutes kinship, this does not preclude that the genealogical grid from having cultural salience in some cultures. Nor does it preclude the genealogical grid and the terminological space as both having cultural salience and serving as alternative conceptual structures that can be used to frame how persons are seen to be related to one another. It is evident that users of the American Kinship Terminology will often use the genealogical grid to define a kin term, as when a parent explains to a child that an Uncle is a parent's brother. As discussed above, Schneider's argument against the universality of "kinship" is predicated upon his assertion that the genealogical grid is part of European culture (Schneider 1984:200); hence, it cannot be assumed to be a pan-cultural conceptual structure. Since kin terms determined via the terminological space can also be mapped onto the genealogical grid, they can be given definition via the genealogical grid even if the genealogical grid is irrelevant to how the terminological space is formulated.

Even when the genealogical grid does not have cultural salience, the genealogical tree, which only depends upon recursive use of the concepts of genealogical father and genealogical mother, may be an alternative way in which relations are conceived. The fact that the !Kung san use something like the kin term product to determine whether or not ego and alter are kin does not preclude the possibility that in other contexts genealogical tracing may be the means for

working out the relationship between ego and alter. Or, to put it another way, if genealogical tracing (as opposed to the genealogical grid) is universal, as some have suggested, the relation between ego and alter can be viewed either from the perspective of the terminological space and its attendant culturally defined rules of instantiation, or from the perspective of genealogical tracing. When the meaning of kin terms as determined through the terminological space is not based upon properties that can also be expressed via genealogical tracing, the two systems for how relations are perceived need not be congruent. This provides a way to resolve the seeming, native contradiction posed by Strathern. He notes that

> … at a Melpa exchange ceremony a ceremonial speech-maker declared `I call you my sister's sons, my cross-cousins. I am your true cross-cousin, living close to you. My sisters' sons, my cross-cousin, you say you see big pigs, big shells, well, now I have given you large pigs'. …The speaker says he is a `true' cross-cousin because he lives near to his kin and is their regular and generous exchange-partner. (Strathern 1973:32)

In terms of the framework presented in Table 2, the reference is to the terminological space and how the abstract symbols are given instantiation. Yet at the same time, Strathern notes that in other contexts "speakers will say that `X is not my true (i.e. immediate genealogical) cross-cousin, we call each other by this term only because we exchange pigs and shell valuables.' In the latter context the genealogical component is selected as indicating the `true' relationship" (Strathern 1973:32). In terms of Table 2, the reference is to genealogical tracing rather than to how the abstract symbols of the terminological space are instantiated. Once we recognize that genealogical tracing and the terminological space can both be culturally salient, yet need not be congruent when the means for giving the abstract, terminological symbols instantiation do not relate to properties that can be expressed in terms of genealogical tracing, there is no conflict in

the two seemingly contradictory statements to which Strathern refers, only a difference with regard to the context that makes one or the other framework more salient for the situation at hand. The interesting question then becomes one of understanding when one conceptual framework is appropriate and when the other is appropriate, not whether the genealogically framed reference is somehow more real and the terminologically framed reference is "metaphoric." As Schneider observed "One must take the native's own categories, the native's units, the native's organization, and articulation of those categories and follow their definition, their symbolic and meaningful divisions wherever they may lead" (1972:51). Viewing kinship as having to do with the persons culturally identified through culturally specified rules for the instantiation of the culturally produced abstract structure of which the kinship terminology is an expression is a step in this direction.

NOTES

[1] The genealogical grid is defined more formally below. Roughly, it is the structure represented in the form of a standard genealogical chart and presumed to have indefinite extension.

[2] This approach has much in common with Montague's suggestion (Chapter 2, this volume) that kinship be viewed as a "multiple slotting system" of classification. However, whereas Montague is interested in the definitions of individual taxa, my concern is with the formal logical integration of the overall system.

[3] That kin terms can be related to the genealogical grid is evident and is the basis of Rivers' genealogical method for elicitation of kin terms. The algebraic modeling demonstrates something more, namely that the terminological structure can be generated without reference to the genealogical grid and the mapping of kin terms onto the genealogical grid can then be predicted from the terminological structure. The prediction can be verified by Rivers' genealogical method. For the two terminologies where this has been tested, the predicted mapping of kin terms to the genealogical grid is in complete agreement with the empirically obtained mapping of kin terms to the genealogical grid.

[4] In accord with Barnes (1961) and Buchler and Selby (1968:33-35), the following distinctions will be made: (1) genetic father/mother -- the person providing the spermatozoon/ovum, (2) genitor/genetrix -- the culturally defined person(s) (if any) who is (are) culturally recognized as, or asserted to be, the physical father/mother and (3) <u>pater/mater</u> – the person(s) recognized as the social father/mother.

[5] Although genitor/genetrix may, in some cultures, be the basis upon which genealogical tracing is conducted, the process of genealogical tracing only depends upon the association of a

single male person and a single female person with ego in such a manner that that association can be done recursively with respect to the two persons so identified. Whether or not the male person is genitor and the female person is genetrix is irrelevant from the viewpoint of the logic of genealogical tracing. One can also trace using a cultural specification (should that be the case) that the male person defined as the husband of mother is the basis upon which the male part of genealogical tracing is conducted. In this case the genealogical "tree" so identified would not be the pedigree of ego, but would be ego's culturally relevant genealogical structure.

[6] Kin types are usually viewed as abstractions of genitor and genetrix, but genealogical tracing need not be based upon genitor and genetrix. Yet it is evident that the genealogical grid, even if defined in terms of kin types based upon genitor and genetrix, is supposed to be a representation of an idealized genealogy based upon the idea of genealogical tracing. To avoid inconsistency, then, the basis for genealogical tracing and the basis for the genealogical grid must be the same. Hence I am using genealogical father and genealogical mother as the common basis for genealogical tracing and the genealogical grid. Genealogical father and genealogical mother can, but need not, be genitor and genetrix, respectively. Identification of genealogical father and genealogical mother with genitor and genetrix depends upon cultural specification rather than an assumption that genitor and genetrix are universally recognized as the basis for genealogical tracing.

[7] A binary operation such as the concatenation operation is associative when it is not necessary to use parentheses to indicate the order in which the binary operation takes place. Thus, if $\underline{s}$, $\underline{t}$ and $\underline{u}$ are symbol strings, then the fact that $\underline{(st)}\ \underline{u} = \underline{s(tu)} = \underline{stu}$ implies that the concatenation operation is associative.

[8] Equations (2) and (3) are the same as the "Half-Sibling Rule" used in rewrite rule analysis.

[9] Equations (4) – (9) are considered axiomatic by Scheffler and Lounsbury: "It may be regarded as an axiom of all kinship systems we know of that, e.g., the parent of a sibling is a parent or step-parent, and conversely, the sibling of a child is a child or step-child. Similarly, the sibling of a sibling is regarded as a sibling …" (Scheffler and Lounsbury 1971:128n).

[10] From the perspective of genealogical calculations, ego's father's son could be ego if ego is male. However, in the genealogical grid represented by the genealogical diagram it appears to be assumed that ego's father's son is ego's brother.

[11] In the algebraic modeling, kin terms begin with a capital letter in order to distinguish them from kin types for those cases where the kin term and the kin type use the same semantic form; e.g., Father (kin term) versus father (kin type).

[12] Right to left notation is used for kin term products rather than the more common left to right notation as a way to distinguish between kin term products and kin type products when reading symbolic notation. The kin term product, Parent o Child, for example, is read "Parent of Child", whereas the kin type product, pc, is read "parent's child" in accord with the usual notation and reading of kin type products. The former expression refers to a kin term (namely the kin term ego uses for $alter_2$ when ego properly refers to $alter_1$ as Child and $alter_1$ properly refers to $alter_2$ as Parent in the AKT), whereas the latter expression refers to a genealogical position (namely the alter who is ego's parent's child).

[13] This is consistent with Montague's argument (this volume, Chapter 8) that Trobriand Islanders do not define kin terms genealogically, and that the usual English glosses for Trobriand kin terms are fundamentally misconceived.

[14] The “0” indicates that the kin term product does not yield a kin term. The symbol “0” is added to the set of symbols to ensure that the kin term product is closed over the set of symbols.

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TABLE I

Siriono Kin Term	Focal Kin Types
Ami	{ff, mf}
Yande	{female's fzs}
Ari	{fm, mm}
Eru	{f}
ezi	{m}
anongge	{b, z}
edidi	{s, d}
ake	{ss, sd, ds, dd}
akwani	{females bd, male's zd}
yande	{male's mbd}
akwanindu	{female's bs, male's zs}

TABLE 2

TYPE OF STRUCTURE			
Genetic Tree	Genealogical Tree	Genealogical grid	Terminological Space
STRUCTURAL ELEMENTS			
Empirical Relation	Cultural Relation	Abstract Symbols: Universal Kin Types	Abstract Symbols: Terminology Specific Atomic Kin Terms
genetic father genetic mother	genealogical father genealogical mother spouse	*Ego* Consanguineal *f, m, s, d, b, z* Affinal *h, w*	*AKT* Self Consanguineal Parent, Child Affinal Spouse *Shipibo* Ea (“Self”) Consanguineal Papa (“Father”) Tita (“Mother”) Bake (“Child”) Affinal Bënë (“Husband”) Ahuiín (“Wife”)
STRUCTURAL OPERATION			
Recursion	Recursion	Binary Product: Concatenation	Binary Product: Kin Term Product
STRUCTURAL EQUATIONS			
Genetic father ≠ genetic mother	genealogical father ≠ genealogical mother	Universal Equations: Equations (2) – (9)	Terminology Specific Equations: ***AKT*** Equations (10) – (14)

TABLE 2 (Continued)

INSTANTIATION OF SYMBOLS			
Genetic father → male providing spermatozoon Genetic mother → female providing ovum	Genealogical father → culturally prescribed male person Genealogical mother → culturally prescribed female person Spouse → culturally defined person	*Ego* → focal person *f* → genealogical father *m* → genealogical mother *s* → male person whose genealogical father or genealogical mother is ego *d* → female person whose genealogical father or genealogical mother is ego *b* → genealogical father's or genealogical mother's *s* *z* → genealogical father's or genealogical's *d* *w* → female spouse *h* → male spouse	***(1) AKT*** Self → focal person Parent → culturally prescribed person Child → reciprocal of Parent Spouse → culturally prescribed person ***(2) AKT*** (genealogical) Self → *{ego}* Parent → *{m, f}* Child → *{s, d}* Spouse → *{h, w}*

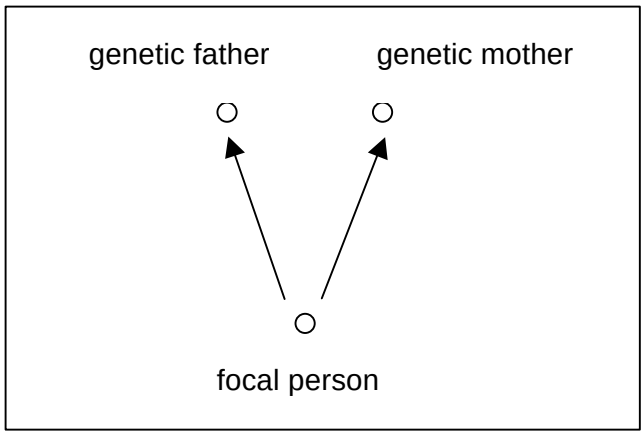

Figure 1: Triadic structure linking the focal person with the biologically determined genetic father and genetic mother.

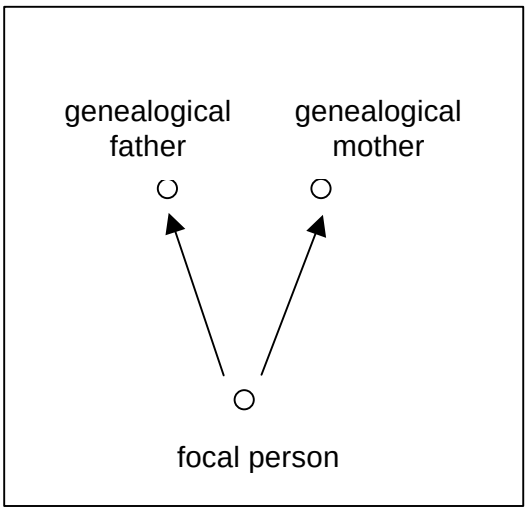

Figure 2: Triadic structure linking the focal person with the culturally determined genealogical father and genealogical mother.

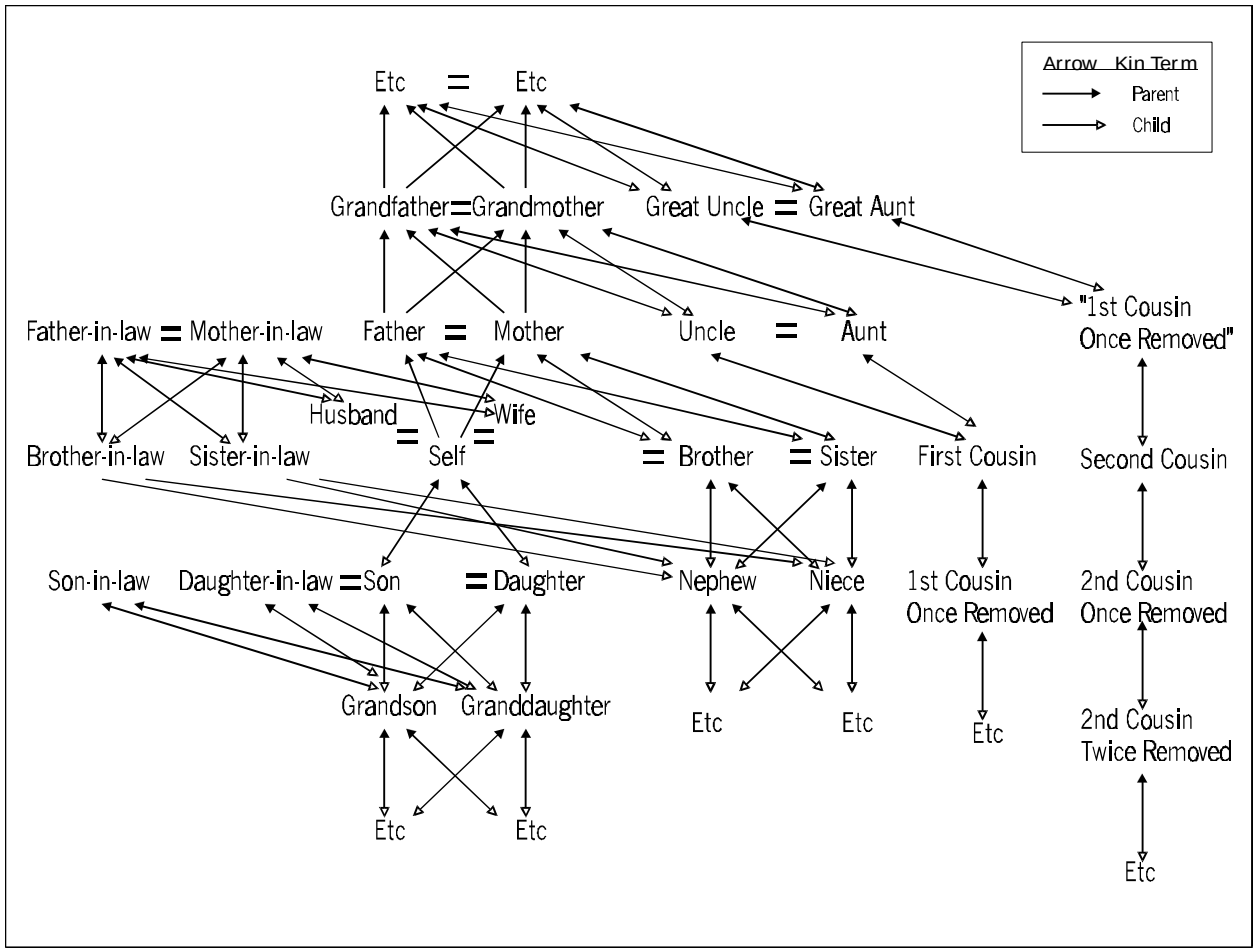

Figure 3: Kin term map for the American Kinship Terminology. Upward arrows represent the result of taking kin term products with the kin term, Parent. Downward arrows represent the result of taking kin term products with the kin term, Child. The "=" sign represents the result of taking kin term products with the kin term, Spouse. The nodes labeled with Etc. indicate that the map continues using the same pattern as displayed in the immediately preceding nodes.

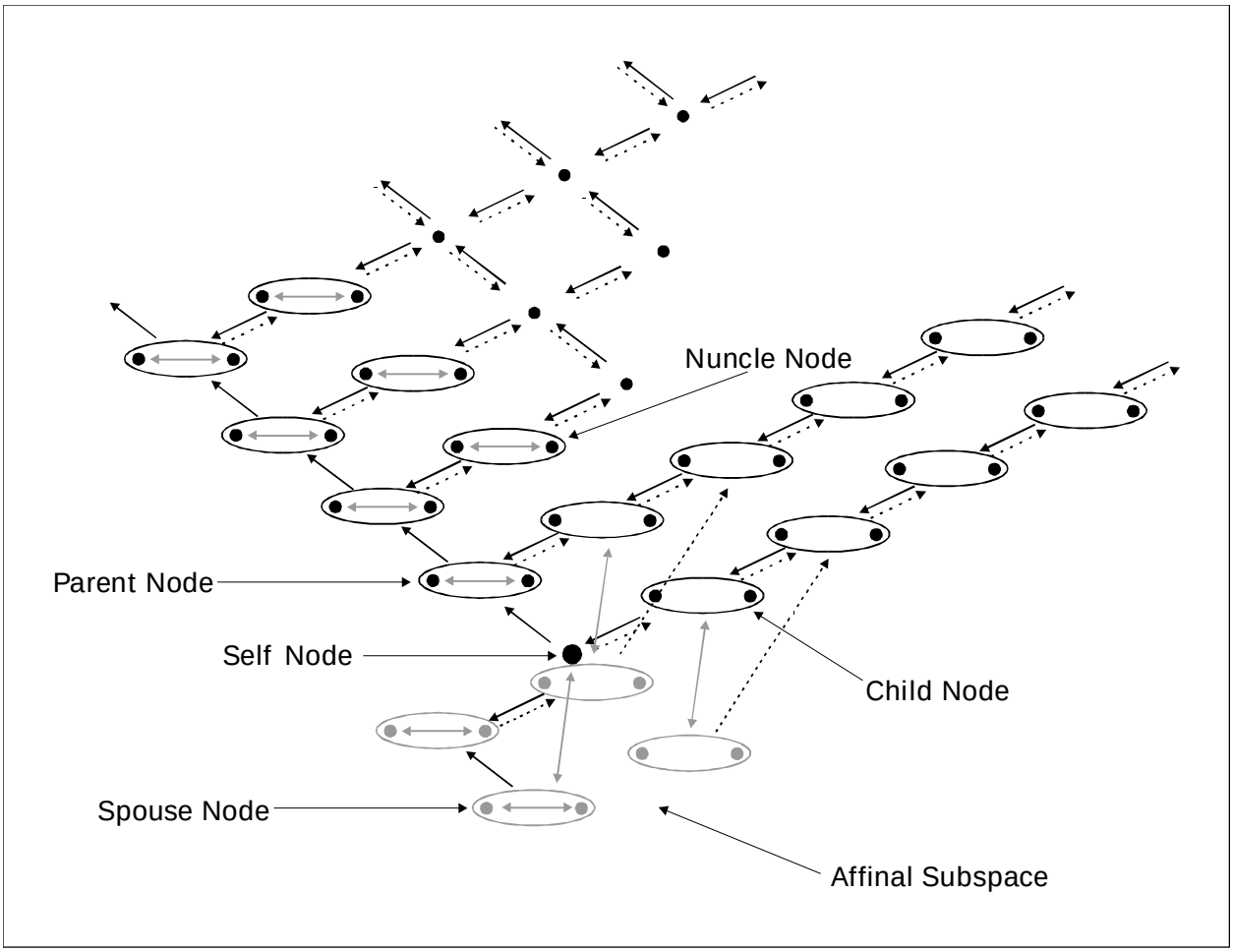

Figure 4: Graph of the algebraic structure isomorphic to the kin term map for the AKT. The nodes for the generating symbols, Self, Parent, Child and Spouse are indicated with arrows. The latter three nodes are bifurcated into two nodes due to the rule for sex marking of symbols. The gray nodes in the bottom part of the graph form the affinal subspace and are precisely the nodes marked with an "-in-law" suffix when the algebraic structure is mapped to the kin term map.

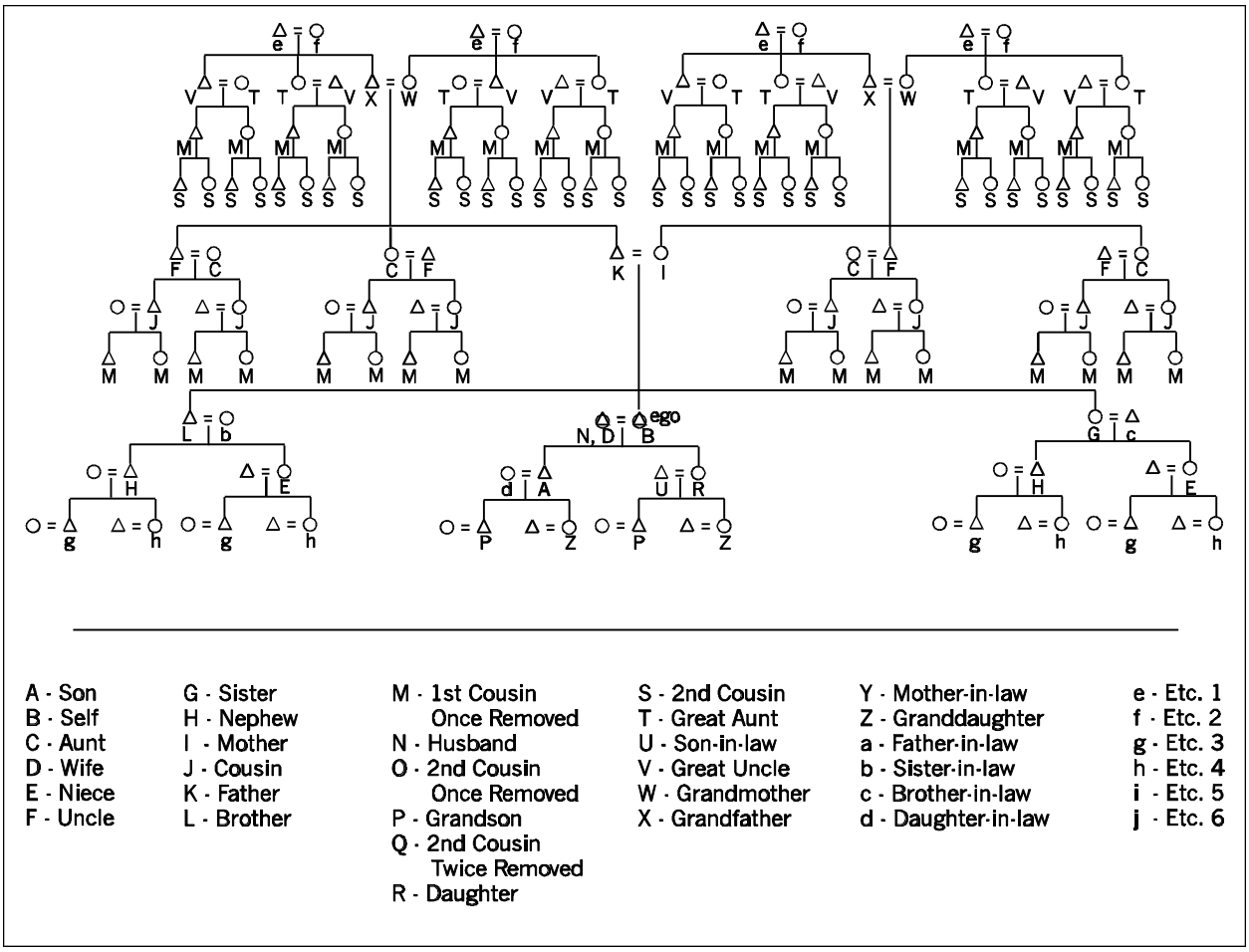

Figure 5: Genealogical diagram for the AKT as predicted from the algebraic structure shown in Figure 4 and the mapping from symbols to kin types defined by Self → *{ego}*, Parent → *{m, f}*, Child → *{d, s}* and Spouse → *{w, h}*.

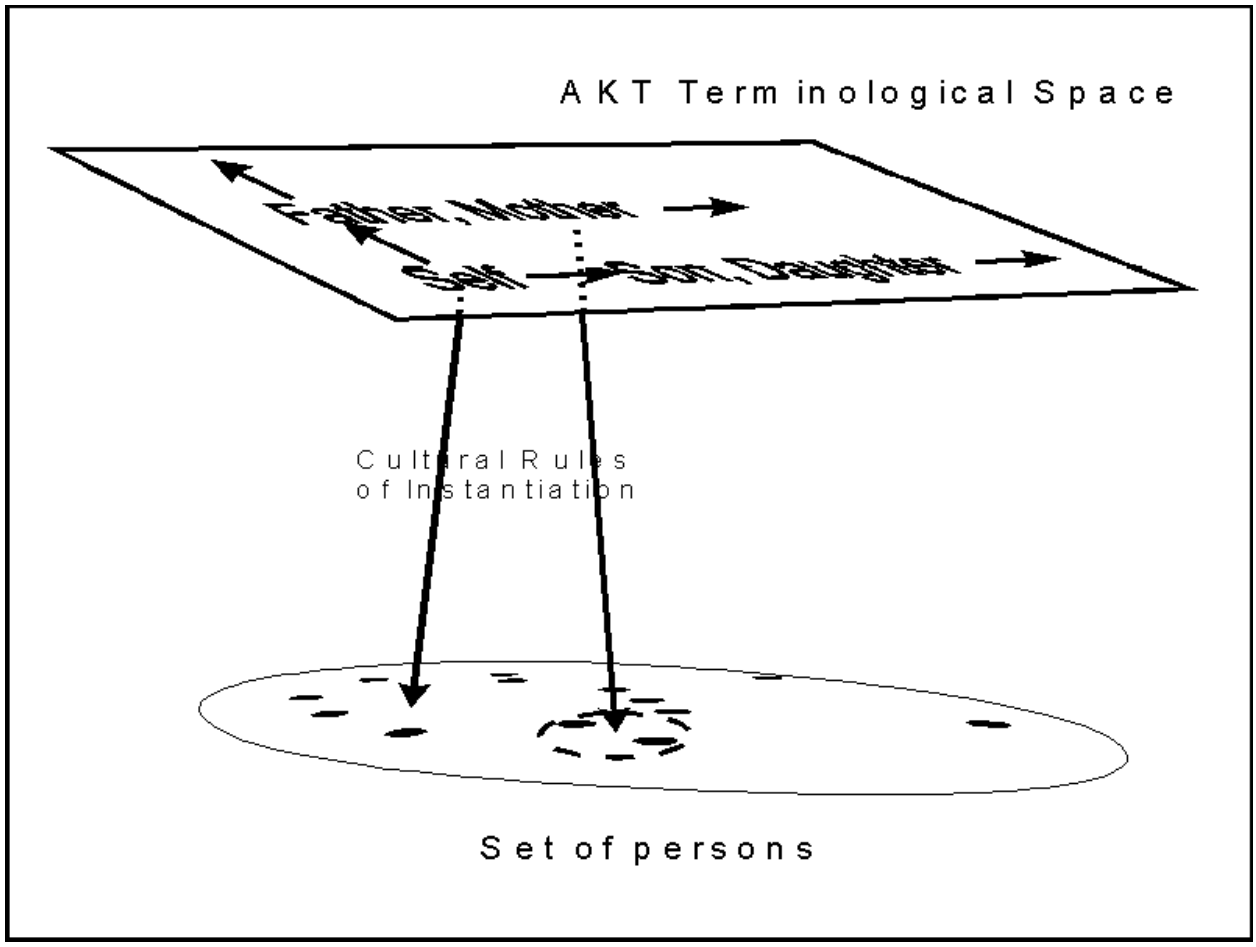

Figure 6: Diagram illustrating the mapping of AKT kin terms viewed as symbols onto a set of persons via cultural rules that specify how the symbols should be instantiated. The left arrow indicates that the kin term, Self, has been mapped to a person (ego), and the pair of symbols, Mother and Father, have been mapped to two persons circled with a dashed line. No *a priori* claim is made as to the genealogical relationship (if any) of the latter two persons to ego; e.g., the two persons might be the two persons ego calls Mother and Father by virtue of adoption.