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PURPOSE AND MATHEMATICS

A PROBLEM IN THE ANALYSIS OF CLASSIFICATORY KINSHIP SYSTEMS

When a science develops the kind of complexity which demands the employment of computers for the solution of its problems a certain amount of stocktaking is apt to take place; ideas are overhauled and old questions looked at anew to see if they are formulated in a manner fit to be fed into the computer. This, very largely, seems to be the object of Professor Levi-Strauss's Huxley Memorial Lecture on "The Future of Kinship Studies" (Levi-Strauss 1965). His own work has, of course, made a major contribution to that development, and in recent years this has been one of the leading influences in these studies. The Huxley Memorial Lecture therefore represents a milestone by which the progress made in the past twenty years can be measured.

Two problems are advanced in this lecture for further consideration: that of presenting kinship data in a form suitable for processing and classification, and the larger problem of the transformation of the "web" of classificatory kinship into the modern type of kinship ties with their statistical distribution. These problems are presented as interconnected, the connecting link, both analytically and historically, being formed by the Crow-Omaha systems; together they present the challenge of a new integration in which recent results of the study of African, Polynesian, Melanesian, Indian and Arab societies must find their place as well.

Such a formidable programme would seem daunting to the most ambitious minds were it not for the step-by-step outline of those aspects of the total problem which bear in themselves the seeds of possible solutions. Levi-Strauss has given answers, in some cases tentative ones, to many questions which have been raised in the intense controversies of recent years. Out of these answers and hints new ways of posing questions arise which will no doubt give fresh impetus to

kinship studies both in the ethnographic field and in the library. Of these I would select as promising of reward the further study of the purpose of the type of kinship system "composed of commutative classes and networks endowed with a periodical structure" (Levi-Strauss 1965:21) and the peculiar qualities they possess which set certain limits to that purpose.

The place of purpose in the genesis of kinship systems has occasioned some heart searchings on two counts: the intricacies of classificatory kinship systems, in particular, have been thought to be beyond the powers of "primitive" people to devise; and, secondly, apprehension has been expressed lest anthropologists be accused of a teleological outlook. Levi-Strauss (1965:14-15) deals with both aspects of the question of purpose; nevertheless, it seems to me that it may not be superfluous to go further into this problem.

Its second aspect is philosophical rather than anthropological or structural; it stems from the desire to treat anthropology as a natural science. Now the objection to teleology in the natural sciences is that it imputes to *inanimate* nature a quality which is specific to the higher animals, particularly man. Since his subject is human society, the anthropologist, it seems to me, should not therefore have to be chary of the accusation. To enquire into the purpose of social institutions should, I feel, require no apology, even if the institutions concerned belong to the earliest or most primitive periods of social development. One might go further and say that the opposite accusation is more to be feared: that where the conventions of human intercourse are concerned it is imperative to enquire into their purpose, and that to neglect to do so could seriously hamper understanding and explanation.

If that be so, the two aspects of the problem reduce themselves to one, namely the question of the purpose for which certain societies devised systems of relations of kinship and affinity and a corresponding terminology so complicated that to this day we experience difficulties in fully understanding their working. To put it in the words of a "simple-minded undergraduate... faced with the complexities of Australian sub-sections and marriage classes... 'Yes, but why do they go to all that trouble?'" (Leach 1962:133).

I. THE MODEL OF CLASSIFICATORY KINSHIP

In the short century since Morgan first drew the attention of ethnographers to the peculiarities of classificatory relationship systems and

initiated the far-flung research which culminated in his "Systems of consanguinity and affinity of the human family" (Morgan 1871) there have been more attempts to answer that question than can be surveyed in one article. His own explanation that these systems were the result of the practice of group marriage, though accepted and partially confirmed by contemporary ethnographers (Fison and Howitt, Spencer and Gillen) was, however, regarded as objectionable by the majority of anthropologists. The most formidable challenge came from Radcliffe-Brown (1941:5) who denounced it as "conjectural history".

There is, however, an aspect of Morgan's theory of classificatory kinship which is independent of any philosophical, moral or sociological interpretations but is purely structural, and which has survived the onslaught of all his critics, albeit somewhat inobtrusively. This is the model by which the ethnographic data on systems of classificatory kinship, marriage and descent are made accessible to our limited understanding. This model derives from the singular property of these systems which distinguishes them sharply from descriptive systems. In Morgan's own words the distinction between the classificatory and the descriptive systems of kinship is that

"Under the first, consanguinei are never described, but are classified into categories, irrespective of their nearness or remoteness in degree to Ego; and the same term of relationship is applied to all the persons in the same category. Thus my own brothers, and the sons of my father's brothers are all alike my brothers; my own sisters and the daughters of my mother's sisters are all alike my sisters... In the second case consanguinei are described either by the primary terms of relationship or a combination of these terms, thus making the relationship of each person specific. Thus we say brother's son, father's brother, and father's brother's son... A small amount of classification was subsequently introduced by the invention of common terms...

"This task was perfectly accomplished by the Roman civilians, whose method has been adopted by the principal European nations, ... under the stimulus of an urgent necessity, namely, the need of a code of descents to regulate the inheritance of property" (Morgan 1877: 403 and 406).

These passages extract from a lengthy argument the bare essentials for the understanding of the model for the Australian systems which are of the first kind and the radical difference between them and the second kind: the latter recognises collaterals as separate and distinct, and the secondary classifications do not alter this; the former makes no distinction whatever between collaterals of any degree, either in real life or in the terminology. The model recognises this by not making separate provision for collaterals except where they are of opposite

sex; all terms expressing kinship apply between groups of collaterals, and within each group of collaterals of the same sex there is strictly speaking no relationship necessary and no term for brother required. In fact often brothers address or refer to each other by adjectives meaning "elder" or "younger" respectively without the addition of any noun denoting the "brother". They may be thought of, as it were, as each others' "alter ego".

Whenever the model is given graphic expression the various groups of collaterals are distinguished by a name or symbol, usually a letter of the alphabet, or the name which it bears in the given society, and this name or symbol is understood to be shared by all the collaterals in the particular group; males and females may be distinguished by the addition of the abbreviations m. or f., by the use of capitals and lower case letters respectively, or by the conventional symbols Δ and $\bigcirc$. The groups may be arranged in table form, each horizontal row representing a generation, and the arrangements of the groups in the next row depending on the manner in which the group names are passed on to the children. Further symbols may then be added to indicate certain fundamental relationships, such as that between brothers and sisters (members of a named group but of different sex) or between man and wife (members of one named group to members of another named group of the opposite sex). Finally, one of the groups may be singled out as Ego and by the name or symbol of each group may be written the relationship term which links Ego and his (or her) collaterals to the members of these other groups of collaterals.

All this may seem trite and familiar to any reader of the literature on kinship, and so it is; for this model pervades the entire literature. No writer on the subject has been able to escape it, although the form in which it is expressed may vary; the notation may be different, the arrangement of the tables may differ from one author to another, and quite different geometrical constructions may be employed. But up to now no one has offered a satisfactory analysis of a single classificatory relationship system in terms of any other model, although it has not been for want of trying. But this is, after all only as natural as to expect a stone to drop down, not up; when a kinship terminology does not distinguish between collaterals one cannot expect to distinguish between collaterals, even collateral wives and husbands, by means of such a terminology.

While the contemplation of this most elementary property of the model for classificatory kinship suggests that Radcliffe-Brown's re-

jection of Morgan was too sweeping, it does not dispose of his argument against the concept of group marriage. But the further consideration of the implications of the model may tend to deprive his argument of more of its sting.

In the first place, the model makes no stipulation about the permanent living together of the collateral husbands and wives; indeed, they need not live together at all and their contacts may be entirely casual, as is indicated by many of the traditions of Central Australian tribes (for examples see Spencer and Gillen 1899 and 1904). Group "marriage" may therefore not be the best expression to convey the meaning implied by the model, and in any case it does not preclude the living together of members of the groups in individual families.

In the second place, and this has a closer bearing on the problem of purpose, the model makes no stipulation either concerning the number of collaterals comprised in each group. Provided the members of the society are not too unevenly distributed over the groups, it does not make any difference to the working of the model whether each group consists of a dozen people or of one Adam and one Eve. Now classificatory systems of relationship seem to flourish most in the island regions of the world and in remote and isolated mountain areas. Such areas seem unlikely to have been colonised initially by large numbers; the ancestors of the Australians, for instance, most probably arrived on their continent as castaways some 15,000 years ago in presumably very small numbers (Hart and Pilling 1964: 1-5); Berndt and Berndt 1964: 4-7).

In the course of the millennia they increased to only about 300,000 on the eve of the European colonisation, which implies a rate of growth of only 2 per cent per generation if the original castaways were a single couple, and an even slower rate if there had been more of them (the average rate of growth of the world population today is nearly 2 per cent *per annum*). At the faster rate it would have taken the original couple some thirty-five generations to double their numbers; therefore, even given considerable fluctuations in the rate of growth, for many generations it would have been a rare experience for a man to have a brother or more than one sister whom their parents could rear to maturity.

Under such circumstances the most pressing problem for the little community, after that of finding something to eat, would have been to ensure even *one* mate for every member, so that it might survive, its aged be cared for and emotional upsets avoided. If they were the

ancestors who are credited with having made the first arrangements for "group" marriage, they must have been possessed by an extreme sense of primness and propriety. They may, of course, simply have followed a precedent that was already well established in their old home by a similar chain of events.

These considerations are offered here not as another piece of "conjectural history" (even though the conjectural element is really quite small) but in order to draw attention to analytical possibilities of a kind which has been largely shut out from view in much of recent work on classificatory kinship systems. It has become customary to begin the examination of social systems, in so far as they are influenced by considerations of kin to any decisive degree, from the kinship relations valid for the members of that society and from them to deduce the categories of persons who exercise certain roles in the society, including the roles of husbands and wives, fathers and children, mother's brothers and sister's sons. This procedure was initiated by Radcliffe-Brown and its fullest validation is to be found in his 1941 Presidential Address to the Royal Anthropological Institute.

His starting point was the extension theory whereby classificatory relationships originate in the individual family as a means to instruct the child in his social obligations, the terms being gradually extended to apply to more and more distant relatives. This theory has recently been criticised by several authors (including Goody 1959, I; Needham 1962a: 259; Maybury-Lewis 1965: 212). Lounsbury (1964), however, has attempted to reinstate it, and he has been supported by Buchler (1964). Levi-Strauss, too, accepts at least certain aspects of the theory (e.g.: "the primary function of a kinship systems is to define categories from which to set up a certain type of marriage regulation" 1965: 14).

S. A. Tyler, on the other hand, in an article in which he criticises Buchler's argument for its lack of substantiating evidence (1966: 513), has pointed out that, contrary to Lounsbury's assertions, the evidence suggests the *irrelevance* of genealogical reckoning (514).

The alternative approach here suggested takes full account of the absence of genealogical distinctions by *starting from the categories* which are defined as *groups of collaterals* whose matrimonial arrangements have as an *unintended outcome* the establishment of relationships between the groups, which, under these circumstances, can only be classificatory. This is not to deny that children have to be educated in their social obligations; but the question of purpose would seem to me to belong properly to the sphere of the alternative approach.

This alternative, as I hope to show, has certain advantages when it comes to answering the specific questions raised in Levi-Strauss's Lecture. It certainly takes the mystery out of the question of purpose, for it does not postulate that an intricate and finely balanced system of kinship relations was deliberately instituted by people in a situation where they, one might think, had more pressing problems on their hands. It suggests instead that the purpose was to find a direct and simple answer to a commonplace problem of urgency for a small number of men and women in an isolated position: who shall marry whom?

That problem is one which could have faced any group of men and women cast away on a desert island or finding a refuge from adversity in a wilderness; it may one day face the first men in the moon. Their decision will affect the future of their children, and what that effect may be will perhaps depend as much, if not more, on the rate of growth of the isolated population as on its original size. But the decision itself was not "all that trouble": it demanded no superhuman foresight, but only a measure of common sense and a recognition of the importance of naming for the purpose of the identification of the persons thus united in marriage. And if the rate of growth was slow, many generations would pass before any question of extending the terms or the relationships even arose.

Concerning the first Australians, although at one time it was fashionable to regard "savages" as devoid of commonsense and ruled by superstition and belief in magic, we are now perhaps more ready to admit that the very fact of their survival without outside aid in a continent which had little sustenance to offer, a feat which no white man has been able to emulate, ought to inspire some respect for their intellectual qualities. No small part in their ability to survive has apparently been played by the minute survey of the resources of the continent made by the "totemic" ancestors; the ingenious methods they adopted for classifying nature and preserving the knowledge so gained for the benefit of future generations suggest that they were fully aware of the importance of *naming* for scientific identification. The classification of the members of society themselves into named units for matrimonial purposes would seem to be a natural part of this wider outlook.

It might be objected that the practice of referring to the legitimate marriage partner by the degree of kinship in which potential spouses stand to each other militates against the assumption that the kinship

system was secondary to the marriage regulation and not the primary factor in the making of the arrangements. For what we are discussing is not a hen-and-egg fallacy but an empirical situation in which we must pay attention to the recorded facts. There is also the further difficulty that in some Australian societies the moieties, sections or sub-sections to which the marriage rules pertain are not named.

For an appraisal of the significance of these objections we need to examine more closely the connection between classificatory kinship systems and the "commutative classes and networks endowed with a periodical structure", that is to say the model described above (p. 5-6).

II. THE PRESENTATION OF THE MODEL IN TWO DIMENSIONS

This examination can be facilitated or obstructed by the method chosen for the presentation of the model, and this requires in the first place some consideration of its geometry. How many dimensions are required for the adequate presentation of a system of N groups of collaterals linked in pairs by marriage, which repeats itself after a period of P generations? Levi-Strauss submits that it requires "a genealogical space" with a number of dimensions which is a function of N and time:

"...an asymmetrical marriage system is tri-dimensional, while a Crow-Omaha system calls on many more dimensions, because on the one hand, the position of any descent line within the system is a complex function of perhaps as many clans or descent lines as the system may include, and on the other, because the system unfolds through time and consequently a time dimension should be added to the spatial ones. For each marriage changes the structural pattern according to which marriages may or may not take place in the following generations" (1965: 18-19).

Levi-Strauss then also defines the nature of the complex function: "...the generalised definition of a Crow-Omaha system may best be formulated by saying that whenever a descent line is picked up to provide a mate, all individuals belonging to that line are excluded from the range of potential mates for the first lineage, during a period covering several generations" (*ibid.*).

Levi-Strauss concedes that an asymmetric system operating among four groups can be represented in a plane, that is a space of only two dimensions (1965: 17), as well as a patrilineal system operating among three groups, although in this case the marriage rule alters from one generation to the other. In fact, it alters exactly according to the generalised definition for the special case of $N \equiv 3$. In this case only one change of marriage rule is possible: since a man A , for example, cannot marry a woman a because of the incest rule, he can marry either b or c , and if in the first generation men of group A have married

women of group b they can only change to marriage in group c and back again in the following generation.

It is not immediately evident why this rule should make for greater difficulties in the general case of $N \geq 3$; and I shall submit that it does not. In the traditional table form of presenting the model the marriage rule is written out for all groups of a particular generation to fill a horizontal row; it imposes no constraint on the row for the next generation to be formed in precisely the same fashion. The marriage rule can vary in any way desirable from one row to the next, and since each row represents a complete generation and these follow each other in time, the time dimension, too, is automatically looked after.

The table form, of course, as Levi-Strauss rightly pointed out in his lecture, is derived from a cylinder cut open along one of its generating straight lines and spread out (developed) into a plane. But this does not signify that the model even for a system with $N \equiv 3$ is three-dimensional, for the model occupies only the surface of the cylinder. Geometrically, therefore, the distinction between a patrilaterally asymmetric system and a Crow-Omaha system of the most general kind is simply in the parameter N . This parameter governs one dimension, time the other; and, Buchler (1964a) notwithstanding, these two dimensions are sufficient to describe a system of any complexity. This finding is in accord with those of Maranda (1964: 519-520) and Coult (1964: 32, whose "genealogical space" has two dimensions).

Real difficulties are nevertheless encountered if one wishes the table to convey at a glance as much as possible of the internal connections and symmetries of a given system, in particular between one generation and another, the repetitive nature of the system, or its kinship structure. Levi-Strauss has made use of a graphic means to achieve this end (1949: ch. XII ff., figs.) which is particularly effective in demonstrating certain features of patrilaterally asymmetric systems for any N ; it consists in linking the symbol for a marriage in one generation with the issue of that marriage in the next by a stroke.

This method can cope with one change of marriage rule by the simple expedient of changing the order of the sexes in alternate rows, which changes the direction of the stroke linking children and parents. But since this can only be done once and back again, it is limited to just these cases, namely where the marriage rule changes only once and then returns to the original, which creates the false impression that it is limited to $N \equiv 3$. But such difficulties are not inherent in the

model, only in a specialised form of its presentation as a table.

They are avoided in a method of arranging the tables first introduced in my paper "A method for analyzing classificatory relationship systems" (Ruhemann 1945). It differs from the traditional by placing not only every group of sons below that of their fathers but also every group of daughters below their "mothers" instead of "daughters-in-law" below "mothers-in-law" (quotes indicate classificatory relationship).

This kind of table will here be referred to as a lines table. Where suitable, use will also be made of a variant arrangement which aligns "daughters" below their "fathers" and "sons" below their "mothers"; the latter will be called ropes tables in analogy to a usage reported for the Mundugumor of New Guinea (Mead 1935: 176-177).

Too much should not be read into these lines (or ropes) since they are purely an analytical device. Needham (1959: 402) has taken exception to the lines on the grounds that they "diagrammatically" create female descent lines in a patrilineal system. (We should then, perhaps, also object to the diagrammatical creation of mother-in-law/daughter-in-law lines in the traditional table form; but see J. P. B. de Josselin de Jong 1952: 32, 45). Needham has both failed to catch my meaning (399) and overlooked the fact that the recognised descent lines of the system are in every case emphasised by the appearance of the same name in every generation of the diagrammatic line, while the non-recognised lines cycle through a number of names in successive generations and are thereby clearly distinguished from the recognised ones.

Now it is precisely this feature of the lines form of the tables which brings into clear view the inherent symmetries of each system. The permutations indicate the characteristic periodicities of the system for any given N and combination of rules of marriage and descent. This means that the lines table for any particular system can be produced in one of two ways: either by applying the rules of marriage and descent to a given arrangement of N groups of collaterals, or by making the appropriate permutations, and the theoretical construction of all possible systems with a given N can be effected by using all the relevant permutations of the letters which stand for the names of the groups. The method is therefore ideal for computer purposes.

It also has a number of other advantages, not the least being that it can accommodate any number of changes in the marriage rule (and even of the rules of descent, if required) while keeping easy track of the descendants or ascendants without the need for cross lines. This feature also makes it possible to trace with ease the meaning of the

classificatory kinship terms in descriptive terms (see Ruhemann 1945: 533-535) which in turn facilitates the sorting out of the terminological equations which are diagnostic for any particular system from those which are merely classificatory in the general sense, i.e. specify collaterals.

One particular advantage which none of the traditional methods have is that the lines (and ropes) method makes visible the classificatory relationships other than the marriage and sibling relationships, which increase in number with increasing N . Room is automatically made for them as periodically the siblings and spouses are not found side by side in the table. True, not all the relationships characteristic for the system are made visible simultaneously in every generation; but each appears at least once within the period P of the system. This disadvantage is, however, slight, since one only has to look up another generation to discover any that are missing from one particular one; in addition, the periodicities in the signs indicating the relationships further strengthen the visual impact of the structural features of the different systems.

These points will be most easily appreciated on specific examples.

III. SYSTEMS WITH TWO OR THREE GROUPS OF COLLATERALS: "MATRI"- AND "PATRI"-LATERALITY

The nomenclature used in the accompanying tables differs in some respects from that employed in my earlier papers (Ruhemann 1945 & 1948); it has been devised for greater ease and speed in typing the tables. It makes manual operation of the systems a little less formidable; nevertheless, competition with the computer is not the aim, but rather selective presentation of certain systems which illustrate particular problems.

In figure 1 several presentations of these systems are combined so that their various merits and faults can be compared. The graphic or geometrical method uses a series of concentric circles instead of a cylinder; each circle represents a generation, the groups being marked at regular intervals by letters in alphabetical order in the counter-clockwise direction. The letters are given indices to mark the number of the successive generation, hence the radii carry the time dimension. The arrows on the circles indicate the direction of the group into which the men of any given group marry.

FIG. 1.

Variants of this method have been used by Lane (1961: Fig. 2) and Coult and Hammel (1963); in the more general form of fig. 1, where the time dimension is laid off on the outward progressing radii, it is the most comprehensive method of any yet devised, capable of illustrating all the structural features of classificatory kinship systems in a single picture. It can, moreover, serve to illustrate complex questions of population growth, post-marital residence, segmentation, and so forth.

in an almost perfectly realistic manner. Its limitations are purely technical, as large-scale drawings are required to exploit its potentialities fully. Its circles can, of course, be cut open just like those of the cylinder and straightened out to yield the horizontal rows of the table form.

For the latter capital and lower case letters are used to distinguish the sexes and the generation indices are omitted as not absolutely necessary. The signs (=) and (—) are used to indicate the marriage and sibling relationship respectively. (This necessitates the use of the symbol $\equiv$ to indicate equality, if confusion is to be avoided). The linearity of the systems represented depends on whether the capitals are used to signify the male or the female sex; if, as is usual, the former, all the systems here are matrilinear. But that they can be read in the opposite linearity shows that the structures are independent of the linearity, as Levi-Strauss (1949: 334) and Needham (1962: 19-20) have maintained.

The first table form presented is the traditional one, preferred by most anthropologists since Radcliffe-Brown, including Needham. It will be seen that it consists largely in tautological repetition of the marriage rule; for that reason it is particularly suitable for the kind of system which Needham has called "prescriptive alliance" (1960: 274). It has the merit of stressing the cyclical nature which is common to the latter and to the systems here considered; but it does not provide a clue to the periodicities and structural features of systems of "commutative classes and networks endowed with a periodical structure". It can, however, usefully be retained as an adjunct to other methods at least as a convenient means of reference to the marriage rule, particularly in cases where these rules change from generation to generation as in the generalised Crow-Omaha systems.

Levi-Strauss' method is a good deal more graphic by lending emphasis to the sibling link alongside the marriage relation and gives some inkling of the structural properties by connecting the siblings with the parents, thus rendering unnecessary a separate table of descents. The cyclical nature of the tables is indicated by the repetition of the marriage relationship sign at the left and right hand. It is particularly suited to demonstrate the distinction between the "patri"- and the "matri"-lateral systems, or at least an aspect of this distinction. But it is still a little difficult for the reader to see immediately the structural implications of different systems, and if one looks through the tables in *Les structures élémentaires* one is struck by their mono-

tonous appearance, relieved largely by the use of different shapes for the strokes between the generations.

The reason is that like the traditional method it lays stress on the links in the horizontal rows to the extent of not allowing these to be severed even analytically for a single generation. This can only be done at the expense of the inter-generational links which become confused as soon as more changes of marriage rule are admitted when N exceeds three.

This limitation disappears when instead of the horizontal links the vertical connections are kept intact, as in the lines and ropes tables. In these the individual groups of collaterals, male and female, can move about the tables independently, and thereby the table as a whole demonstrates a wide range of structural features of the given system. (Incidentally, this is quite a realistic aspect of the model, at least as far as the first Australians are concerned; for in their traditions, which ascribe the introduction of their matrimonial systems to their distant ancestors, these ancestors are also frequently depicted as roaming the country in groups consisting either of men or women, and only rarely both).

This suggests that it could be useful to regard as the truly irreducible units of the structure, its "atoms", the groups of collaterals of one sex denoted by one symbol, rather than the complex "structures élémentaires" in the sense in which Levi-Strauss used this term in his article "L'Analyse structurale en linguistique et en anthropologie" (1945, transl. 1963). The latter might be more appropriately labelled "molecules", consisting of a number of atoms and the bonds which link them, which reveal certain elementary features of the structure they produce by regular repetition.

Analogies of this kind are useful provided they are not carried beyond their immediate purpose, in this instance the elucidation of structural regularities. If this is borne in mind we can indeed liken the classificatory kinship structures with the arrangements of atoms and molecules in the planes of a crystal. We may then also find that there is not necessarily one universal element that can usefully be isolated in every structure, but that the "molecules" may vary from one structure to another.

Fig. 1 illustrates this at the same time as it shows how necessary it can be for the full understanding of a structure to view it from more than one angle, that is to examine it with more than one method. In the recent discussions on the question of "patrilateral" systems use has

been consistently made of the lines method (Needham 1958: 207; fig. 2; 1960: 280, fig. 1c; 1962: 15, fig. 2; Salisbury 1964: 169, fig. 1; Kay 1965: 39, fig. 6; Maybury-Lewis 1965: 215, fig. 3) to represent hypothetical systems with "patrilateral cross-cousin marriage"; yet no firm conclusion has been arrived at even concerning the structural peculiarities of such a system that could find general acceptance.

Perhaps it is unfortunate that the choice for the application of this method should have fallen on a system which it cannot by itself fully elucidate, as fig. 1 shows. For it conceals the "molecule" of this structure, the configuration which contains the "unmarriageable cross-cousin", the Mother's Brother's Daughter:
$$\begin{array}{cc} b & - & B \\ B & & c \end{array},$$
 for example,

which is only revealed in a ropes table. The latter, in turn, conceals the "unmarriageable cross-cousin" relationship characteristic for the

"matrilateral system", the Father's Sister's Daughter:
$$\begin{array}{cc} b & - & B \\ b & & C \end{array},$$
 which

only shows up in a lines table. In a lines table the "patrilateral" system looks like a mere numerical extension of the moiety system, while in a ropes table this is the case for the "matrilateral" system. Only the examination of both forms of the tables for these systems discloses the fact that they are indeed complementary, *complex* mirror images, so to speak, of each other.

I must here stress again that I am only speaking of systems in which groups of collaterals are able to act independently, and not as parts of corporate descent lines. Even the recognised lines in such systems are not necessarily corporate bodies in whatever sense one may wish to use the term; the purpose of allotting the name of one of the parents to the children is purely to ensure the continuity of the matrimonial system. It need have no other object, and it is not even necessary to make the allotment of the name in this fashion. For N as low as three there is already the possibility of allotting the children to the third name, which yields systems in which both diagrammatic descent lines cycle through all three names.

Whether this is merely a theoretical possibility not realised in any existing society is by the way; as a theoretical possibility it distinguishes these systems from Needham's systems of "prescriptive alliance" which are formed by corporate descent lines. The latter can be viewed as a specialised development of the particular case of the former with direct descent of the name of one parent to the children (see Ruhemann 1948: 190-192); in that case both will find a natural place in the

general scheme of things envisaged in broad outline in Levi-Strauss' lecture (1965). I shall return to a discussion of this possibility below.

I have refrained from introducing a symbol to represent the "unmarriageable" cross-cousin; even in the minimal case of $N \equiv 3$ they have, of course, opposite specifications in descriptive terms for the two asymmetrical systems, and the gap highlights their structural difference. If I am not entirely happy with the designations "matri"- and "patri"-lateral, it is not for the reasons which Needham has sought to adduce (S & S 1962:107-111) but because the corresponding specifications bear this descriptions only for the male partner. Whenever a man has married his Father's Sister's Daughter, his wife has married her mother's brother's son, and vice versa in the "matrilateral" case. These designations, therefore, seem to me arbitrary, particularly if one lays stress on the fact that the linearity of a system has no bearing on its "laterality".

There are other ways of referring to the difference in these systems; we might have recourse, for example, to Levi-Strauss' suggestion of using the concept of prohibited degrees (1965:17). We could distinguish the "matrilateral" system as the system in which the marriage rule remains unchanged from generation to generation, i.e. where a man or woman of a given name always marries a man or woman of a particular other name. This would throw into the opposite class all systems where the marriage rule changes, no matter how; this bracket would be a little too wide for comfort, as Levi-Strauss insists, since it would throw together "patrilateral" systems and Crow-Omaha systems of the most general type.

Reference to the geometrical representation of these systems shows the following significant circumstance: In a moiety system ($N \equiv 2$) it makes no difference in which direction of the cycle a man goes to find his wife; for $N \equiv 3$, the "matrilateral" system results if he always goes in the same direction in every generation, and the "patrilateral" system if he moves alternatively anti-clockwise and clockwise around the circle. This definition would be the same whether we picked on the man or the woman to demonstrate it. Now a moiety system is obviously symmetrical, while both Lane (1961) and Needham (1963) have agreed on restricting the use of the word "asymmetrical" to "matrilateral" systems (of whatever kind in other respects); hence I would suggest the term "anti-symmetrical" for the "patrilateral" systems; it will, of course, not apply to systems of "prescriptive alliance".

While not ideal, the term anti-symmetric has the merit of distin-

guishing the systems which prohibit marriage into the group of the Mother's Brother's Daughter and prescribe marriage into the group of the Father's Sister's Daughter (father's sister's son and mother's brother's daughter respectively for the woman) from the more general Crow-Omaha systems with different prohibitions and prescriptions which become possible in addition when N is larger than three.

IV. SYSTEMS WITH FIVE GROUPS OF COLLATERALS

FIG. 2.

Asymmetric
(Matrilateral)Anti-symmetric
(Patrilateral)

Lines

- a - A = b - B = c - C = d - D = e - E =	- a - A = b - B = c - C = d - D = e - E =
- a - B = b - C = c - D = d - E = e - A =	- a - B = b - C = c - D = d - E = e - A =
- a - C = b - D = c - E = d - A = e - B =	- a - A = b - B = c - C = d - D = e - E =
- a - D = b - E = c - A = d - B = e - C =	
- a - E = b - A = c - B = d - C = e - D =	
- a - A = b - B = c - C = d - D = e - E =	

Ropes

- a - A = b - B = c - C = d - D = e - E =	- a - A = b - B = c - C = d - D = e - E =
- A = b - B = c - C = d - D = e - E = a -	- A = b - B = c - C = d - D = e - E = a -
- b - B = c - C = d - D = e - E = a - A =	- b - B = c - C = d - D = e - E = a - A =
- B = c - C = d - D = e - E = a - A = b -	- B = c - C = d - D = e - E = a - A = b -
- c - C = d - D = e - E = a - A = b - B =	- c - C = d - D = e - E = a - A = b - B =
- C = d - D = e - E = a - A = b - B = c -	- C = d - D = e - E = a - A = b - B = c -
- d - D = e - E = a - A = b - B = c - C =	- d - D = e - E = a - A = b - B = c - C =
- D = e - E = a - A = b - B = c - C = d -	- D = e - E = a - A = b - B = c - C = d -
- e - E = a - A = b - B = c - C = d - D =	- e - E = a - A = b - B = c - C = d - D =
- E = a - A = b - B = c - C = d - D = e -	- E = a - A = b - B = c - C = d - D = e -
- a - A = b - B = c - C = d - D = e - E =	- a - A = b - B = c - C = d - D = e - E =

Fig. 2 shows that the asymmetrical and anti-symmetrical systems are generated in the case of $N \equiv 5$ by the same processes as before; the first by going always in the same direction to marry (which might

perhaps be taken for granted), the second by moving in the clockwise and anti-clockwise direction in alternate generations. The first implies, of course, marriage into the group of the Mother's Brother's Daughter (father's sister's son); the second marriage into the group of the Father's Sister's Daughters (mother's brother's son).

They also show the same structural differences in the lines and ropes tables, the only difference being that the structural "molecule" is lengthened in the vertical direction because the system cycles through all five groups before marriage is again contracted between the direct descendent groups in the male and female line of a sibling group in the asymmetrical system, in the two combined half-ropes in the anti-symmetrical system. Only if one looks at the ropes table in the asymmetrical and at the lines table in the anti-symmetrical case is it obvious that this does not preclude marriage with very close relatives of the opposite specification.

Clearly, such systems can be constructed in the same way for any number N of groups of collaterals, the length of the structural element (molecule) in every case being the same as N , and hence also the period elapsing between the repeated appearance of the symbol (=). The true period of the system as a whole is, however, always $2N$, as is apparent from the ropes table. That is to say, the symmetry character of the system is established only in the second generation, when it becomes clear whether the marriage rule is to be changed or not. But no matter how many groups are involved, marriage always remains with such a close relative as either the "Mother's Brother's Daughter" or the "Father's Sister's Daughter". (Quotation marks are used to indicate that the relationship is to be taken in the classificatory sense).

We go to the opposite extreme in Fig. 2a which represents a generalised Crow-Omaha system in accordance with Levi-Strauss' definition for $N \equiv 5$. Its construction is no more difficult than that of fig. 2; to the first row we apply successively the four possible marriage rules I - IV (there are always $N-1$ possible rules because of the incest prohibition) to obtain the lines table of periodicity four. Geometrically this means that we do not only go round the circle but also in the diagonal directions, always skipping the groups which have provided marriage partners 1, 2, 3 and 4 generations back. I omit the ropes table; it has, of course, a periodicity of $4 \times 5 \equiv 20$, and it displays an intriguing pattern of secondary periodicities of seven and three, but does not otherwise supply any relevant information that cannot be read off the lines table.

FIG. 2a.

Generalised Crow-Omaha System with $N \equiv 5$

Marriage Rules:

- I: $A = b, B = c, C = d, D = e, E = a$
 II: $A = c, B = d, C = e, D = a, E = b$
 III: $A = d, B = e, C = a, D = b, E = c$
 IV: $A = e, B = a, C = b, D = c, E = d$

Lines Table:

- (I) = $a - A = b - B = c - C = d - D = e - E =$
 (II) = $a' - B' - b' - C' - c' - D' - d' - E' - e' - A' -$
 (III) = $a - D = b - E = c - A = d - B = e - C =$
 (IV) = $a' - B' - b' = C' - c' = D' - d' = E' - e' = A' -$
 (I) = $a - A = b - B = c - C = d - D = e - E =$

From the geometrical figure, the marriage rule table and the lines table we can see that this system is perfectly capable of working "on the ground", with the same certainty with which a designer can tell from the blueprint whether his aircraft will fly. But it is nevertheless a curious system and differs radically from the known classificatory systems as we discover when we try to formulate the marriage rule in kinship terms. For this rule cannot be formulated in the same way for all generations.

Members of generations (2) and (4), etc. (indicated by dashes) marry a very distant relative, who can be described most readily as the "Father's Father's Father's Sister's Daughter's Daughter's Daughter", but also as "Father's Mother's Brother's Daughter's Daughter". But if it had been the intension to marry the most distant relative possible, as one might think from the care with which the groups of previous mates of the same group are avoided, then that intention is thwarted in the next generation, the members of which all marry their "Father's Sister's Daughters".

It is hard to see how such a result could have been intended; but then, there is perhaps no such system to be found in reality. As a theoretical possibility, however, it tends, I think, to strengthen the supposition that the notion of prescribed (or of prohibited) degrees did not enter into the original purpose which brought any such systems about but was the unintended outcome of the matrimonial arrangements between groups of collaterals. It would, of course, in practice soon be noticed as a convenient shorthand, so to speak, to express the marriage rule in a form applicable to everybody alike without having to recite the whole catalogue of groups and their marriage relationships. This is, of course, the almost universal practice among the societies with such systems, and the observation of this widespread way of expressing the marriage rule seems to be responsible for the idea that it was its original purpose.

Between the two extremes of figs. 2 and 2a there lies a number of systems which can be produced by different combinations by two's and three's of the marriage rules. It would be tedious to reproduce them all in table form here; suffice it to note that combinations of two marriage rules one of which follows the circle and the other the diagonals produce systems in which the marriage rule can be formulated as marriage with the "Father's Mother's Brother's Son's Daughter", and that whenever clockwise and anti-clockwise combinations occur, there also occurs at least one generation with "Father's Sister's Daugh-

ter's" marriage. With one exception, these systems, however, exhibit another anomaly: the specifications for one and the same group of relatives traced through different paths in the table are not the same for all groups, as they should be in a normal type of system. They differ not only from one system to another (even when the marriage rule is the same), but from one generation to another within the same system.

The exception is sufficiently interesting to warrant a closer look. It is the system produced by the application of marriage rules (II) and (III), i.e. where we follow the diagonals alternately in the clockwise and anti-clockwise direction. This produces, as one might expect, an anti-symmetrical system; superficially, however, it looks different from that of fig. 2. Its lines table is as follows:

(II)	a — A	b — B	c — C	d — D	e — E
(III)	a = C	b = D	c = E	d = A	e = B
(II)	a — A	b — B	c — C	d — D	e — E

It brings out a characteristic feature of anti-symmetrical systems which Levi-Strauss has often stressed: namely, that they are composed of short cycles which span the generations. I cannot follow his argument against Maybury-Lewis (1965), however, in which he claims that these short cycles constitute "the one and only pertinent feature" of these systems (1965: 17). The occurrence of each name in two of the cycles is sufficient indication that long cycles are hidden by this manner of presentation which are not, therefore, mere optical illusions. We may suspect that they can be brought out by the ropes table for the same system.

TABLE 1: *Ropes Table for combination of marriage rules (II) and III)*

(II)	a — A	b — B	c — C	d — D	e — E
(III)	A — c	B — d	C — e	D — a	E — b
(II)	= d	C = e	D = a	E = b	A = c
(III)	— D	e — E	a — A	b — B	c — C
(II)	b = E	c = A	d = B	e = C	a = D
(III)	B — b	C — c	D — d	E — e	A — a
(II)	e — B	a — C	b — D	c — E	d — A
(III)	= E	d = A	e = B	a = C	b = D
(II)	— c	D — d	E — e	A — a	B — b
(III)	C = a	D = b	E = c	A = d	B = e
(II)	a — A	b — B	c — C	d — D	e — E

When this table is compared with the ropes table for the antisymmetrical system of fig. 2, how shall we describe the difference in structure?

The structural elements are of the same length; everybody marries his "Father's Sister's Daughter", and in whatever way we specify this group of relatives in descriptive terms, or any other group of relatives for that matter, they are the same in both tables. True the structural elements are displaced differently with respect to one another, but that does not appear to make any difference to the structure; it is compensated for by the different permutations in the ropes.

Now we can, of course, take the endpoints of the diagonals and arrange them on the circle so that we go through them in the same order as before by proceeding along the circle; all we have done thereby is to re-arrange the order of the groups on the circle. We will get a lines and ropes table exactly corresponding to that of the diagonals by moving anti-clockwise and clockwise along the circle, and the form of the tables will be exactly the same as that of fig. 2 except for the re-naming of the groups: ($= a - A = c - C = e - E = b - B = d - D =$) instead of ($= a - A = b - B = c - C = d - D = e - E =$). In other words, this system has the same long cycles as the antisymmetrical system of fig. 2, and if we take the latter and perform the same operations backwards we will arrive at a lines table with that system's short cycles.

These two systems are structurally identical; they both have short and long cycles, their structural element is of the same length, and they have the same marriage rule expressed in kinship terms. The reason is that they have both been produced in the identical fashion: by operating on their different initial arrangements with the same cycle of marriage rules (II and III in alternation).

We have thus arrived at an important principle which governs classificatory kinship systems: their structures depend solely on the succession in which the rules of marriage are applied to an initial arrangement of groups of collaterals on a circle, and not on that initial arrangement, provided only that it remains the same throughout the period of the operation of the marriage rules concerned.

I have already had occasion to refer to another important principle, first stated by Levi-Strauss (1949), namely that the structure of a classificatory kinship system is independent of its linearity, and to the rule to which the normal classificatory kinship systems are expected to conform, namely that the set of specifications which define a certain group of collaterals in relation to a given other group (the Ego group) in descriptive terms does not depend on the position of the Ego group but is diagnostic for the structure.

These three conditions combined rule out virtually all the systems with $N \equiv 5$ except the asymmetrical and the anti-symmetrical. The only variation not yet considered is the internal permutation of the groups in the marriage rules. The effect of this, however, would be the same as that of changing the arrangement of the groups on the ring in the course of applying the marriage rules, and it can easily be seen that the systems thereby created will be even worse than the others. They will become lopsided, that is anomalous not only in the generations but in the columns as well.

The net result of our investigation of systems of groups of collaterals so far has shown that increasing the Number N from three to five has not increased the number of possible systems by even one; which is very far from what we were led to expect. In addition, only the asymmetrical systems are at all suggested by the ethnographic literature and the anti-symmetrical systems remain hypothetical. In the case of $N \equiv 7$, however, it is possible to examine an actual ethnographic case.

V. THE SEVEN "CLANS" OF THE EASTERN CHEROKEES

The Eastern Cherokees have been studied by Gilbert (1943), and their system of seven "clans" is mentioned by Levi-Strauss (1965:19) as one of the systems of the Crow-Omaha family in the sense of his definition. These "clans" are "primarily the regulating agent of preferential marriage and the most important single manifestation of its structural basis" (245 — all page references in this section are to Gilbert 1943 unless otherwise indicated) and Gilbert emphasises that it is the clan, not the lineage, which performs this "pivotal" function (280, 310). He concludes that "the Cherokees of today are in possession of a system of preferential mating which in its peculiarities and ramifications can be duplicated among described tribes only in Australia", which may be the product "of certain special conditions surrounding the small inbred Cherokee communities during the nineteenth century rather than an inheritance from the pre-Columbian past" (372).

The Eastern Cherokees are the descendants of some 2,000 Cherokees who stayed behind in small local communities when in 1838 the bulk of the tribe was transported to Oklahoma; they were settled on the boundary of North Carolina and Tennessee in a small mountainous tract, where by 1890 they had increased to nearly 3,000. An influx of white people in search of land had reduced the pure Cherokee population

which retained its clan affiliations to less than 1,000 by 1930. Among these, however, solidarity between clan "brothers" is strong, although they are spread among distant villages, while the more local lineages, which are not land-owning, hardly intervene at all between the clan and the individual family. (197-198; 208).

The Cherokee "clan" has, therefore, sufficient similarity with the groups of collaterals of our model to be treated as such. The clan name is transmitted in the female line and the marriage rule is of the general Crow-Omaha type. Two alternative marriages are possible: with a woman of the clan of either the "Father's Father" or the "Mother's Father", and marriage into one's own and one's Father's clan is forbidden. These women are related as "grandmothers" to Ego. It is implicit in these arrangements that "Mother's Brother's Daughter" is also not marriageable; but Gilbert does not comment on this.

It would seem at first glance as if this system had all the ingredients of one impossible to solve: "we may never be able to reach an initial stage from where our simulations could start" (Levi-Strauss 1965: 20). However, since we have now already seen that the structure does not depend on the initial arrangement, we may try and proceed as before with the alphabetical arrangement of seven groups A to G in a row, which shall represent the generation of the parents of the prospective spouses. But since the marriage depends on the clans of the "grand-fathers", we shall introduce a line above for generation (0) in which provisionally only the female lines are marked, about which there is, of course, no doubt. The question marks indicate the positions which will be occupied by the clans of the Mother's Father and the Father's Father. Generation (2) consists of the children of generation (1), the clan name descending in the female line; and the problem we have to solve is: into which group can, e.g., a man of group E (Ego) marry? This obviously is the same question as that of the names of the "grand-father" clans. We have so far:

$$\begin{array}{llllllll}
 (0) & a = & b = & c = & d = ? & e = ? & f = & g = \\
 (1) & = a - A = b - B = c - C = d - D = e - E = f - F = g - G = \\
 (2) & - a & B - b & C - c & D - d & \triangle E - e & F - f & G - g & A -
 \end{array}$$

The three clans into which Ego cannot marry are d, which is the Father's; e, which is the Mother's, and f, which is the Mother's Brother's Daughter's. This leaves four clans: a, b, c or g, who must contain the FaFaSiDaDa, the MoFaSiDaDa, the MoMoBrDaDa and

the MoMoBrSoDa (280). The question is narrowed down to which of these four clans contain which of these four relatives?

Since the two positions to be filled in line (0) are next to each other, the clan names for them must follow each other in alphabetical order; and if both grandparents are to belong to non-prohibited clans only the three possibilities set out in fig. 3 are open: (I) which uses A and B, (II) which uses G and A, and (III) which uses B and C. In the table Ego is marked by Δ , his wife by $\square$, and the groups MoMoBrDaDa and MoMoBrSoDa respectively by * and †. The alternative marriages in each case yield two systems (a) and (b), the former with a period of three generations, where the FaFaFa's clan is the same as Ego's, the latter with a period of four generations, where the FaFaFa's clan is the same as the Mo's Fa's (cf. Gilbert's finding p. 240).

Closer examination of system I shows, however, that it is an impossible one for alternative (a), since generation (0) marries a "MoBrDa"; although she does, of course, belong to the correct clan, the specification "MoBrDa" does not hold for generations (1) and (2). This system therefore violates the third rule (see p. 104 above). In addition, both the alternative wife groups of Ego's group are identical with the groups of the MoMoBr's Children's Daughters, which amounts to an additional prohibition on the clans g and c not suggested by the ethnography.

We are then left with the two systems II and III as the only ones which offer the children of one and the same family the two alternatives specified by the ethnographer (280). We have, as far as I can see, no direct means of deciding which is the one the Cherokees use; quite possibly they both function side by side. Nor is it possible to say whether there is any regularity in the application of the alternative marriage rules (Gilbert 244-245).

For our purpose it is sufficient to find that the number of possible systems with the required properties is exceedingly small, and that taken by itself each system is perfectly regular, easy to construct, and exhibits all the properties of a finite network with the periodicities and permutations characteristic for classificatory relationship systems of the more elementary kind. If there is any room for a turbulence of probabilistic events this is not due to the complexity of the changes in the marriage rules but to the admission of alternatives, unless these are also applied with regularity.

In short, regularities do not produce chaos, however complex the rules may be which govern them. We may therefore have to consider

FIG. 3.

Ia: $E = FaFaSiDaDa = a$; $MoFaSiDaDa = b$

$$a = E \quad b = F \quad c = G \quad d = A \quad e = B \quad f = C \quad g = D \quad (0)$$

$$-a - A = b - B = c - C = d - D = e - E = f - F = g - G = (1)$$

$$-a^* B - b^+ C - c \quad D - d \quad \triangle E - e \quad F - f \quad G - g \quad A - (2)$$

$$a = E \quad b = F \quad c = G \quad d = A \quad e = B \quad f = C \quad g = D \quad (0)$$

Ib: $E = MoFaSiDaDa = b$; $FaFaSiDaDa = a$

$$a = E \quad b = F \quad c = G \quad d = A \quad e = B \quad f = C \quad g = D \quad (0)$$

$$-a - A = b - B = c - C = d - D = e - E = f - F = g - G = (1)$$

$$-a^* B - b^+ C - c \quad D - d \quad \triangle E - e \quad F - f \quad G - g \quad A - (2)$$

$$a \quad F \quad b \quad G \quad c \quad A \quad d \quad B \quad e \quad C \quad f \quad D \quad g \quad E \quad (3)$$

$$a = E \quad b = F \quad c = G \quad d = A \quad e = B \quad f = C \quad g = D \quad (0)$$

IIa: $E = FaFaSiDaDa = g$; $MoFaSiDaDa = a$

$$a = D \quad b = E \quad c = F \quad d = G \quad e = A \quad f = B \quad g = C \quad (0)$$

$$-a - A = b - B = c - C = d - D = e - E = f - F = g - G = (1)$$

$$-a \quad B - b^* C - c^+ D - d \quad \triangle E - e \quad F - f \quad G - g \quad A - (2)$$

$$a = D \quad b = E \quad c = F \quad d = G \quad e = A \quad f = B \quad g = C \quad (0)$$

IIb: $E = MoFaSiDaDa = a$; $FaFaSiDaDa = g$

$$a = D \quad b = E \quad c = F \quad d = G \quad e = A \quad f = B \quad g = C \quad (0)$$

$$-a - A = b - B = c - C = d - D = e - E = f - F = g - G = (1)$$

$$-a \quad B - b^* C - c^+ D - d \quad \triangle E - e \quad F - f \quad G - g \quad A - (2)$$

$$a \quad E \quad b \quad F \quad c \quad G \quad d \quad A \quad e \quad B \quad f \quad C \quad g \quad D \quad (3)$$

$$a = D \quad b = E \quad c = F \quad d = G \quad e = A \quad f = B \quad g = C \quad (0)$$

IIIa: $E = FaFaSiDaDa = b$; $MoFaSiDaDa = c$

$$a = F \quad b = G \quad c = A \quad d = B \quad e = C \quad f = D \quad g = E \quad (0)$$

$$-a - A = b - B = c - C = d - D = e - E = f - F = g - G = (1)$$

$$-a^+ B - b \quad C - c \quad D - d \quad \triangle E - e \quad F - f \quad G - g^* A - (2)$$

$$a = F \quad b = G \quad c = A \quad d = B \quad e = C \quad f = D \quad g = E \quad (0)$$

IIIb: $E = MoFaSiDaDa = c$; $FaFaSiDaDa = b$

$$a = F \quad b = G \quad c = A \quad d = B \quad e = C \quad f = D \quad g = E \quad (0)$$

$$-a - A = b - B = c - C = d - D = e - E = f - F = g - G = (1)$$

$$-a^+ B - b \quad C - c \quad D - d \quad \triangle E - e \quad F - f \quad G - g^* A - (2)$$

$$a \quad G \quad b \quad A \quad c \quad B \quad d \quad C \quad e \quad D \quad f \quad E \quad g \quad F \quad (3)$$

$$a = F \quad b = G \quad c = A \quad d = B \quad e = C \quad f = D \quad g = E \quad (0)$$

alternative ways of answering the question raised by Levi-Strauss if we wish to find our way towards the realisation of a comprehensive theory of kinship valid for all times and for all societies. I would submit that the boundary lines between the "elementary" and the "complex" systems should be drawn differently; that it is not the Crow-Omaha systems pure and simple which form the divide, but a phenomenon which accompanies them but is not expressed in Levi-Strauss's definition of them: the possibility of members of the same family concluding alternative marriages, not necessarily in a regular pattern.

This possibility already exists in the much more elementary systems of certain Australian tribes, the Murngin, for example; hence it is not tied to the Crow-Omaha systems alone but operates at a different level.

VI. CLASSIFICATORY AND GENEALOGICAL KINSHIP: A BASIC DISTINCTION

Gilberts stresses how the smallest irregularity disrupts the orderly functioning of the normal system of the Cherokees (241, 278). Their clans exchange men (not women) and a delicate balance has to be struck each time a marriage is concluded (278-280). "In the normal family of four or five brothers and sisters, some half will marry into the father's father's clan and the other half into the mother's father's clan. Thus the balance is preserved", he writes (280).

This may be so numerically, but it also means that an element of differentiation is thereby introduced not only into the clan but into every individual family and this differentiation would grow from generation to generation. Brothers (and sisters as well) would have to observe different kinship patterns of behaviour depending on the marriages of parents and grandparents. This difficulty could be met either by a regular pattern of alternations of the two forms of marriage (which is not reported), or by a complete reorganisation of the kinship nomenclature compared with the classical model, which is what has happened in the Cherokee case, as Table 2 shows.

Gilbert's list (224-227) contains both consanguine and affinal terms of which the first have specifications conforming apparently to the classical type of Australian model while the second apply to both men and women of a married couple which is contrary to classification by clan. Only the former are entered in Table 2, and they also show a

TABLE 2: *Cherokee classificatory relationship terms ordered according to normal usage*

a = F	b = G	c = A	d = B	e = C	f = D	g = E			
				DuDu					
= a — A	= b — B	= c — C	= d — D	= e — E	= f — F	= g — G =			
		DuDiya	Loki	Dada	Dzi	Dudji lu i	Nili/ Nutsi	Etsi etsi	Etsi etsi
— a	B — b	C — c	D — d	E	— e	F — f	G — g	A —	
Dzi			Dada	Loki	Nili/ Nutsi da	Da lu i	DuDiya		
a = F	b = G	c = A	d = B	e = C	f = D	g = E			
lu i	Etsi etsi	Nili/ Nutsi	Loki	Etsi etsi	Atu etsi	DaDa	Ina etsi		

TABLE 2a: *Cherokee classificatory relationship terms ordered according to relatives' own clans*

— a	B	— b	C	— c	A	—
Dzi (Mo) lu i (famobrda)	Etsi (MoMoBrSo) DuDiya (FaSiHu)	Etsi (MoMoBrDa)	DuDu (MoFaSiSo) DaDa (Fa)	Loki (FaSi)	Dudji (MoBr) Nili/Nutsi (e/y FaMoBrSo)	
a	= C	b	= A	c	= B	
Dzi (FaSiSoWi) Da (Si) lu i (si)	DaDa (FaSiSo)		Nili (Elder) Nutsi (younger) da (br)	Loki (FaSiDa)	DuDiya (Hu of Loki)	
= a	— A	= b	— B	= c	— C	=
Atu (SiSo) lu i (fasosida)	Ina (SiDa) Nili/Nutsi (e/y FaSiSoSo)	Etsi (Da) etsi (brda)	Etsi (So) etsi (brso)	Loki (FaSiDaDa)	DaDa (FaSiDaSo)	

(To save space and bring out the salient features prefixes have been omitted from the Cherokee terms, after Gilbert p. 221. The specifications in descriptive terms are the same for both tables; they are given in brackets in table 2a. Capital initials denote terms used by men or by men and women, lower case initials terms used by women only. Note absence of specification for MoBrDa).

remarkable deviation from the usual classification: relatives are classified not by their own clan but by their father's clan, or as husbands and wives of Ego's matriclan. So Dzi ("Mo") can belong to e or a, provided she is a wife of D; Dudiya can be C or G, provided he is a husband of d. Children of men of Ego's clan are Etsi, whether their own clan is G or B, and all children of men of Ego's father's clan D are Nili or Nutsi depending on relative age. For Ego's "sister" e all the daughters of men D are lu i. The only exception to this classification is Ego's father's clan, where all men are DaDa and all women Loki, irrespective of who their fathers might be.

Since this classification is definitely matrilineal it can hardly be due to the introduction of European-type family names which the law requires to descend in the male line. It clearly reflects the fact that the alternative marriages have made a breach in the identity of clan brothers (and clan sisters) who now have to be classified by the clan from which a particular mother has obtained their father; the matriclan has split into lineages. The primitive cycle is broken and there are many gaps in the relationship table; in particular, the mother's brother's son and daughter are nowhere mentioned as such, and there is no kin term for the wife (except the "hawaiian" term ginisi or "grandmother" which classifies only by generation).

Table 2 gives simple and visual expression to the "skewing rules" of the Crow-Omaha type system of the Cherokees for which Lounsbury (1964) and Buchler (1966) have devised "re-write rules" for a number of different cases on the basis of the genealogical derivation of classificatory kinship systems. These rules are of such complexity and demand room for so many exceptions that they can hardly be said to satisfy Lounsbury's own criterion of "specifying only the absolute minimum of assumptions necessary to account for the data". Nor do they attempt to provide an explanation why such "skewing rules" should be necessary; Table 2 above gives this explanation without any fuss.

The futility of the extension theory can be further illustrated by the errors to which it can give rise (an instructive example is quoted by Buchler himself; see Needham 1960a, Keesing 1964; Needham 1964). If we knew nothing of the clan structure of the Cherokees and had only their kinship terms to go by, we might be tempted to reconstruct the categories of their society from the nomenclature on the assumption that the classification is by a person's own clan. Such a reconstruction is made in Table 2. The result is not exactly unsuccessful, for it does yield a cyclical system; surprisingly, however, it is an asymmetrical

system with $N \equiv 3$, that is to say, a system which prescribes marriage with the "mother's brother's daughter". It has only one conspicuous gap: the wife, who should be that "mother's brother's daughter".

This marriage does, of course, not occur in the Cherokee system which might more accurately be described as a second or third degree antisymmetrical system which prescribes marriage with either the "father's father's sister's daughter's daughter" or the "father's father's father's sister's daughter's daughter's daughter" ($\equiv$ "mother's father's sister's daughter's daughter"). This difference between the reconstructed and the actual system is perhaps even more fundamental than the difference in the number of the clans.

Should we take this to mean that in some distant past, perhaps in the 16th century when the earliest report describes them as subsisting on roots, herbs, berries and game (315), the Cherokees had a simple asymmetrical system like this, and that the loss of the term for wife with the specification MoBrDa is due to the taboo placed on such a marriage when the reorganisation into the seven clans took place? We shall probably never know, because of the lack of continuity in the historical tradition due to the disruptions of tribal life in the past two centuries. By the late 18th century they were settled agriculturists and had heptagonal council houses, presumably to accomodate the representatives of seven clans, as was the case some time later. (316 ff.)

At the time of Gilbert's visit, in 1932, they were again growing fairly rapidly in numbers, to judge by the size of the families and by the youthful age distribution of the 1930 census (198). This is a situation very different from that in which any Australian tribes found themselves, where the dissolving effect of alternative marriages is at best incipient. It also differs from the conditions of African societies with their complex societies of cultivators and cattle breeders, where lineages have not only emerged but segmented rapidly, and where population growth has in many parts been rapid and led to densely settled countries with state organisation.

While detailed historical enquiries into these societies are as yet insufficiently advanced to establish possible historical connections and transitions between different forms of social organisation in individual societies, it should be feasible with our present anthropological knowledge to establish an analytical series of the kind projected in Levi-Strauss's lecture (1965: 21), with cyclical networks at one end and at the other open societies where the normal marriage is with a non-relative, relationships are genealogically differentiated and statistics

takes over from periodicities.

But I would not expect that the feature responsible for a transition, wherever it may be possible to observe it, would be the simple increase in the radius of curvature of the circle A, B, C, . . . , N, A due to increasing N. The "ghost" of such a circle may well survive in a corner of the consciousness or the culture or historical tradition of a people; but it may well be that of a much closer cycle, as in the Cherokee case. But the *regular* marriages appropriate to any such cycle, whatever the size of N, can never destroy the periodicities, break the cycle and produce marriages with non-relatives, and lead to a radical reorganisation of kinship classification, let alone genealogical differentiation.

Crow-Omaha systems may well have a claim to a place in the transition, but it will be on account of a feature stressed by Radcliffe-Brown (1941:7), namely the distinction between lineal and collateral relatives which they make, and which is due to the emergence of lineages caused, in at least one instance as we have seen, by the admission of alternative marriages. The first element of randomness is thereby introduced, and this is what causes the diffuse picture drawn by Levi-Strauss in his lecture. (1965:19-20).

Radcliffe-Brown's extension theory will, however, not be of help in devising such an analytical series; for from one and the same starting point, the individual family, it leads in two diametrically opposite directions: "primitive" and "modern" society, between which there thus yawns an unbridgeable gulf.

Historically, the result of genealogical differentiation is less likely to be its own obliteration in a classification by undifferentiated groups of collaterals than the dissolution of the latter groups and their replacement as units of society by genealogically defined kin groups, lineages or cognatic kindreds, and the associated terminologies. Analytically, the distinction between the classificatory and the genealogical concepts of kinship is of fundamental importance, as Livingstone (1964, 1965) has recently insisted.

It might then be useful to name all the former systems "elementary" and societies with genealogically defined kin groups "complex". A kinship theory based on such a distinction could accommodate all hitherto examined societies without the difficulties encountered when classificatory and genealogical kinship are not kept distinct.

In an expanding agricultural society increasing geographical separation would assist the dissolution of the circles in favour of alliances with strangers who happen to reside in close proximity. When the

cyclical connections have been almost forgotten and marriage is normally with a stranger, statistical laws take over. Only then does it become meaningful to speak of special preferential arrangements such as marriage with the mother's brother's daughter or cross-cousin marriage. But, as Morton Fried has suggested (1957: 22-23), their significance is likely to lie in the realm of landed property rather than kinship.

VII. THE CLASSIFICATION OF ELEMENTARY (CYCLICAL) SYSTEMS

If the criterion introduced by Levi-Strauss in his 1965 Huxley Memorial Lecture thereby loses its significance as the demarcation point between the elementary and the complex systems, it will gain in significance, I think, and gain most remarkably, as a general definition of elementary systems. The lack of such a definition of sufficient precision and generality has made itself acutely felt in the controversies of recent years which have sometimes been conducted in terms which suggest that all kinship structures are fundamentally of the same general kind.

On the other hand, P. E. de Josselin de Jong in a recent article (1966) has expressed the need for isolating the properties which all "class" systems of kinship have in common, be they dyadic or triadic, symmetric or asymmetric, and for a means of setting out the whole range of elementary structures as consistently and fully as possible (1966: 81). Such a means has indeed long been overdue.

My submission, in conclusion, is that in Levi-Strauss's generalised definition of Crow-Omaha systems:

"whenever a descent line is picked up to provide a mate, all individuals belonging to that line are excluded from the range of potential mates for the first lineage, during a period covering several generations" (1965: 19)

we have a definition of "class" systems of kinship of every kind, if we allow "descent line" to stand for one of N groups of collaterals arranged in a ring in a given order, and the word "several" to include the cases of nought and one, which yield the asymmetrical and anti-symmetrical systems respectively. This definition will give us all the answers required for a general classification and theory of classificatory relationship systems first raised by Radcliffe-Brown (1941: 16) and which has now again been brought to the fore by Levi-Strauss and de Josselin de Jong.

All that is required then is a simple and instructive method for

tabulating the systems, and this requirement is supplied, as I hope to have shown, by the lines and ropes table form of presenting the model of classificatory kinship. In this form it is easy first of all to produce the asymmetric and antisymmetric systems for any number of N , which are always possible systems in that they conform to the three conditions (see p. 104 above); then the tables for systems where N is a prime number, from which anomalous and lopsided systems will have to be eliminated by, for example, comparing various specifications in descriptive terms for the "spouses". Lastly, the systems with N equal to a product of two or more prime numbers (four, six, eight, nine etc.) can be produced in the same table form by combining the marriage rules for the requisite number of prime components of N .

Perhaps I may briefly illustrate the latter case on the example of $N \equiv 4$. The marriage rules, by Levi-Strauss's definition, will be:

I	$A = b,$	$B = c,$	$C = d,$	$D = a$
II	$A = c,$	$B = d,$	$C = a,$	$D = b$
III	$A = d,$	$B = a,$	$C = b,$	$D = c$

It will be noted that (I) and (III) are the anti-clockwise and clockwise marriage rules, whereas (II) dissociates the society into two moiety systems along the diagonals of the square formed by A, B, C, D . These are the marriages with direct exchange which are possible as a regular feature only in systems where N is even. Here a change of marriage rule becomes imperative in the next generation if the system is not to remain permanently disunited. The possibilities are:

II	$A = c,$	$C = a;$	$B = d,$	$D = b;$	
IV	$A = d,$	$D = A;$	$B = c,$	$C = b;$	and
V	$A = b,$	$B = a;$	$C = d,$	$D = c.$	

Combinations of any two of these produce Arunta type systems (in which new names can be introduced for the second, fourth, etc. generation), i.e. where marriage is with the MoMoBroDaDa's group, which is not identical with the group of the FaFaSiDaDa. The two combinations of all three of these rules produce systems of a type which might be called antisymmetrical Arunta, in which marriage is with the "FaFaSiDaDa" who is not also the "MoMoBrDaDa". One of the latter should be eliminated, however, as not producing equal specifications for "spouses" in all generations.

This manner of deriving the Arunta system is, of course, different from that which ascribes it to the effect of intersecting moieties of

opposite linearity; while it does not exclude the latter possibility, it is not restricted to systems with direct exchange and therefore fits into the general scheme for the derivation of all classificatory systems. It suggests the possibility, which might be usefully examined, that such systems arose from a chance meeting of two tribes with moiety systems deciding to stay together and form one society by swapping, as it were, marriage partners for their children's generation.

In the case of systems with direct exchange the ropes table does not yield any information additional to the lines table; but it is useful in the rare case in which ropes are actually recognised. The Mundugumor system can be described as the rope form of an Arunta system with the added complication created by the desire to invest the ropes with distinctive names.

This renaming, rather than simply the difficulty of remembering relationships to the fourth generation (with which the Arunta cope quite cheerfully), may well be the reason why the fourth generation marriages are never contracted (Mead 1935: 183-184). For this would mean that people who share the same rope name would be married. Although they are in no sense siblings, this situation seems to engender an acute sense of guilt and a rush of adaptations suggesting that the Mundugumor idea of incest is linked with naming, rather than biological relationship, as would be the case if their original purpose had been as suggested at the beginning of this paper. In fact the adaptations are liable to lead to more incestuous marriages in the biological sense than the regular Arunta-type marriages.

Combination of marriage rules (I) or (II) with the direct exchange rule (II) yield anomalous systems. We have thus exhausted the possible number of systems with $N \equiv 4$. Systems with "FaFaSiDaDa" marriage and with direct and generalised exchange in alternating generations can be constructed by an extension of the principle of Levi-Strauss's definition, namely by admitting repetitions in the sequence of the marriage rules: (I)/(I)/(II) or (II)/(III)/(III). But there would appear to be little profit in such speculative extensions unless they seem to be called for by ethnographic reports.

For completeness, however, one should combine the structurally different systems with the various possible rules of descent, which, as we have already seen, form an independent set of variables, though they can be easily accommodated in the time dimension (the columns) of the tables. Even so, for numbers up to $N \equiv 5$ the representation of all the possible systems in lines and ropes tables is quite feasible

for manual operation; for larger N I would be inclined to leave the job to the computer, which would hardly be overloaded up to any number N that might be required for practical purposes.

To devise a computer programme for producing a complete set of tables should present no great difficulty for computer experts. As they will readily perceive, this can be simply achieved by performing the appropriate permutations of N pairs of letters $A, a; B, b \dots$ in P rows and $2N$ columns. Such a set of tables could render a similar service to anthropology as, say, the tables of logarithms have done for the natural sciences.

The use of such tables is, of course, strictly confined to closed, cyclical, systems the units of which are undifferentiated groups of collaterals not subdivided into lineages along genealogical lines. It would be as futile to try and express the kinship systems arising from a lineage or segmentary system by lines and ropes tables as it is to try and produce a systematic representation of classificatory systems of relationship by feeding a computer with genealogical information. (For an approach to the representation of lineage systems and their historical development see G. Dole, 1960; 1965, and R. J. Smith, 1962).

VIII. THE KINSHIP BASIS OF DOGON PHILOSOPHY

But there are inevitably also intermediate systems with, so to speak, a substratum of classificatory usages although genealogical divisions may be present. The Cherokee system is clearly of this kind, and Needham's systems of "prescriptive alliance" would also appear to belong to this broad category, since the basic divisions ("clans" or "sibs") are always subdivided along genealogical lines while the terminology is still partially classificatory (it was this classificatory substratum which I endeavoured to isolate in my 1948 paper).

An unusually interesting case of a society with lineages with patrilineal descent and patrilocal residence, in which marriage with the Mother's Brother's Daughter is preferred but not prescribed, and a highly esoteric mythology in which cyclical marriage arrangements are clearly expressed is that of the Dogon in West Africa. Their philosophy links the working of the universe with the proper ordering of society (Marcel Griaule and Germaine Dieterlen 1954: 83-97).

Two systems can be recognised in the Dogon mythological world and social order: one created by the descent to earth of four pairs

of male and female twins which accentuates with a spiral distribution of fields; this is represented in fig. 4, using the geometrical method combined with the ropes form, to illustrate the alignment on the ground. It results in a spiral distribution of the fields of each group of descendants of one original couple formed by asymmetric marriage in a cycle. The rope form shows the uterine kingroup as the structural element and demonstrates the "disorder" in the succession of the generations described in the Dogon mythology.

The other system is said to have preceded the first in time and

FIG. 4. DOGON
"Nommo" diagram and
field layout
(fields of A and C shaded)

FIG. 4 a. DOGON
"Amma" diagram and
field layout

FIG. 4 aa. Transition to
lineage structure

according to its rule the cultivators had to work with their backs to the edge of the last field when a new one was to be cleared, "and the area cleared must be of such a shape that the opposite side is much longer than the side from which they start. Thus each field will be an irregular and, as it were, twisted quadrilateral, two sides of which will form a very wide angle opening towards the fields which will subsequently be cleared. This angle symbolises the continuous extension of the world". Fig. 4a shows an anti-symmetrical system in lines form and the corresponding field distribution; it has, of course, the paternal kingroup for its structural element and the generations follow in "orderly" fashion in the male line. The shape of the resulting field distribution is strikingly like the above description. (1954: 94, 92).

(At some time the two systems would appear to have functioned simultaneously, to judge by the emphasis placed on the number seven composed of three and four, symbolising male and female respectively, in the development of the social order, suggesting a situation in some way analogous to the Cherokee system; but the account is not entirely unambiguous here).

These correspondences with the Dogon mythology and symbolism suggest that the Dogon are well aware of the inherent symmetries of the two kinds of systems and of the ways in which they can be systematically represented. It might be that if these two diagrams could be employed in conversation with Dogon people further insights could be gained into their remarkable world view.

For convenience I have labelled the two diagrams by the Dogon terms "Nommo" and "Amma" for the relatives on the mother's and father's side respectively (91); but both could, of course, be drawn for three or four, or for any number N of collateral groups. It may be of interest that they also illustrate the independence of the two structures on the locality of post-marital residence: in both cases it would be as convenient for the men to live with their parents-in-law as with their own parents, since they always extend the fields of their fathers in the direction of the residence of their prospective brides.

There is nevertheless a difference in the two diagrams which can have important social implications. The "Amma" diagram has an "open" layout: it divides the land area of the society into three (or more) large blocs which can expand in a radial direction quite independently of each other. In real life this can encourage the transformation of the originally undivided groups of clan brothers into separate "tribes" with their own marriage arrangements independent

of the cycles and a tendency to form segmentary corporate lineages, as shown in Fig. 4aa.

Here the radii of the field system are progressively lengthened to accomodate a growing population; hence in a few generations the distances between "tribes" and even between lineages can become quite large while the fields become progressively longer and thinner, turn into "strips". Eventually the segments may move completely away from the original centre of expansion without taking the whole encumbrance of cyclical cognates with them, to form separate societies by concluding matrimonial alliances with similar segments from other societies in their new habitat (cf. Southall 1952).

This expansionist kind of development is, of course, not confined to the Dogon but is characteristic for many African societies (Fortes and Evans-Pritchard 1940; Fallers, undated MS). The "Amma" diagram makes the transition to the familiar lineage structure appear so easy and rapid that we may wonder whether the rarity of anti-symmetric systems is not simply due to their tendency to dissolve in this fashion.

By contrast, the "Nommo" diagram is much more compact and conservative. As time goes on, the spirally arranged fields of the different groups continually envelop each other, providing protection for each other and the society as a whole against the outside world, but also isolating it. If land becomes insufficient for the growth of population there is in this case a distinct likelihood that the society will split into two congruous entities and found a new village on the identical pattern. This possibility might perhaps be studied in cognatic societies with bi-lineal or double descent groups.

Alliances formed with the mother's brother's clan on the fringes of lineage societies expanding from different centres for the sake of the protective pattern of settlement which they facilitate could lead to the formation of such local clusters as Levi-Strauss appears to have in mind (1965:21). Similar evidence can even be observed in rural communities in Europe and America.

Lastly, the patterns exhibited in figs. 4, 4a and 4aa recall familiar symbolic designs in the decorative patterns of many cultures of Asia and Europe. The connection is, I think, likely to prove less tenuous than in Buchler's example (1964a); in the Dogon case it is, of course, quite explicit. It reinforces Levi-Strauss's plea for more attention to such symbolism.

CONCLUSION

The ethnographic examples given in this paper are only crudely sketched; but my intention was merely to show the scope which exists for the application of the lines and ropes method of presenting the classificatory kinship model, and the help it can give in solving topical anthropological problems.

Mathematical anthropology has in recent years become a highly specialised subject (cf. White 1963; Hymes 1965). It requires, or seems to require, a proficiency in higher mathematics which leaves the ordinary student of society somewhat breathless, and perhaps at times not altogether unduly sceptical (see Leach 1964). From an almost complete lack of contact between the mathematical and the social sciences we seem to have jumped to such an advanced level of integration that in human terms the gap has, if anything, widened.

I hope to have shown that there is still room for the application of elementary principles of mathematics so ordinary that one can be perfectly at ease with them, even if one is interested primarily in human relationships and only secondarily, if at all, in the intricacies of higher mathematics and formal logic.

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