

**TOWARD THE HISTORICAL RECONSTRUCTION OF
MATRIX PATTERNS IN MORPHOLOGY**

Kenneth L. Pike and Gary F. Simons

University of Texas at Arlington and
Summer Institute of Linguistics

28 June 1991

1. Introduction

2. Procedures for the reconstruction of morphological matrices

- 2.1 As applied to Fore and Gahuku of Papua New Guinea
- 2.2 As applied to Algonquian languages of North America

3. Principles of language change in morphological matrices

- 3.1 Basic matrix types and basic mechanisms of change
- 3.2 As illustrated by Malaitan languages of Solomon Islands

4. Principles that underlie the matrix approach to reconstruction

5. Summary

1. INTRODUCTION

This paper presents a new procedure for historical reconstruction of morphology. In addition to proposing a set of procedures, it illustrates them with examples from a number of languages and elucidates the principles which underlie the procedures. A similar attempt to specify steps in classical historical reconstruction of lexical items was made by Pike (1951, expanded 1957). More recently, Costello (1983) has attempted to develop an approach to syntactic change and reconstruction based on Pike's (1967b) tagmemic approach to language.

What, then, are the basic principles and procedures which need to be added to historical linguistics to better handle morphological reconstruction? In Pike's work (1959, 1982a:19-38), a particular language event can be seen as a particle, or it can be seen as a wave, or it can be seen as a point in a field pattern. As a nonlinguistic illustration of this concept, consider a house. It can be looked at as if it were a single "particle" (or thing), such as might be available for purchase for a certain amount of money; or it can be studied in relation to its current state in the "wave" (or progression) of time, as being almost completed or in good condition or falling down in decay; or it can be looked at from the point of view of its

position in a "field" (or neighborhood) of other buildings, such as having neighboring houses on both sides and across the street or as being by itself at the end of a cul-de-sac or being near the grocery store.

From this kind of perspective, we look at classical historical linguistic reconstructions as building on a particle perspective. The linguist is there trying to reconstruct particular units of sound and lexicon over the millennia. The wave perspective enters in as well when sound changes are explained by conditioning environments in the stream of speech.

But it is the field perspective that concerns us here. Field can be seen as pattern, and pattern involves not mere units, and not mere sequence, but intersecting components in an underlying n-dimensional space of the language structure. It is our belief that such patterns can be exploited in the historical reconstruction of language. This paper explains how we propose to do so.

A classical phonetic chart is an example of a field approach applied to sounds. A traditional paradigm of conjugated word forms is a familiar example from morphology. Even in syntax such two-dimensional tables have been used to show how constructions that vary in orthogonal dimensions relate to each other (Pike 1962). In previous work, Pike has defined a generalization of such charts, paradigms, and tables which he takes to be the basic

unit of the field perspective; he calls it the matrix (Pike 1957, 1962:243).

When applied to morphology (which is the focus of this paper), a matrix has rows and columns labeled by different sets of semantic functions. The cells at the intersection of rows and columns are filled by phonologically-written grammatical entities, which could be morphemes or morpheme complexes or even submorphemic (but recurring) bits of phonological form. We use the term formative as a cover term for the phonological material entered into a cell of a matrix. When a particular formative occurs in every cell of a row or column, it may be called a vector formative. A partial vector formative occurs when a formative is present in some, but not all, of the cells of a row or column. When multiple vectors (whether complete or partial or both) for the same formative overlap or adjoin, they comprise a formative block. As languages change, various formative block shapes can develop over time. The uniqueness of those shapes, in relation to the semantic functions they correlate with, implies that the discovery of comparable formative blocks across languages is not a historical accident but is the result of a shared history that can be reconstructed.

This implies that historical reconstruction of formative blocks may be an important possibility for future comparative-historical work. In this paper we try to illustrate this possibility with examples from various languages. We begin with material from Fore (Papua New Guinea), where Pike (1963) got his

initial insight about the field perspective in morphology. We continue with some startling formative block shapes in Algonquian languages, building particularly on the work of Pike and Erickson (1964), using data from Hockett (1948). Then we turn to an example from the Malaitan languages of the Solomon Islands, taken from Simons (1980).

We assume that readers will be more interested in the theoretical underpinning of the procedures, and in the actual methodology utilizing these procedures, than in extensive specific language data. We have, therefore, tried to put into the forefront of our paper statements of the methodology, in the form of numbered procedures, and statements of basic underlying presuppositions, in the form of numbered principles.

Note, in the bibliography, that the big bulk of this work on matrix descriptive analysis, with its underlying implications for historical morphological matrix reconstruction, was published in the 1960's. We hope that now, in the 1990's, the time has come for further historical application of this material. But the basic breakthrough--from our perspective--for using matrix material for historical reconstruction of morphology (versus for description of clause systems, Pike 1962) came as a by-product of a descriptive problem in analyzing, with Scott, the morphology of Fore (Pike 1963, Scott 1978).

2. PROCEDURES FOR THE RECONSTRUCTION OF MORPHOLOGICAL MATRICES

We now present our procedures for historical reconstruction in the form of a sequence of numbered steps. These should be taken as an initial suggestion, rather than as a complete and final word. The procedures are first described as they are applied to material from Fore and Gahuku of the Eastern Highlands Province of Papua New Guinea. In the second subsection they are further illustrated by application to the Algonquian language family of North America.

2.1 As applied to Fore and Gahuku of Papua New Guinea

The analysis begins by permuting a selected matrix to find an optimal display.

PROCEDURE 1: Permute the rows and columns of a morphological matrix until as many formatives as possible are brought together into contiguous blocks.

One such permutation of object prefixes in Fore (from Pike 1963:2) is given in Figure 1. The startling element in this matrix is the vowel /a/ (which is underlined in the figure to highlight it). It appears both in the row for singular and in the column for first person. Therefore /a/ cannot be simply a morpheme for singular, nor a morpheme for first person. Other interesting formative blocks appear as well. The /si/ is clearly dual--and therefore we put it at the bottom of the chart to separate it off somewhat from the rest of the material. But, in

addition, the /t/ clearly helps identify both plural and dual, provided that it is simultaneously either first or second person. In addition, the /n/ clearly forces an interpretation of singular first person, as /k/ does for singular second person. This leaves a zero formative element in the empty consonantal position as identifying third person.

INSERT FIGURE 1 ABOUT HERE

Note that in classical terms, it is awkward to call /a/ a morpheme here, because of its function as either singular or as first person -- two different vector formatives. Conversely, it is awkward to call /ta/ a single morpheme of first plural, because of its obvious composition of two parts. Classical morpheme procedures are inadequate here --- and continue to be inadequate as applied, for instance, to English. No extensive morphemic analysis of English has yet covered adequately the result of rapid fusions. For instance, what are the morphemes in /jinjoyit/ "Did you enjoy it?" Analysis by matrix formatives may help in the synchronic study of wave results like this that are currently perplexing when studied through static particle procedures. "Morpheme" might ultimately need redefinition in static, dynamic, and relational terms for different purposes.

PROCEDURE 2: Mark matrix formative blocks to show clearly both the specific components of the total

matrix space and the overlapping chunks of that matrix structure.

Figure 2 shows the result of applying the second procedure to the Fore material. The /a/ formative is indicated by the L-shaped block combining the top row and the left column. The dotted square block to the lower left encloses the four items which have /t/, while the solid square to the lower right indicates items with /i/. The /si/ formative is included in the thin rectangular box at the bottom. The dotted rectangle to the right encloses the zero formative for third person. The /n/ and /k/ each represent a partial redundancy; like /a/ they indicate singular number, but they further distinguish the contrast between first person and second person.

INSERT FIGURE 2 ABOUT HERE

This kind of representation allows one to see contrastive formative blocks as intersecting chunks of matrix space, rather than as sequential affixes only. (One can call these, if one wishes, "distorted Venn diagrams" for the interlocking semantic structural features of that paradigm.) That is, the presence of a phoneme or a phoneme sequence from this matrix does not by itself guarantee that we know precisely what it means. For example, it takes the intersection of /t/ with /a/ and the absence of /si/ for us to know that we are dealing with first person plural.

PROCEDURE 3: If the matrix structure involves overlapping formative blocks, decide on segmentation breaks between formatives and pull the single complex matrix structure apart into a sequence of simple matrices in which there are no overlapping formative blocks.

Figure 3 shows the result of applying the third procedure to the Fore matrix in Figure 2. We see that a sequence of three matrices is needed in order to pull apart the overlapping formative blocks. When performing this procedure the analyst is very likely to face indeterminacies in the attempt to segment the formatives. This does not pose a problem for the method as explained below in section 4 (see principles 10 through 12).

INSERT FIGURE 3 ABOUT HERE

PROCEDURE 4: Compare similar permutations of related paradigms in the language to look for internal reconstruction of the shape of formative blocks which are persistent across matrices, even in the face of radically modified phonological material.

Note now the subject suffixes of Fore, given in Figure 4. In this matrix, there is a striking subset of formative structures in which /n/ crisscrosses from first person plural to second person singular; while /w/ crisscrosses from first person singular to second and third person plural. These formatives are

capitalized and underlined, respectively, in the figure in order to highlight the crisscross pattern. (Note that there is no permutation that can put the /n/ formatives in adjacent cells; at best they must crisscross in this diagonal pattern.)

INSERT FIGURE 4 ABOUT HERE

When one adds an emphatic suffix to the morphological material in Figure 4, the fusion leaves morpheme identity very obscure, as in Figure 5. But still, "point by point they have the same internal pattern, in spite of different formatives" (Pike 1963:11), that is, Figure 5 retains the formative shape of Figure 4, in spite of the added material for emphasis. Note in particular how the crisscrossing shape is preserved (again highlighted by means of capitalization and underlining). First person plural and second person singular share the same formative (namely, /mpe/); while first person singular shares the same formative (namely, zero) with second and third person plural.

INSERT FIGURE 5 ABOUT HERE

Once a distinctive pattern like this has been recognized, one searches for other instances of comparable structures. It is our experience that a language tends to use a particular kind of matrix pattern more than once throughout its structure.

PROCEDURE 5: Make comparable descriptive matrix studies of a number of other languages which are assumed to be related to the first.

Another description of material in Papua New Guinea, carrying further the kind of analysis given above for Fore, is found in Deibler (1964, 1973, 1976) for the Gahuku language. Wurm (1982:124) treats Gahuku and Fore as belonging to two different subfamilies of the East-Central family of the East New Guinea Highlands stock of Papuan languages. Figure 6 displays the object prefixes matrix of Gahuku (Deibler 1976:14) which corresponds to the Fore matrix in Figures 1 through 3. Part (a) of the figure gives the matrix of full forms. Part (b) pulls these apart into a sequence of formative matrices (following Procedure 3). Note that the dual versus plural distinction, which is neutralized in Gahuku in the object prefixes while being preserved in the subject suffixes, is represented in these formative matrices in order to maximize their congruence with the corresponding matrices of Fore.

INSERT FIGURE 6 ABOUT HERE

PROCEDURE 6: Take a matrix structure found in one of the languages and check to see if a similar structure can be found in one or more of the other languages. If so, try to guess at a reconstructed matrix shape from which all of these can be derived.

In comparing the matrices of Figures 1 and 6(a) we can see some similarities between the morphemes, but it is not until we factor out the formatives and compare the formative block structures (as in Figures 3 and 6(b)) that the high degree of correspondence between the prefixes in the two languages stands out. Note that the formative structure of the first matrix is identical in both languages. Furthermore, all of the phonological forms have the same point of articulation; the only differences are in the manner of articulation of two of them. The second matrix is much the same as well. The distinctive L-shaped pattern of the /a/ formative in Fore is preserved in Gahuku; it is just that the phonological content has been deleted in every cell except the 3rd person singular (where it could not be deleted without losing the prefix altogether since that cell has zero in the first matrix). The most intriguing result is that the /i/ formative of Fore ends up corresponding to the /k/ formative of Gahuku. We would need to appeal to evidence from other languages to find a plausible explanation for that. Finally, note that the neutralization of the dual versus plural distinction in Gahuku results from the loss of the dual morpheme (which explains the absence of the third formative matrix evidenced by Fore in Figure 3).

INSERT FIGURE 7 ABOUT HERE

As a further example, Figure 7 gives the Gahuku subject suffix matrix which corresponds to the Fore material given in

Figure 4. The two parts of Figure 8 give a direct comparison of the formative structures across the two languages. The first formative matrix in both languages is virtually identical. The third matrix in Gahuku preserves the distinctive crisscross pattern found in the second matrix in Fore; in fact, the second matrix in Fore looks very much like a fusion of the second and third matrices in Gahuku. Note, too, that the second matrix in Gahuku which contains only the /si/ formative for dual is exactly the same as the matrix which appeared in the Fore object prefix (Figure 3) but was absent in the corresponding Gahuku prefix (Figure 6).

INSERT FIGURE 8 ABOUT HERE

We will not go so far at this point as to propose a reconstruction of these matrices for Proto Eastern Highlands; we have not yet performed the detailed comparison with other languages of the family. However, the correspondences of patterns are so striking and the likelihood that they could be due to independent development is so low, that we are confident that these matrix patterns are retained from the parent language and could be reconstructed straightforwardly. (Compare the similar statement by Ivanov (1977:20) regarding syntactic reconstruction: "The relation of the same categories to the same surface structures cannot be accidental and makes the exact syntactical reconstruction possible.") These examples show that matrix patterns can be widely retained across languages separated

by significant genetic distance. Deibler has in fact suggested to Simons (personal communication, quoting Simons 1980:14) that formal correspondences of this nature may prove a better criterion for classifying this group of languages than lexical correspondences, which are often rarer.

PROCEDURE 7: Try to reconstruct the phonological component of each formative block of the reconstructed matrix structure. Make use of the traditional comparative method for this (see, for instance, Pike 1951, Hoenigswald 1960, and Weinreich, Labov, and Herzog 1968). Note, however, that the fusion which is prevalent in morphological matrices is likely to distort the regular sound changes attested in content morphemes.

Having not made a reconstruction of matrix shape in the previous step, we cannot attempt the phonological reconstruction. This step of the procedure is illustrated below with material from other language families. The topic of fusion and its impact on sound change is covered at length below in sections 3 and 4.

2.2 As applied to Algonquian languages of North America

We now turn to one of the most astonishing applications of the descriptive use of formative blocks--its application to the transitive animate verb affixes in Potawatomi, an Algonquian

language of North America. The data are taken from Hockett (1948) by Erickson, as reported in Pike and Erickson (1964).

Figure 9 charts a transitive animate verb prefix, which is made up either of /k-/ or /n-/ or /w-/. The matrix is arranged with rows reflecting the person and number of the subject and columns reflecting the person and number of the object. Singulars are given before plurals. An additional person beyond first, second and third person is here called fourth person; and first person plural inclusive is given as "12". Note that the phoneme forms--for example /k-/--seem to be scattered "wildly" throughout.

INSERT FIGURE 9 ABOUT HERE

We now permute the rows and columns of the matrix to bring the formatives together into contiguous blocks (Procedure 1). It turns out that if we move the row for second person to the top, followed by the row for second plural (2p) immediately below it, along with inclusive (12) immediately below that, and ordering the columns similarly as 2, 2p, 12, then the /k-/ elements form a contiguous block in the top three rows and in the leftmost three columns. Similarly, moving the row and column for first plural next to first singular shows a further grouping, with the /n-/ elements grouped together in rows and columns to the lower right of /k-/. The /w-/ elements then end up grouped further to the lower right. The resulting formative blocks are then marked off

(Procedure 2), as shown in Figure 10. (Since these prefixes contain only a single formative, Procedure 3 does not apply in this case.) We call the result an L-shaped matrix, because of the way the shapes of the formative blocks go "around the corner." (In other permutations of the matrix, the ranking pattern shows up as an intersection of horizontal versus vertical formative vectors in a cross pattern, as illustrated on page 203 of Pike and Erickson 1964. Ranking is more easily perceived by us when charted in the L-shape, but the other arrangement is sometimes necessary for conflation with other parts of the same construct, as on their page 207.)

INSERT FIGURE 10 ABOUT HERE

Figure 10 implies that whenever the second person is involved, whether as the subject or as the object, the prefix /k-/ is used. On the other hand, if second person is not involved, but first person is, then the /n-/ occurs in that slot. But if neither second nor first person is involved in the action, so that only third and fourth person are involved, then /w-/ is used. The gaps along the diagonal are in some sense reflexive; second person subject occurring with second person object is not signaled by /k-/; nor are first or third person reflexives signaled.

Notice that this implies a basic fact about languages: an L-shaped matrix implies that the item in the largest L-pattern

outranks other items in the matrix. The implication here for Potawatomi is that there is a ranking such that if both a second person and a non-second person referent are involved in the verb, then the second person referent will be signaled by /k-/, regardless of whether it is subject or object; the person of the outranked referent must be shown elsewhere in the verb. Also, further structures must be used to signal whether the /k-/ represents the subject or the object (which here is indeterminate). This ranking structure can be startling for scholars who for generations have assumed--with little discussion of the assumption, so far as we have seen--that first person is "obviously" expected to outrank second person (perhaps because we count 1-2-3, not 2-1-3). (For a radically different type of ranking involving intersecting matrices in three dimensions, see DuBois, Upton, and Pike 1980.)

If the reader wishes to see how such a Potawatomi prefix in fact fits into a full verb, with its various suffixes (which function, among other things, to identify the person and number of the second-ranking participant and to identify which participant is subject and which is object), see the chart in Pike and Erickson (1964:208-209) or the detail in Hockett (1948:142, 144). For comparison to other kinds of verbs and nouns in Potawatomi, see Erickson (1965). It turns out that ranking structures recur throughout Potawatomi, both in relation to several suffix positions in the independent transitive animate verb, and to some extent in other verb types and even in nominal

types. This provides scope for the internal reconstruction of such ranking structures (Procedure 4).

We turn now to the historical reconstruction of ranking patterns in Proto Algonquian. The descriptive listing of comparative matrix shapes (Procedure 5) has been done by Morgan (1966) for eight Algonquian languages. Figure 11 reproduces his matrices for the prefix charted in Figure 10. (Unfortunately, he failed to include the first person plural inclusive forms.)

INSERT FIGURE 11 ABOUT HERE

Note in Figure 11 that the ranking shapes are unchanged across all eight languages. These similarities are too regular and too complex to be attributed to borrowing or independent development. Thus we do not hesitate to posit an identical ranking structure for the parent matrix in the proto language (Procedure 6), even though some of the cognate formative blocks have as disparate phonological content as Cheyenne /ne-/ versus Blackfoot /kit-/.

Reconstructing the phonological form for each formative block of the proto matrix is not as straightforward since they differ somewhat across languages. Where Potawatomi has /k-/, Fox has /ke-/, Cree, Ojibwa, and Shawnee have /ki-/, Delaware has /k -/, Blackfoot has /kit-/, and Cheyenne has /ne-/. Similarly, where Potawatomi has /n-/, Fox has /ne-/, Cree, Ojibwa, and Shawnee have /ni-/, Blackfoot has /nit-/, Delaware has /n -/, and

Cheyenne has /na-/. For Potawatomi /w-/, Delaware has /w -/, Ojibwa has /o-/, Shawnee has /ho-/, Cheyenne has /'e-/, and Fox, Cree, and Blackfoot have zero.

Phonological reconstruction has been done in some detail for Algonquian. Note, for example, early reconstruction of the Proto Algonquian sound system in Bloomfield (1946); Goddard (1979) provides a more recent treatment. Goddard (1967 and 1974) has also attempted an extensive treatment of Algonquian verbs with reconstructions. We thus defer to his scholarship in positing the phonological content of the proto formative blocks as *ke-, *ne-, and *we- (Procedure 7). The resulting reconstructed matrix is given in Figure 12.

INSERT FIGURE 12 ABOUT HERE

The full marking of the Algonquian transitive animate verb to disambiguate the person and number of subject and object involves the conflation of the above prefix matrix with the matrices for three suffixes, as shown in Pike and Erickson (1964:207) and Morgan (1966). The other three matrices can be reconstructed following the same procedure to achieve a full reconstruction of the transitive animate verb morphology. (Since doing so here would not add appreciably to the explanation of the methodology, that step is left as an exercise for the reader.)

3. Principles of language change in morphological matrices

The matrix perspective affords us new insights into the nature of language change. Traditional comparative linguistics speaks of split and merger (as of phonemes or of words) as the primary mechanisms of historical change. The matrix perspective highlights two other mechanisms, namely, fusion and analogy, which seem to play a very important role in morphological (as opposed to purely phonological or lexical) change. These principles are introduced in section 3.1 and then illustrated with data from Malaita, Solomon Islands, in section 3.2.

3.1 Basic matrix types and basic mechanisms of change

Pike (1963:16 and 1965:204) has described two basic matrix types; these are illustrated in Figure 13. The first, which he calls a simple matrix, has a full vector formative for each row and column of the matrix. That is, the first row contains the same morpheme all the way across carrying the meaning of that row; the second and third rows have different morphemes representing their respective meanings. Likewise, each column has its own morpheme carrying the meaning of that column. Each cell of that matrix, therefore, contains two morphemes--one representing the meaning of the row, and the other representing the meaning of the intersecting column. The left side of Figure 13 represents this simple shape.

INSERT FIGURE 13 ABOUT HERE

The second basic matrix pattern, which Pike calls an ideal matrix, has only one formative per cell of the matrix. Every cell thus has a different formative which simultaneously signals the meaning of the row and the column. The right side of Figure 13 represents this ideal shape.

With these definitions of the two fundamental matrix types in place, we are now in a position to state our basic principles of morphological change. The first two principles define the significance of the two major mechanisms of morphological change:

Principle 1: Phonological fusion can lead away from a simple matrix of vector formatives toward an ideal matrix with single-celled formatives.

Conversely,

Principle 2: Paradigmatic analogy can lead away from an ideal matrix of single-celled formatives toward a simple matrix with vector formatives.

Fusion, coming from rapid speech, can merge the two morphemes of a cell into one phonological element with the combined semantic meanings. This kind of fusion is a normal phonological process in rapid speech, with no accompanying loss of intelligibility in the immediate context of a conversation. As such fusion progresses over time and becomes frozen, the two original vector formatives in each cell of the matrix can become one single-celled formative.

But pressure can be brought to bear in the opposite direction as well. By a process of analogy, similar phonological bits in single-celled formatives can be reinterpreted as partial vector formatives and ultimately extended to cover the whole vector, thus leading to new conventional morphemes.

The pressure to change by fusion or to change by analogy is not strictly arbitrary, for as Pike (1965:205) points out:

Principle 3: The two basic matrix shapes embody efficiencies of different kinds. A simple matrix is maximally efficient in requiring the lowest number of morphemes to signal all the distinctions in the matrix, while an ideal matrix is maximally efficient in requiring the shortest utterance to signal each distinction.

Fusion and analogy can then be interpreted as processes which change a matrix (or at least one cell of a matrix at a time) from one efficiency type to the other. Fusion leads to greater articulatory efficiency by making the phonological material in a matrix cell shorter and easier to pronounce. Analogy, on the other hand, leads to greater lexical efficiency by reducing the number of morphemes in the lexicon.

The matrix perspective thus leads us to the following explanation of something that students of language change have recognized for over a century:

Principle 4: The history of language is characterized by a perpetual oscillation between two opposite tendencies, the tendency toward greater articulatory efficiency versus the tendency toward greater lexical efficiency.

The first part of this statement of principle is almost a direct quote from Hermann Paul (1889, section 307); the second part is our reinterpretation of what the opposing tendencies are. Pike (1965:206) has observed further, that "presumably the stability of human language reflects this kind of oscillation, about an indeterminate norm, with unknown limits, and perhaps seldom reaching the limits of the fully regular types."

Another way of looking at phonological fusion is to view it as a process of entropy. If such a process should continue indefinitely, many morphological structures of the simple type would disappear, and communication could eventually be damaged. In order to counter this physical tendency in pronunciation, so as to preserve communicative possibility, some kind of counter-process must also be involved, or we would have no languages at all. Loss of communicative clarity, through fusion, can be re-established by a process of analogy which re-establishes simple matrices. More recently, Pike has referred to this counter-process as anti-entropy (in Headland, Pike, and Harris 1990:42-44). Note the similarity of this formulation to that of Paul (1889, section 367): "Each disorganization is followed by a reorganization," through "analogical formation" after the "devastation of sound change."

The matrix perspective can also subsume the notion of "borrowing" as a mechanism of language change. Where different speech communities are in contact, we can view dialect as one more dimension of the typical speaker's field structures. Borrowing can then be interpreted as change via analogic extension along this dimension of dialect (Simons 1980:16).

3.2 As illustrated by Malaitan languages of Solomon Islands

We now illustrate these principles of change via fusion and analogy with an example from the morphological reconstruction of Austronesian languages of the Solomon Islands, specifically a reconstruction of the pronoun system of the languages spoken on the island of Malaita. For this, we take material from an unpublished manuscript by Simons (1980).

Following procedures like those we have presented in section 2, Simons has reconstructed a system of pronouns for Proto Malaitan which has four numbers (singular, dual, trial, and plural), four persons (first exclusive, first inclusive, second, and third), and many functional classes (including free pronouns, possessive suffixes, object suffixes, and multiple categories of subject markers). As a basis for the example given here, Figure 14 shows the forms reconstructed (using the above methodology) for the free pronouns and the future subject markers in singular and dual numbers.

INSERT FIGURE 14 ABOUT HERE

Inspection of Figure 14 indicates a proto system that is somewhere between the two extremes of maximal articulatory efficiency and maximal lexical efficiency. For instance, the future subject markers show a common formative, namely /*kai/, with the exception of a vowel assimilation in the second person singular form indicating the beginnings of fusion. Note, too, that the basic pattern for the future subject markers is that the /*kai/ formative is added to a form very much like the free form. There are a number of significant differences from the free forms, however, which lessen the lexical efficiency in favor of greater articulatory efficiency.

Twelve languages are spoken on Malaita, an island only 100 miles long and 20 miles wide at its widest point. Two of these languages, To'aba'ita and Fataleka, which are spoken just 20 miles apart and share 72% cognates on the Swadesh 100-word list, exhibit radically different historical developments, in terms of the principles we have been discussing. One of them, To'aba'ita (see L. Simons 1986 for a synchronic description of the pronouns), has employed fusion throughout to produce a pronoun system that approaches maximum articulatory efficiency. For instance, in the future subject markers, the dual forms which involve eight to ten phonemes each in the reconstructed forms are fused to forms of only four phonemes. On the other hand, Fataleka has employed analogy throughout to produce a pronoun system that approaches maximum lexical efficiency. For instance, to form the future subject markers, the /kai/ formative has been

extended to apply to every future form, while the free pronouns have been extended to be the basis (without change) of the future forms. The result is that the To'aba'ita lexicon must record every future subject marker as a unique form, while the Fataleka lexicon need record only the single form /kai/ and the syntactic fact that it is combined with the free pronoun. Figure 15 illustrates these developments.

INSERT FIGURE 15 ABOUT HERE

The example of fusion in To'aba'ita is quite striking from the standpoint that Proto Malaitan forms have been reduced to half their original length without any loss of information. Figure 16 shows this process for two of the future subject markers. The Proto Malaitan forms consist of four morphemes totaling eight phonemes in length. The Pre-To'aba'ita stage shown in the figure represents an intermediate proto language common to all the languages of the north Malaitan subgroup. In the contemporary To'aba'ita forms, we see that the fusion process has left a single phoneme as a vestige of each of the original morphemes.

INSERT FIGURE 16 ABOUT HERE

Figures 17 and 18 illustrate that this fusion has taken place without loss of information. First, Figure 17 gives a matrix of the dual and trial future subject markers. Note that

the second person forms are the ones given in the preceding figure. Synchronically, it makes the most sense to analyze these forms as having two morphemes, the first signaling person and number and the second signaling their syntactic function as future subject markers. Note that all eight person and number contrasts are preserved in unique forms for the first morpheme, though drastically abbreviated in phonological shape from the Proto Malaitan. The allomorphic variation of the /-ki/ morpheme in the third person forms is actually a case of a displaced contrast. The two subject marker forms that would be expected if the second morpheme did not vary, namely /keki/ and /kiki/, occur in the plural row of the full paradigm. To avoid the potential ambiguity, the vowels of the Pre-To'aba'ita number morphemes, *-ro and *-lu (see Figure 16), have ended up being inserted into the future-forming suffix to form /-koi/ and /-kui/. This has the effect of retaining the original number information.

INSERT FIGURE 17 ABOUT HERE

Figure 18 shows how the person and number morpheme of To'aba'ita developed. In Proto Malaitan, person and number marking was achieved through a simple matrix pattern. In the permutation given in Figure 18, the person distinctions are signaled by column vector formatives and the number distinctions by row vector formatives. This matrix structure is preserved in the Pre-To'aba'itan stage, though all formatives have been abbreviated to a single syllable. In present-day To'aba'ita, the

original simple matrix with regular vector formatives has fused completely into an ideal matrix with single-celled formatives. Note that all of the original contrasts are present in the fused matrix, with the number distinctions now preserved in the vowel height while the person distinctions preserved in the combination of consonant and vowel roundedness.

INSERT FIGURE 18 ABOUT HERE

On the other hand, just 20 miles from To'aba'ita, the Fataleka language has changed the same proto language material through the process of vector extension by analogy. A full example was given above in Figure 15. Figure 19 takes just the singular forms and illustrates how the third singular form is extended to replace a set of single-celled formatives by a full vector formative.

INSERT FIGURE 19 ABOUT HERE

Figure 15 summarizes the strikingly different paths these closely related languages have taken in developing from Proto Malaitan--one opted for syntagmatic fusion to maximize articulatory efficiency while the other opted for paradigmatic analogy to maximize lexical efficiency. That such radical differences could exist between languages geographically so close and lexically so overlapping is one of the most astonishing things we have seen. We are not aware of any other approach to

historical linguistics which makes this result appear so "reasonable" when discovered. This example suggests that once the process of vector extension by analogy is well under way, it does not easily revert to morpheme fusion, nor does the reverse appear easily to occur.

4. Principles that underlie the matrix approach to reconstruction

With the principles of language change introduced in section 3 serving as a background, we can now consider some of the general principles which underlie the reconstruction procedures introduced in section 2. These principles, we believe, explain why the reconstruction procedures work. Each of the seven procedures is considered in turn with its underlying principles.

Procedure 1 involves putting the morphological material into a matrix and permuting the rows and columns to discover the inherent matrix structure. Underlying this is the belief that:

Principle 5: The analyst must be prepared to choose a temporary standpoint as an observer, viewing units either as (a) relatively static and with sharp boundaries--a particle view--or (b) points in a temporal sequence of units with identifiable nuclei but with fuzzy borders--a wave view--or (c) points in a larger (e.g., matrix) pattern of semantic relationships--a field view.

The general possibility and value of such observer flexibility is discussed in Pike (1959) and in Pike (1982a:19-38), where it is

identified as a fundamental component of universal human nature. This flexibility of observer viewpoint is crucial to the reconstruction methodology presented here.

Pike's original breakthrough on using a matrix perspective in synchronic analysis of morphology came as a result of the inadequacy of a particle view by itself. As he wrote at the time (Pike 1963:10):

Principle 6: A "linear display of allomorphs--though often useful and relevant to and valid within particle theory--is insufficient where [semantic] category and formative fail to coincide neatly."

Our breakthrough in historical reconstruction also comes as a result of recognizing the inadequacy of the particle view by itself. The traditional comparative method is based on a particle view in which reconstructable units are seen as particles which change by shift, split, and merger. We have found that the primary mechanisms of morphological change are, rather, fusion and analogy, for which we need the wave and field perspectives. Thus,

Principle 7: For historical reconstruction one must deal with units like morphemes not only as particles which may change over time by processes like shift or split or merger, but also as units in a wave sequence which may change over time by a process of fusion, and as units in a field structure (or matrix) which may change over time by a

process of analogy (via vector extension).

Procedure 2 involves marking the formative blocks in the permuted matrix structure. The existence of formatives which are neither single-celled nor full-vectorized suggests the following principle:

Principle 8: The meaning of a morpheme does not have to be in an isomorphic relation between one phonological shape and one semantic contrastive feature, nor a sum of contrastive features always tied to that particular morpheme.

The meaning of a formative, including a classical morpheme as a special instance, may in fact be the disjunction of a set of semantic features (or of combinations of features). The determination of which features are relevant at a particular point in a larger construction depends on the intersection of those sets of meanings for all the formatives in the construction. There must be an analog of a Venn diagram reflecting the overlapping relationships of the potential meanings of various formatives at different places in the structure to force the selection of the particular meanings which are relevant and accessible to the hearer at that particular moment. Thus,

Principle 9: The total signal as to the components of meaning involved in a particular instance of a constructed form is carried not simply by the addition of meanings of

the constituent morphemes, but by the intersection of formative blocks when the matrix structures are conflated.

This process of matrix conflation is illustrated in detail in Pike and Erickson (1964:207).

Procedure 3 involves positing segmentation boundaries between formatives and arranging the segmented formatives in a sequence of matrices. But this is not always easy to do; it is often difficult, if not impossible, to decide where a boundary belongs. Indeed, this result is predicted by the wave perspective:

Principle 10: In a wave view, units are seen as having identifiable nuclei (at the crests) but as having indeterminate (or fuzzy) borders (in the troughs).

Several decades ago Pike pointed out (1943:107) that a phonetic segment can be defined as a sound "having indefinite borders but with a center that is produced by a crest or trough of stricture." Later he found that comparable indeterminacies could obtain in identifying morpheme breaks as well. (For waves of meaning, see Pike 1982a:120; for phonological waves, see pp. 24-26, 88-91. For waves introduced as an important component in analysis of clause and sentence, see Pike 1967a.)

The wave perspective, as applied to morphological analysis, thus leads to the following procedural principle:

Principle 11: The analyst must be prepared to accept some indeterminacy--or arbitrariness--in the place where one chooses to divide between contiguous (or even simultaneous) formatives which are to be entered into the cells of coterminous (or possibly overlapping) matrices.

Pike discovered this principle in his first work with matrices in morphology, namely, in the Fore study cited above in section 2.1. In that study, Scott was forced to make some arbitrary choices (Pike 1963:14-15), but the typical result was that such arbitrariness in segmentation point did not "affect basically the topology of the system--the number of matrices, their cells, and their interrelations," even when the phonetic detail of the formative components was changed within the cells of the system (Pike 1963:15).

A special case of segmentation indeterminacy occurs when the formatives involved overlap, either partially or completely. Historical reconstruction of some languages will be hindered if one expects words and sentences to be reconstructed as simple sequences of simple phonemes. Some scholars in Asia, for instance, have objected to the "Euro-centered" view that begins with phonemes; they would rather treat the syllable as the basis for reconstruction. Denlinger (1987:19-23) points out that in Sino-Tibetan languages, the syllable is the unit that bears tone, as well as other simultaneously articulated contrastive features like length, nasalization, and laryngeal voice quality. He also notes that it is more productive to analyze syllables not as a

sequence of phonemes but as consisting of an "initial" plus a "final" (or rhyme) in which individual phonetic features (such as nasal versus stop) play a role in making key contrasts. In a matrix reconstruction, the relevant simultaneous formatives (such as tone, length, nasalization, voice quality, or distinctive features) would be pulled apart into separate matrices for comparison. (For a synchronic analysis of tone using matrix techniques, see Pike and Jacobs 1968, Pike 1970:81-83, and Pike 1982b. Pike and Becker (1964) treat vowel quality, length, and tone in Navaho verbal inflections.)

The danger of being misled by an errant segmentation decision in comparative reconstruction is even less than in a synchronic study. This is because comparing the same material across languages makes it possible to detect and unravel the fusions that may obscure the original segmentation and thus complicate the synchronic picture for a given language. This leads to a further procedural principle:

Principle 12: The analyst must be prepared to go back and change early segmentation decisions as the comparative data from related languages bring insight about fusions that have taken place.

Comparison of data from related languages brings such insight because,

Principle 13: Syntagmatic fusion of sounds, or phonological abbreviation of morphemes, often occurs with no loss of

original contrastive lexical units, because of preservation of vestiges in later stages.

This point is illustrated in detail in section 3.2 with the data from Malaita. See Figures 16 and 18 above.

A final note on segmentation indeterminacy is an early observation by Pike which may help explain why comparativists (and linguists in general) have favored a particle view of language over a wave view (Pike 1963:15):

Principle 14: "It is not [necessarily] communicative value which is impaired by the segmentation indeterminacy, but [sometimes it is] only the convenience of the particle analyst who wishes to proceed from morpheme to word to sentence (or the reverse) in clean-cut steps."

Procedure 4 involves comparing different matrix structures within the same language to see what is possible in terms of an internal reconstruction of an earlier stage of the language. A principle that underlies this procedure is the recognition that,

Principle 15: A language tends to utilize a particular kind of matrix pattern more than once throughout its structure.

When a given structure recurs throughout the language, internal reconstruction can posit its existence at an earlier stage of the language. We have already illustrated above in section 2 the recurrence of the crisscrossing pattern in Fore and of the L-

shaped pattern in Potawatomi. In fact, in the latter case, the L-shaped pattern is so pervasive that it occurs in different permutations in different matrices.

Another principle that is useful in internal reconstruction is the following:

Principle 16: When one finds a more-or-less regular formative system, a break in the regularity of that system may imply a change over time.

That is, if a matrix is essentially of the simple type (with mostly vector formatives), then one should check to see if fusion can explain the exceptions to the regular pattern, making it plausible to reconstruct a simple matrix. On the other hand, if the matrix is essentially ideal (with mostly single-celled formatives), then one should check to see if analogic extension can explain the exceptions to the regular pattern, making it plausible to reconstruct an ideal matrix. In external reconstruction, one would not rely solely on such inferences, but would look for evidence from other languages to support a posited reconstruction. Such reasoning can still be useful, however, in developing hypotheses to test with external data. (For an example of matrix techniques applied to a problem in internal reconstruction, see Pike and Becker 1964.)

Procedure 5 involves making comparable matrix studies in related languages in order to find evidence for an external

reconstruction of an earlier stage of the language. The basic principle which underlies this quest for the reconstruction of matrices is:

Principle 17: Matrix formative patterns may be retained over time, in spite of heavy fusion which may conceal (in the early stages of research) the historical continuation of common phonological sources.

And following from this is the further principle of reconstruction that:

Principle 18: Shared matrix formative patterns, especially distinctive ones, are more likely to be there because of historical preservation, than because of arbitrary independent development.

Some years ago Pike was in Germany showing to Professor Hansjakob Seiler, a linguistic historian, the Fore crisscrossing structure (see Figures 4 and 5 above). This prompted him to observe that he had found the preservation of a similar crisscross pattern in a submatrix of the nominal inflection system of Classical Greek. That is (quoting him from Pike 1965:208n): "this submatrix has become, in the course of development towards Postclassical and Modern Greek, the basis of the whole nominal inflection" (with references given there to his publication on the subject). This was the first strong support, from a historian, of the assumption that matrix pattern could in

fact contribute toward historical reconstruction of morphology.

Procedure 6 involves attempting to reconstruct matrix structures by comparing them across languages. The suggestion to reconstruct shapes of formative blocks before attempting to reconstruct their phonological content is based on the following principle:

Principle 19: Matrix formative shapes are often more consistently retained than the phonological content of those formatives.

We believe this to be the case because of the following:

Principle 20: Affixes and other grammatical morphemes which are short and unstressed are particularly susceptible to fusion and other forms of irregular change over time.

Note that the traditional comparative method for reconstruction works best on lexical roots. From a wave perspective, such forms (which normally bear stress) occur in the flow of speech at the crests of the waves; in this most salient position of the wave they are most likely to follow laws of regular sound change. Unstressed grammatical morphemes, however, occurring in the troughs of the waves (in the regions of fuzziness between the clear centers) are not as susceptible to follow the postulated sound laws and are much more likely to change in irregular ways. We therefore believe that,

Principle 21: In reconstructing morphology, matrix reconstruction is often more certain than phonological or morphemic reconstruction.

Reconstructing the structure of a matrix works because the elements being reconstructed are emic units of a language. That is,

Principle 22: A matrix formative block, having both a form and a meaning, is an emic unit of pattern; as such it is susceptible to reconstruction.

As an emic unit, a formative block is also "well-defined as to contrast, [etic] variation, and distribution" (Pike 1963:11) and may be described in these terms.

In classical comparative linguistics, we look for correspondences between emic units in which a similarity of form correlates with a similarity of meaning. One contribution of the matrix approach to reconstruction is that the shapes of the formative blocks give a formal characterization (and visualization) of the meaning of the emic units involved. As a result, the shapes of the blocks can be quickly and easily compared to discover the degree of meaning similarity between potentially corresponding units.

Procedure 7 involves attempting to reconstruct the phonological content of the formative blocks. In reconstructing

these phonological forms, the analyst should take advantage of the traditional comparative method and use regular sound change as much as possible to explain differences in phonological forms between languages. However, because of principle 20 above, the regular sound laws cannot be expected to work for affixes to the same extent that they do for root morphemes. Thus,

Principle 23: In the absence of regular sound changes, the phonological content of a matrix formative can be reconstructed by positing a form which (1) leads to the attested daughter forms by applying plausible phonological changes, and (2) offers the most parsimonious set of changes possible that produce the attested forms.

Because of the effect described in principle 20 and the widespread tendency toward greater articulatory efficiency described in principle 3, phonological changes like assimilation, coalescence, weakening, and deletion, though irregular from the standpoint of historical sound laws, are nevertheless plausible and to be expected. The factor of parsimony is a time-honored evaluation criterion in historical linguistics; in the case of competing reconstructions, the one which requires the fewest independent changes is generally preferred.

The notion of phonetic rank of stricture, developed by Eunice Pike (1954, also summarized in K. Pike 1967b:329-331), may be helpful in explaining changes like weakening and deletion. She proposes ranking the phonemes of a language in a number of

dimensions (such as degree of stricture of the oral cavity), and shows in a comparative study of Mazatec dialects in Mexico, that it is consonants of lower rank which are typically deleted in sound change. Extensive discussion of strength hierarchy can also be found in Hooper (1976, especially pp. 196-205).

5. SUMMARY

Numerous articles on matrix analysis were published by Pike and colleagues in the 1960's. These articles pointed out the potential contribution of a matrix approach for identifying historical morphological relationships between languages and for understanding processes of change in morphological systems. They opened the door to the development of an approach to historical reconstruction of morphology based on comparison of matrices.

In this article we have attempted to describe such an approach. The key to the approach lies in viewing the units to be compared and reconstructed not simply as particles in isolation, but also as points in waves of temporal sequence and as points in fields of semantic relationships.

The traditional comparative method for lexical reconstruction focuses on units as particles which shift, split, and merge over time. The proposed matrix method for morphological reconstruction focuses on units (namely, matrix formative blocks) as points in waves and fields. As points in waves, these units are seen to change by a process of syntagmatic

fusion. As points in fields, they are seen to change by a process of paradigmatic analogy. A fundamental tension between greater articulatory efficiency on the one hand, versus greater lexical efficiency on the other, keeps both mechanisms of change active in morphological systems. It is our hope that these insights based on viewing language through wave and field perspectives will augment the particle-based contributions of 19th century linguistic historians to offer a richer comparative method that is effective for historical reconstruction in morphology.

References

- Bloomfield, Leonard. 1946. "Algonquian." *Linguistic Structures of Native America*, Viking Fund Publications in Anthropology 6, Harry Hoijer, and others (eds.). New York: The Viking Fund.
- Brend, Ruth M. (ed.) 1972. *Kenneth L. Pike: Selected Writings*. To commemorate the 60th birthday of Kenneth Lee Pike. The Hague: Mouton.
- Costello, John R. 1983. *Syntactic Change and Syntactic Reconstruction: A Tagmemic Approach*. Dallas, TX: The Summer Institute of Linguistics and the University of Texas at Arlington.

Deibler, Ellis W. 1964. "The Application of Matrix to Gahuku Verbs." Occasional Papers, Series A, No. 3, Linguistic Circle of Canberra Publications (now Pacific Linguistics) 3:17-26.

Deibler, Ellis W. 1973. Gahuku Verb Structure. Dissertation, University of Michigan.

Deibler, Ellis W. 1976. Semantic Relationships of Gahuku Verbs. Summer Institute of Linguistics Publications in Linguistics, number 48.

Denlinger, Paul B. 1987. "'Tone' in Sino-Tibetan." In Agatha C. Brankamp, Yi-chin Fu, Arnold Sprenger, and Peter Venne (eds.), Chinese-Western Encounter: studies in linguistics and literature, pages 3-24. Taipei: Chinese Materials Center.

DuBois, Carl D., John Upton, and Kenneth L. Pike. 1980. "Constraints on Complexity Seen via Fused Vectors of an n-Dimensional Semantic Space." Semiotica 29:209-243.

Erickson, Barbara. 1965. "Patterns of Person-Number Reference in Potawatomi." International Journal of American Linguistics 31:226-236.

Goddard, Ives. 1967. "The Algonquian Independent Indicative." Contributions to Anthropology and Linguistics I (Algonquian), pp. 66-106. National Museum of Canada, Bulletin 214.

Goddard, Ives. 1974. "Remarks on the Algonquian Independent Indicative." *International Journal of American Linguistics* 40:317-327.

Goddard, Ives. 1979. "Comparative Algonquian." In Lyle Campbell and Marianne Mithun (eds.), *The Languages of Native America: historical and comparative assessment*, pages 70- . Austin: University of Texas Press.

Headland, Thomas N., Kenneth L. Pike, and Marvin Harris. 1990. *Emics and Etics: a dialogue between Kenneth Pike and Marvin Harris*. Newberg Park, CA: Sage Publications.

Hockett, Charles F. 1948. *Potawatomi I: Phonemics, Morphophonemics, and Morphological Survey; II: Derivation, Personal Prefix, and Noun; III: The Verb Complex; IV: Particles and Sample Texts*. *International Journal of American Linguistics* 14:1-10, 63-73, 139-149, 213-225.

Hoenigswald, Henry M. 1960. *Language Change and Linguistic Reconstruction*. Chicago: The University of Chicago Press.

Hooper, Joan B. 1976. *An Introduction to Natural Generative Phonology*. New York: Academic Press.

Ivanov, Vyacheslav V. 1977. "The Relation between Different Grammatical Levels in the Linguistic Evolution." *Sprache* 23:20-24.

Morgan, James O. 1966. "A Comparison of the Transitive Animate Verb in Eight Algonquian Languages." *Anthropological Linguistics* 8, number 5, part 2, pages 1-16.

Paul, Hermann. 1889. *Principles of the History of Language*, translated by Strong from the Second Edition [1886]. New York.

Pike, Eunice V. 1954. "Phonetic Rank and Subordination in Consonant Patterning and Historical Change." *Miscellanea Phonetica* 2:25-41.

Pike, Kenneth L. 1943. *Phonetics: A Critical Analysis of Phonetic Theory and a Technic for the Practical Description of Sounds*. Ann Arbor: University of Michigan Press.

Pike, Kenneth L. 1951, amplified 1957. *Axioms and Procedures for Reconstruction in Comparative Linguistics: An Experimental Syllabus*. Santa Ana [now Huntington Beach], CA: Summer Institute of Linguistics.

Pike, Kenneth L. 1959. "Language as Particle, Wave, and Field." *The Texas Quarterly* 2:37-57. Reprinted in Brend 1972:129-143.

Pike, Kenneth L. 1962. "Dimensions of Grammatical Constructions." *Language* 38:221-244. Reprinted in Brend 1972:160-185.

Pike, Kenneth L. 1963. "Theoretical Implications of Matrix Permutation in Fore (New Guinea)." *Anthropological Linguistics* 5:8:1-23.

Pike, Kenneth L. 1965. "Non-Linear Order and Anti-Redundancy in German Morphological Matrices." *Zeitschrift fur Mundartforschung* 32:193-221.

Pike, Kenneth L. 1967a. "Grammar as Wave." *Monograph* 20:1-14. Georgetown University, Institute of Languages and Linguistics. (Reprinted in Brend 1972:231-241.)

Pike, Kenneth L. 1967b [1954, 1955, 1960]. *Language in Relation to a Unified Theory of the Structure of Human Behavior*. The Hague: Mouton and Company.

Pike, Kenneth L. 1970. *Tagmemic and Matrix Linguistics Applied to Selected African Languages*. Norman, OK: Summer Institute of Linguistics, The University of Oklahoma.

Pike, Kenneth L. 1982a. *Linguistic Concepts: An Introduction to Tagmemics*. Lincoln, NE: University of Nebraska Press.

Pike, Kenneth L. 1982b. "Tune and Tone: Generalized Syntagmatic Pitch Patterns Constrained by Particular Lexical Patterns." *Journal of West African Languages* 12.2:22-41.

Pike, Kenneth L. and Alton L. Becker. 1964. "Progressive Neutralization in Dimensions of Navaho Stem Matrices." *International Journal of American Linguistics* 30:144-154.

Pike, Kenneth L. and Barbara Erickson. 1964. "Conflated Field Structures in Potawatomi and in Arabic." *International Journal of American Linguistics* 30:201-212. Reprinted: *Advances in Tagmemics*, ed. Ruth M. Brend. Amsterdam: North-Holland Publishing Co., 1964, pp. 135-146.

Pike, Kenneth L. and Jill Jacobs. 1968. "Matrix Permutation as a Heuristic Device in the Analysis of the Bimoba Verb." *Lingua* 21:321-345.

Scott, Graham. 1978. *The Fore Language of Papua New Guinea*. Pacific Linguistics, Series B, No. 47.

Simons, Gary F. 1980. "Morphological Reconstruction and Change in the Pronoun Systems of the Malaitan Languages." A paper presented at the Third New Zealand Linguistics Conference, Auckland, New Zealand, September 3-5, 1980. Unpublished manuscript.

Simons, Linda L. 1986. The pronouns of To'aba'ita (Solomon Islands). In Ursula Wieseemann (ed.), *Pronominal Systems*, pages 21-35. Tuebingen: Gunter Narr Verlag.

Weinreich, Uriel, William Labov, and Marvin I. Herzog. 1968. Empirical foundations for a theory of language change. In W. Lehmann and Y. Malkiel (eds.), *Directions for Historical Linguistics*, pp. 95-180. Austin: University of Texas Press.

Wurm, Stephen A. 1982. *Papuan Languages of Oceania*. Tubingen: Gunter Narr Verlag.

	1st	2nd	3rd
singular	<u>na</u> -	<u>ka</u> -	<u>a</u> -
plural	<u>ta</u> -	ti-	i-
dual	<u>tasi</u> -	tisi-	isi-

Figure 1: Fore object prefixes (after Pike 1963:2)

Figure 2: Field structure of Fore object prefixes (from
Pikel1963:6)

	1	2	3		1	2	3		1	2	3
s	n	k			a						
p			#	+				+		#	
d		t				i				si	

Figure 3: Fore object prefix as three simple matrices of nonoverlapping formative blocks

	1st	2nd	3rd
singular	-u <u>w</u>	-aaN	-a <u>y</u>
plural	-uN	-aa <u>w</u>	-aa <u>w</u>
dual	-us	-aas	-aas

Figure 4: Fore subject suffixes (after Pike 1963:8)

	1st	2nd	3rd
singular	-o#	-aaMPE	-ami
plural	-oMPE	-aa#	-aa#
dual	-ome	-aame	-aane

Figure 5: Fore subject suffixes fused with an emphatic suffix
(after Pike 1963:9)

(a)

	1st	2nd	3rd
singular	n	g	a
plural	l	lk	k

(b)

	1	2	3		1	2	3
s	n	g			#		a
p			#	+			
d		l					k

Figure 6: Object prefixes of Gahuku: (a) as a matrix of complex forms, (b) as a sequence of formative matrices

	1st	2nd	3rd
singular	-uve	-ane	-ive
plural	-une	-ave	-ave
dual	-usive	-asive	-asive

Figure 7: Gahuku subject suffixes (from Deibler 1976:24)

(a) Fore

	1	2	3		1	2	3
s			ay		w	n	#
p	u	aa		+	n	w	
d						s	

(b) Gahuku

	1	2	3		1	2	3		1	2	3
s			i						ve	ne	
p	u	a		+				+	ne		
d						si					ve

Figure 8: Formative matrices for subject suffixes of Fore and Gahuku

		Object							
		1	2	3	4	12	1p	2p	3p
Subject	1		k-	n-	n-			k-	n-
	2	k-		k-	k-		k-		k-
	3	n-	k-		w-	k-	n-	k-	
	4	n-	k-	w-		k-	n-	k-	w-
	12			k-	k-				k-
	1p		k-	n-	n-			k-	n-
	2p	k-		k-	k-		k-		k-
	3p	n-	k-		w-	k-	n-	k-	

Figure 9: Potawatomi person prefixes for the transitive animate independent verb(after Pike and Erickson 1964:202)

		Object							
		2	2p	12	1p	1	3	3p	4
Subject	2				k-	k-	k-	k-	k-
	2p				k-	k-	k-	k-	k-
	12						k-	k-	k-
	1p	k-	k-				n-	n-	n-
	1	k-	k-				n-	n-	n-
	3	k-	k-	k-	n-	n-			w-
	3p	k-	k-	k-	n-	n-			w-
	4	k-	k-	k-	n-	n-	w-	w-	

Figure 10: Potawatomi person prefix matrix permuted to show ranking structure (after Pike and Erickson 1964:203)

Figure 11: Matrix structure for person-number prefix in
eight Algonquian languages (from Morgan 1966:5-6)

		Object							
		2	2p	12	1p	1	3	3p	4
Subject	2				*ke-	*ke-	*ke-	*ke-	*ke-
	2p				*ke-	*ke-	*ke-	*ke-	*ke-
	12						*ke-	*ke-	*ke-
	1p	*ke-	*ke-				*ne-	*ne-	*ne-
	1	*ke-	*ke-				*ne-	*ne-	*ne-
	3	*ke-	*ke-	*ke-	*ne-	*ne-			*we-
	3p	*ke-	*ke-	*ke-	*ne-	*ne-			*we-
	4	*ke-	*ke-	*ke-	*ne-	*ne-	*we-	*we-	

Figure 12: The reconstructed matrix for the person-number prefix of Proto Algonquian transitive animate verbs

"Simple"				"Ideal"			
	A	B	C		A	B	C
X	xa	xb	xc	X	d	e	f
Y	ya	yb	yc	Y	g	h	i
Z	za	zb	zc	Z	j	k	l

Maximizes lexical efficiency

Maximizes articulatory efficiency

Figure 13: Two regular paradigm types

	Free pronoun	Future subject marker
1 sg	*nau	*kukai
2 sg	*'oe	*'okoi
3 sg	*nia	*kai
1in dl	*gurua	*gurua kai
1ex dl	*gamirua	*mirua kai
2 dl	*gamurua	*murua kai
3 dl	*girarua	*girarua kai

Figure 14: Some pronoun forms reconstructed for Proto Malaitan
(from Simons 1980:46)

*'okoi

*'okoi

*'okoi

Figure 15: Morphological change via fusion versus analogy
in future subject markers of two Malaitan languages
(after Simons 1980:45)

	2nd dual	2nd trial
Proto Malaitan	*mu-rua ka-i	*mu-olu ka-i
Pre-To'aba'ita	*mu-ro ka-i	*mu-lu ka-i
To'aba'ita	m - o -k -i	m - u -k -i

Figure 16: Fusion in the development of To'aba'ita future subject markers (after Simons 1980:44)

	lin	lex	2	3
dual	ko-ki	me-ki	mo-ki	ke-koi
trial	ku-ki	mi-ki	mu-ki	ki-kui

Figure 17: Results of fusion in To'aba'ita future subject markers
(after Simons 1980:43)

Proto Malaitan

Pre-To'aba'ita

To'aba'ita

Figure 18: Fusion without loss of information in To'aba'ita
person-number formatives (after Simons 1980:44)

	1 sg	2 sg	3 sg
Proto Malaitan	*kukai	*'okoi	*kai
Fataleka	kai	kai	kai

Figure 19: Extension by analogy in Fataleka future subject markers (after Simons 1980:39)