SUPRASEGMENTAL PHONOLOGY

by

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ABSTRACT

This thesis demonstrates properties of suprasegmental features, phonological features which are underlyingly represented on linguistic units larger than the segment. Suprasegmental tonal operations are described in several languages of West Africa: Mende, Tiv, Maninka, Bambara, and Hausa. Rules governing nasal prosodies are formulated for two languages of South America: Terena and Desano.

Suprasegmentals are shown to have a number of characteristics which distinguish them from segmental features. They are shown to be represented on the morpheme and on the phonological word. The possibility of regarding the syllable as a feature-bearing suprasegmental unit is considered and rejected.

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CONTENTS

INTRODUCTION

This work is devoted to establishing the existence of a suprasegmental level of representation for certain phonological features, in particular, for tone and nasality in a number of languages, and to exploring the implications of this proposal for certain aspects of phonological theory. Certainly, the suggestion of the existence of suprasegmental features is not in itself new, but at several points, differences in various proposals for suprasegmental representation are noted and discussed; cf. especially chapter 6. The most important conclusion reached is that various facts about the behavior of tone would introduce seemingly inescapable anomalies unless interpreted in the light of the particular suprasegmental hypothesis put forward here.

I have attempted to strike a balance between the need for some depth in the analysis of the languages discussed and the need to consider enough different languages to suggest a proper interpretation of the evidence. Often enough, what seems incredibly exotic or complex in a given language turns out, upon deeper analysis and comparison with other languages, to be rather straightforward and expected. Furthermore, a suggestion that may appear rather straightforward or unsurprising when expressed informally may, when formalized appropriately, lead to anomalies or provide the key to interpreting other data, which may have appeared unrelated at first glance.

For this reason, I have attempted to describe each language as deeply as time and the availability of data would permit and to formalize the results whenever the resulting statement appeared to shed light on other problems encountered.

In some cases, I fear that I have failed miserably. At a number of points in the discussion, for example, I uncover instances in which a linguistic entity appears to act like a single segment in some respects but like two segments in others. In Standard Thai, for example, the first element of a compound in certain instances has its vowel shortened, so that two underlying vowel segments are collapsed into one; whenever this happens, an underlying rising or falling tone is collapsed into a mid tone. In the analysis of Mende proposed in chapter 2, or, apparently, in any reasonable analysis of Mende, it is necessary to view tone sequences as represented as a sequence of features on a single segment at some level of representation. In the discussion of syllables in chapter 6, cases are encountered in which a sequence of two apparently distinct segments count as only one segment for the operation of phonological rules. These instances are not predicted by the theory I propose, and it seems likely that a truly adequate theory may be able to treat them all properly in one and the same way.

What I have attempted to do is to make as much sense as possible of the data at hand--that is, to propose principles

with some plausibility that explain the data and to examine the interaction of these principles with a view to finding ways in which they either reinforce each other or present anomalies. The ability to accommodate a rather significant array of facts does not in itself establish the correctness of my proposals, but it does help define a potential area of concern for related future work, which hopefully will not only avoid whatever pitfalls I have stumbled into but also succeed at least as well in providing explanations on specific points.

CHAPTER ONE. THE THEORY OF SUPRASEGMENTAL REPRESENTATION[1]

1.0. Introduction.

1.0.1. Perhaps the most striking aspect of the description of tone is the number of distinct kinds of underlying representation that have been posited for it in various languages. For example, Edmondson and Bendor-Samuel (1966) claim that the tonal patterns on words in Etung are such that tone cannot reasonably be regarded as other than a feature of the phonological word; Rowlands (1959) makes a similar claim for Gambian Mandinka. Welmers (1962) makes an observation about stress assignment in Kpelle which he regards as formulable only if tone is expressed as a feature on morphemes. Similarly, McCawley (1970a) proposes that in Bantu verbs and in the Southern and Western Kyushu dialects of Japanese, tone is phonologically represented as a morpheme feature assigning pitch to the pitch-bearing unit; this proposal draws on the observation in McCawley (1964) that in Southern and Western Kyushu, the amount of tonal information necessary in an underlying representation is independent of the length of the morpheme. At the same time, Pike (1948) defines the syllable as the tone-bearing unit in a tone language; McCawley (1964, 1970a), too, adopts the syllable as the domain of tonal features in tone languages, and Wang (1967) also argues in favor of this position. Finally, Woo (1969), Schachter and

Fromkin (1968), and Maddieson (1971) express tone phonologically as a feature on segments.

1.0.2. Is tone such a special phenomenon that it must be viewed as a feature on morphemes or larger units in some languages, as a feature on syllables in others, and as a feature on segments in still others? If so, then there is something to explain: namely, why tone, unlike any other linguistic entity we know anything about, is capable of this many different types of representation. Most phonological features appear to be capable of only one type of representation; for example, features like [continuant] or [strident] are almost universally maintained to be features only on segments, while features like [+Past] or [+First Conjugation] are represented as features on morphemes or larger units. Although Chomsky and Halle (1968), hereafter SPE, propose a convention assigning these morpheme features to individual segments in order to account for certain phonological facts, it is clear that such features are not subject to the sorts of phonological changes that tone may undergo. The representation of features on syllables is discussed and rejected in chapter 6; but, granting for the moment that some types of features might be expressed on syllables, we lack clear evidence which would distinguish the behavior of such features from the behavior of features on other linguistic units, such as the morpheme or the segment; this makes it hard to come by

justification for positing tone as a feature on syllables. Still, if we abandon the claim that tone is capable of all of these different kinds of representation, then an equally difficult question arises: what has caused these different representations to be proposed, and what principles limit the available representations for tone?

1.0.3. The basic thesis that will be defended here is that tone is not really all that different from other phonological phenomena that have been studied, that at least one of these other phenomena--nasalization--is also expressible as a feature on two different kinds of linguistic unit (cf. chapter 4), and that, given a proper analysis of the data, there is no contradiction or paradox involved in maintaining that these phenomena behave sometimes like segmental features and sometimes like suprasegmental features, where "suprasegmental" is taken to characterize features on linguistic units larger than the segment.

To demonstrate these points, we need criteria for differentiating segmental from suprasegmental behavior, and these criteria will have to be specified formally. The framework of generative phonology is an attractive vehicle for this purpose, since by its very nature it affords a concrete evaluation of claims about segmental or suprasegmental behavior. For example, if one maintains that tone is a segmental phenomenon, the formalism clarifies the nature of

the task involved in demonstrating, first, that this claim has some content, and second, that the claim is true; one would aim to show that there are non-segmental phonological phenomena in language and that tone behaves not like these but like other clear cases of segmental phenomena. Similarly, if one advocates representing tone as a feature on morphemes, one's evidence will exhibit similarities between the behavior of tone and the behavior of undisputed morpheme features.

1.0.4. The present work, and the present chapter in particular, will point up a number of empirical predictions latent in a formalism; this situation, which is not at all uncommon, provides perhaps the most potent justification for concern with formalism in linguistic description. Insofar as the present work is devoted to formal aspects of the representation of suprasegmental phenomena, it may appear subject to recent attacks on the "empty formalism which has characterized generative phonology and its derivatives to date" [Ohala, 1972]. Ohala (1973) has condemned "the sterile, faddish formalism and unchecked speculation that characterizes most of generative phonology and its offshoots."

The speculation which Ohala criticizes is in fact checked, and rather conclusively at that, by linguistic data. To the extent that a totally explicit analysis seeks to explain why a certain set of facts obtain, it makes predictions that go beyond the data; this is so because any explanation

must rest on empirical assumptions that are independent of the data explained (cf. SPE and Chomsky, 1965). As the accuracy of the predictions is examined, the validity of the explanation can be judged. A linguistic formalism would be sterile if in principle it provided no clue as to the adequate representation of linguistic statements--if, in short, it made no empirical predictions. But the formalism of generative phonology, while it may turn out to be inadequate, is hardly to be characterized as sterile, in this sense.

Kiparsky (1972), in a discussion of two Finno-Ugric languages, has provided what is perhaps the clearest example to date of the benefits achieved from the current "fad" of formulating rigorous, explicit descriptions. Eastern Cheremis has a stress rule which, expressed informally, has two parts:

(1) STRESS (Eastern Cheremis)

1. Accent the last unreduced vowel of the word.
2. If there is no unreduced vowel, accent the first syllable.

In Komi, on the other hand, stress is assigned in the following way:

(2) STRESS (Komi)

1. Accent the first heavy vowel in the word.
2. If there is no heavy vowel, accent the last vowel.

Hence, if we symbolize reduced or non-heavy vowels with $\breve{V}$, we may schematize facts of these languages in the following way, using C_o to designate any number of consonants:

(3) a. Eastern Cheremis

i. $C_o\breve{V}C_oVC_o\acute{V}C_o$

ii. $C_o\acute{\breve{V}}C_o\breve{V}C_o\breve{V}C_o$

b. Komi

i. $C_o\breve{V}C_o\acute{V}C_oVC_o$

ii. $C_o\breve{V}C_o\breve{V}C_o\acute{\breve{V}}C_o$

Now, Kiparsky observes, if we attempt to formulate Part 1 of the Eastern Cheremis stress rule in the simplest way (i.e. using the "simplistic" notion employed in SPE), we arrive at the following result, which has been modified from Kiparsky's published version to reflect some recent unpublished work by M. Halle and J.-R. Vergnaud:

(4) STRESS (Eastern Cheremis)

$V \longrightarrow [+acc] / \_\_ Q\#$

CONDITION: $Q \neq$ ...[-reduced]...

In this rule, Q is a variable which can stand for any string of segments that does not contain a word boundary; the condition imposed on Q, which prohibits it from containing unreduced vowels, guarantees that the final unreduced vowel of the word will be accented. But in addition to expressing the first

part of the informal stress rule in (1), (4) also automatically yields the second part; there is a general convention on the interpretation of variables like Q which requires that the first expansion of Q must be the maximal one (in this case, the expansion which makes the V to be accented the first vowel in the word); furthermore, once we establish that the rule applies in this environment, subsequent applications of the rule to noninitial vowels are blocked by a convention specifying disjunctive ordering for the environments enumerated by Q.

For similar reasons, the simplest statement of Part 1 of the Komi stress rule automatically yields Part 2 as a special case:

(5) STRESS (Komi)

$$V \longrightarrow [+acc] \;/\; \#Q \_\_$$

CONDITION: $Q \neq \ldots[+heavy]\ldots$

Note that the point here is not simply that our notational conventions make possible a few elegant solutions to stress problems; rather, these notational conventions, which were arrived at on completely independent grounds, will, when coupled with an evaluation measure, permit us to explain why these two languages differ not just in Part 1 or in Part 2 of the stress rules (1) and (2), but in <u>both</u> parts of these rules. Since the analysis in (4) and (5) says that only one

rule is involved in each of these cases, it follows from this analysis that a language which differs from Eastern Cheremis or Komi in one part of the stress rule in (1) or (2) will also optimally differ in the other part of the stress rule.

In addition, J. H. Greenberg and C. A. Ferguson have privately observed that the sort of situation depicted in Eastern Cheremis and Komi is quite common in languages. This is exactly what our notational conventions would predict, given that languages tend toward optimal representations for their rules.

1.0.5. These notational conventions, since they constitute empirical hypotheses about how language works, are, of course, subject to disconfirmation. Consider, for example, the complicated account of Hausa stress in Abraham (1934). From the data that Abraham gives, we may judge that stress is assigned by the following ordered informal rules:

(6) STRESS (Hausa)

1. Assign [1 stress] to all H (for high) tones.
2. Reduce [1 stress] to [2 stress] on all vowels when either LH or HL precedes in the same word or when HL follows in a separate word.
3. Disyllabic nouns with the pattern LH have their stress shifted back to the L vowel when a word beginning with H follows; the shifted stress is reduced to [2 stress].
4. In a reduplicative compound of the form LH-LH, stress on the first H is shifted back onto the L vowel and reduced to [2 stress].

It is impossible to express this account in an elegant set of rules using the SPE conventions. Hence, assuming Abraham's characterization of the Hausa stress facts to be correct, we might look for notational conventions to supplant those of SPE which would permit a more reasonable statement of (6) while at the same time providing for rules in English, Eastern Cheremis, Komi, and other languages in which the current notational conventions have proved adequate. On the other side of the coin, however, we see that the current notational conventions, since they do appear to be justified by the facts of a number of languages, cast doubt upon the correctness of (6) as a representation of linguistic data, judging from the relatively awkward form of (6) when expressed under these conventions. Since Abraham's observations appear never to have been taken seriously by any scholar, the second side of the coin is most likely the appropriate one in this case.

This points up the function of a theory in scientific fact-gathering; insofar as a theory appears to be justified, it should be permitted to shape our expectations about how the facts will turn out; and insofar as a theory induces empirically incorrect expectations, it needs to be modified or abandoned. In the case of Hausa stress, of course, there is a chance that the notational conventions are essentially correct, that Abraham's report of the data is accurate, and that the optimal representation of the facts in this case

happens to appear quite awkward. This position could be disconfirmed by producing facts from a closely related language, as with Eastern Cheremis and Komi, which demonstrate that the subparts of (6) are more closely related than the present notational conventions would predict.

In the study of tone, as in any other study of linguistic structure, we have every reason to expect that concern with the formal aspects of representation, far from resulting in what some have called a "pseudo-algebra" or a "sterile game", will produce a real algebra which is subject to disconfirmation when applied to language and which will, in the end, shed light on the behavior of tone.

1.1. Segmental representation of tone.

1.1.0. As noted above, tone is treated as a segmental phenomenon by Woo (1969), Schachter and Fromkin (1968), and Maddieson (1971), among others. However, in all of these cases, justification for the segmental representation of tone is either extremely complex or else totally unmentioned. For the present purposes, it will suffice to summarize an analysis of tone changes in Standard Thai compounds, and then to review some facts from languages in which tone is subject to influences from surrounding segments.

1.1.1. The analysis of tonal changes in Thai compounds, taken from Leben (1971b), provides a quite succinct demonstration of one sort of argument that may be made in favor of segmental representation for tone. Data is from Henderson (1949).

Thai is regarded as having two styles of speech: the isolative style, in which syllables are articulated relatively slowly, and the combinative style, which is more rapid. In the combinative style, distinctions in tone and vowel length are neutralized to a considerable extent. In particular, in compounds, a long vowel in the first element will be shortened in the combinative style, and its tone, if it is a contour tone, will be simplified to Mid.

(7)

	Isolative		Combinative		
a.	thi: HL	nai LH	thi· M	nai LH	'where?'
b.	thi: HL	ni H	thi· M	ni: H	'there'
c.	si: LH	kha:u LH	si· M	kha:u LH	'white'
d.	sa:u LH	sa:u LH	sau M	sa:u LH	'young girls'
e.	wa:ŋ HL	wa:ŋ HL	waŋ M	wa:ŋ HL	'at your leisure'

The single dot after the vowel of the first element in the combinative style in (7a-c) indicates that some length is retained on vowels not followed by a consonant or glide in the same syllable, even though shortening applies. In cases where

the first element has an underlying level tone, shortening applies, but the level tone is maintained as before; it is not changed to a Mid.

(8)

	Isolative		Combinative		
a.	na:m H	tɸha: M	nam H	tɸha: M	'tea'
b.	na:m H	ta:n M	nam H	ta:n M	'sugar'

At this point, we may summarize the facts informally in the following way: in the combinative style, the vowel of the first element of a compound is shortened, and if it has a complex tone, this is simplified to Mid. The following two sets of forms establish that there is a close connection between the shortening of the vowel and the simplification of the tone:

(9)

	Isolative		Combinative		
a.	tɔŋ HL	ka:n M	tɔŋ HL	ka:n L	'want'
b.	thau HL	rai M	thau HL	rai M	'how much'

Here we see that if shortening does not apply (that is, if there is no long vowel to be shortened), then tone simplification also does not apply.[2]

We can account for the connection between what appeared at first glance to be two separate operations by expressing

long vowels as geminates, VV, and by expressing contour tones as sequences of level tones, with each level tone expressed as a feature on an individual segment, as proposed for other languages by Woo (1969). Vowels with falling and rising tones will then be represented as in (10a,b), respectively.

(10) a. $\underset{[+H]}{V}\ \underset{[+L]}{V}$ = Falling

b. $\underset{[+L]}{V}\ \underset{[+H]}{V}$ = Rising

This permits us to express vowel shortening and tone simplification as a single rule, making the connectedness of these operations explicit.

(11) VOWEL SHORTENING (Thai)

$VV \longrightarrow V$

As Sapir and others have suggested, the result of collapsing two segments into one is in some sense a "compromise" between the original segments; consider, for example, a rule collapsing a vowel and a following nasal--the normal result is a nasalized vowel. Establishing this as a convention on rules of collapsing will cause (11) to merge the sequences HL and LH on vowels into Mid, while leaving the sequence HH as H.

The case for underlying segmental tone features in Thai is supported on independent grounds by the distributional restrictions noted in Henderson (1949) and Abramson (1962): contour tones do not occur on short vowels, but only on

sequences containing a vowel followed by a voiced segment. If contour tones are represented as sequences of level tones and if the phonological segment is taken as the domain of the level tone feature, the possibility of representing a contour tone sequence on a single short vowel is correctly excluded in principle.

1.1.2. Another instance of segmental behavior on the part of tone involves its being subject to influences from the surrounding segmental environment. Greenberg (1968) discusses a number of languages in which tone exhibits, or historically has exhibited, this type of behavior. For example, he mentions a synchronic example from Xhosa in which a high tone is realized as rising when preceded by a "depressor" consonant, such as bɦ, mbɦ, mɦ, v, ɦ, but not when preceded by consonants like p, ph, t, ɓ, m, f, h. As we might expect, a falling tone, which is really the sequence HL, is realized as rising-falling, LHL, when preceded by a number of this same class of depressor consonants.

(12) a. into 'thing'
H H
[¯ ¯]

b. inja 'dog'
H H
[¯ ˩]

c. impuku 'rat'
H HL H
[¯ ˥˩ ¯]

d. imbhila 'rabbit'
H HL H
[¯ ˩˥ ¯]

A number of proposals have been advanced to account phonetically for the influences of a preceding consonant on a tone; two of these, presented in Ladefoged (1972) and Halle and Stevens (1971, 1972), will be described briefly in chapter 5. For the case at hand, it is sufficient to note that, while part of the consonantal influence on tone is a completely automatic consequence of the physiology of speech, languages like Xhosa must also incorporate a phonological rule which prefixes a low-toned component to a H preceded by a depressor consonant, since the physiology of speech is not sufficient to account for the degree of lowering evidenced; this point is discussed at greater length in Fromkin (1972) and Hyman and Schuh (1972).

Given this, we may say that in the case of Xhosa, tone behaves like a segmental feature, at least at some point in the phonology, since it is influenced by surrounding segments; later we will see that non-segmental features are not subject to such influences.

1.2. Some apparent idiosyncrasies in the behavior of tone.

1.2.0. Evidence for segmental features of tone has led some researchers to reduce all instances of the behavior of tone to a representation in which tone is characterized exclusively as a feature on segments. This position is defended by Woo (1969). Schachter and Fromkin (1968) express tone in Akan as a feature on vowels in underlying representations; in addition, they

permit phonological derivations to give rise to a tone feature represented on an entity which has no segmental features other than [+seg]. This proposal is reformulated in Fromkin (1972), where these segmentally unspecified entities are characterized as [-seg]. A somewhat similar proposal is made for Nigerian and other languages in Maddieson (1971), but with [-syllabic] substituted for [-seg].

In this section I will attempt to demonstrate that tone does not uniformly behave like a segmental feature in languages, that sometimes it exhibits behavior that must be characterized as suprasegmental. Further evidence is presented in chapters 2, 3, and 4. To make this point, I will discuss cases in which segmental tone features cannot explain and can only awkwardly characterize the operation of tone, while suprasegmental tone features make possible a quite satisfying explanation. In addition, I will show that if the use of segmental tone features is extended to characterize these cases, such an extension would make latent predictions about the possible behavior of other segmental features, and these predictions turn out to be false.

1.2.1. Rowlands (1959) proposes that the word is the underlying tone-bearing unit in Gambian Mandinka, noting that regardless of how many syllables a word has, essentially only two pitch patterns are possible in a given environment. Similarly, McCawley (1970a) has observed that in Southern and Western Kyushu, only two types of tonal pattern are possible on lexical entries, a

falling pattern and a non-falling pattern; he emphasizes that the possible tonal patterns are thus completely independent of the number of vowels or syllables in the lexical entry. Polysyllables can occur with only two possible patterns, and these patterns are the same as for monosyllables. This fact is captured by specifying each lexical entry for a value of the feature [Falling]; a phonological rule then maps the pattern onto the segments of syllables of the lexical entry.

The same point is demonstrated in Tiv by McCawley (1970b); the tonal pattern of a given verbal form is arrived at by a phonological rule which combines the basic tone of the verb with the basic tone of the tense or aspect morpheme that is attached to the verb. As shown in chapter 3, this rule operates without regard for segmental information about the verb. Subsequently, a phonological rule maps the tonal pattern arrived at in this way onto the segments or syllables of the verbal form.

The fact that the operations which precede tonal mapping occur without reference to segmental information is captured on an analysis in which the tonal information is specified suprasegmentally; suprasegmental tones are by definition independent of any segments--rather than being expressed as features on segments, they are features on larger linguistic units. This makes it impossible for suprasegmental tone rules to refer to individual segments over which they may range, and hence predicts that suprasegmental tone rules will not need to refer to segmental information.

If tone is expressed as an underlying segmental feature in these languages, on the other hand, the question of why rules prior to tonal mapping operate independently of segmental information is left unanswered. The latter analysis would be consistent with a situation in which such rules did require segmental information. Insofar as we can show that this type of situation is unexpected in languages, we are justified in embracing the suprasegmental proposal over the segmental one, since the suprasegmental proposal makes an apparently correct prediction, while the segmental proposal seems to make no prediction at all. Later on, we will see that there are indeed predictions latent in the segmental proposal, and that these predictions are quite certainly false.

1.2.2. Another type of tonal relationship that is captured without reference to segmental information occurs in Mende, a Mande language of Sierra Leone. Mende lexical entries can have the tonal contour LHL; this contour can occur on words of one, two, or three syllables. Hence, in Mende we have $\underset{LHL}{mba}$, 'companion', $\underset{L\ HL}{nyaha}$, 'woman', and $\underset{L\ H\ L}{nikili}$, 'groundnut'.[3] However, no Mende lexical item can have the tonal pattern HLH, and this restriction applies to words of arbitrarily many syllables; that is, the following are impossible in Mende: $*\underset{HLH}{mba}$, $*\underset{H\ LH}{nyaha}$, $*\underset{HL\ H}{nyaha}$, $*\underset{H\ L\ H}{nikili}$.

A possible explanation for this restriction is suggested in chapter 6. In chapter 2, the representation of Mende tone as a suprasegmental feature is justified in some detail. The fact that the constraint on morpheme structure described here is independent of the number of vowels or syllables in the lexical entry is a direct consequence of the proposed suprasegmental underlying representation. The restriction in question can only be described--and quite awkwardly at that--if we are forced to regard Mende tone as a property of segments or syllables.

1.2.3. Bambara and Maninka, two closely related Mande languages, have the same sort of limitation on underlying tone patterns that was pointed out above for Southern and Western Kyushu and for Tiv; there are only two patterns possible, according to accounts in the literature, regardless of how many vowels or syllables a given word has. To express this fact, Welmers (1949) posits the underlying forms in the first line on the left in (13a,b,c); pronounced before a low tone, these words have the pitches represented in brackets below each form. For our purposes, these underlying forms will be re-expressed in the manner shown on the right, with the superscripts designating suprasegmental tones.

(13) a. jíri [¯ ¯] = ^{H}jiri 'tree'

b. mùso [_ ¯] = ^{LH}muso 'woman'

c. sà [ノ] = ^{LH}sa 'snake'

The motivation for expressing these tones suprasegmentally in underlying representations can, as in the cases mentioned above, be based simply on capturing the limitation on the distribution of tone patterns in these languages; a phonological rule of tone mapping eventually assigns the appropriate tones to individual vowels. What is particularly interesting about Bambara and Maninka is that it is possible to establish the existence of an operation on these tones which treats them as suprasegmental entities. As will be shown in chapter 4, if the operation in question referred to the tones as segmental features, it would produce incorrect results. Also in chapter 4, however, a possible qualification of the limitation of words to two tone patterns will be mentioned.

1.2.4. The discovery of facts which appear to pose a problem for the segmental representation of tone is by no means unprecedented. In the past, some researchers have responded to this by extending the segmental descriptive apparatus in various ways in order to meet the demands of the problematical tonal facts.

Consider, for example, the issue of "floating tones". Bird (1966) has posited a floating L for the Bambara definite

marker. This tone has no segmental realization; the L either is absorbed by a following L or becomes attached to the immediately preceding vowel, which, if it is H prior to attachment, will then be realized as HL; this is illustrated in (14). Less convincingly, perhaps, Bird (1968) has posited a floating H to mark the Bambara indefinite. Similarly, Hyman (1972a,b) proposes a floating tone for the Igbo and Fe'Fe' associative marker.

(14) a. ^{LH}muso-$^{L}\emptyset$ ^{L}kunu-na [_ - _ _ _] 'the woman was swallowed'

b. ^{LH}muso-$^{L}\emptyset$ [_ ◝] 'the woman'

In (14a), the floating L is absorbed by the following L; but in (14b), it is attached to the noun, changing a H into HL.

In the works cited, the existence of floating tones hardly appears to constitute a serious problem; this is due largely to the fact that the authors did not concern themselves sufficiently with formalizing their results. However, in works like Schachter and Fromkin (1968), Fromkin (1972), and Maddieson (1971), where formalism was a concern, the problem immediately surfaces. This points up one of the values of formalism in grammar. In some cases, it brings up anomalies and in others, it suggests explanations which would otherwise go unnoticed.

Schachter and Fromkin (1968) represent floating L in Akan with the matrix [+segment, +L], with no other segmental specifications. This proposal is clearly ad hoc, since no other segmental feature has ever been shown to be capable of this

sort of representation. For example, it has not been proved that languages need matrices like [+segment, +continuant] with no other feature specifications filled in. This constitutes an anomaly on the segmental view. Why should one type of segmental feature be able to float, when no other segmental feature appears to have this property? If we permit this question to go unanswered, the statement that tone is a segmental feature becomes undisconfirmable and therefore uninteresting; the claim that a given entity is a segmental feature, if unaccompanied by an explanation for why this entity is capable of behavior different from that of other segmental features, opens the door to an endless number of possible claims of segmental status for entities that clearly are not segmental. Hence, this proposal for a "segmental" representation for floating tones owes us an explanation before we can be expected to accept this view.

The suprasegmental theory, on the other hand, practically leads us to expect the existence of floating tones. This theory says, roughly, that two separate feature matrices can be specified for a given lexical entry in a tonal language: the first represents a sequence of segments, and the second represents a sequence of suprasegmentals. We know that in some of the languages argued above to have suprasegmental tones lexically, certain morphemes are nonetheless inherently toneless, their tones being in all cases assigned by rule. Such morphemes are thus specified underlyingly with only one of the two types of feature matrix, the segmental type. In view of this, we may

expect that other morphemes in such languages will be specified only with the suprasegmental type of feature matrix; this is exactly what a floating tone is.

Other proposals which have attempted to escape the supra-segmental nature of floating tones are subject to the same criticisms as the unspecified-[+seg] proposal. Maddieson's (1971) assignment of tone features to "segments" which have the feature [-syllabic] but no other segmental features is obviously ad hoc in the same way as the proposal which has [+seg] where Maddieson has [-syllabic]. Under a proposal in Fromkin (1972), a floating L would be represented by [-seg, +L]; the assignment of a "segmental" feature to [-seg] is, again, totally ad hoc, leaving unanswered the question of why languages do not appear to contain matrices like [-seg, +strident]. Fromkin's proposal says, in effect, that tone is the only feature that is possessed both by [+seg] and by [-seg]. Hence, although the proposal reflects an attempt to reduce tone to the same sort of description as other phonological phenomena, it cannot avoid the claim that tone behaves in unique ways.

1.2.5. For similar reasons, any theory which requires that tone be expressed exclusively as a segmental feature is hard put to explain how restrictions like the ones noted in sections 1.2.1 and 1.2.2 could exist. Taking the Mende prohibition against the sequence HLH as an example, the segmental theory would lead us to expect similar prohibitions to apply to clear cases of segmental features. We might expect that it would be possible for

a language to prohibit the sequence [+nas][-nas][+nas] in words of three segments, while permitting the sequence [-nas][+nas][-nas]. In this language, the restriction would rule out words like mam, ãtã, and ĭln while permitting words like amb, tãt, and ini. It is quite certain that restrictions of this type are nonexistent in natural languages.

Another type of case that we might look for is a language in which an undisputed segmental feature, such as [rounded], was subject to a prohibition ruling out the following:

(15) a. $*C_o\ V_{[+rd]}\ C_o\ V_{[-rd]}\ C_o\ V_{[+rd]}\ C_o$

b. $*C_o\ V_{[+rd]}\ C_o\ \overset{\frown}{V}_{[-rd][+rd]}\ C_o$

c. $*C_o\ \overset{\frown}{V}_{[+rd][-rd][+rd]}\ C_o$

where the tie $\frown$ is taken to indicate a sequence of features on a single segment. There are two problems here. The first involves the expression of sequences of features on single segments; this will be examined in the discussion of contour tone features, section 1.3. The second problem involves the expression of "melodies" containing transitions in segmental feature specifications ranging over lexical entries or over the vowels of lexical entries. One type of phenomenon that may appear related to this is vowel harmony, whereby all of the vowels up to a given point in a word are specified as agreeing in some feature, such as [tense], [back], or [rounded]. But this is

the most trivial sort of segmental "melody", involving not a transition in values of a feature but rather agreement in the value of a feature. This phenomenon might actually prove to warrant suprasegmental treatment, like the nasalization prosodies discussed in chapter 5, but this question will not be investigated here. However, even if vowel harmony is granted to be a purely segmental phenomenon, the segmental descriptive apparatus it requires will not be sufficient to accommodate the expression of tonal melodies. Any extension of segmental phonology to accommodate putative segmental characteristics of tone will raise the question of whether clear cases of segmental features behave similarly, and if not, why not.

1.2.6. Another phenomenon which the segmental theory of tone appears unequipped to deal with, involving syllable inversion games in languages, was first brought to my attention by L. M. Hyman. Haas (1969) points up a language game in Thai and Burmese in which the syllable finals of adjacent words in a constituent are interchanged; for example, the bracketed expressions in the Thai example (16a) are interchanged, producing the output in (16b).

(16) a. k[on] j[aj] ⟶ 'big bottom'
HL L

b. k[aj]j[on]
L HL

Note that the tone moves along with the vowel and syllable final. Haas compares this game with English spoonerisms, such as the

conversion of half-formed wish into half-warmed fish. Hombert (1973) has established that a similar language game is played in Bakwiri, a Bantu language of Cameroon. In this game, the first syllable is moved to the end of a word. For example, the words in (17a) and (18a) are converted into (17b) and (18b):

(17) a. mɔkɔ ⟶ 'one person'
L H

b. kɔmɔ
L H

(18) a. k^{W}eli ⟶ 'falling'
H L

b. lik^{W}e
H L

Note that in this language, the tone pattern of the input is preserved in the output--the tone does not move along with the shifted syllable. If we can establish independently that tone is a suprasegmental phenomenon in this language, a likelihood in a Bantu language, then the suprasegmental theory has an explanation for this difference between the language games of Bakwiri and Thai, namely, that in Bakwiri the tone pattern is a property of the word, while in Thai, as can be gathered from the discussion in section 1.1.1., tone is a property of individual segments and hence moves along with the segments. The theory that tone is only a property of segments provides no explanation for this difference.

However, Hombert also observes that the vowel length pattern in a word is also immobile. Examples are:

(19) a. luunga 'stomach' ⟶ ngaalu
L H L H

b. muulu 'senior' ⟶ luumu
L H L H

c. 'esee 'it is not' ⟶ se'ee
H L H L

The length of the vowel in the first or second position remains unaltered in each of these pairs, even though the vowel itself may have changed. Thus, in order for the proposed explanation for the preservation of the tonal pattern to go through, some explanation must be found for the preservation of the vowel length pattern. In the absence of any explanation, it must be admitted that if this example is taken as evidence for the suprasegmental character of tone in Bakwiri, then it must also be taken as evidence for the suprasegmental character of vowel length in this language.

1.3. Contour tone features.

1.3.0. One of the most difficult questions to answer in the study of tone concerns the possibility of expressing contour features, such as [Rising], [Falling], and [Rising-Falling]. If such features are disallowed, the suprasegmental theory would receive another boost, since it alone appears capable of adequately expressing the underlying tone of Mende words like mbu (HL), 'owl', mba (LH), 'rice', and mba (LHL), 'companion', all of which have been reported to contain a short underlying vowel. The

alternative of representing these contours by adding entities labelled [+seg], [-seg], or [-syllabic] capable of bearing tone features was discarded in section 1.2; other conceivable alternatives to the suprasegmental theory will be treated in this section.

It would perhaps be reckless to suggest that underlying contour features do not exist; an example from Wang (1967) is discussed in chapter 2. However, it is possible to demonstrate that in certain languages which exhibit surface contour tones on single syllabic nuclei along with complex tonal melodies, such as those in Mende, in lexical representations, these contour tones do not have the properties of known phonological features; specifically, these contours do not behave like indivisible units, as the feature representations [Rising], [Falling], and [Rising-Falling] would imply.

1.3.1. An instance in which this point is easy to see is the phenomenon of downdrift in African languages. The phenomenon involves the lowering of successive high tones when they are preceded by low tones. (Successive noncontiguous low tones may also be lowered.) For example, the phonological sequence HLHLH would, if this contour remained unchanged in the course of a derivation, be assigned the phonetic pitch representation in brackets below:

(20) H L H L H

[¯ _ ¯ _ _]

The way that pitch assignment is normally expressed (e.g. in Schachter and Fromkin, 1968, and Voorhoeve, Meussen, and DeBlois, 1969) is by having a preceding L cause a lower pitch to be assigned to a H than would otherwise be the case.[4] Now, in any language with downdrift, it so happens that the initial part of a falling tone is subject to downdrift just as is any H; furthermore, the final part of a falling tone occasions downdrift, just as any L would. The same point can be made with reference to rising tones and rising-falling tones. This fact is an immediate consequence of regarding a falling tone as a sequence of HL, a rising tone as a sequence of LH, and so forth. One apparent alternative to treating contour tones as sequences of level tones would involve adding the redundant specifications [+H] and [+L] to contour features, as illustrated below:

(21) a. Falling b. Rising c. Rising-Falling

$$\begin{bmatrix} +\text{Falling} \\ +\text{H} \\ +\text{L} \end{bmatrix} \qquad \begin{bmatrix} -\text{Falling} \\ +\text{H} \\ +\text{L} \end{bmatrix} \qquad \begin{bmatrix} +\text{Convex} \\ +\text{H} \\ +\text{L} \end{bmatrix}$$

Not only is this use of distinctive features entirely ad hoc --contradictory specifications such as [+H, +L] are unheared of in phonology--this solution does not even work! The reason is that, although we know that the initial part of a falling tone behaves like a high tone, and the final part of a falling tone behaves like a low tone, there is nothing in this solution which prevents us from incorrectly taking the feature [+H] in the matrix (21c) as causing the initial part of this tone to

undergo lowering after L (as the feature [+H] in (21a) does), or as permitting a H following this tone to remain on the same pitch as the final part of this tone (as the feature [+H] in (21b) does). To avoid this undesirable situation, it is necessary to add to the grammar a convention for interpreting the feature complex [+Convex, +H, +L] as a sequence L-H-L, and so on. This extra convention is unnecessary in the suprasegmental theory, which represents the tone in question directly as the sequence LHL, and in cases where this sequence is to be mapped onto a single segment, it is mapped as a sequence--cf. 1.4 and chapter 2, 2.4. The theory of segmental representation is here forced to recognize the feature complexes in (21) as sequences also, by adding a convention which states this. In other words, the segmental theory incorporates a great deal of ad hoc machinery in trying to express a point elegantly stated in the suprasegmental theory: contour tones are sequences of level tones in languages with a level of suprasegmental representation for tone.

1.3.2. Another instance in which contour tones do not behave like indivisible units involves the rule of TONE COPYING, reported in Leben (1971c) for Hausa and in chapter 2 for Mende. This rule copies the immediately preceding tone onto an inherently toneless element. When the immediately preceding element has what might be described as a contour tone, such as Mende $\underset{HL}{mbu}$ or $\underset{LH}{mba}$, the tone copied is not a falling or a rising tone

but rather the last level tone of the sequences HL or LH. The suprasegmental theory, which disallows contour features in languages with a suprasegmental level of representation, again makes the correct prediction.

1.4. Tone mapping rules.

1.4.0. If we accept the proposal that a suprasegmental level of representation is possible in some languages, there are some questions to be answered concerning the nature of the extension of phonological theory that such a level would require and concerning the apparent uniqueness of tone in appearing in both suprasegmental and segmental representations.

The evidence presented in section 1.2 is sufficient to warrant any extension of phonological theory required in order to permit the expression of a suprasegmental level of representation on lexical items whose tones exhibit the non-segmental behavior pointed out above. But in fact, the required modification of phonological theory can hardly be termed an extension at all. There are already many clear cases of features attached to lexical entries: lexical category features, features marking a given lexical entry as an exception to a general phonological rule or as undergoing a minor rule, and the like. Among these features is at least one "sequence" feature, the feature which specifies the order of segments in the lexical item. Suprasegmental representation requires simply that another sequence feature be expressed on a lexical item, a feature specifying

the order in which suprasegmentals occur on the lexical item. In addition, a phonological mapping rule is required, to map the suprasegmentals onto the segmentals at some point in the derivation. This type of rule is shown to exist independently of tone in chapter 5, though it must be confessed that the formal apparatus required for tone mapping rules appears rather involved. Informal examples of tone mapping rules are presented in chapters 2, 3, and 4.

1.4.1. To illustrate the suprasegmental proposal, it will be helpful to consider a possible formulation of a tone mapping rule, and to do this, it will first be necessary to clarify the nature of the input to such a rule. In chapter 2, it is proposed that in Mende, ^{HL}kenya is mapped into kenya (H L). The input is a morpheme which has associated with it a sequence of segments, a sequence of suprasegmentals, and whatever morpheme features are needed to insure the correct application of morphological and phonological rules, such as the information that this morpheme is a noun. The output is different only in that the sequence of suprasegmentals has been interpreted as a sequence of tone features added to the segments of the morpheme. In SPE, it is noted that the sequence of segments in a morpheme can be regarded as a set of categories to which the morpheme belongs:

> ...each formative falls into many categories; in fact, each formative may be regarded as being constituted simply by a certain set of categories. For example,

> the formative inn belongs to the syntactic categories "noun", "common", "nonanimate", "count", etc.; to certain semantic categories which specify its meaning; and to the phonological categories "initial-vocalic", "initial nontense", "second-consonantal", "second-nasal", etc....
>
> It is clear that many of the phonological categories can be represented in terms of a "phonological matrix", in which the rows are associated with features such as "nasality" and "tenseness" and the columns are called "phonological segments." Thus, assignment of the morpheme inn to the categories "initial-vocalic" and "initial-nontense" can be indicated by entering + in the first column in the row labeled "vocalic" and - in the first column in the row labeled "tense"; its assignment to the category "second-nasal" can be indicated by entering + in the second column in the row associated with "nasality", and so on. [pp. 164-165]

In other words, a phonological matrix is a means of representing the set of phonological categories to which a morpheme belongs; it must be kept in mind, though, that what a matrix represents is a certain subset of morpheme features. A parallel suggestion can be made for suprasegmental tones. A morpheme with the contour HL belongs to the categories "first, [+H]" and "second, [-H]", which, in this case can also be represented as a rather trivial matrix, containing one row and two columns. We may picture the phonological specification of Mende kenya in the following way, where the segmental features are designated schematically as F_1, F_2, ..., F_n and their values assigned arbitrarily, and where the suprasegmental feature [H] stands for "high-toned":

(22) kenya

a. Matrix 1:

F_1	+	−	+	−	+
F_2	−	+	−	+	−
⋮					
F_n	+	+	+	+	+

b. Matrix 2:

H	+	−

c. Other morpheme features

The result of tone mapping is to convert Matrix 2 into information about certain segments of Matrix 1: the first vowel is to acquire the feature [+H] and the second is to acquire the feature [-H]. (As the discussion of nasal prosodies in chapter 5 shows, segmental features must actually be regarded as distinct from the corresponding suprasegmental features; this complication is disregarded in the present illustration.) Thus, the output of the mapping process may be depicted as follows:

(23) kenya

a. Matrix 1:

F_1	+	−	+	−	+
F_2	−	+	−	+	−
⋮					
F_n	+	+	+	+	+
H		+			−

b. Other morpheme features

1.4.2. Next, a first approximation of the mapping rule may be attempted. As shown in the next chapter, the following principles express the mapping informally:

(24) TONE MAPPING (Mende)

a. If the number of level tones in the pattern is equal to or less than the number of vowels in the word possessing the pattern, put the first tone on the first vowel, the second on the second, and so on; any remaining vowels receive a copy of the last tone in the pattern.

E.g. ^{LHL}nikili becomes $\underset{L\ H\ L}{\text{nikili}}$

^{H}pɛlɛ becomes $\underset{H}{\text{pɛlɛ}}$ and then $\underset{H\ H}{\text{pɛlɛ}}$.

b. If the number of level tones in the pattern is greater than the number of vowels in the word possessing the pattern, put the first tone on the first vowel, the second on the second, and so on; remaining tones are expressed as a sequence on the last vowel available.

E.g. ^{HL}mbu becomes $\underset{HL}{\text{mbu}}$

^{LHL}nyaha becomes $\underset{L\ HL}{\text{nyaha}}$

To express notions like "first tone on the first vowel", it will be necessary to attach subscripts to the vowels in a string of segments and to the tones in a string of suprasegmentals. Thus, let us assume that the successive vowels in a string are marked $V_1, V_2, \ldots, V_m$, and that the successive tones are designated $T_1, T_2, \ldots, T_n$.

To express the environment for the mapping, it is necessary to take note of the following convention, proposed in SPE: "Every segment of a lexical matrix μ is marked [αK] for each category [αK] to which μ belongs." For example, each segment of the noun kenya is marked [+noun]. Since the noun kenya belongs to the categories "first, [+H]" and "second, [-H]", each

of its segments will by convention be marked [+first, [+H]] and [+second, [-H]]. This permits us to express the first part of the mapping rule as follows:

(25) $V_i \longrightarrow [\alpha H] \; / \; [_{+\underline{j}th,\ \overline{[\alpha H]}}]$

CONDITION: $i = j$ OR if $j = m$, $i \geqslant j$

This rule says that a vowel whose subscript agrees with the number designating the position of the suprasegmental tone acquires that tone as a segmental feature, and that a vowel whose subscript is greater than that of the last tone, the vowel acquires the last tone as a segmental feature. (Recall that the need for distinct labels for segmental and suprasegmental features is being ignored in this account.)

The formulation in (25) also expresses the part of (24b) which assigns one tone per vowel; what remains to be expressed is that if some tones are left over, they must be grouped in sequence on the last vowel. This occurrence of a linear sequence of features on a segment is discussed a bit further in the next chapter. To formulate the rule, another convention must be introduced:

(26) CONVENTION

> A rule mapping a suprasegmental tone onto a segment already specified for a tonal feature does not replace this feature but instead adds another tone feature in sequence.

This convention is also needed for many cases in which a

floating tone is added to a segment without replacing the tone already possessed by the segment.

The remaining part of the mapping rule may now be formulated as:

(27) $V_m \longrightarrow [\alpha H] / [_{+\underline{j}th, \overline{\quad [\alpha H]}}]$

CONDITION: $m < j$

V_m here denotes the last vowel in the string. The arrangement of the tones in their proper sequence must be assured; this is possible in principle, since the proper order of the supra-segmental features is given by the relative values of their subscripts. The formulation of this requirement is not attempted here, but presumably the output of (27) on the last segment of $\underset{L\ HL}{\underline{nyaha}}$, for example, would resemble the following:

(28) $\underline{a}$

[1, [+H]]
[2, [-H]]

where the numerals 1 and 2 give the order of these features on the segment.

Obviously, rules (25) and (27) can be collapsed into (29):

(29) $V_i \longrightarrow [\alpha H] / [_{+\underline{j}th, \overline{\quad [\alpha H]}}]$

CONDITION: $i = j$
OR if $j = n$, $i \geqslant j$
OR if $i = m$, $i < j$

1.4.3. The existence of tone mapping rules serves to constrain phonological derivations. We should expect that before mapping rules convert prosodic patterns into features on segments, the patterns will not be capable of undergoing operations that depend on the nature of the segments over which they range. This is captured by the suprasegmental theory as an automatic consequence of a constraint that is already built into present phonological theory. That is, for the same reason that the present formalism will not permit the operation described in (30a), it will prohibit (30b).

(30) a. Lexical items with the feature [+First Conjugation] acquire the feature [-Rule 1001] when their final segment is [-consonantal].

b. Lexical items whose suprasegmental matrix has the feature [+H] acquire the feature [-H] when their final segment is [-consonantal].

Notice that this does not prohibit all operations on suprasegmentals; in particular, it permits the suprasegmental rules of TONE SPREADING and TONE COPYING, described in the chapters that follow, which do not refer to segmental information. The question of whether these rules are simply types of mapping rule is tackled in chapter 2, where it is argued that mapping is a distinct process.

This analysis provides an ordering principle; it says that any rule in which tone is affected by surrounding segments must be ordered after any rule in which tone is represented as a suprasegmental. Similarly, in a language with the nasalization

prosodies discussed in chapter 5, we would expect the interaction of nasals and surrounding segments to await the mapping of the nasalization melody onto segments. This perfectly obvious principle goes unstated in a purely segmental analysis.

FOOTNOTES TO CHAPTER ONE

[1]This chapter appears in modified form under the title, "The role of tone in segmental phonology", in Larry M. Hyman, Ed., Proceedings of the First Annual USC Symposium on Consonant Types and Tone, Los Angeles: University of Southern California, 1973.

[2]The change on the final syllable from M to L, which does not appear to be related to the other phenomena under discussion, may be the result of a common tendency in tonal languages to lower a tone before pause when its level is intermediate between H and L if it is preceded by HL. This same phenomenon occurs in Hausa, Bambara, and Maninka, though in the latter two it may be somewhat more general. In Hausa, there is no Mid tone, but any H following a sequence HL is lowered to a pitch intermediate between the pitch of the preceding H and L; thus, relative to the preceding H and L, this lowered H is a Mid tone. But before a pause, the pitch of this lowered H is lowered still further, so that its pitch is only slightly higher than that of the preceding L. This observation has been verified by pitch recordings; some data which demonstrates this phenomenon is published in Wängler (1967). This accounts for the fact that beginning students often mis-transcribe Hausa HLH before pause as HLL.

[3]It should be noted that the accuracy of this data has been contested. D. Dwyer (personal communication) has observed that mba (LHL), although it is given in Spears (1967a,b) with a short vowel, may actually have a long vowel (as it is given by Innes, 1969) and may have derived from a disyllable. If the vowel is long, this still does not affect my argument insofar as the argument seeks to establish that the permissible and impermissible tone patterns for monosyllables are the same as for other words. If mba originates synchronically from a disyllable, then another instance of a monosyllable with the tonal pattern LHL would have to be sought. In addition, Dwyer has suggested that nikili and all other monomorphemic three-syllable words in Mende may be fairly recent borrowings. In this event, we would have no native monomorphemic three-syllable words on which to observe the behavior of the pattern LHL. However, there is nothing to suggest that the behavior of nikili is irregular in any other respect; furthermore, it is demonstrated in chapter 2 that bimorphemic words whose last morpheme is inherently toneless behave tonally in the same way as monomorphemic words. Assuming this, a word like nyaha-ma (L H L), 'on a woman', could be used to make the same point as nikili (L H L) in the text.

[4]A very interesting alternative for expressing downdrift, involving a rule of LOW RAISING, is proposed by Hyman and Schuh (1972); it, too, is subject to the point made in the text.

CHAPTER TWO. SUPRASEGMENTAL TONE RULES IN MENDE

2.1. Tone Deletion vs. Tone Extension.

2.1.1. Mende is a Mande language of Sierra Leone. This chapter is devoted to a reformulation of the analysis of Mende proposed in Leben (1971c) and to further consideration of the description of contour tones. First, I will review the essential points of the old analysis. Mende words with a falling tone or a rising tone sometimes have these tones simplified to level tones, as illustrated in (1). The suffix -ngaa is the indefinite plural morpheme, and -i is the definite marker.

(1) a. mbu - ngaa > mbu-ngaa 'owls'
HL L H L

b. mba - i > mba-i 'the rice'
LH H L H

Whenever the low part of a contour tone is immediately followed by L, and whenever the high part of a contour is immediately followed by H, this part of the contour is lost. This is expressed by rule (2):

(2) TONE DELETION (Mende)

$$[\alpha\overset{\frown}{H}][-\alpha H]\ [-\alpha H] \longrightarrow [\alpha H][-\alpha H]$$

where α can be either plus or minus and the tie $\frown$ appears above tones that are on the same vowel or syllable. For the

moment, I will assume that the syllable is the relevant tone-bearing unit; later, I will argue against this assumption.

Even when a contour tone does not fall in an environment whose underlying tones would permit the operation of (2), sometimes the contour [$\alpha\widehat{H}$][$\widehat{-\alpha H}$] is simplified to [αH]. This occurs in cases where the contour tone is followed by an inherently toneless syllable, such as a monosyllabic postposition like <u>hu</u>, 'in', <u>ma</u>, 'on', and so on. Thus, corresponding to (1), we get forms like those in (3):

(3) a. mbu - ma > mbu-ma 'on an owl'
HL H L

b. mba - hu > mba-hu 'in rice'
LH L H

There are essentially two ways of dealing with this phenomenon. One is to say that the similarity of (3) and (1) is a result of the fact that before the contour tone is simplified in (3), a rule of TONE COPYING copies the last element in the contour onto the toneless postposition, converting the left-hand side of (3) into (4):

(4) a. mbu-ma
HL L

b. mba-hu
LH H

Then (4), like the inputs of (1), is subject to (2) TONE DELETION, producing the results depicted in (3).

The other way of expressing the similarity in the outcome

illustrated in (1) and (3) is by positing a process of TONE EXTENSION for both sets of cases. This process would extend the domain of a tone to include a following syllable either (i) if this syllable were toneless, as in (3), or (ii) if this syllable agreed in tone with the last element of the tone whose domain is to be extended. In this case, a level H or a level L over an extended domain would be interpreted in the obvious way; a rising tone extended over a domain of an extra syllable would be interpreted as L over the former domain, followed by H on the extra syllable, while an extended falling tone would result in a level H over the previous domain, followed by L on the extra syllable. This would clearly result in the same output depicted in (1) and (3). The question is, which account is preferable.

2.1.2. In Leben (1971c), evidence was presented in favor of the first account, involving TONE COPYING followed by TONE DELETION. The evidence came from compounds. In Mende compounds, all members except the first have their tones erased and replaced by low tones, and the first syllable of each member takes on part of the tone of the preceding member. For example, if the word <u>hani</u>, 'thing', is made the second element of a compound, the following results:

(5) a. kɔ - hani > kɔ-hani 'weapon, war thing'
H H H L

b. kpa - hani > kpa-hani 'debt thing'
L L L L

c. mbu - hani > mbu-hani 'owl thing'
HL H L L

d. mba - hani > mba-hani 'rice thing'
LH L H L

In the case of the contour tones, the last part of the rise or the fall ends up on the first syllable of the second element. This is the same behavior observed in (1) and (3), and the two proposals being considered still may appear equally well equipped to handle the facts. This can be shown to be incorrect. The analysis involving TONE EXTENSION would have to say that in (5) the tone of the last syllable of the first element extended its domain to include the first syllable of the second element; this is very strange, since it expresses a tone pattern (that of the last syllable of the first element) as a feature on a sequence of two syllables (the last syllable of the first element followed by the first syllable of the second element)--this sequence is not a word, not a morpheme, not a linguistic unit at all. Current phonological theory does not permit us to express features on arbitrary units of this sort, and to relax this restriction in this case should be unthinkable. Thus, even considering only the compounds in (5), there is already a strong reason to dismiss the analysis positing TONE EXTENSION, since it (and it alone, so far as is

known) would necessitate relaxing a very plausible constraint on the use of phonological features.

But the case against TONE EXTENSION can be made even stronger if we bring into consideration the facts of compounds whose second element is a monosyllable.

(6) a. kɔ - mɔ > kɔ-mɔ 'war person'
H H HL

b. kpa - mɔ > kpa-mɔ 'debt person'
L L L

c. mbu - mɔ > mbu-mɔ 'owl person'
HL H L

d. mba - mɔ > mba-mɔ 'rice person'
LH L HL

The analysis involving TONE EXTENSION will miss a generalization in describing the facts of (5) and (6). Note that in (6) it is only the first part of the first syllable of mɔ that receives the end of the contour of the preceding syllable, while in (5) it is the entire first syllable of hani that receives it. This can be explained on the account employing TONE COPYING and TONE DELETION, as will be demonstrated directly, but on the analysis involving TONE EXTENSION, we are forced to say that the domain of a contour tone is expanded to include an extra syllable in (5) but only an extra half-syllable in (6). This lack of generality is a second strong reason for rejecting the TONE EXTENSION proposal.

The analysis employing TONE COPYING and TONE DELETION avoids these problems (although it may appear to entail ex-

pressing tone as a feature on syllables--this aspect of the analysis is discussed below). The operations involved in deriving (5) and (6) are the following:

(7) COMPOUND RULE (Mende)

a. Replace the inherent tones of all but the first member with low tones.

b. Copy the last tone of the first member onto the first syllable of the second member, retaining the assigned low tone on the end of this syllable.

c. Perform (2) TONE DELETION.

The requirement in (7b) to retain the assigned low tone even when a new tone is copied onto the same syllable is to be viewed as an application of convention (26) proposed in the preceding chapter. Unlike the alternative involving TONE EXTENSION, the account in (7) permits us to express the assignment of tone in the same way for a polysyllabic second member as for a monosyllabic one. The resulting derivations are sketched here:

(8)

	(7a)		(7b)		(7c)
a.	kɔ-hani	>	kɔ-ha ni	>	kɔ-hani
	H L L		H HL L		H H L
	kɔ-mɔ	>	kɔ-mɔ		
	H L		H HL		
b.	kpa-hani	>	kpa-ha ni		
	L L L		L LL L		
	kpa-mɔ	>	kpa-mɔ		
	L L		L LL		

	(7a)		(7b)		(7c)
c.	mbu-hani	>	mbu-ha ni	>	mbu-hani
	HL L L		HL LL L		H L L
	mbu-mɔ	>	mbu-mɔ	>	mbu-mɔ
	HL L		HL LL		H LL
d.	mba-hani	>	mba-ha ni	>	mba-hani
	LH L L		LH HL L		L H L
	mba-mɔ	>	mba-mɔ	>	mba-mɔ
	LH L		LH HL		L HL

By convention, sequences of identical tones on single syllables, such as LL in (8b,c), are interpreted as single tones.

2.2. The underlying tonal system.

2.2.1. Having established the invalidity of the TONE EXTENSION account, we may now examine some suspicious properties of (2) TONE DELETION. One of the changes effected by this rule is the conversion of a sequence $\widehat{\text{LH}}$ H into L H; this is strikingly similar to a rule which Hyman and Schuh (1972) refer to as TONE SPREADING. This rule, which is formulated as (11) below, converts a sequence LHH into LLH. The only significant difference between TONE DELETION and TONE SPREADING is that the former appears to make crucial use of the fact that the first two tones are represented on a single syllable, while the latter does not. In chapter 6, it is argued that syllables do not bear phonological features. However, even if it is maintained that syllables can be employed as feature-bearing units, the contention that a given language has such-and-such a syl-

lable feature should still be made with considerable hesitation, for methodological reasons. Since, as demonstrated in chapter 6, the position that certain features occur on syllables is so poorly documented, there are really no independent criteria available at present for determining what sort of behavior to expect and what sort of behavior not to expect from putative syllable features. This robs any individual proposal involving syllable features of a powerful means of confirmation or disconfirmation.

In Mende, the proposal that tone is represented as a feature on syllables gives rise to a paradox, since the distribution of Mende tonal patterns is independent of the number of syllables in the word. In chapter 1, this was taken to indicate that Mende tone is underlyingly a feature on a unit larger than the syllable. If, independently of any assumptions about the possibility or impossibility of the existence of features on syllables, it can be shown that TONE DELETION must be reformulated in a way which does not express Mende tones on syllables, the paradox will be resolved.

2.2.2. First of all, consider the fact that certain Mende nouns exhibit the pattern LH in isolation but are LL before H; an example is nika, 'cow'. Its behavior is illustrated here:

L H

(9) a. nika-i 'the cow'
L L H

b. nika-ngaa 'cows'
L H L

c. nika-ma 'on a cow'
L L H

d. nika-hani 'cow thing'
L L H L

This word was analyzed in Leben (1971c) as $\underset{L\ LH}{\text{nika}}$. The final syllable was converted into L before H by TONE DELETION; in the remaining environments, before L and #, the rising sequence of the final syllable was simplified to H by another rule. In other words, the phonological rising sequence posited on the last syllable of this type of word was never realized as such. Not much comment was made on the abstractness of this solution; but it was noted that certain other disyllabic Mende words had the surface contour LH, such as $\underset{L\ H}{\text{navo}}$, $\underset{L\ H}{\text{jako}}$, and a handful of others. These latter words, unlike the vast majority of Mende disyllables with a LH pattern, were not subject to the alternation whereby the final syllable became L before a high tone. That is, we get the following contrasts in the behavior of words ending in abstract rising tones (in the left column) and those ending in high tones (in the right column):

(10)	Words like nika (L LH)	Words like navo (L H)
a. Before -i (H)	nika-i L L H	navo-i L H H
b. In compounds	nika-hani L L H L	navo-hani L H H L
c. Before toneless suffixes	nika-ma L L H	navo-ma L H H

It was observed that, assuming the correctness of (2) TONE DELETION, the contrast between these two types of noun could be expressed by representing nika with a LH sequence on the last syllable, while representing navo with a H on the last syllable. This would obvioulsy give the correct outputs in both (9) and (10).

The only other way of dealing with these facts, it was argued, would involve representing both nika and navo phonologically as words whose last vowel or syllable was H; then, instead of incorporating TONE DELETION, the analysis would state a rule which lowered H before another H, and certain words, like navo, would be listed as exceptions to this rule. But it was claimed that such a solution, which employs diacritic exception features, is less desirable than the first, which was thought to employ an independently motivated phonological feature (the rising tone, which does occur on some monosyllables, like mba (LH), 'rice') and independently motivated rules (TONE DELETION is necessary to account for the lowering of the final H on mba (LH) before another H, and the rule proposed to convert

$\widehat{LH}$ to H in other environments was seen to operate on some monosyllables, such as $\underset{LH}{ndi}$, though not on $\underset{LH}{mba}$). However, this argument ignored the fact that although regular phonological features were being employed in the solution adopted, they were employed diacritically, in the sense of Kiparsky (1968). That is, the distinction between H and $\widehat{LH}$ was used in effect solely to permit the grammar to predict which nouns would and which nouns would not undergo TONE DELETION. The distinction was not motivated by any other consideration. Furthermore, this analysis had no account of the fact that words like navo are extremely rare, while words like nika are very common. Finally, the analysis failed to observe that the abstract rising sequences posited for nouns like nika were always preceded in the same word by a L on the first syllable. (This observation comes from Spears, 1967b.) Thus, along with $\underset{L\ LH}{nika}$, we would have $\underset{L\ LH}{pele}$, 'road', $\underset{L\ LH}{fande}$, 'cotton', $\underset{L\ LH}{hani}$, 'thing', and many more.

2.2.3. If we abandon this analysis and reanalyze all of these nouns as containing a simple H on the final vowel or syllable instead of a sequence LH, the same formulation of TONE SPREADING proposed by Hyman and Schuh (1972) and established for Maninka and Bambara in chapter 4 would, if applied to Mende, predict that the H of the final syllable becomes L before another H. The small set of nouns like navo whose final H is never realized

as L would simply be listed as exceptions to this process. Such an analysis would make use of the fact that all of the words whose final H undergoes the rule have a L preceding this H, thus providing a proper input to TONE SPREADING when a H follows the word in question. In view of this, we formulate TONE SPREADING for Mende as (11). Its operation on nika in various environments is illustrated in (12). The rule will not be able to apply when nika is followed by L or by #.

(11) TONE SPREADING (Mende)

$$H \longrightarrow L \;/\; L \_\_ H$$

(12) a. nika
L H

b. nika - i → nika - i
L H H L L H

c. nika - ma → nika - ma → nika - ma
L H L H H L L H

In (12c), the tone on ma, which is inherently toneless, is obtained by copying the preceding tone. As this analysis would predict, nika as the first element of a compound is realized with a level L, but before this change takes place, the final H of underlying nika occasions the copying of a H onto the following syllable, thus yielding derivations like the following:

(13) a. nika - hani → nika - ha ni → *nika - ha ni
L H L L L H HL L L L HL L

b. nika - mɔ → nika - mɔ → nika - mɔ
L H L L H HL L L HL

Since TONE DELETION has been eliminated from this analysis, the compound rule produces an incorrect result in (13a), and it appears that another operation must be formulated which will have the effect illustrated in (14).

(14) *nika - ha ni → nika - hani
L L HL L L L H L

However, this problem will be shown below to have a more general solution, based on the suprasegmental treatment of Mende tone.

2.2.4. The revised analysis differs from the one rejected only in the way that it differentiates the large class of nouns like nika from the limited class to which navo belongs. The previous analysis said that the difference was a phonological one, consisting in the distinction between a final rising tone and a final high tone; the present analysis says that the difference is only in a rule feature, the exceptional nouns being marked as exceptions to TONE SPREADING. (Dwyer, 1971, has suggested that these exceptional nouns are largely recent borrowings.) But even this slight difference has some quite sweeping consequences for the description of the underlying tonal system of Mende. Unlike the old analysis, the revised analysis does not employ contour tones on vowels or

syllables in the underlying form of words like nika. This permits us to state the following as the possible phonological tone patterns of Mende nouns, with the examples indicated to the right:[1]

(15) a. H pɛlɛ, kɔ
H H H

b. L bɛlɛ, kpa
L L L

c. HL kenya, mbu
H L HL

d. LH nika, navo, mba
L H L H LH

e. LHL nikili, nyaha, mba
L H L L HL LHL

2.3. Tone Mapping.

2.3.1. The simplification of the underlying tone patterns which the revised analysis affords makes it possible to express the tone patterns of Mende lexical items suprasegmentally in underlying representatons. This is a desirable result, since the same conclusion was indicated independently by the restrictions on tone sequences noted for Mende in chapter 1. In addition, it is shown in chapter 4 that the rule of TONE SPREADING is an operation on suprasegmental tones in these languages; we might expect the same to be true in Mende, especially since it is a related language.

The mapping of the tonal patterns on the left in (15) onto Mende segments is achieved by the following rule:

(16) TONE MAPPING (Mende)

a. If the number of level tones in the pattern is equal to or less than the number of vowels in the word possessing the pattern, put the first tone on the first vowel, the second on the second, and so on; any remaining vowels receive a copy of the last tone in the pattern.

E.g. $\overset{LHL}{\underline{nikili}}$ becomes $\underset{L\ H\ L}{\underline{nikili}}$

$\overset{H}{\underline{pɛlɛ}}$ becomes $\underset{H}{\underline{pɛlɛ}}$ and then $\underset{H\ H}{\underline{pɛlɛ}}$

b. If the number of level tones in the pattern is greater than the number of vowels in the word possessing the pattern, put the first tone on the first vowel, the second on the second, and so on; remaining tones are expressed as a sequence on the last vowel vowel available.

E.g. $\overset{HL}{\underline{mbu}}$ becomes $\underset{HL}{\underline{mbu}}$

$\overset{LHL}{\underline{nyaha}}$ becomes $\underset{L\ HL}{\underline{nyaha}}$

A preliminary attempt at formalizing this rule appears in chapter 1, 1.4.2. As a result of this new system, it is possible to capture the relatedness of certain constraints on tone distribution in Mende which could only be formulated awkwardly in an account which posited tone as an underlying feature on syllables or vowels. The sequences H $\widehat{HL}$ and H H L are equally impossible in Mende; both of the disallowed sequences would, on the suprasegmental analysis, arise from the prosodic contour HL associated with a word of two and three syllables, respectively. But the nonoccurrence of H $\widehat{HL}$ is simply a result of the fact, expressed by (16), that HL is assigned to a word of two syllables by placing H on the first vowel and L on the second; and the nonoccurrence of H H L is a

result of the fact that HL is assigned to a word of three syllables by placing H on the first vowel and L on the remaining two. Similarly, Mende appears to exhibit a parallel restriction against L $\widehat{LH}$ and L L H, which is captured in an entirely analogous fashion.

Suprasegmental representation directly expresses a number of constraints on tonal distribution whose connectedness could not be captured in an analysis which exclusively employed segmental tone features or tone features on syllables. Furthermore, in view of what was said in the preceding paragraph, it is clear that the proposal of suprasegmental representation makes an interesting prediction for the languages for which it is posited; namely, because contours such as HHL and HLL have the same "melody", which is represented suprasegmentally as HL, it follows that a language in which tone is suprasegmental in underlying forms will not be able to have distinct contours HHL and HLL in underlying representations. This claim holds true for Mende, which on the revised analysis would map HL into the contour HLL in a three-syllable word but not into HHL. With any other type of representation for tone, we could only make the observation that Mende permits the tonal pattern HL on words with two vowels but not the pattern H $\widehat{HL}$, and H L L on words with three vowels, but not the pattern H H L. But the relatedness of these two constraints on tonal structure is a direct consequence of the proposed suprasegmental representation. Thus, the theory of suprasegmental representation

can be said to explain why both constraints hold rather than just one of them. The corresponding prediction involving the pattern LH applied to words of three syllables is problematic, since Innes (1969) gives a number of instances of words with the prohibited L L H contour and I have been unable to find an adequate way of analyzing these.

2.3.2. There are a number of other Mende words whose tonal pattern does not appear to be provided for by the proposed account. For example, the word $\underset{H\ \widehat{HL}}{ngɔngɔ}$, 'tooth', looks like an exception to the restriction against H $\widehat{HL}$. But its reduplicative form suggests that it is a compound composed of two instances of the "word" ^{H}ngɔ. Since ^{H}ngɔ by itself does not appear to be a Mende word, we may list the word for 'tooth' in the lexicon as ^{H}ngɔ-ngɔ, where the hyphen is the informal notational device employed for compounds and other polymorphemic words. This word will then undergo the normal compound rules and will in this way obtain the correct surface tones. Similarly, it is possible to find apparent violations of the restriction against HLH in a lexical entry; $\underset{L\ H\ \ L\ H}{ndamindami}$, 'slime left by a snail', is an example. But this is an obvious reduplicate, and although the form $\underset{L\ H}{ndami}$ is not listed in the Mende-English dictionary of Innes (1969), one may assume that the reduplicated form is lexically listed as ^{LH}ndami-^{LH}ndami, which is in perfect conformity with the tonal rules of Mende. Given

the fact that the overwhelming majority of cases do conform to these statements, along with the ability of this analysis to explain a number of aspects of the behavior of Mende tone, it appears reasonable to assume, for the moment, at least, that the recalcitrant cases will fall into line upon the formulation of an adequate morphological analysis of Mende; if they do not, then the underlying tonal system of Mende must be reformulated, and the generalizations captured here must be expressed in some other manner. If we assume that lexical entries may be polymorphemic, then the case of ^{H}ngɔ-ngɔ and ^{LH}ndami-^{LH}ndami provides evidence for expressing suprasegmental tones in Mende on morphemes rather than on lexical entries; additional evidence for this position will be discussed later.

2.4. Segmental sequence features.

2.4.1. One topic which merits further treatment is the fact that (16) TONE MAPPING assigns some tone features as sequences of features on vowels. For example, by applying (16b) to the words on the left in (17), we obtain the outputs on the right:

(17) a. ^{HL}mbu ⟶ mb u
[+H][-H]

b. ^{LHL}nyaha ⟶ nya h a
[-H] [+H][-H]

At first glance, this may appear to contradict the position in chapter 1 rejecting sequence features such as [[+H][-H]] when

posited on phonological segments. However, this is not so. We have direct phonetic evidence for the existence of transitions such as HL on words like mbu, and these transitions can be shown to occur phonetically on the short vowels of these words, rubbing off also on surrounding segments capable of bearing pitch. Thus, no theory can get by without recognizing transitions on single segments. (In particular,it seems that the sort of explanation advanced by Halle, 1971, for Slavic--ascribing surface rising contours to the interaction of stress with tones in the environment--will not do for languages like Mende.) What was declared ad hoc in chapter 1 was the use of such transition features in underlying representations. That is, while we have undeniable evidence for the presence of transition features in surface phonetic representations, we have no evidence for the presence of such features in underlying phonological representations.

One question that remains to be settled concerns the nature of the representation of these transitions. From the discussion of downdrift in chapter 1, it can be concluded that these transitions are expressed as sequences of level tones. This assumes that downdrift applies at some point after TONE MAPPING, and this assumption appears to be true. Hausa, for example, has at least one segmental tone rule, LOW TONE RAISING, described in chapter 4, which is ordered before downdrift. Since this rule is ordered after TONE MAPPING, it shows that downdrift also is ordered after TONE MAPPING.

2.4.2. There are two ways in which the restriction against segmental sequence features of tone in underlying representations could be disconfirmed. One way would involve discovering a generalization that could not be expressed within a framework that disallowed such underlying representatons; for example, a language might be found in which the first rule of the phonology needed to refer to a tonal sequence feature on a segment. Such cases have yet to come to light. A second way would involve demonstrating the validity of Fromkin's (1972) claim, attributed to Margaret Langdon, that it is possible for any phonetic distinction to turn into a phonological one. (Fromkin, personal communication, has subsequently withdrawn this claim, but it still appears to be maintained by others; for example, cf. Truteneau, 1973.) If this claim were true, any framework which admitted to the existence of tonal sequence features on segments at some stage in derivations would automatically be admitting to the possibility that such features might also crop up in underlying representations. This claim has some plausibility in the light of examples examined in works such as Kiparsky (1968, 1971, 1972) and Hyman and Schuh (1972); the examples involve phonetic contrasts which originally did not correspond directly to an underlying contrast but rather resulted from differences in the conditioning environments of phonological rules. In the examples considered, the phonological rules and the underlying representations were historically restructured in such a way that the phonetic contrast in question became a phonological one.

2.4.3. An initially plausible example is the case of downstep, a phenomenon whereby a sequence of two level tones that one might otherwise expect to be pronounced on the same pitch is pronounced in such a way that the second has a slightly lower pitch than the first. This gives rise to a phonetic contrast, in which some HH sequences, for example are realized as [ˉ ˉ] while others are realized as [ˉ -]. In many cases, it is possible to trace the HH sequences exhibiting downstep to synchronic HLH sequences which have first undergone downdrift, resulting in [ˉ _ -], and subsequent deletion of the second tone in the sequence, resulting in [ˉ -]. In some cases, it has been argued that this phenomenon is not synchronically traceable to a deleted low tone, even though it may be historically traceable to one; for example, Fromkin (1972) suggests that there is no synchronic motivation for deriving the downstepped H on the final vowel of the Akan name Akua [_ ˉ -] in this way. In each case that has been discussed in the literature, it is difficult to assess the weight of the synchronic evidence presented. For the sake of argument, however, let us grant that this sort of restructuring does occur and that what may have been a purely phonetic contrast between H and downstepped H could become an underlying contrast between H and downstepped H.

Fromkin's claim is that this sort of restructuring is possible with any phonetic contrast. But this claim seems far too strong. For example, if we accept the claim that English

(or some other language) has three or four phonetic levels of stress, then Fromkin's claim would predict that in some language (perhaps even a future state of English), it would be possible to have three or four underlying levels of stress. No known language comes close to having this many levels of stress distinguished in underlying representatons. Another instance involves the phenomenon of downdrift itself, which gives rise to a great number of surface pitch contrasts, and which even obscures the distinctness of high tones and low tones, since it may cause a low tone at the beginning of a string to have exactly the same pitch as a high tone which appears later in the string. According to Fromkin's claim, we should expect it to be possible for a language with downdrift to become restructured in a way that will result in the phonemicization of the many phonetic pitch contrasts. Although every linguist would likely agree that such a change would be impossible, it should be noted that the hypothetical change would simply be a large-scale version of what some linguists have been willing to accept on a small scale, viz. the phonemicization of downstep. This casts considerable doubt on the notion that any phonetic contrast can give rise to a phonological one. Because of this, there appears to be no objection in principle to a framework which permits tonal sequence features to arise on segments in the course of a derivation while forbidding the expression of such features on segments in underlying representations.

2.4.4. To interpret this restriction on underlying representations correctly, we must now consider the use of contour tone features such as [Rising] and [Falling] in underlying representations. Wang (1967) has proposed these features for Chinese and has made a case for this proposal by suggesting that particular phonological rules must make use of contour features. He formulates the sandhi rule in Amoy Hokkien in the following way:

(18) $\begin{bmatrix} \alpha\text{High} \\ \beta\text{Falling} \end{bmatrix} \rightarrow \begin{bmatrix} \beta\text{High} \\ -\alpha\text{Falling} \end{bmatrix}$

Woo (1969) has attempted to demonstrate that contour features are unnecessary, but the attempt is based in part on principles which are in some dispute, such as the proposal that tone is universally a segmental feature. On the one hand, the attempt to re-express Wang's rules by substituting [[-H][+H]] for [Rising], and so forth, appears to complicate the rules (cf. Woo's (1969: ch. 3) formulation); on the other hand, Wang's rules themselves might be viewed as suspicious, since with an unprecedented amount of freedom they employ the device of expressing sameness or difference of feature values with the variables α and β. In any event, in the absence of an attractive counterproposal to Wang's, the status of the features [Rising] and [Falling] remains an open question.[2]

2.4.5. It should be emphasized that the question of the status of segmental contour features such as [Rising] and [Falling] is separate from the question of the status of

segmental sequence features such as [[-H][+H]].[3] A framework might permit the use of contour features in underlying representations while still prohibiting the use of sequence features in underlying representations. Such a restriction would have the following consequence: it would entail that a language with underlying contour tone features would not have rules which needed to decompose these contours into sequences of level tones. As shown in the preceding discussion of Mende and, in greater detail, in Leben (1971c), some languages have rules (such as TONE COPYING) which apply only to the L of a HL sequence. Such rules would be impossible in a language which employed contour features instead; a copying rule, if applied to a contour tone, would copy the entire contour feature, [Falling] or [Rising]. This demonstrates that a theory which prohibits segmental sequence features in underlying representations is making a claim with some empirical import, even if it allows for the possibility of segmental contour features.

2.5. Refinements.

2.5.1. The reanalysis proposed for Mende is in need of further elaboration. It is clear that some of the functions of (2) TONE DELETION, which converts $\widehat{HL}$ L into H L and $\widehat{LH}$ H into L H, are taken over by (11) TONE SPREADING, which converts any sequence L H H into L L H. In addition, some of the functions of TONE COPYING may be thought to be taken over by (16) TONE MAPPING. Let us consider the latter possibility first. TONE

COPYING was first proposed to account for the assignment of tone in two sorts of instances. The first sort involved inherently toneless morphemes, such as the postpositions ma, hu, and the like.

(19) a. ^{H}pɛlɛ-hu > ^{H}pɛlɛ-^{H}hu > pɛlɛ-hu (H H H) 'in a house'

b. ^{L}bɛlɛ-hu > ^{L}bɛlɛ-^{L}hu > bɛlɛ-hu (L L L) 'in trousers'

c. ^{HL}kenya-ma > ^{HL}kenya-^{L}ma > kenya-ma (H L L) 'on an uncle'

d. ^{LH}nika-ma > ^{LH}nika-^{H}ma > nika-ma (L L H) 'on a cow'

The second sort of instance involved items whose inherent tones are deleted due to their appearance in a particular construction, such as noninitial elements in compounds, which are automatically assigned a low tone.

(20) a. ^{H}pɛlɛ-^{L}hani > ^{H}pɛlɛ-^{HL}hani > pɛlɛ-hani (H H H L)

b. ^{L}bɛlɛ-^{L}hani > ^{L}bɛlɛ-^{LL}hani > bɛlɛ-hani (L L L L)

c. ^{HL}kenya-^{L}hani > ^{HL}kenya-^{LL}hani > kenya-hani (H L L L)

d. ^{LH}nika-^{L}hani > ^{LH}nika-^{HL}hani > nika-hani (L L H L)

In the case of (19), one might argue that TONE COPYING is unnecessary, and that what actually happens is that the postpositions are incorporated into the tonal domain of the head noun, with TONE MAPPING applying to the resulting complex.

This proposal is depicted in (21), where stage (i) represents the result of incorporation and stage (ii), the result of TONE MAPPING; stage (iii) gives the output of TONE SPREADING, which in this hypothetical proposal must be construed as a segmental rule, since it applies to the output of TONE MAPPING.

(21)

	(i)		(ii)		(iii)
a.	^{H}pɛlɛ-hu	>	pɛlɛ-hu H H H		
b.	^{L}bɛlɛ-hu	>	bɛlɛ-hu L L L		
c.	^{HL}kenya-ma	>	kenya-ma H L L		
d.	^{LH}nika-ma	>	nika-ma L H H	>	nika-ma L L H

Furthermore, we might consider it possible to eliminate TONE COPYING from the operations involved in the derivation of the compounds in (20) by incorporating the noninitial elements in a similar way, but this time adding a low tone at the end of the suprasegmental contour, since a low tone invariably is introduced onto the noninitial elements in compounds, even when the initial element has a level high tone. We see that this proposal produces incorrect results in (22a,d):

(22)

	(i)		(ii)
a.	^{HL}pɛlɛ-hani	>	*pɛlɛ-hani H L L L
b.	^{L}bɛlɛ-hani	>	bɛlɛ-hani L L L L

c. ^{HL}kenya-hani > kenya-hani
H L L L

d. ^{LHL}nika-hani > *nika-hani
L H L L

These counterexamples are not limited to compounds; rather, they extend to any case in which the noninitial element has a tone to contribute to the tonal melody of the construction. Consider the affixation of the indefinite plural marker, -^{L}ngaa. If this were to be incorporated into the tonal unit in the same way illustrated in (21) and (22), it would fail in cases where the noun to which it was attached had an underlying tone pattern ending in H:

(23)

	(i)	(ii)
a. ^{H}pɛlɛ́-^{L}ngaa >	^{HL}pɛlɛ-ngaa >	*pɛlɛ-ngaa H L L
b. ^{LH}mba-^{L}ngaa >	^{LHL}mba-ngaa >	*mba-ngaa L HL

The counterexamples in (22) establish that prior to the operation of TONE MAPPING, a rule of TONE COPYING must apply; furthermore, the counterexamples in (23) show that the affixation of tone-bearing elements does not produce a "tonological" word of sorts whose elements' tone pattern is combined into a single suprasegmental pattern and then distributed back over the whole complex. This demonstrates that there is no benefit to eliminating TONE COPYING from the assignment of tone to toneless postpositions (the procedure illustrated in (21)), even though

it would be possible to do so. In addition, it lends support to the notion that in Mende suprasegmental tones are represented on morphemes and not on words as such.

2.5.2. Having established the existence of the two operations TONE COPYING and TONE MAPPING, we can now re-examine the respective roles of TONE SPREADING and TONE DELETION in this analysis. The results of (23) show that the tones of the noun and the plural suffix must be mapped separately; when this is done with a monosyllabic noun with a HL contour, the following incomplete result is obtained:

(24) ^{HL}mbu-^{L}ngaa > *mbu-ngaa
HL L

The correct form is mbu-ngaa (H L). One's first guess might be that this form could be produced from the output in (24) by generalizing the rule of TONE SPREADING, which converts L H H into L L H, to apply to the sequence H L L, converting it into H H L. Let us first suppose that this generalized version of TONE SPREADING is a suprasegmental rule; for this to be the case, it would have to precede TONE MAPPING, since the effect of this latter rule is to convert tones into segmental features. This would produce the desired result in (25a), but it would by the same token produce an incorrect result in (25b). Stage (i) in (25) represents the output of generalized TONE SPREADING, and stage (ii) represents the output of TONE MAPPING.

(25)

	(i)	(ii)
a.	^{HL}mbu-^{L}ngaa >	^{H}mbu-^{L}ngaa > mbu-ngaa (H L)
b.	^{HL}kenya-^{L}ngaa >	^{H}kenya-^{L}ngaa > *kenya-ngaa (H H L)

The second syllable in kenya-ngaa ought to be L rather than H. The generalized rule cannot be restricted to applying only to monosyllables, since, as a suprasegmental rule, it would have no access to information about the number of segments over which the tones range. Therefore, let us now assume that generalized TONE SPREADING is a segmental rule, applying after TONE MAPPING. This will permit the rule to refer to information about the segments which bear the tones. To avoid the incorrect result obtained in (26b), the rule will have to be modified to apply only to a HL sequence on a single segment. This will result in the following derivations:

(26)

a.	^{HL}mbu-^{L}ngaa > mbu-ngaa (HL L)	> mbu-ngaa (H L)
b.	^{HL}kenya-^{L}ngaa > kenya-ngaa (H L L)	

SEGMENTAL TONE SPREADING will not apply in (26b), and so the problem in (25b) is avoided. However, in order to accomplish this, we have had to alter TONE SPREADING in a way that makes it identical, for all practical purposes, with the rule of TONE DELETION; that is, it simplifies only tone contours that are expressed on a single segment. However, this version of

the rule is inconsistent with the reanlaysis of Mende that has been justified here, since it leaves us with no way of lowering the tone of the second syllable of nika in the following examples, where the forms on the right represent the output of TONE MAPPING:

(27) a. ^{LH}nika-^{H}i > *nika-i
L H H

b. ^{LH}nika-^{HL}hani > *nika-hani
L H H L

There are two conceivable ways out of this problem. Either one retains SEGMENTAL TONE SPREADING and posits an additional rule which will lower the second vowel of nika in (27), or one re-adopts the version of TONE SPREADING expressed in (11) and posits an additional rule to simplify the falling tone on mbu in mbu-ngaa in (24) to a high tone. There appear to be no arguments in favor of the former alternative, and there are two which favor the latter one. First of all, the original version of TONE SPREADING expressed in (11) is the one which applies in Maninka and Bambara, as is shown in chapter 4; given the suprasegmental analysis of tone, this rule, a suprasegmental rule in Maninka and Bambara, makes an interesting claim: since the rule applies to the sequence L H H, and since this sequence, when represented suprasegmentally on a single morpheme, is equivalent to the sequence L H, the implicit claim is made that the rule never applies internally to a single morpheme. That is, it never converts monomorphemic $C_{o}VC_{o}VC_{o}V$
$_{L}\ \ _{H}\ \ _{H}$

into $C_{o_L}VC_{o_L}VC_{o_H}V$.

A second argument in favor of the latter analysis is that the additional rule required by forms like the one in (24) can be collapsed with a rule independently required in Mende. The additional rule, stated by itself, would convert $\widehat{HL}\ C_o\ L$ into $H\ C_o\ L$. The rule independently required assimilates a low tone to a following H if the low tone is preceded by H. Let us first consider this latter rule separately.

It is pointed out in Spears (1967a: 193) that if a falling tone on a single syllable is immediately followed by H, the sequence is not pronounced as $\widehat{HL}$ H but rather as $H^{!}H$, where ! signals downstepping of the H following it. As we have already seen, the downstepping of H is conditioned by preceding L, a phenomenon which has been called downdrift. Thus, the assimilation of the low component of $\widehat{HL}$ to the following H must be ordered after the downdrift rule. Next, on the same page, Spears observes that if there is a level low-toned vowel with a high tone in the preceding syllable and another high tone in the following syllable, the low tone optionally assimilates to the following high tone; that is, from a sequence HLH is optionally derived as sequence $H^{!}HH$. Examples of the application and nonapplication of this rule are:

(28) a. mbu - i [¯ –] 'the owl'

b. kenya - i [¯ – –] OR [¯ _ –] 'the uncle'

On the basis of Spears' account, and from my own informal observations, it may be concluded that the assimilation in question is a phenomenon that is quite close to the surface and whose applicability is made more probable as the rapidity of speech increases. However, the probability of application is increased to 1 when the HL contour is on a single vowel. Interestingly, the reverse of this process, which would assimilate a H to preceding L in LHL, does not occur. These facts make it likely that the simplification of HL to H on mbu when followed by L is to be collapsed with the assimilation rule discussed here. The resulting rule is ordered after downdrift and would optionally simplify any HL sequence to H, regardless of whether it was followed by H or L. Somehow, however, it would have to be specified that the option must be taken when the HL sequence is on a single vowel, again regardless of whether the following tone is H or L. As this rule is expressed, one would expect it to apply optionally to kenya-ma (H L L), in some way neutralizing the L which follows the H; interestingly enough, this L is neutralized, at least when this form is pronounced in isolation: its tones are kenya-ma (H M L), where M signifies a tone approximately half-way between H and L. This reinforces the claim that it is an assimilation rather close to the surface that accounts for the simplification of $\widehat{HL}$ to H in (24).

2.5.3. Finally, on the weight of the evidence from Maninka and Bambara presented in chapter 4, I will assume that TONE

SPREADING is a suprasegmental rule in Mende. As has been shown in the discussion surround examples (25) and (21), this is a tenable view as long as there is an independent explanation for the result in (24); furthermore, as has already been noted, the analysis which posits TONE SPREADING as a suprasegmental rule implicitly makes the interesting prediction that this rule does not apply word-internally to a single morpheme.

FOOTNOTES TO CHAPTER TWO

[1]However, cf. the report of Dwyer's remarks on mba (LHL) and nikili (L H L) in chapter 1, fn. 3. In addition, some further comments must be made on the patterns described in (15). For example, in (15e) the disyllabic nyaha with the tone pattern LHL is assigned the tones nyaha (L HL), with a falling tone on the last vowel; this state of affairs is quite regular. But there are a number of words in Mende which also appear to be disyllabic and which have the pattern LHL assigned in a different way. Examples are: gɔta (LH L), 'gutter', gɔtɔ (LH L), 'rope', tolo (LH L), 'kola nut', tika (LH L), 'coal', mana (LH L), 'banana'. These, instead of having a falling tone on the final vowel, have a rising tone on the initial vowel. Such words are not very numerous in comparison to the normal disyllabic words with LHL contours. In addition, there is at least one disyllabic word with a LH contour that is exceptional in the same respect: bɛsi (LH H), 'pig', has a rising tone on the first vowel instead of the expected low tone. Both sets of exceptions will conform to the patterns in (15) if we assume that the vowel of the first syllable is actually a sequence of two [+syllabic] segments; these two-syllable words will then behave like three-syllable words, and the tones will be correctly assigned by the mapping rule (16).

A similar phenomenon in Tiv is noted in chapter 3. It is not clear whether these vowels in Mende are phonetically long or short; if they are short, a syncope rule will be required, but this will raise the problem of deleting a segment without deleting its tone. The same problem may arise in Tiv. In view of this, another means of expressing the tone patterns on these exceptional words may have to be found.

[2]Woo (1969: ch. 3) criticizes Wang's formulation, observing that Wang must consider low level tones to be low falling; this artifice, Woo claims, makes it necessary to include two more rules in the phonology of Amoy in order to produce the correct surface tones. Thus, Wang's case for the appearance of contour tone features in phonological rules seems to rest on some shaky assumptions. Unfortunately, Woo's own alternative to Wang's sandhi rule, which avoids the use of contour features, appears quite complex and is unaccompanied by any demonstration to the effect that it captures some generalization that would otherwise remain unexpressed.

[3]Wang (1967) actually maintains that the contour features, along with his other tone features, are represented on syllables rather than on segments. His arguments are criticized in chapter 6.

CHAPTER THREE. THE TONAL SYSTEM OF TIV

3.0. Introduction.

Tiv, a Benue-Congo language of Nigeria, presents a considerable challenge to the suprasegmental representation of tone, as this proposal has been outlined in preceding chapters. This language is tonally more intricate than Mende, and yet Arnott (1958, 1964) and McCawley (1970b) have demonstrated convincingly that the grammar of this language treats underlying tone patterns in verbs separately from segments--a characteristic of languages with a suprasegmental level of representation. In some respects, Arnott's and McCawley's analyses depart quite radically from the sort of treatment of suprasegmental tone proposed in the present work. In this chapter, it is demonstrated that their analyses can be improved upon within the suprasegmental framework.

3.1. Downstep.

3.1.1. Arnott (1964) posits three tonemes for Tiv: high, low, and downstep. The presence or absence of downstep is shown to be lexically contrastive in the following examples. kwa, 'ring of huts', in (1a) is distinguished from kwa, 'leaf', in that only the latter is preceded by a downstep.

(1) a. i lu kwa ga 'it was not a ring of huts'
[— — — —]

b. i lu kwa ga 'it was not a leaf'
[— — — —]

In addition, words can end in a downstep. An example is the word mba, 'there is', which causes a following high tone to be downstepped, as illustrated in (2a). Example (2b) shows that this word, when followed by a pause, is pronounced with a falling tone.[1]

(2) a. mba kasev 'there are women'
H! H H
[— — —]

b. kasev mba, 'there are women'
H H H!
[— —]

McCawley argues that the behavior of words like mba shows that they can be represented underlyingly with a HL contour. The L component of this contour accounts for the downstepping of a subsequent H, since any H following a L is subject to downdrift. The later disappearance of the L component is attributable to an assimilation to the following tone.

3.1.2. As will be demonstrated shortly, McCawley's proposal regarding downstep permits a simplification of the account of the verbal system. In addition, it should be noted that the interpretation of downstep as L permits one to explain why a sequence of two downsteps occurring between two H tones has the same effect as a single downstep would, rather than having

a double downstepping effect, and why a downstep preceded or followed by L has no effect. The reason is that !!, $^{!}$L, and L$^{!}$ are all interpreted as LL, which never differs from L in its effects on surrounding tones.

3.1.3. McCawley's proposal gives the lexical representation of a word like kwa as $\underset{LH}{kwa}$, where the tones are interpreted as properties of the syllable. For the present purposes, these tones could equally well be represented as properties of the syllabic segment a; I will not draw a distinction in this chapter between the representation of tones on syllables and their representation on syllabic segments; however, cf. chapter 6. McCawley notes that his reinterpretation makes it necessary to posit rules eliminating the low component of a LH or HL contour when these contours are represented on a single syllable. These rules must be ordered after the downdrift rule, so that the L will have its effect on the surrounding contour before being deleted. For the most part, the needed rules appear quite plausible. The simplification of a $\widehat{HL}$ sequence to H before a H that has undergone downdrift is a very common rule.[2] Similarly, the simplification of $\widehat{HL}$ to H before another L has been described in a number of languages as absorption by Hyman and Schuh (1972). $\widehat{HL}$, as already observed, does not simplify to H before pause. As for the rule which converts $\widehat{LH}$ into H, it is matched by the need in Arnott's analysis for a special statement to the effect that a downstep immediately after pause

or L has no influence on the following H. Later, the precise formulation of the needed rule will be discussed.

3.2. General features of the verbal system.

3.2.1. As will soon be apparent, the verbal system of Tiv displays a considerable amount of complexity. Arnott describes twelve sorts of tense, mood, and/or aspect in which a given root may appear, including four separate forms for the present habitual. These twelve categories are distinguished from each other by their characteristic tone patterns and, to a lesser extent, by segmental alternations in the verb root and by differences in which class of subject pronouns they may co-occur with. For each category in the verbal system, Arnott (1964) describes the characteristic tonal contour or set of tonal contours which are to be mapped onto the syllables of the verb root. By modifying the mapping principle and the formalism for representing the characteristic contours, McCawley (1970b) shows that Arnott's formulas can be simplified and generalized to a considerable extent.

The tonal patterns in question are more intricate than those described for Mende in chapter 2, and this leads McCawley to make some additional assumptions which were clearly unnecessary in the Mende account. Unfortunately, some of these assumptions actually contradict aspects of the suprasegmental framework proposed in the preceding chapters, but in this chapter it will be shown that this framework is capable of a

treatment of the Tiv verbal system that is superior to McCawley's in some respects and equal to it in others.

An interesting feature of the syllabic structure of Tiv is that a number of consonants can function syllabically as vowels, even in immediately post-vocalic position; like vowels, they can bear tone. Abraham (1940: 3-4) claims that in certain words the consonants m, n, l, r, v, and gh (apparently, a uvular fricative) are syllabic. The following, for example, would be two-syllable words: kən, 'inside', and nagh, 'his'. He emphasizes that these syllabic consonants are pronounced as separate syllables, and, though he adds that they are pronounced rapidly after the preceding syllable, he distinguishes them from final consonant sounds that are nonsyllabic, such as the final r in gbanger, 'is broad'. That these syllabic consonants are capable of bearing tone will be demonstrated shortly.

For the purposes of this discussion, I will assume that any tone-bearing segment in Tiv is [+syllabic]. A sequence of two vowels is counted by Abraham and Arnott as two tone-bearing units and hence, in this discussion, will be represented as a sequence of two [+syllabic] segments. About these sequences, Abraham says that, "it is possible ... to repeat a vowel with what seems like a break between, but is really a diminution of breath, and then increase of it for the second vowel" (p.2). He goes on to point out that the break between vowels is automatic when the two vowels in the sequence are different, as in dzua, 'got, met', but that this break also occurs when the same

vowel is repeated at the same pitch or with the tones LH, and that this break is distinctive: dzal (L), 'juice', dzaal (LL), 'corn platform inside a house'. In the introduction to a republication of Abraham (1940), Arnott notes that geminate vowels also occur with falling tones and says that the break between vowels which Abraham observed in the other cases is open to question. In view of the shaky phonetic evidence and the scant phonological evidence, one might prefer to designate the tone-bearing segments of Tiv with some arbitrary diacritic feature rather than with the phonological feature [syllabic]. For the purposes of this chapter, it does not matter which course is taken, and so I will arbitrarily choose the latter.

3.2.2. There are two classes of verb roots in Tiv, H and L. The underlying tone of the verb root combines, in ways that will be illustrated, with the basic tonal formula for a given tense, to produce the tonal contour appropriate to that verb root in that tense.

3.3. General Past and Imperative.

3.3.1. In the General Past tense, the following facts obtain:

(3) GENERAL PAST

H Root	L Root
va !H	dza L
kɔr !HL	nyɔr LL
due !HL	tsue LL
tire !H L	hide L L
keer !HLL	mɔɔr LLL
umbur !H LL	rumun L LL
nyɔɔso !HL L	sɔɔso LL L
yevese !H L L	kengese L L L

By comparing the following forms in the first column: tire (!H L) umbur (!H LL), nyɔɔso (!HL L), one sees that the presence or absence of a geninate vowel can lead to a tonal contrast. Grouping the roots according to the number of syllabic segments they possess, Arnott expresses the pattern for the General Past in the following way, where B stands for the basic tone of the verb root.[3]

(4) GENERAL PAST	1syll	2syll	3syll
	$^{!}B$	$^{!}BL$	$^{!}BLL$

The roots in the second column of (3) are thus assigned to a pattern beginning with $^{!}L$, which by convention is equivalent to L. McCawley represents the initial downstep with a L, and he collapses Arnott's formulas in (4) into a single formula:

(5) GENERAL PAST $\overset{\frown}{LB}L_o$

This formula is to be interpreted in the following way. The tie over $\overset{\frown}{LB}$ indicates that these tones are to be represented on a single syllable; the symbol L_o indicates that if there are any additional syllables, they are each to be assigned a low tone. If the base tone B is L, then, of course, $\overset{\frown}{LL}$ will result on the first syllable, and this will be interpreted as L.

3.3.2. The formula expressed in (5) is different from the suprasegmental formulas proposed for Mende in one crucial way: it is not totally independent of segmental informaton, since it expresses the fact that the first sequence LB is to be represented on a single syllable (or on a single syllabic segment) and since it says in addition that the remaining part of the contour, L_o, is expressed only if the root in question has additional syllabic segments.

McCawley's notational system represents a much weaker hypothesis about possible suprasegmental contours than the one

put forward in the present work. To see this, it is only necessary to consider the fact that all of the Mende contours discussed in the preceding chapter--H, L, HL, LH, LHL--are directly translatable into McCawley's system as H_o, L_o, HLL_o, LHH_o, and $LHLL_o$, while many contours which McCawley's notation is capble of expressing are not translatable into the suprasegmental notation proposed for Mende; for example, the distinction between HLL and HHL is representable in McCawley's notation, while in suprasegmental notation, both sequences reduce to HL.

A first attempt at re-expressing the General Past formula within the limits of the more highly constrained suprasegmental theory might involve translating (5) into BHL, but the needed mapping rule would be quite different from that of Mende. A L root would be assigned the contour LHL; a one-syllable verb like dza would have the total contour mapped onto it, resulting in $\underset{LHL}{dza}$; subsequently, downdrift would apply and rules posited by McCawley would delete the initial and final L, resulting in a high-toned verb preceded and followed by downstep; we may represent this result as $\underset{!H!}{dza}$. This is incorrect, however, since the actual form contains a high tone preceded but not followed by downstep: $\underset{!H}{dza}$.

A second problem is that with L roots having more than one syllabic segment, the mapping rule would operate incorrectly if it were the same as the Mende mapping rule; the actual

mapping rule that this analysis would seem to require is extremely awkward. Recall that the Mende mapping rule maps tones onto syllabic segments on a one-to-one basis, insofar as possible; if the number of syllabic segments exceeds the number of tones, the last tone of the contour is extended to the end of the word; if the number of syllabic segments is less than the number of tones, the remaining tones are compressed onto the last syllabic segment of the word. If this principle operated with the Tiv contour LHL, it would incorrectly yield forms like $\underset{L\ HL}{\text{tire}}$ instead of $\underset{LH\ L}{\text{tire}} > \underset{H\ L}{\text{tire}}$. Applying the mapping rule from right to left would produce the correct result in this instance, but not in some other tenses; furthermore, this procedure would not solve the first problem mentioned, involving verb roots with a single syllabic segment.

3.3.3. A successful solution to the first problem can be motivated by means of a contrast that goes unnoticed by Arnott and McCawley. Consider the data from the Imperative, another of the "tenses" described by Arnott:

(6) IMPERATIVE

H Root	L Root
va H	dza H
kɔr HL	nyɔr LH
due HL	tsue LH

tire H L	hide L H
keer HHL	m r LHL
umbur H HL	rumun L HL
nyɔɔso HH L	sɔɔso LH L
yevese H H L	--

The formulas for the Imperative given by Arnott are:

(7) IMPERATIVE	1syll	2syll	3syll
	H	B + opp.	BHL

The formula for the two-syllable roots indicates that the first syllabic segment bears the basic tone of the root, while the second bears the opposite tone. This polarity principle does not operate in any of the other "tenses" described by Arnott, and so this proposal may be viewed with some suspicion. Worse yet, no relation is observable among the three formulas proposed. McCawley's formulas for the Imperative are the same, requiring separate statements for roots of one, two, and three syllables. But there is a pattern in the Imperative, though granted not a completely regular one. The longest L roots clearly have the contour BHL; this pattern may be extended to L roots with two syllabic segments if we assume that the final HL of the BHL is realized as H when it is assigned to a single syllabic segment. The principle involved must operate before

downdrift--otherwise H! would result. The same rule is needed in the General Past for the H root va, to convert $\underset{\text{!HL}}{\text{va}}$ into $\underset{\text{!H}}{\text{va}}$; this rule will be discussed at greater length below. Before considering the monosyllabic L roots, let us turn to the H roots. The Imperative formula BHL is interpreted as HHL = HL when the basic tone is H. This yields $\underset{\text{HL}}{\text{va}}$, which is converted into $\underset{\text{H}}{\text{va}}$ by the simplification rule just mentioned; the two-syllable roots are assigned the correct HL contour; a special statement is needed for the three-syllable H roots.

The final root to be discussed is the monosyllabic L root dza. The mapping rule yields $\underset{\text{LHL}}{\text{dza}}$, which must somehow be converted into $\underset{\text{H}}{\text{dza}}$. There is, of course, a ready way to eliminate the final L in this case; the only remaining problem is to account for the realization of LH as H.

The LH in the Imperative contrasts with the LH which results on dza in the General Past. In the General Past, this sequence must be realized as !H, while in the Imperative, it is realized as H. This contrast can be expressed by distinguishing between a floating L and the L of a contour associated with a morpheme that has a segmental realization in addition to a suprasegmental realization. In the General Past, the downstepping effect that precedes H roots will be attributed to a floating L prefixed to the base form of all roots in this tense. This proposal is quite plausible in view of the fact

that many of the twelve verbal categories have a characteristic affix associated with them; these affixes have a segmental and/or a suprasegmental realization. In the Imperative, on the other hand, the absence of a downstepping effect that might be contributed by the L of LH before this L is deleted is explained by ordering the deletion before the downdrift rule. This ordering, of course, is the same one that is called for in the cases cited above in which HL is simplified to H: the L must be deleted before it can occasion downdrift on a floating H.

3.3.4. It may be objected that the fact that the instances of L in question do not occasion downdrift argue that they are not really there in the first place. While such an objection may initially seem to have some plausibility, I believe that it is answered by considering some completely parallel facts in Hausa, involving simplification of $\widehat{LH}$ and $\widehat{HL}$ contours to H in cases in which the underlying presence of these contours could hardly be doubted. These cases are described in Leben (1971a).

Hausa does not permit surface rising tones, but there are clear cases in which rising tones arise in the course of a derivation; in such cases, the rising tone is realized as H. For example, the verb $\underset{H\ \ L}{\text{daukaa}}$, 'take', appears anomalous at first glance because it takes the endings of a Grade 2 verb in all environments and yet its surface tonal pattern HL is

distinct from that of other disyllabic Grade 2 verbs, which invariably have the tonal pattern LH. This anomaly can be resolved by postulating that ɗaukaa has three [+syllabic] segments, namely, a, u, and a; this will cause ɗaukaa to be assigned the tonal pattern of a three-syllable Grade 2 verb, which is LHL. But the u in $\underset{LH\ L}{\text{ɗaukaa}}$ becomes nonsyllabic, thus subjecting $\widehat{LH}$ to a rule which converts it to H.

Another instance in which this rule operates involves contraction. Object pronouns in Hausa can sometimes lose their vowel; when this happens, the tone of the object pronoun is retained. For example, in the sequence $\underset{H}{\text{baa}}\ \underset{L}{\text{ni}}$, 'give me', i can be dropped; the result is $\underset{HL}{\text{baan}}$, which is shortened to $\underset{HL}{\text{ban}}$ by a general rule. Similarly, in the sequence $\underset{H\ L}{\text{kaamaa}}\ \underset{H}{\text{si}}$, '...catch him', i can be dropped; the result would be $\underset{H\ LH}{\text{kaamaas}}$, shortened to $\underset{H\ LH}{\text{kaamas}}$; however, LH is simplified to H, yielding $\underset{H\ H}{\text{kaamas}}$.

In both of the instances discussed, the deleted L does not occasion downdrift on the following H, just as in the Tiv examples. But surely there is no chance, at least in the latter instance, of saying that the deleted L is never there.

An interesting case in Hausa of the realization of HL as H involves the productive verbal noun suffix ${}^{L}\text{Ø} + {}^{H}\text{waa}$, where ${}^{L}\text{Ø}$ designates a floating L. When this suffix is attached to

a verb ending in a long vowel, the floating L is assigned to the long vowel of the verb ending; for example, karantaa, (H L H) 'read', has the verbal noun karantaawaa. (H L HL H) But Hausa does not permit surface falling tones on short vowels; thus, when the nominalizing suffix is attached to a verb ending in a short vowel, such as yiyu, (L H) 'be done', the floating L is lost, yielding yiyuwaa (L H H) and not *yiyu waa. (L HL H) Here, too, as in Tiv, the disappearing L does not occasion downdrift; but again it would be difficult to maintain that the L was never present at all.

The Hausa cases strongly support the principles proposed for Tiv. Before returning to the analysis of Tiv, one more general comment is in order.

3.3.5. The ability to affix floating tones greatly increases the power of the suprasegmental formalism; if the use of floating tones is completely unconstrained, almost any tonal contour will be expressible suprasegmentally, thereby making the suprasegmental hypothesis considerably less testable. Evidence from many languages shows that it would be impossible to absolutely prohibit the expression of floating tones, but the use of floating tones must obviously be restricted in some way. In Tiv, there appears to be adequate motivation for the floating tones. As will be seen, there are segmental affixes associated with the verb root in various categories, and this should lead us,

on the suprasegmental hypothesis, to expect that there may be suprasegmental affixes in some cases: this is what $^{L}\emptyset$ represents. The proposal for floating affixes in Tiv is not ad hoc, with each specific instance motivated in the same way as are instances of segmental affixes whose realization is sometimes Ø: the effect on the surrounding environment is observed and a rule expressing the alternation between the Ø realization and the other realization of the affix is shown to be plausible.

3.3.6. Before considering the remaining Tiv tenses, it may be helpful to review and illustrate the suprasegmental proposal. To facilitate reference, Arnott's formulas for the General Past and Imperative are reproduced here:

(4) GENERAL PAST	<u>1syll</u>	<u>2syll</u>	<u>3syll</u>
	$^{!}$B	$^{!}$BL	$^{!}$BLL
(7) IMPERATIVE	H	B + opp.	BHL

The suprasegmental re-interpretation for these is:

(8) GENERAL PAST $^{L}\emptyset$ + ^{BL}Root

(9) IMPERATIVE ^{BHL}Root (except for 3syll H roots)

The suprasegmental sequence BL is, of course, interpreted as L if B is L, and BH is interpreted as H if B is high. Mapping of the tonal contour onto the segments is specified by the following principle, which is identical to the mapping rule proposed for Mende in chapter 2:

(10). TONE MAPPING (Tiv)

a. Assign the first level tone of the root contour to the first [+syllabic] segment, the second tone to the second, and so on.

b. If there remain any [+syllabic] segments that have not been assigned a tone, assign them a copy of the last tone assigned.

c. If there remain any tones that have not been assigned, assign them in sequence to the last [+syllabic] segment of the root.

The following deletion rule is to apply after (10) and before downdrift.

(11) TONE SIMPLIFICATION (Tiv)

Delete any L that occurs in sequence with H on a [+syllabic] segment.

The following are sample derivations.

(12) GENERAL PAST

(H root)	(L root)	(H root)	
a. $L_{\emptyset}$ + HL_{va}	b. $L_{\emptyset}$ + L_{rumun}	c. $L_{\emptyset}$ + HL_{yevese}	
va H	rumun L	yevese H L	(10a)
	rumun L LL	yevese H L L	(10b)
va HL			(10c)
va H			(11)
$L_{\emptyset}$ + va H	$L_{\emptyset}$ + rumun L LL	$L_{\emptyset}$ + yevese H L L	

In (12a,c) the floating L is realized as downstep on the following H; in (12b) the floating L has no effect, since it is followed by L.

Next, some sample derivations are given for the Imperative; va is a H root, and dza and hide are L roots.

(13) IMPERATIVE

	(H root)	(L root)	(L root)	
	a. ^{HL}va	b. ^{LHL}dza	c. ^{LHL}hide	
	va	dza	hide	(10a)
	H	L	L H	
	va	dza	hide	(10b)
	HL	LHL	L HL	
	va	dza	hide	(11)
	H	H	L H	

There remains the problem of the three-syllable H roots. For these, the BHL Imperative contour would be interpreted as HL, and (10) TONE MAPPING would assign the tones HLL to these: *yevese. The correct form is yevese. Inspection of the re-
H L L H H L

maining categories treated below will show that it would be impossible to alter the mapping rule to derive this form from the general Imperative contour. In addition, it will be seen that in the remaining tenses, the three-syllable verbs often behave somewhat differently from shorter verbs: in some cases, they do not take the segmental suffix that the shorter verbs do. In the present case, it is proposed that the three-syllable verbs take a $^{L}\emptyset$ suffix, and that the Imperative contour is mod-

ified for them from BHL to BH. This will yield $\underset{H\ H\ H}{yevese} + {}^{L}\emptyset$, which a general tone retraction rule converts into $\underset{H\ H\ L}{yevese}$. Note that the three-syllable L roots may also be described in terms of the modified three-syllable contour; in these cases BH + ${}^{L}\emptyset$ is interpreted as LH + ${}^{L}\emptyset$, yielding $\underset{L\ HH}{rumun} + {}^{L}\emptyset$, which becomes $\underset{L\ HL}{rumun}$ by the same retraction process. The retraction process is expressed as follows:

(14) TONE RETRACTION (Tiv)

$$[+seg] \longrightarrow [+L] \ / \ \_\_ \ C_o \ {}^{L}\emptyset$$

Later this rule will be shown to apply only to three-syllable verbs. This rule can also be shown to exist in certain Maninka dialects. A word like ${}^{H}\underline{jiri} + {}^{L}\emptyset$, 'the tree', is pronounced $\underset{H\ HL}{jiri}$ in the standard dialect, but in Faranah Maninka, as reported in Spears (1966), it is pronounced $\underset{H\ L}{jiri}$. This provides evidence for the same rule of TONE RETRACTION in Faranah Maninka.

Although the suprasegmental analysis may have seemed incapable of describing the intricate contours of the Tiv verbal system, the above treatment of the General Past and Imperative shows that the possibility of expressing floating affixes, along with certain mapping, deletion, and retraction principles established for other languages, permits an account

that is at least slightly more general than previous ones. In the remainder of this chapter, the rest of the Tiv tenses will be discussed.

3.4. Continuous.

In the tonal pattern of the Continuous, the basic tone of the root plays no role; formulas for the H roots and L roots are identical.

(15) CONTINUOUS

Arnott: (1syll) HL; (2syll) HLL; (3syll) HLL

McCawley: HL_{O}

One point of interest in the Continuous is that roots of less than three syllables are adjusted by suffixing a low-toned n to them. The appropriate formulas are expressed in (16), and sample derivations are given in (17).

(16) CONTINUOUS (1,2syll) $^{HL}Root + {}^{L}n$; (3syll) $^{HL}Root$

(17) a. $^{HL}va + {}^{L}n$ b. $^{HL}ungwa + {}^{L}n$ c. $^{HL}yevese$

va	ungwa	yevese	(10)
HL	H L	H L L	
va			(11)
H			
van	ungwan	yevese	
HL	H LL	H L L	

3.5. Habitual.

3.5.0. Tiv has four separate tenses which have a present habitual meaning, and Arnott (1964) comments that it has not yet been determined whether these tenses differ from each other in meaning or syntactic behavior. But they do differ in phonological form.

3.5.1.

(18) HABITUAL 1

	1syll	2syll	3syll
H roots:	!H	!HH	HHL
L roots:	!H	LH	LHL
Arnott:	!H	!BH	BHL

McCawley: (1,2syll) L͡B H; (3syll) BHL

To formulate the suprasegmental reanalysis for this tense, it will be helpful to examine some actual instances of roots in this tense.[4]

(19) HABITUAL 1

H Root	L Root
va !H	dza !H
ungwa !H H	venda L H
yevese H H L	ngohor L HL

The three-syllable form yevese (H H L) is anomalous in this tense because it represents the only type of H root that is not preceded by downstep. As it turns out, this form is homophonous with one of the possible three-syllable forms in Habitual 4, taking even the same class prefix. Thus, a likely possibility for eliminating this anomaly is to claim that three-syllable H roots do not occur in Habitual 1. This sort of gap in the verbal paradigm is not without precedent, since Arnott himself notes that three-syllable L roots do not seem to occur in Habitual 2.

The remaining H roots provide evidence for a preceding $^{L}\emptyset$ affix; the three-syllable L root in Habitual 1, exemplified by ngohor (L HL), might give us reason to believe that the root contour is BHL, but, if applied to two-syllable H roots, this would incorrectly yield !ungwa (H L). Thus, the formula for one- and two-syllable roots must be $^{L}\emptyset + {}^{BH}\text{Root}$, while the three-syllable formula is $^{L}\emptyset + {}^{BH}\text{Root} + {}^{L}\emptyset$. Sample derivations follow:

(20) a. $^{L}\emptyset + {}^{H}$ungwa

ungwa
H H

$^{L}\emptyset$ + ungwa
H H

b. $^{L}\emptyset + {}^{LH}$venda

venda
L H

$^{L}\emptyset$ + venda
L H

c. $^{L}\emptyset + {}^{LH}$ngohor + $^{L}\emptyset$

ngohor (10)
L HH

L HL (14)

$^{L}\emptyset$ + ngohor
L HL

Initial $^{L}\emptyset$ in (20a) is realized as downstep before the H, while the remainining instances of $^{L}\emptyset$ in these examples are lost, since they are either preceded or followed by L.

3.5.2. The next habitual tense, Habitual 2, applies to roots modified segmentally according to principles that need not concern us here (cf. Arnott, 1958, 1964). As noted above, three-syllable L roots are not attested in this tense.

(21) HABITUAL 2

	1syll	2syll	3syll
H roots:	$!_{H}!$	$!_{HH}!$	$!_{HHH}$
L roots:	$!_{H}!$	$LH^{!}$	--
Arnott:	$!_{H}!$	$!_{BH}!$	$!_{BHH}$

McCawley: (1,2syll) $\widehat{LB}\ \widehat{HL}$; (3syll) $\widehat{LB}$ H H

Reanalysis: (1,2syll) $^{L}\emptyset + {}^{BH}\text{Root} + {}^{L}\emptyset$; (3syll) $^{L}\emptyset + {}^{BH}\text{Root}$

Again, the three-syllable root is the exceptional one. Observe that the reanalysis will yield two-syllable H roots with the pattern $^{L}\emptyset + \underset{H\ \ H}{ongo} + {}^{L}\emptyset$, but in this case (14) TONE RETRACTION, which would incorrectly put the final floating L onto the preceding vowel, lowering its high tone, may not apply. This shows that (14) must be restricted to apply only to three-syllable roots.

3.5.3. In Habitual 3, the verb root must again undergo adjustments, and the adjustments are different from the ones mentioned in connection with Habitual 2. Monosyllabic roots have their vowel lengthened, and all roots suffix a high-toned n, except that this suffixation is not totally obligatory with three-syllable roots--some speakers, Arnott notes,[5] normally use

three-syllable Habitual 3 forms without a suffix.

(22) HABITUAL 3

	1syll	2syll	3syll
H roots:	$^{!}$HHH	$^{!}$HHH	$^{!}$HHH(H)
L roots:	$^{!}$HHH	$^{!}$LHH	$^{!}$LHH(H)
Arnott:	$^{!}$HHH	$^{!}$BHH	$^{!}$BHH(H)
McCawley:	$\widehat{\text{LB}}$ H H H_{o}		

McCawley observes that the convention assigning tones to syllables must be refined in this case to account for the fact that the first syllable of an underlyingly one-syllable root is H, while the corresponding syllable in underlying two- and three- syllable roots is H. The refinement he suggests is that when three syllables worth of tones is to be assigned to two syllables, in this case LB H H to dza-an, the middle tone is to be associated with the first syllable. This gives LBH on dza, which is realized as LLH $\longrightarrow$ LH $\longrightarrow$ $^{!}$H. (Note that McCawley, contrary to Arnott, does not regard the final n of dzaan as a separate syllable.) This convention gives an incorrect result for the underlying two-syllable L root vendan, which, on McCawley's account, has two surface syllables
L H
like dzaan. The first syllable, ven, would be assigned LBH, which would be realized as $^{!}$H. Besides producing an incorrect result, McCawley's convention appears rather unnatural in the light of the absorption processes noted by Hyman and Schuh

(1972). If a language has a sequence LHH or HLL, with no place for the middle tone of the sequence to go, this tone is in general absorbed by the tone to the right if it is identical to it. The tones caught in the middle in McCawley's analysis fit this description, but, rather than being absorbed by the tone to the right, they are moved leftward into a nonabsorptive environment.

These problems can be solved by ordering tone assignment before vowel lengthening, which operates only on underlying monosyllabic roots. In McCawley's framework, the Habitual 3 pattern could be re-expressed as $\widehat{LB}\ H\ H_o$. This would yield $\underset{LBH}{dza}\text{-}\underline{n}$ and $\underset{LB\ H}{venda}\text{-}\underline{n}$, which are realized as $\underset{!H}{dzan}$ and $\underset{L\ \ H}{vendan}$. Subsequently, the vowel of the first root would be lengthened. This same ordering is proposed for the suprasegmental reanalysis.

(22) HABITUAL 3 $\quad L_{\emptyset} + {}^{BH}\text{Root} + {}^{H}\underline{n}$

As in the previous analyses, the optionality of ${}^{H}\underline{n}$ for three-syllable verbs must be marked.

3.5.4. The Habitual 4 roots undergo essentially the same modifications noted for Habitual 3, again optionally in the case of three-syllable roots, but in this case it is a low-toned $\underline{n}$ that is suffixed. The base tone of the root does not enter into the tonal patterns of this tense. With a three-syllable root, if there is a final $\underline{n}$, the preceding tones are all H; if there

is no n suffix, the last vowel is L, and all preceding ones are H.[6]

(23) HABITUAL 4

Arnott: (1syll) HHL; (2syll) HHL; (3syll) HH(H)L

McCawley: H_oL

Reanalysis: $^{H}\text{Root} + {}^{L}\text{Suffix}$

In the reanalysis, Suffix represents n after a one- or two-syllable root and either n or Ø after a three-syllable root. If the root is followed by $^{L}Ø$, (14) TONE RETRACTION will correctly change the last vowel of the root from H to L.

3.5.5. In addition to the four present habitual tenses, there is a Past Habitual. The segmental form of the root is the same as in Habitual 4, except that in this case, the low-toned n suffix is obligatory even with three-syllable roots.[7]

(24) PAST HABITUAL

	1syll	2syll	3syll
H root:	!HHL	!HHL	!HHHL
L root:	!HHL	LHL	LHHL
Arnott:	!HHL	!BHL	!BHHL

McCawley: $\hat{L}B\ H\ H_o\ L$

Reanalysis: $^{L}Ø + {}^{BH}\text{Root} + {}^{L}n$

3.6. Future, Recent Past, and Subjunctive.

3.6.0. Four tenses remain to be discussed: Future, Recent Past A, Recent Past B, and Subjunctive. The last two mentioned are identical insofar as the verb root is concerned, differing only in the class prefixes taken.

3.6.1.

(25) FUTURE

Arnott: (1syll) $^{!}B$; (2syll) BL; (3syll) BLL

McCawley: (1syll) $\widehat{LB}$; (2,3syll) B L_{o}

Reanalysis: (1syll) $^{L}\emptyset + {}^{B}\text{Root}$; (2,3syll) $^{BL}\text{Root}$

3.6.2.

(26) RECENT PAST A

Arnott: (1syll) $^{!}H$; (2syll) $^{!}BH$; (3syll) $^{!}BHL$

McCawley: $\widehat{LB}$ H L_{o}

Reanalysis: $^{L}\emptyset + {}^{BH}\text{Root} + {}^{L}\emptyset$

3.6.3.

(27) RECENT PAST B and SUBJUNCTIVE

Arnott: (1syll) H; (2syll) HB*; (3syll) HHL
where B* is interpreted as $^{!}_{H}$ if B is L

McCawley: (1syll) H; (2syll) H $\widehat{BH}$; (3syll) H H L

Reanalysis: (1,2syll) $^{HB}\text{Root} + {}^{H}\emptyset$; (3syll) $^{H}\text{Root} + {}^{L}\emptyset$

The reanalysis in this case requires an additional statement. A two-syllable L root, such as the Recent Past $\underset{H}{\text{vende}}$, is $^{!}_{H}$

analyzed as $^{HL}\underline{\text{vende}} + {}^{H}\emptyset$, which is mapped into $\underset{H\ \ H}{\underline{\text{vende}}} + {}^{H}\emptyset$. To permit the root-final L to be converted into downstepped H, the L must be allowed to assimilate to the floating H after downdrift. This is consistent with the principles that have been described for Tiv: in particular, floating tones have been assumed throughout to be referred to by the downdrift rules, and the assimilation of L to a following H is a widely attested process. But it might still be questioned whether the rule involved is independently necessary in Tiv.

FOOTNOTES TO CHAPTER THREE

[1]Cf. Arnott (1964: 39, fn. 2) for a description of this falling tone; he notes that the final part of the fall is inaudible, perhaps due to devoicing.

[2]Cf. Stewart (1971), Schachter and Fromkin (1968), and Spears (1967a,b), for example.

[3]Arnott's notation is modified slightly, to facilitate translation into the reanalyses.

[4]In a table facing p. 48 of his article, Arnott (1964) actually gives $\underset{H}{dza}$ instead of $\underset{!H}{dza}$, but in two other places in this article, pp. 48, 49, Arnott specifies a !H pattern for roots fitting this description.

[5]The example given by Arnott (1964) in the table facing p. 48, $\underset{H}{al\text{ɔ}m}$ $\underset{HH}{vaan}$, would lead one to think that the H root in $\underset{HHH}{vaan}$ is not preceded by downstep in Habitual 3. However, this is contradicted by Arnott's formulas on pp. 48, 49. Thus, it appears that a downstep mark has mistakenly been omitted before $\underset{HHH}{vaan}$.

[6]Again, an example in the verb table is inconsistent with the formulas on pp. 48, 49 in Arnott (1964). I assume that the correct form for ngohor (H HH) is ngohor (H HL).

[7]Arnott's verb table gives yevesen (H H HL) for this tense, but this is in conflict with the formulas he provides on pp. 48, 49. Thus, it should be corrected to yevesen (H H HL).

CHAPTER FOUR. TONE SPREADING IN MANINKA, BAMBARA, AND HAUSA

4.0. Introduction.

Maninka and Bambara, two Mande languages that are much more closely related to each other than to Mende, are cited in the literature as languages in which tone is phonologically a property of morphemes. Welmers (1949) posits only one tone per morpheme in Maninka underlying representations, and Bird (1966) reaches the same conclusion for Bambara. As was noted in chapter 1, this conclusion was based on the distribution of tone in underlying forms: it has been claimed that there are essentially just two types of morpheme in these languages, high toned and low toned morphemes. But in addition, assuming this distribution, it is possible to demonstrate that these languages have tone rules which refer to suprasegmental tones; if tone were regarded exclusively as a segmental feature, at least one of these rules could not be expressed without loss of generality.

A similar case can be made for some tonal rules of Hausa; on the other hand, Hausa has at least one tone rule which must be construed as segmental. But as the suprasegmental framework would predict, this rule is ordered after the suprasegmental rules. These rules will be motivated and discussed in this chapter.

4.1. Tonal alternations in Maninka.

4.1.1. Spears (1968) proposes an analysis of some tonal changes in Maninka that are not explicitly dealt with in Welmers (1949). Although I believe the analysis to be wrong, the data presented is quite interesting for the purpose of establishing a suprasegmental analysis of tone.

In Maninka, the mark of the definite is a floating low tone. Its manifestation is illustrated in the following examples:

(1) a. bon + $^{L}\emptyset$ 'the house'

H
[⌒]

b. bon te yan 'a house is not here'

H H L
[¯ ¯ _]

c. bon + $^{L}\emptyset$ te yan 'the house is not here'

H H L
[⌒ ¯ _]

By comparing the indefinite form $\underset{H}{\text{bon}}$, 'a house', with the definite form $\underset{HL}{\text{bon}}$, 'the house', we see that the definite is formed by adding a low tone to the noun.

Next, Spears points out that certain Maninka high-toned morphemes are realized as L in the following environments: when preceded by L and followed by either H or #. Included in the class that undergoes this change are certain morphemes which might be termed "function words", such as ye, 'is', la,

'in', te, 'Neg. (Pres.)', ra, 'Passive'; in addition, the rule apparently applies to verbs in general and to some pronouns. To witness the alternation, compare the underlined forms in the following pairs:

(2) a. a ye yan — 'he is here'
L H L

a ye bon la — 'he is in the house'
L L HL L

b. n bɔ ra — 'I went out'
H H H

a bɔ ra — 'he went out'
L L L

c. a ka n kudu — 'it bumped me'
L L H L L

a ka n kin — 'it bit me'
L L L L

In (2b), the lowering of the verb bɔ provides the environment for the lowering of ra; in (2c), the lowering of n provides the environment for the lowering of kin, which phonologically has a high tone; kudu in (2c), meanwhile, is phonologically low. As a result, we might first guess that an iterative rule is involved which operates from left to right. The rule which Spears formulates is called TONAL DISSIMILATION and may be represented as follows:

(3) TONAL DISSIMILATION (Maninka)

$$\underset{[+P]}{V} \longrightarrow L \;/\; L \_\_ \begin{Bmatrix} H \\ \# \end{Bmatrix}$$

[+P] is a diacritic feature possessed by vowels in words capable of undergoing this rule. As the examples in (2) demonstrate, rule (3) must apply iteratively from left to right in the present formulation. That is, given a sequence:

(4) $C_o \quad L \; C_{o[+P]} \; H \; C_{o[+P]} \; H \; C_{o[+P]} \; H \; C_o$

rule (3) will first apply to the leftmost H, converting it to L; this resulting L will then qualify as the left-hand portion of the environment of rule (3), and this will permit the next H in the sequence to become L, and so on. While it is clear that rule (3) would have to re-apply to its output in this fashion, there is some uncertainty about whether languages actually have such rules. Below, when (3) is reformulated, an alternative to iterative application of this rule will be suggested.

4.1.2. It is not immediately clear from looking at (3) why it should have been considered a tonal dissimilation rule; to see why, we must consider another phenomenon, which Spears proposes to collapse with this rule. The phenomenon involves the assignment of a high tone to the second syllable of disyllabic low-toned nouns and to the last half of monosyllabic nouns; this takes place before any L, such as the floating L of the definite. The tone inserted is underlined in the following two examples:

(5) a. muso + $^{L}\emptyset$ 'the woman'

L H

[_ ⌒]

b. sa + $^{L}\emptyset$ 'the snake'

LH

[⌒]

That is, the proposed underlying L of the nouns becomes LH in certain environments. Although Spears suggests that the rule involved here is to be collapsed with (3), he does not formally state this rule, or its subparts; and he calls the informal rules proposed tentative. But if we attempt to collapse the rules formally, we begin to see why Spears viewed this set of operations as an instance of tonal dissimilation.

First of all, let us ignore the fact that rule (3) may apply to tones preceding pause. As suggested in chapter 1, fn. 1, this may simply represent a conversational process that appears quite common in tone languages. This simplification permits us to collapse (3) with the rule which creates the high tones in (5), producing:

(6) "GENERALIZED" TONAL DISSIMILATION (Maninka)

$$\underset{[+P]}{V} \longrightarrow [\alpha H] \;/\; L\ C_o \_\_ C_o\ [-\alpha H]$$

This rule, although it looks more like a dissimilation by virtue of making a vowel's tone opposite to the tone immediately following it, is still very suspect. The two subrules it collapses are quite different from each other, since they

apply to entirely different types of morphemes. The subrule expressed in (3) applies to certain function words, verbs, and pronouns, and the other subrule applies to nouns. To permit the rule to operate correctly, we would need to have two diacriticis assoicated with it. Recall that in the discussion of subrule (3) it was noted that a diacritic feature [+P] would have to mark those vowels which were subject to the rule; but the vowels marked [+P] are only to undergo the portion of the rule that takes place before H (i.e. the portion given by (3)), and another diacritic feature, [+Q], would be needed to mark the vowels that undergo the other portion of the rule, which takes place before L. Furthermore, for the collapsing of the two operations to be feasible, a way would have to be found to associate the diacritic feature P with the minus value of α in [αH] while associating the diacritic Q with the plus value of α.

In addition, rule (6) could not apply correctly to $\frac{sa}{L}$ + $^{L}\emptyset$, 'the snake', producing $\frac{sa}{LH}$ + $^{L}\emptyset$. The reason is that this word has no vowel capable of serving as [V, +P] in (6). The only vowel of the word is the low-toned one which must serve as the leftmost part of the environment for the rule. Hence, the second subpart, although at first it may have appeared formally similar to the first, must be modified to include the following operation:

(7) $\emptyset \longrightarrow H \;/\; L\ C_o \_\_ C_o\ L$

In view of this, the rules are not as amenable to collapsing as one's first impression may have suggested.

4.1.3. A more conclusive argument against this formulation is that a much more revealing solution is possible. Since the most problematic aspect of the formulations in (6) and (7) seems to involve the part of the rule which raises certain vowels to H in some environments, let us attempt to do without this operation. In particular, let us reject the assumption made heretofore that the low tone is basic in the nouns involved in these latter cases, with a high tone added by rule. Instead, the form containing a high tone will be considered basic. This gives underlying forms /muso/ and /sa /; before
L H LH

a definite marker or any other low tone, they would retain this tonal pattern, being realized as illustrated in (5) when the definite marker is attached. But the high tone of these proposed underlying forms would have to be lowered in certain instances, namely, when another high tone followed. This is demonstrated in the following examples, where the high tone to be lowered is underlined; the result of the lowering is shown in the pitch representations beneath.

(8) a. muso te yan 'no woman is here'
L H H L
[_ ‾ ‾ _]

b. sa te yan 'no snake is here'
LH H L
[_ ‾ _]

Obviously, the operation required here is exactly what is already specified in rule (3): a H preceded by L and followed by H is lowered to L. Hence, by revising our assumptions about the underlying form of "low-toned" nouns, we have increased the applicability of (3) greatly, without altering its formulation, and we have avoided the need for formulating an additional, problematic rule. If we continue to disregard the portion of (3) which applies to H before #, we have a rule which is not a dissimilation at all, but rather a rule of TONE SPREADING like the one described for Mende in chapter 2 and like the other instances of this phenomenon brought up in Hyman and Schuh (1972):

(9) TONE SPREADING (Maninka)

$$\underset{[+P]}{H} \longrightarrow \dot{L} \;/\; L \_\_ H$$

This rule does not have the restricted application noted in the case of rules (3), (6), and (7). Rather than applying to a small set of categories, the rule applies quite generally to elements fitting its description. This makes it likely that the diacritic feature [+P] will be able to be removed from this rule and from the underlying forms of Maninka.

4.2. The underlying tonal system of Maninka.

4.2.1. The proposed reanalysis in effect redefines Welmers' classes of high toned and low toned nouns respectively as nouns with a level H and nouns with a rising pattern:

(10) a. H nouns

jiri < /^{H}jiri/
H H

b. L nouns

muso < /^{LH}muso/
L H

sa < /^{LH}sa/
LH

When simple one- or two-syllable words like these are considered, it appears that the same rule of TONE MAPPING proposed for Mende in chapter 2 will serve for Maninka. In (10a), the single H is assigned to both vowels. In (10b), the LH contour is split between the two vowels, if there are two, and is assigned to a single vowel if there is only one. However, since the details of the behavior of nouns of three or more syllables have not been completely spelled out in the literature on Maninka, or on Bambara, it is difficult to determine how the mapping rule will have to be extended to account for these longer words. Welmers (1949) reports that nouns of three or more syllables are rare in Maninka, but he gives examples of three types: all high, all low, and a single low tone followed by a sequence of high tones. These are illustrated here:

(11) a. <u>All high tones</u>: kɔrɔndi 'cotton'
tamɛnɛn 'flame'

b. Low - High: sambara 'shoes'
L H H

bitiran 'head dress'
L H H

c. All low tones: baroma 'forked stick'

mɛlɛka 'angel'

Welmers leaves open the possibility that some of the forms in (11) are compounds, though he supposes that not all of them are. In Gambian Mandinka, a fairly closely related languate, Rowlands (1959) asserts that, with minor qualifications, there are only two tonal patterns possible for a word in a given environment, but his data indicates that along with the level H words, there are at least two types of words with rising patterns, exemplified by kambano, 'boy', and mindango, 'cup'. Thus, it is possible that these languages cannot be treated in a completely parallel fashion with Mende. What may be necessary is not the mere expression of the underlying suprasegmental contours H and LH, but instead a marking of which vowel in a given word contains the first H. The three types of tonal pattern evidenced in (11) might then be captured as follows: kɔrɔndi, sambara, baroma. Alternatively, perhaps the all-low pattern of baroma is simply a consequence of its having undergone TONE SPREADING, in which case it would result from underlying baroma.
[+H]

4.2.2. This system, if it is correct, might seem inconsistent with the suprasegmental analysis of tone in this language, since it involves a feature [+H] on an individual segment. But in fact such a system would underlyingly involve a diacritic feature on lexical entries which would, in effect, specify which vowel a tone mapping rule was to assign the first H to. This sort of treatment was proposed in McCawley (1964, 1970a) for languages with similar distributional facts, and McCawley has noted that the possession of such a feature, specifying the location of some accentual phenomenon, is one of the distinguishing characteristics of languages which are not true tone languages--that is, languages which do not have segmental features of tone in underlying representations.

Such an analysis would make the tonal system of Maninka seem very similar to that of Japanese, as described by McCawley (1968), and that of Slavic, as described by Halle (1971). Systems of this sort are not investigated in the present work. The suprasegmental tone features under examination are not diacritic features, which simply trigger the operation of a phonological rule; rather, they are phonological features that happen to be expressed on a suprasegmental level.

Determination of whether Maninka actually employs a diacritic suprasegmental feature must await the acquisition of more data. If there turn out to be only two regular tonal patterns in three-syllable nouns, then this will argue for phonological suprasegmental features in Maninka.

4.3. Suprasegmental operations in Maninka and Bambara.

4.3.1. The behavior of Maninka compounds may shed some light on the nature of the tonal representations which serve as inputs to the rule of TONE SPREADING. To facilitate the demonstration, it should be noted that Bambara exhibits the same types of alternation as Maninka, though there appear to be some differences. TONE SPREADING does apply in (12), lowering the final tone of muso before the floating H of the Bambara indefinite marker, proposed by Bird (1968).

(12) $^{L}a\ ^{H}ma\ ^{LH}muso\ ^{H}\emptyset\ ^{H}ye$ 'he didn't see a woman'

In other instances in which TONE SPREADING would be expected to apply in Maninka, Bird's (1966, 1968) data indicates that it does not apply in Bambara. However, K. Courtenay (personal communication) has noted that the alternations which are said here to result from TONE SPREADING are more frequent than Bird's data would lead one to expect. At any rate, even if we accept only the data published by Bird, there will still be sufficient evidence for a rule of TONE SPREADING in Bambara.

4.3.2. We must next ask whether TONE SPREADING is a segmental or a suprasegmental rule in Maninka and Bambara. Consideration of compounds in these languages provides evidence for the suprasegmental nature of this process. Drawing on remarks in Spears (1966, 1968) and Woo (1969), we may formulate the following observational account of Maninka and Bambara compounds.

(13) COMPOUND RULE (Maninka, Bambara)

a. If the first word is H, then every vowel of the compound is H.

b. If the first word is L (i.e. LH in the reanalysis), then all vowels preceding the last word in the compound are L, and the last word is H.

In both languages, the tonal shape of the compound is entirely dependent upon the tonal shape of the first member. The contrast between compounds with a high toned first member and those with a non-high toned first member is illustrated in (14), a Bambara example.

(14) a.	^{H}jiri	jiri-finman-nyiman H H H H H H	'good black tree'
b.	^{LH}muso	muso-finman-nyiman L L L L H H	'good black woman'

The observational account in (13) gives us no clue as to <u>why</u> high toned and non-high toned nouns behave as they do in compounds; in effect, it says that there is no explanation for their behavior and that if these languages instead contained a compound rule such as the following, they would be no more complicated.

(15) COMPOUND RULE (artificial)

a. If the first word is H, then every vowel of the compound is H.

b. If the first word is L, then all vowels preceding the last word are H; the last word is L.

Now, there is nothing in itself wrong with an analysis which does not explain why certain facts are the way they are, since certainly there are many facts in languages for which no explanation will suffice. However, from what we know about the rest of the grammar of Maninka and Bambara, we can see that there <u>is</u> an explanation for why the compound rule is as it is expressed in (13); the explanation rests on the operation of TONE SPREADING, which causes a transition from L to H to be moved rightward in a word. This is, TONE SPREADING permits us to re-express (13) as (16):

(16) REVISED COMPOUND RULE (Bambara, Maninka):

a. Copy the last tone of the first word (i.e. a high tone in all instances) onto all noninitial words in the compound.

b. Perform (9) TONE SPREADING

If this rule is applied to segmental tone features, as in (14), its output will be slightly incorrect, since it causes the vowel of the penultimate syllable in (17b) to be L, while it should be H. (Let us continue, for the moment, to assume that TONE SPREADING applies iteratively.)

(17) a. jiri-finman-nyiman		b. muso-finman-nyiman	
H H		L H	
H H H H H H	(16a)	L H H H H H	
	(16b)	L L H H H H	
	(16b)	L L L H H H	
	(16b)	L L L L H H	
	(16b)	L L L L L H	

However, if the rule can be stopped from applying to the vowel of the penultimate syllable, the correct output will be obtained. This result is what would be acheived by interpreting this rule as applying to suprasegmental tones, as illustrated in (18):[1]

(18) a. ^{H}jiri- finman- nyiman
^{H}jiri-^{H}finman-^{H}nyiman (16a)

b. ^{LH}muso- finman- nyiman
^{LH}muso-^{H}finman-^{H}nyiman (16a)
^{L}muso-^{H}finman-^{H}nyiman (16b)
^{L}muso-^{L}finman-^{H}nyiman (16b)

Subsequently, the tones will be mapped onto individual vowels by the same mapping rule alluded to above. This will yield the forms given in (14).

4.3.3. There is a question as to whether phonological rules ever apply iteratively. In a version of phonological theory which does prohibit iterative rules, the most promising way of restating the compound rule would be to have it apply cyclically to forms bracketed as in the first line of (19). Derivations would then proceed in the following way:

(19) a. [[[^{H}jiri] finman] nyiman]

^{H}finman	(16a)
	(16b)
^{H}nyiman	(16a)
	(16b)
^{H}jiri-^{H}finman-^{H}nyiman	

b. [[[^{LH}muso] finman] nyiman]

^{H}finman	
^{L}muso	
^{H}nyiman	
^{L}finman	
^{L}muso-^{L}finman-^{H}nyiman	

If this latter analysis is to be maintained, one must, of course, seek independent justification for this bracketing. For example, one might check to see whether the adjective finman, 'black', restricts only jiri while the adjective nyi-man, 'good', restricts the full constituent jiri-finman. Similar evidence to support this view in Mende and in languages containing a nasal prosody is discussed in chapter 5. Whichever principle of application is chosen, we may conclude that the suprasegmental analysis can explain the tonal behavior of compounds on the basis of principles arrived at on completely independent grounds, based on the behavior of non-compounds; the segmental analysis, on the other hand, can only observe this behavior.

The existence of a phonological rule which operates on suprasegmental tones, along with the fact noted in preceding sections that certain restrictions on tone patterns can be most adequately stated suprasegmentally, establishes strong support for the notion that tone cannot be solely regarded as a segmental feature.

4.4. Tone Spreading in Hausa.

4.4.1. Hausa also appears to have an instance in which it is necessary to specify a process as applying to suprasegmental tones. The following forms illustrate an alternation between H and L in various types of nouns and adjectives. The vowels on which the alternation occurs are underlined. The tones are

those which appear prior to the operation of LOW TONE RAISING, a rule described and motivated in Leben (1971a), which raises word-final L on a long vowel to H when preceded by L. This rule, expressed in (20), will cause all of the forms in (21) to have their final tone raised to H.

(20) LOW TONE RAISING (Hausa)

$$\overset{V}{[+\text{Long}]} \longrightarrow [+H] \;/\; [+L]\ C_o \_\_\ \#$$

(21) a.	jinjir+ii (m.) H L L	jinjir+nii+aa (f.) H H L L	'baby'
b.	ma+bi+ii (m.) H L L	ma+bi+ii+aa (f.) H H L L	'follower'
c.	ba+kataagum+ii (m.) L L H L L	ba+kataagum+ii+aa (f.) L L H H L L	'person of Kataagum'

The L of the underlined vowel in the masculine form corresponds to a H in the feminine form. The verb bi, 'to follow', which occurs in (21b), possesses a high tone in its underlying representation, but in the agentive construction, of which (21b) is an instance, the underlying tones of the morpheme in this position are disregarded, as a morphological tone assignment rule places a level L on the morpheme in the masculine form. In each of these cases, the feminine form is derived from the masculine by affixing the feminine suffix -aa; in addition, in (21a) the masculine suffix -ii is converted to -nii in the feminine form. The tone of the feminine suffix -aa is obtained by copying the preceding tone. This process is justified in

Leben (1971a), where the behavior of this same suffix is described when it is preceded by H and by other instances of L.

The tone of the underlined vowel in the feminine form is derived from the corresponding one in the masculine by the following rule:

(22) TONE SPREADING (Hausa)

$$L \longrightarrow H \;/\; H \_\_ L +$$

Except for the plus sign in the environment,[2] this rule appears similar to the one established for Maninka and Bambara. The plus sign is needed, for example, to prevent (21a) jinjir+ii (H L L) from becoming *jinjir+ii (H H L). Thus, (22) will not apply to masculine forms, but in the feminine, it will convert the underlined vowels in (21) from L to H. Does this rule apply to tone features on vowels, or does it apply to suprasegmental tones? To answer this question, it suffices to examine a masculine-feminine pair in the same agentive construction exemplified by (21b), but this time containing a verb with more than one syllable.

(23) ma+aikat+ii (m.) (H L L L) ma+aikat+ii+aa (f.) (H H H L L) 'worker'

In the masculine, the verb root aikat is assigned a level low-toned contour, and in the feminine the entire root has its tone

raised to H. If we apply TONE SPREADING to segmental tones, the following incorrect derivations will result:

(24) a. ma+aikat+ii
H L L L
H H L L (22)

b. ma+aikat+ii+aa
H L L L L
H H L L L

If we assume that TONE SPREADING does not apply iteratively, the incorrect outputs *ma+aikat+ii (H H L L) and *ma+aikat+ii+aa (H H L L L) will be obtained (again ignoring the raising of the last tone in these forms by (20)). Even if we permitted iterative application, the first of these incorrect outputs would still not be avoided. What TONE SPREADING needs to capture is that the level L on aikat acts like a single unit. When aikat appears in the environment of TONE SPREADING, the tone pattern of the entire morpheme must be raised to H. This is precisely what the suprasegmental analysis would yield:

(25) a. ^{H}ma+^{L}aikat+^{L}ii
(22)

b. ^{H}ma+^{L}aikat+^{L}ii+^{L}aa
^{H}aikat

This establishes that TONE SPREADING is a suprasegmental rule in Hausa. Furthermore, TONE COPYING must precede TONE SPREADING, since it accounts for the low tones assigned to -ii and -aa in these forms. Hence, TONE COPYING is also a suprasegmental rule in Hausa.

4.4.2. In one sense, the Hausa example may seem somewhat less striking than the Maninka-Bambara example which preceded, since

the present instance only applies to a small subsection of Hausa morphology. Rule (22), although its formulation makes it look quite general, appears to have an application only in derived feminine forms, exemplified in (21). But since the facts of Hausa are firmer than the corresponding ones in Maninka and Bambara, this example should carry some weight.

The case of Hausa is of some additional interest, since this language has also been shown to contain at least one tone rule which refers to tone as a segmental feature, rule (20), which makes crucial use of the length of the vowel bearing the tone. As noted in Leben (1971c) and in chapter 1, the supra-segmental framework provides an ordering principle for tone rules: all rules which refer to suprasegmental tone features are ordered before all those which refer to segmental tone features. It is clear from the account in Leben (1971a) that (20) is ordered after TONE COPYING, since (20) applies to tones which have resulted from TONE COPYING. Furthermore, there is nothing to suggest that TONE SPREADING should apply after (20), and this is consistent with the predictions of the suprasegmental framework.

FOOTNOTES TO CHAPTER FOUR

[1]If the underlying tones of Maninka are instead specified by diacritic features, this account must be modified. Since the behavior of three-syllable nouns containing a LH contour has not been reported in the literature, in particular in environments in which the LH contour might be expected to become L, it appears futile at present to speculate on the formulation of TONE SPREADING that would result.

In addition, K. Courtenay has privately called it to my attention that the adjectives finman and nyiman are both bimorphemic; the Bambara-French dictionary of Bazin (1906) corroborates this, listing fin, 'black', and nyi, 'good, beautiful'. Unfortunately, this source does not list -man. It is important to note that fin and man in finman, although they are separate morphemes, are not separate elements of the compound. What this case appears to demonstrate, then, is that it is the word (e.g. a whole element in a compound) that is the domain of suprasegmental tone in Maninka and Bambara and not the morpheme.

[2]Apparently, some linguists believe that environments which begin or end with a morpheme boundary should by convention also be interpreted as possibly beginning or ending with a word boundary. The reason for this putative convention is presumably to capture the fact that just as plus signs mark the end

of a morpheme, so do word boundaries. If this convention is adopted, then (22) will have to be modified to include another L after the plus sign in the environment. This would somewhat obscure the similarity between Hausa TONE SPREADING and Maninka-Bambara TONE SPREADING, but it would not make any other difference. However, the convention itself is of rather dubious value; in practically any situation like the one in Hausa, in which the presence of a word boundary is not to be taken to imply the presence of a morpheme boundary for the purpose of application of a given rule, the rule could simply be restated in such a way that its environment will not be met by a string with a word boundary where a plus boundary is called for.

CHAPTER FIVE. NASALIZATION PROSODIES

5.0. Introduction.

From the preceding chapters, one might judge that tone is unique in requiring two levels of representation--suprasegmental and segmental--in some languages. The present chapter discusses some nasalization phenomena which also require these two levels of representation. Since these nasal prosodies appear less intricate, demanding less analysis, they make a fairly straightforward independent case for the general properties of the theory required to accommodate and explain the tonal facts discussed thus far. At the same time, however, these nasal prosodies are not sufficiently complex to determine all of the properties of this theory. For example, in this chapter it will be observed that the nasal "melodies" discussed are much less intricate than the tonal melodies considered. Because of this, they fall in as a special and somewhat simple case of the general phenomenon of suprasegmental representation.

5.1. Nasalization in Terena.

Terena is an Arawakan language of Brazil. Bendor-Samuel (1960) reports that in this language the first person marker is not a segmental sequence but rather a nasalization prosody which is mapped onto the unmarked form of a noun or a verb by the following rule:

(1) FIRST PERSON (Terena)

a. Nasalize all vowels and semivowels in the word up to the first stop or fricative.

b. Nasalize the first stop or fricative in the word as follows: mb replaces p, nd replaces t, ŋg replaces k, nz replaces both s and h, and nž replaces both š and hy.

Examples of the operation of this rule are given below. The unmarked noun to which the rule applies is in fact the third person form.

(2) a.	emo?u	'he desires'	ẽmõ?ũ	'I desire'
b.	ayo	'his brother'	ãỹõ	'my brother'
c.	owoku	'his house'	õw̃õŋgu	'my house'
d.	piho	'he went'	mbiho	'I went'
e.	ahya?ašo	'he desires'	ãnža?aso	'I desire'

Bendor-Samuel also describes a palatalization prosody for the second person marker. In the case of the nasal prosody, he argues that to treat the feature [nasal] as a segmental feature in underlying representations would complicate the description and would completely distort the plausible observations in (1). From this we may conclude that the transition from [+nasal] to [-nasal] on first person forms must somehow result from a rule or rules triggered by the presence of the first person morpheme. A formulation of this process is suggested in 5.4 below, after some slightly different examples are considered.

5.2. Nasalization in Desano.

5.2.1. A second nasalization prosody is indicated by Kaye's (1971) treatment of Desano, an Eastern Tucanoan language spoken in Colombia and Brazil. There are three types of morpheme in the language: those which are specified as [+Nasal], those specified as [-Nasal], and those which are unspecified for this feature. At some stage in the derivation, each morpheme which is marked [+Nasal] is subject to a rule which maps this feature onto its segments. This rule appears similar to the one described for Terena, except that its operation is not inhibited by the presence of obstruents or of any other segments. The feature [+Nasal] on a morpheme causes its vowels to become nasalized, and b becomes m; d or r becomes n; g becomes ŋ, the palatal glide j becomes ñ, and w becomes w̃. Kaye says that it is unclear whether the voiceless segments p, t, k, s, and h have distinct nasal and oral realizations. This mapping results in "minimal pairs" such as the following, where the words in (a) are [+Nasal] and those in (b) are [-Nasal]:

(3) a.	[w̃ãĩ]	'name'	[wai]	'fish'
b.	[ñõhsõ]	'kind of bird'	[johso]	'kind of lizard'

5.2.2. The mapping rule is straightforward, assuming, after SPE, that in a morpheme with the feature [+F], each segment is also marked [+F].

(4) NASAL MAPPING (Desano)

$$[+\text{voiced}] \longrightarrow [+\text{nasal}] \; / \; [_{+\overline{\text{Nasal}}}]$$

Hereafter, the abbreviation [N] will be used for the morpheme feature [Nasal]. Observe that rule (4) treats the morpheme feature [Nasal] as distinct from the segmental feature [nasal]. This conclusion appears inescapable as long as we automatically assign morpheme features to every segment in the string. It will do no good to simply drop this convention, since this would appear to make the mapping rule unstateable. This same conclusion is indicated by the formulation of the Terena mapping rule in (24) at the end of this chapter.

All major category morphemes and some affixes are lexically specified for the feature [N]. The remaining affixes are not specified lexically for this feature, but they may take on this feature in certain environments in the course of a derivation. The NASAL MAPPING rule is, of course, ordered after the stage at which the feature [N] may be acquired by these affixes. This is analogous to the situation in Mende and other tonal languages, in which major category morphemes and some affixes are specified underlyingly for a tonal pattern, while other affixes are inherently toneless, acquiring their tone by rule.

5.2.3. The central problem encountered in the description of Desano nasalization is the determination of the environment in which the feature [N] is acquired by affixes lexically unspeci-

fied for it, and this problem is best solved by keeping in mind the behavior of tonal prosodies. In certain environments, affixes clearly take on the same value of this feature as is possessed by a contiguous morpheme. This is illustrated in the following examples, in which the realization of /du/, a nominal classifier, and /by/, 'old', depends on the nasality of the neighboring noun. The alternating surface representations of these two morphemes are underlined below.

(5) a. [sẽnãnũ] 'pineapple'
b. [goru] 'ball'

(6) a. [mỹnã] 'old men'
b. [bygy] 'old man'

[y] here denotes a high back unrounded vowel. If /du/ is assigned the feature [-Nasal], /d/ will be converted to [r] by a rule which appears to have no bearing on the rest of this discussion.

On the basis of the alternations illustrated in (5) and (6), we may expect that Desano has the following rule:

(7) NASAL COPYING (Desano)

$$[+\text{morpheme}] \longrightarrow [\alpha N] \;//\; [\alpha N]$$

The double // will be used to indicate a "mirror image" rule--one in which the environment can either precede or follow the item affected by the rule.

This rule must be prevented from applying to a two-morpheme sequence in which both morphemes are lexically specified for [Nasal] already, since in these cases the nasality of the morphemes does not change even if their values of [N] are distinct, as the examples in (8) show:

(8) [bohse + nỹ] 'holiday'
[kõmẽ + da] 'wire'

Kaye proposes to express the fact that a morpheme is lexically unspecified for [Nasal] by marking it [+Rule (7)] in the lexicon; remaining morphemes are, of course, [-Rule (7)]. This provides a way of avoiding the problem of using a binary distinction to separate three classes: plus, minus, and unspecified. In the present case, the"inherently unspecified" affixes may be given lexical representations with the unmarked value of [N], which is [-N], and they will still be distinguishable from major category morphemes marked [-N] by virtue of the feature [+Rule (7)].

5.2.4. Thus far, the facts are very similar to the facts surrounding TONE COPYING, as described in previous chapters. Recall that in Hausa, Maninka, Bambara, and Mende, there were morphemes which were underlyingly specified for a certain tonal pattern and, in addition, there were some affixes that were designated as inherently toneless, along with some items whose underlying tones had been removed. As with the Desano

affixes that were first termed "inherently unspecified" for the nasal prosody, the so-called toneless affixes may be regarded as being underlyingly specified for the unmarked value of the tone features and can be distinguished from other morphemes by virtue of being marked to undergo TONE COPYING.

One difference between TONE COPYING and NASAL COPYING is that the former operates from left to right, at least in the languages discussed, while the latter was shown in (5) and (6) to operate in either direction.

After such copying rules, a rule applies which maps the suprasegmental features onto segments. It is less complex than the tonal mapping rules, simply because the tonal melodies to be mapped are more intricate than the nasal "melodies" [+N] and [-N]. One might argue that the reason for this difference is that it is far easier to control changes in the rate of vibration of the vocal cords than it is to alter the movement of the velum.

5.2.5. One complexity that enters into the description of Desano nasalization involves cases in which (7) NASAL COPYING must be prevented from applying. Consider, for example, the contrast between (9) and (10).

(9) a. bi + di + du 'a small round thing'
[+N]
[mĩnĩnũ]

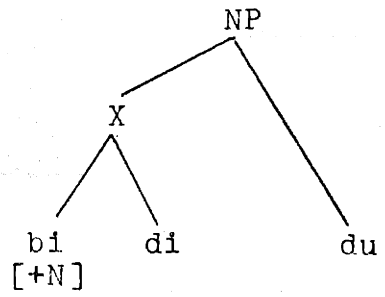
b. wya + di + du 'a large round thing'
[-N]
[wyariru]

(10) a. ai + di + á [+N] 'to have taken'
[ãĩra] (di + á is realized as ra)

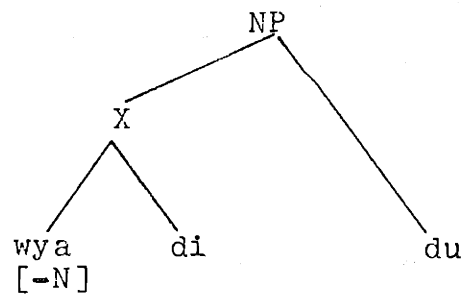
b. waju + di + á [-N] 'to have loaned'
[wajura]

Nasalization extends to the rightmost morpheme in (9a) but not in (10a). Furthermore, in (9a), nasalization applies to the morpheme di, converting it to ni, but in (10a) it does not apply to di, which is an instance of the same morpheme. Kaye proposes to handle this problem by means of a difference in constituent structure between the words of (9) and (10); he presents some justification for the structures he posits, though he himself admits that the evidence may not be all that compelling. The differences in constituent structure are illustrated in (9') and (10').

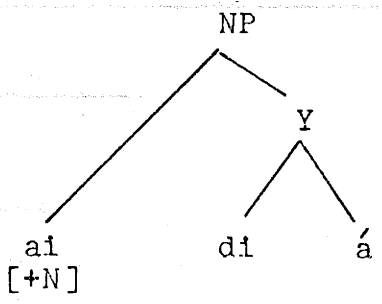
(9') a.



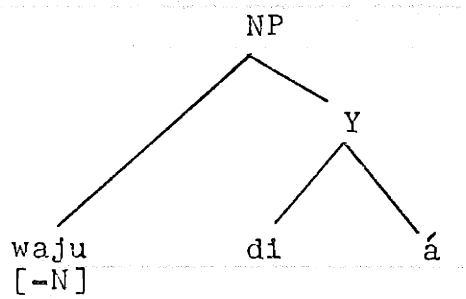
b.



(10') a.



b.



The symbols X and Y are intended to avoid the problem of justifying node labels in these constructions. Later, these structures will be reconsidered.

If (7) NASAL COPYING is applied cyclically to the structures in (9'), the first cycle will operate on the node X. In (9'a) di will acquire the feature [+N], and in (9'b) di will be assigned [-N]. Subsequently, on the NP cycle, du in (9'a,b) will take on the value of [N] that is specified for the immediately preceding morpheme, di.

5.2.6. For the structures in (10'), a way must be found to prevent the elements dominated by Y from copying the feature [+Nasal] from the preceding morpheme. For this reason, Kaye proposes the following convention:

(11) CONVENTION

After each cycle, all morphemes contained in that cycle are specified [-Rule (7)].

If the validity of this convention could be granted, then on the NP cycle, all of the elements in (10') would have been marked [-Rule (7)]; those which are not lexically [-Rule (7)] are so marked by convention (11). Hence, on the NP cycle, (7) would not apply, and so the first element in each case would remain [+Nasal] while the remaining elements in the string would retain the value [-Nasal], thus producing the correct output, (10).

5.2.7. However, even if we accepted Kaye's claims about constituent structure, convention (11) would be ad hoc, and, as Kaye himself points out, would run totally counter to the principle of the cycle, which causes rules to re-apply in successively larger domains. Moreover, although there appears to be some support for his suggestion that there is a constituent in (9') which he labels X, the suggested constituent Y in (10') is extremely implausible. The constituent X in (9') is composed of a verb plus an infinitive marker, while the constituent Y in (10') is composed of two affixes, the infinitive marker and the nonpresent tense marker. Cycles on "constituents" of this latter kind are totally unprecedented, and even if one did permit rules to cycle on this combination of affixes, one wonders what principle would be called in to explain why the rules do not also cycle first on the affix du in (9'). If the rules did cycle on du in (9'), then convention (11) would mark du [-Rule (7)] at the end of this cycle, causing du not to undergo NASAL COPYING on the subsequent NP cycle. In short, this possibility seems quite hopeless.

One might attempt to block the copying of the nasality of the head morpheme in (10) onto the suffixes by inserting # before the suffixes, giving /ai # di + á/ and /waju # di + á/, but other evidence suggests that this is impossible. The infinitive marker di is subject to (7) in other cases, as illustrated in (12), and so is the nonpresent marker a, as shown

in (13). In these instances, then, the affixes cannot be separated from the head morpheme by #.

(12) a. duudi + di — 'to bite, sting'
[+N]
[nũ?ũnĩ + nĩ]

b. duudi + di + á — 'to have bitten, stung'
[+N]
[nũ?ũnĩ + ra]

(13) a. goroto + á + bi — 'he exchanged'
[-N] [+N] (bi is a third person morpheme)
[goroto + á + mĩ]

b. doobe + á + by — 'I moved'
[+N] [-N] (by is a first person morpheme)
[nõ?õmẽ + ã́ + by]

5.2.8. As a last resort, it appears necessary to adopt an alternative proposed by Kaye in a footnote (p.55), which would involve reformulating (7) as (14):

(14) REVISED NASAL COPYING (Desano)

[+morpheme] → [αNasal] // [αNasal] __]

The rightmost bracket in (14) stands for a constituent boundary. The rule says in effect that NASAL COPYING applies to an element only if there is nothing in its constituent on the opposite side of it from the conditioning [αNasal] element. It is not immediately clear whether this is a reasonable type of rule, but it does produce the desired results. If we accept the bracketing of (9) which Kaye has proposed, and if we

omit his internal brackets in (10) for the reasons given above, we will have derivations like the following:

(15) a. [[bi + di] du]
[+N]

[+N]

[+N] (14)

[mĩnĩnũ]

b. [[wya + di] du]
[-N]

[-N]

[-N] (14)

[wyariru]

(16) a. [ai + di + á]
[+N]

-- (14)

[ãĩra]

b. [waju + di + á]
[-N]

--

[wajura]

(14) applies cyclically in (15), successively making each suffix nasal in (15a) and nonnasal in (15b). If the oblique case marker de is added to the expression in (15a), forming the following word,

(17) [[[bi + di] du] de]
[+N]

another cycle will apply, nasalizing de, as we would expect. What blocks the application of (14) in (16) is the fact that more than one affix is present between the head morpheme and the constituent boundary, while rule (14) calls for only one affix to be present. Hence (14) does not apply, and these affixes retain their unmarked value, [-Nasal].

The examples in (12a) and (12b) work like (15a) and (16a), respectively. The correct forms will be predicted for the examples in (13) if they are assigned the constituent structure indicated in (18):

(18) a. [[goroto + a] bi]
[-N] [+N]

b. [[doobe + a] by]
[+N] [-N]

5.2.9. Kaye cites Kuroda's (1967) treatment of Yokuts epenthesis as a precedent for the use of a constituent boundary in the environment of a rule to prevent its re-application on later cycles. However, Kean (1971) has argued that what blocks the unwanted applications of Yokuts epenthesis is a much more general principle--the strict cycle, which prohibits any operation on a later cycle that only involves elements appearing in an earlier cycle. This reanalysis unfortunately does not apply to the Desano phenomena, and so we are left with the curious rule (14).

There is a possibility that this rule can be made to seem more reasonable if we recall a problem that arose in the application of suprasegmental TONE SPREADING in Maninka and Bambara. In chapter 4, it was observed that for this rule to convert an input string of the form LHHH to the correct output LLLH, it would have to apply either iteratively or cyclically. These two methods of application are illustrated in (19).

(19) a. Iterative application

Input: LHHH
SPREADING: LLHH
SPREADING: LLLH

b. Cyclic application

Input: [[[L H] H] H]
SPREADING: --
SPREADING: [L L H]
SPREADING: [L L L H]

Note that the left-branching structure in (19b) is similar to the left-branching structure in (18). The function of these structures is similar in the two cases: they permit a suprasegmental rule to continue operating rightwards. Since the evidence presented to justify these structures has been extremely limited, this may, unfortunately, be equivalent to saying that the same artifice appears to help a questionable analysis to work correctly in both cases. At any rate, the rule of TONE COPYING can also be re-examined in this light. Since TONE COPYING provides inputs to TONE SPREADING, the former must be ordered before the latter. Since TONE SPREADING is suprasegmental and, by hypothesis, cyclic, TONE COPYING must be suprasegmental and either cyclic or pre-cyclic. In the absence of any motivation for construing it as pre-cyclic, I will here assume that TONE COPYING must be cyclic. Thus, TONE COPYING will apply to the same left-branching structure as TONE SPREADING, illustrated in (19b).

As TONE COPYING has been described thus far, there is no direct evidence for its applying cyclically. For example, in Maninka and Bambara, if we ignore any considerations beyond the formulation of this particular rule, we might just as well have derivations of the form sketched below.

(20) Input: $[\alpha H]...[\beta H]_{\underline{word}}$ - $\underline{word}$ - $\underline{word}$

TONE COPYING: $[\alpha H]...[\beta H]_{\underline{word}}$-$[\beta H]_{\underline{word}}$-$[\beta H]_{\underline{word}}$

But in Maninka and Bambara, it was necessary to posit left-branching structures in order to permit TONE SPREADING to apply correctly. TONE COPYING could also apply correctly to these structures, and in the absence of any motivation to the contrary, it should, as was reasoned above. In Mende, there is evidence to suggest that TONE COPYING actually does apply to such structures. The reason is that these structures are exactly what the syntax provides. In noun compounds, the head is the rightmost element. For example, the nouns fande, 'cotton', and bɛlɛ, 'trousers', combine to form the compound fande-bɛlɛ, 'cotton trousers', and the head of the construction appears at the right. Similarly, if we add hani, 'thing', to the right of this compound, the result, fande-bɛlɛ-hani, means 'a thing for cotton trousers' and not 'a trouser-thing made of cotton'. That is, the constituent structure of this compound is [[fande-bɛlɛ] hani] and not *[fande [bɛlɛ-hani]]. Interestingly, adjectives, which form compounds with nouns in the same way, appear as the rightmost element in such constructions.

Obviously, in these cases, the adjective in rightmost position could hardly be called the head of the construction; but nonetheless the syntax does cause the adjective to occupy the right branch of the construction. For example, in constructions of the form $Noun_1$-$Noun_2$-Adjective, the adjective modifies the entire noun compound $Noun_1$-$Noun_2$ and not just $Noun_2$. The bracketing is thus the same as in the three-element compounds of nouns: [[$Noun_1$-$Noun_2$] Adjective].

5.2.10. Although many pieces remain to be filled in before the puzzle can be said to be completed, there appear to be reasons converging from two directions which indicate that the rightward-operating rule of TONE COPYING applies to structures that are left-branching and that have only one element on the rightmost branch. This is what the syntax has been shown to provide in Mende, and this is also what the subsequent rule of TONE SPREADING requires in Maninka and Bambara (unless the rule is iterative). Thus, it appears that the following expression of TONE COPYING would adequately capture the facts in these languages, although its use of the constituent boundary has not been shown to be necessary:

(21) TONE COPYING

$$\left\{\begin{matrix}\text{word}\\ \text{morpheme}\end{matrix}\right\} \longrightarrow [\alpha H] \;/\; [\alpha H] \_\_ \;]$$

Thus, it is possible to speculate that TONE COPYING rules are formally quite similar to NASAL COPYING rules, the major dif-

ference being that the latter have been shown to operate in both directions, while in the cases considered, TONE COPYING operates only from left to right.

5.3. Nasalization in Guaraní.

Guaraní also appears to have a nasal prosody, as described by Lunt (in press), who notes that the language behaves somewhat like Desano. Major class morphemes are either nasal or nonnasal. If they are nasal, Lunt observes that the amount of nasalization increases gradually in the morpheme up to the stressed vowel, which is fully nasalized, and then tapering off again if a stressless suffix follows. The nasalization of vowels does not appear to be an underlyingly segmental phenomenon in Guaraní, resulting rather from the mapping of a nasal "melody" onto [+Nasal] morphemes. The nasal melody reflects the timing of an articulatory gesture--in this case, the lowering and raising of the velum--in perhaps the same sense as Öhman (1965) has suggested that falling tonal accents in Swedish may differ from each other only in the timing of the relaxation of the vocal cord tension, to which he attributes the drop in pitch. Similarly, the suprasegmental tonal operations described in chapters 2 and 4 might be construed as involving solely an instruction concerning the timing of a transition in pitch. Neither of the two operations described alters the tonal contour; in the case of TONE COPYING, the copied tone is, in a sense, permitted to have a longer duration, and in the

case of TONE SPREADING, the transition from H to L or from L to H is simply postponed. Similarly, a large number of the tonal changes described by Hyman and Schuh (1972) are of the type which do not change the shape of tonal contours; instead, they redefine the points of transition from H to L or from L to H. A possibly related set of phenomena, involving the interaction of Lɔmɔngɔ tone rules to preserve tonal melodies, is discussed by Lovins (1971). The nasal prosodies mentioned in this chapter seem to exhibit a similar characteristic. In a Terena word in the first person form, the morphological sequence [+Nasal] + [-Nasal] is realized as a word whose first part is nasal and whose second part is nonnasal; the location of the transition is specified by the mapping rule. In Desano, morphemes which are inherently specified for nasality do not assimilate to the nasality of surrounding morphemes; it is only morphemes underlyingly "unspecified for nasality" (i.e. having the feature [+Rule (14)]) that, under certain circumstances, do assimilate. This serves to preserve the underlying nasal "contour" of a word.

If the notion of timing is involved in these cases, it is of an interesting type. The perseverance of a given tone or the gradual increase of nasalization is not in general equivalent to the fixing of a mechanism of speech into a given position or even to the fixing of the rate of change in this mechanism. Rather, the timing may affect only certain segments of a string, such as the vowels. Some evidence that

speakers can store knowledge in this way may come from the work of V. Fromkin on speech errors, who notes examples like Lemadon, which was uttered by a subject when Lebanon was intended. We may interpret this roughly as indicating that the speaker, having mistakenly substituted the nasal m for the monorganic nonnasal b, compensated for this by denasalizing the following nasal, which was in a corresponding--syllable-initial--position. Similarly, one might argue that, given instructions to the larynx which define a certain pitch for a vowel, the speaker is able to come back to the same configuration for subsequent segments in corresponding positions. This view may help to make explicit the obvious relatedness of corresponding suprasegmental and segmental features, which have been shown to be distinct from each other but which nonetheless appear to have the same values for marked and unmarked specifications. [nasal], for example, may simply be the feature [Nasal] accompanied by information about the timing of the articulatory gesture it describes. This suggestion is admittedly vague and speculative, and it is not at all clear how it could be formalized. There is a need to specify the relationship between the suprasegmental and segmental features discussed in this work, and the notion that suprasegmental rules are constrained to preserve underlying contours, while the rules mapping suprasegmentals onto segments serve to pinpoint the transitions in the contours, may help to fill this need--and, at the same time, to unify the treatment of the different suprasegmental operations discussed in this work.

5.4. Segmental influences on mapping.

5.4.1. There is one more point of comparison to be noted between nasal and tonal prosodies. In Terena, the mapping of the nasal prosody onto a word was shown to be sensitive to segmental information: as soon as an obstruent was reached in the string of segments, the spread of the nasal prosody was halted. In Desano, on the other hand, this did not occur. Although it is possible that voiceless segments in this language do not acquire the feature [+nasal], they still do not arrest the spread of the nasal prosody, as demonstrated by (3). It is fairly clear why obstruents should be able to block a nasalization prosody in a language: since the velum must be raised in the articulation of these sounds, to prevent air from escaping through the nasal cavity, it is natural to expect it to be at this point that the nasalization of segments would cease; this is what happens in Terena. But it is not required that nasalization cease at this point--the velum is easily raised again after the production of an obstruent, and this is what occurs in Desano.

A similar phenomenon is involved in tonal prosodies. In the languages discussed in the preceding chapters, the tonal melody was assigned to segments with no regard for the peculiar articulatory characteristics of the environment. But this is not the case in all languages. Hyman and Schuh (1972) note tonal processes that are blocked by the presence of certain

features. For example, Ngizim, a Chadic language of Nigeria, has a rule of TONE SPREADING, which causes certain low tones to become falling tones (i.e. to have a high-toned component added before them) after a high tone. This is illustrated by the following examples:

(22) a. na kaasuw → na kaasuw 'I swept'
H L H H HL H

b. a rəpci → a rəpci 'open!'
H L H H HL H

In these cases, the phonological transition between H and L is in effect delayed until one reaches the vowel bearing the low tone. But this process is blocked in those cases where the spreading H would have to cross over a voiced obstruent before reaching the L, as shown by (23).

(23) a. na bakə ... 'I roasted ...'
H L H

b.*na bakə...
H HL H

This is somewhat reminiscent of the alternation noted in Xhosa in chapter 1, whereby a high tone was realized as a rising tone (that is, it acquired a preceding low-toned component) on a vowel preceded by a voiced obstruent. Recall that this was cited as an instance of segmental influence on tone. The Ngizim example can be brought in with what has been established about the suprasegmental character of tone in some languages if we assume that the spreading of tone in Ngizim is similar to the spreading of the nasalization prosody in Terena.

Ngizim H will spread rightward (in certain environments) unless it encounters resistance. Resistance to the spreading of tones is not as uncontroversially defined as resistance of the spreading of nasalization. Halle and Stevens (1971, 1972) have hypothesized that one of the mechanisms involved in the voicing of obstruents is equally involved in the regulation of pitch. They note that the increased tension of the vocal cords which is responsible for the production of higher pitches will also inhibit the vibration of the vocal cords during the production of obstruents. On the other hand, Ladefoged (1972) suggests that the correlation between high tones and voiceless obstruents be instead attributed to the fact that a voiceless consonant may have a higher larynx position than the corresponding voiced one, which may result in a stretching of the vocal cords, thereby causing a neighboring vowel to have a higher pitch; a similar suggestion is made by Maran (1971). In addition, Ladefoged points out that the rate of air flow is higher for voiceless sounds, and this also may contribute to the increased frequency of vibration for vowel sounds in the environment.

Whatever the phonetic explanation, it appears that just as the spread of a nasal prosody can be halted by natural articulatory characteristics of segments, so can the spread of a tonal prosody. Furthermore, just as the blocking of the nasal prosody is not phonetically necessary, so the blocking of the tonal prosody is not phonetically necessary.

5.4.2. We may judge, on the basis of the analysis of Desano and of the tonal prosodies, that the Terena first person morpheme is incorporated into the unmarked form of a noun or verb by means of a morphological rule which simply adds the feature [+Nasal] to the noun or verb in question. Each segment of the word is then assigned the feature [+Nasal] by convention, and the following rule accomplishes the mapping of this prosodic feature into the corresponding segmental feature:

(24) NASAL MAPPING (Terena)

$$[^{+segment}_{+Nasal}] \longrightarrow [+nasal] \; / \; \_\_ \; X([-son]Q)\#$$

The variable Q in parentheses is interpreted as receiving a maximally long interpretation. This insures that if there is at least one [-son] element in the string, the leftmost [-son] element will block the spread of nasalization to the right. The variable X in this rule permits the mapping to apply simultaneously to all segments preceding the leftmost [-son] element, if there is one, or to all of the segments in the string, if there is no [-son] element. The feature [-son] is used here to designate the sounds which necessitate the lowering of the velum in order to be pronounced. There may be a question as to whether glottal stop and h are actually [+son], as this definition would imply. This, however, is the specification which follows from the SPE definition of [sonorant].

Subsequent assimilation rules can change the leftmost [-son] element into one of the nasalized forms described in (1b). The case of (24) demonstrates again that the supra-segmental feature [Nasal] is distinct from the segmental feature [nasal]. All segments of a first person form acquire the feature [+Nasal], by the familiar SPE convention, but only those segments which precede the first stop or fricative in the string acquire the feature [+nasal].

CHAPTER SIX. SYLLABLE AND MORA AS PROSODIC UNITS

6.0. Introduction.

6.0.1. In chapter 1 it was observed that tone has been variously described as a feature on words, morphemes, syllables, and segments. Documentation for the claim that some tonal systems exclusively employ tone as a segmental feature was provided by the Standard Thai example in chapter 1. In addition, the discussion of Hausa tone in Leben (1971c) and in chapter 4 has shown that even in a language for which a suprasegmental level of representation is established, there can exist rules which treat tone as a segmental feature. Such rules, however, must be ordered after the rule or rules which map suprasegmental tones onto individual segments.

6.0.2. A suprasegmental feature is defined as one expressed on a larger unit that the segment. In the case of the suprasegmental features motivated and described in chapters 2 through 5, the domains were shown to be either the morpheme or the word. Due to the controversy over the nature of lexical entires, in particular, over the question of whether they are exclusively monomorphemic or not (cf. Chomsky, 1970, and Halle, 1973, for some discussion and for additional references), and due to the resulting uncertainty about how morphology is done in a generative grammar, the possible distinctions between words, lexical entries, and morphemes have been glossed over, for the most part, in preceding chapters.

In addition, an analysis of the morphology of some of the languages discussed in this thesis--which might help to resolve some of the uncertainty about the content of the lexicon and of the morphological component--has been hindered by lack of factual evidence from these languages.

6.0.3. Still, some tentative statements can be made. In Mende and in Tiv, it was shown that the underlying contours of morphemically complex words are possessed by the constituent morphemes rather than by the whole word up to the point of tonal mapping. For example, in chapter 2, 2.5.1, the tones of ^{H}<u>pɛlɛ</u> and ^{L}<u>ngaa</u> in <u>pɛlɛngaa</u>, 'houses', were shown to be properties of these morphemes themselves. What showns that tone cannot be regarded as a property of the phonological word in Mende is the apparent inability of such a proposal to explain the contrast illustrated in (1):

(1) a. ^{H}pɛlɛ + ^{L}ngaa > pɛlɛngaa
H H L

b. ^{HL}kenya + ^{L}ngaa > kenyangaa
H L L

It is the tones of morphemes that are mapped onto segments. If instead we combine the morphemic tones into a pattern expressed on the phonological word, the derivations in (2) will result:

(2) a. ^{H}pɛlɛ + ^{L}ngaa > ^{HL}[pɛlɛ + ngaa] > *pɛlɛngaa
H L L

b. ^{HL}kenya + ^{L}ngaa > ^{HL}[kenya + ngaa] > kenyangaa
H L L

The same point can be made for Tiv, where it has been shown that the floating tones must be kept separate from the tones of the verb root. Combining them in a "tonological" word would obliterate certain distinctions and would call for a radically different mapping rule.

What now of the Mende reduplicative words, which, if regarded as single tonal units, would violate constraints on tone sequences in Mende, such as ngɔngɔ, 'tooth'? In chapter 2, 2.3.2, it was proposed that this word be represented lexically as a compound: ^{H}ngɔ-ngɔ. The compound rule would derive the correct tones, again assuming that the high tone belongs to the first morpheme alone and not to the entire lexical entry. Reduplicative forms like ndamindami, on the other hand, would be represented lexically as ^{LH}ndami-^{LH}ndami, with tones again regarded as being expressed on morphemes and not on lexical entries.

6.0.4. A related phenomenon in Tangsic is discussed by Kennedy (1953), who argues against associating the underlying representation of tone with single syllables in this language. Tangsic compounds behave very similarly to those of Mende, Maninka, and Bambara, in that the inherent tones of noninitial elements are lost, with the first element determining the tonal contour of the compound. He observes that there are compound words some of whose elements are meaningless in isolation. For example, in yin-kwoŋ, 'England', kwoŋ means

'country', but he says that the only "meaning" of yin in this compound is that it is the first syllable of the word for 'England'. If this situation is handled in the same way as in Mende, the lexical entry will be ^{M}yin-kwoq. But TONE MAPPING in Tangsic appears to apply to a contour expressed on the word as a whole. For instance, one form of the word for 'America' is $\underset{HM}{mea}\text{-}\underset{ML}{kwo}$, lexically represented as ^{HL}mea-kwo. As noted at the end of chapter 5, the transition between H and L in this word is gradual, like the transition from non-nasal to nasal in Guaraní words. If Tangsic tone is in fact similar formally to Guaraní nasalization, the similarity would be obscured by representing the compound rule of Tangsic as assigning suprasegmental tones to individual elements of the compound, resulting in ^{HL}mea-^{L}kwo or ^{H}mea-^{L}kwo. Rather, it may be that Tangsic tone is a property of the word rather than the morpheme and that TONE MAPPING applies directly to ^{HL}mea-kwo, spreading the transition from H to L out over the entire word. Since this sort of solution has been shown to be untenable in Mende and Tiv, it would necessitate regarding tone as a property of morphemes in some languages but of words in others.

An alternative might be to express TONE MAPPING in Tangsic exactly as in the other languages discussed, resulting in intermediate forms like ^{HL}mea-^{L}kwo and ^{HL}pao-^{L}hyie-^{L}kong-^{L}s, with the gradualness of the actual phonetic contour achieved as the result of a rule which would distribute the transition from HL evenly across the word. Such a rule might also pro-

vide the best account of the fact that in isolation, Mende kenya+ma, 'on an uncle', is pronounced kenya+ma. The gradual increase in nasalization in Guarani words might be expressed by a similar rule. What such rules would in effect express is a gradual shift in articulatory position, distributed across certain segments in a word. The fact that the supra-segmental framework provides no criteria for evaluating these alternatives shows that it is in need of considerable further elaboration.

6.0.5. However these matters are resolved, we are still left with the question of the syllable as a possible domain of tone features. One potential source of confusion on this issue is that, although our definition of suprasegmental features would lead tone features on syllables to be regarded as suprasegmental, since syllables are larger units than segments, the intent of the explicit proposals concerning tone features on syllables, as put forward by Pike (1948), Lehiste (1970), Wang (1967), and McCawley (1968), is to eliminate the possibility of segmental features of tone rather than to distinguish segmental tone from suprasegmental tone. These proposals run into a number of different problems, however. First of all, it has been demonstrated that tone behaves like a segmental feature in some cases. In addition, the arguments advanced in favor of the representation of tone on syllables are not all that strong; they are discussed below in section 6.1. Furthermore, it may be possible to discount these proposals

on the basis of a much more general principle--that syllables are not phonological units at all and thus are not available as feature-bearing entities; this principle is defended in Leben (1973).

6.1. Trubetzkoy's typology of accentual systems.

6.1.1. Trubetzkoy (1939) has asserted that tone and prominence ("intensity") are not the properties of vowels as such; rather, the syllable is the basic prosodic unit in some languages, and the mora is the basic prosodic unit in others. Languages of the first type are referred to as syllable-counting languages; those of the second type are mora-counting. Trubetzkoy says (p. 182) that prosodic units are differentiated from each other by intensity in syllable-counting languages and by pitch in mora-counting languages. This framework is modified and extended by McCawley (1968); his proposals are reviewed in section 6.4 below.

Trubetzkoy opposes languages in which distinctions between prosodemes--the basic prosodic units--have only a meaning-differentiating function to languages in which this is not always the case. As examples of the former type, he notes Czech, a syllable-counting language in which the intensity of a given syllable in a word is said to be independent of the other syllables, and Igbo, a mora-counting language in which the pitch of a given mora is independent of the other moras of the word. Languages in which the differential prop-

erties of prosodic units are not always distinctive exhibit redundancies in the distribution of prosodic properties. He proposes that in such languages, the basic prosodic units "are distributed in such a way that each word has only a single prosodeme which by virtue of its differential property stands out among all others. The remaining prosodemes of the same word show the opposite differential property." (p. 182) As examples, he cites Russian, in which only one syllable per word is prominent, though different words can have different prominent syllables, and Lithuanian, whose words have only one high-pitched mora, though again the location of this mora may differ for different words. Trubetzkoy refers to the type of accentuation exhibited by Lithuanian as "musical accent" (p. 184), as opposed to tonal systems which exhibit "distinctive oppositions of tone register," like the system of Igbo.

6.1.2. If we apply Trubetzkoy's typology to the underlying properties of accentual systems, it appears to require at least one modification. Halle (1971) has observed that some Russian nouns are underlyingly unaccented, having an accent assigned to their first vowel or syllable by a phonological rule; there appears to be no reason to separate this type of accentual system from one which differs from it only in not permitting underlying unaccented words. In view of this, Trubetzkoy's definition, quoted above, might be amended to say

that in a given word in such languages, at most a single prosodeme stands out among all the others. A similar problem appears to arise in the case of accentual systems employing pitch. Mende, which Trubetzkoy actually mentions (p. 185), though in a slightly different connection, would not qualify as a language having a distinctive pitch represented on each mora, for reasons given in chapter 2. Hence, in Trubetzkoy's classification, Mende would have to be regarded as a language with musical accent. However, unlike Lithuanian, all of whose words are said to contain a high-pitched mora, Mende words can have a level low contour, e.g. bɛlɛ, bomuko. (L L; L L L) One's first guess might be that, just as in the case of Trubetzkoy's syllable-counting languages, the appropriate modification of his definition would involve saying that the prosodic units of a musical accent language are distributed in such a way that at most one high-pitched mora stands out from all the others in a given word. This modification does not at first appear to suffice, since Mende words can contain a succession of high tones, e.g. pɛlɛ, gbokito. (H H; H H H)

6.1.3. But a very interesting solution to this problem is possible if, as in the Russian case, we attempt to apply Trubetzkoy's classification to underlying forms, rather than to surface forms, and if we adopt the analysis of Mende proposed in chapter 2. The suprasegmental analysis of Mende provides

a single high tone for the underlying form of nouns like pɛlɛ and gbokito and a single low tone for bɛlɛ and bomuko. Other attested contours, as described in chapter 2, are HL, LH, and LHL. Thus, we may describe the underlying accentual systems of musical accent languages in a way completely parallel with the description proposed for the underlying system of syllable-counting languages like Russian: at most a single prosodeme stands out among the others. This would explain the restriction against HLH in Mende underlying forms: this forbidden contour contains two high-toned prosodeme, and only one is permitted. Thus, LHL, in which only a single H stands out, is permitted.

Trubetzkoy's framework, amended in the light of the suprasegmental analysis of tone, predicts that in a language which for other reasons would be classified as a musical accent language, underlying contours like HLH, LHLH, HLHL, would not occur. It is not entirely clear whether this prediction will stand up against the facts. It would entail, for example, that in a language with underlying suprasegmental tones, surface contours like High - Downstepped High could not arise from HLH if they were possessed by a single lexical entry or, perhaps, by a single morpheme. Furthermore, although Igbo is used by Trubetzkoy as an example of a non-musical accent tone language, the fact that it contains a "floating" low-toned associative marker suggests that it may have underlying suprasegmental representation, like Mende. Yet Trubetzkoy gives an Igbo word

with a HLH contour, nkata, 'conversation', and other words
H L H

containing the sequence High - Downstepped High. But it is still possible that the underlying contours are not as complex; consider the underlying patterns proposed for Tiv in chapter 3, for example. Hausa also has surface contours of the form HLH, but the final H is always on a long vowel; this vowel, since it is in word-final position and is preceded by L, would be raised to H from underlying L by LOW TONE RAISING; cf. chapter 4. By viewing Hausa HLH as arising from HLL (which in turn arises from suprasegmental HL), we could explain why Hausa contains no words with the surface contour HLH in which the final vowel is short. No other explanation has ever been offered for this fact.

6.1.4. Whether or not the proposed modification of Trubetzkoy's typology turns out to be correct, it is still possible to reinterpret his framework in the light of the theory proposed in the present work. Languages which Trubetzkoy refers to as mora-counting have underlying pitch information specified for lexical entries; languages of this type in which pitch oppositions have only a meaning-differentiating function are those which have underlying segmental representation for tone--those which McCawley (1970a) would label as being tone languages from the outset of a synchronic derivation; musical accent languages are languages with an underlying suprasegmental representation for pitch. In the light of the propos-

als of McCawley (1964, 1968, 1970a), we may say that there are two types of suprasegmental representation, as noted in chapter 4. The first is the type in which the underlying tonal contour of a lexical entry is specified by a sequence of tonal features: LH, LHL, etc. The second type of suprasegmental representation attaches a diacritic feature to each lexical entry specifying the location of the first high tone or, at any rate, the location of some pitch phenomenon. Examples of this latter type of language are Lithuanian and Japanese. As McCawley (1964) has argued, there is no reason to suggest that these two types of musical accent language are significantly different--the same types of rules appear to occur in both.

Turning now to systems in which Trubetzkoy says that prosodemes are differentiated by intensity, we may say that a language like Czech, in which the question of whether a given vowel is stressed is reported by Trubetzkoy to be independent of whether other vowels in the word are stressed, has an underlying segmental representation for stress information--each vowel in underlying forms is specified for a value of a certain binary accentual feature, perhaps [stress]. Russian, on the other hand, has its underlying accentual information represented in a way completely parallel to those musical accent languages in which lexical entries are marked with a diacritic feature specifying the location of some accentual phenomenon.

6.1.5. The only remaining question is whether there is any essential difference between languages whose accentual features are differentiated by pitch and those whose accentual features are differentiated by intensity. Differing opinions on the answer to this question are set down in McCawley (1964) and Woo (1969). Halle (1971), drawing on an idea attributed to R. Jakobson, makes a proposal which unifies the treatment of accentual phenomena in different Slavic languages. Halle says (p.2):

> In its grossest terms the idea is that underlying all Slavic prosodic phenomena is a pitch contour of the word that is much like that of a "terrace tone" language such as Japanese. In Japanese..., in order to specify the pitch contour of a word, it is ... necessary only to indicate the vowel after which the low pitched portion of the word begins. This initial marking of the Japanese word is provided by the morphological component of the grammar.... The prosodic contour of the word is established by special phonological rules which characteristically differ from dialect to dialect but always take as their input the word with the specially marked vowel as provided by the morphology.... I shall try to show in the discussion that follows that an analogous situation prevails in Slavic.

For each Slavic language, Halle (1971) posits a morphological rule assigning a high tone to a vowel lexically marked to receive it; subsequent phonological rules distribute this high tone leftward in the word, assign stress, and adjust the prosodic contour of the word in such a way that the correct accents are produced. The ability of this treatment to interrelate the otherwise seemingly diverse accentual phenomena in

closely related set of languages recommends it as a promising approach to the description of accentual systems. The fact that the stress system of modern Russian appears to be most adequately described in terms of underlying tonal features, rather than underlying intensity features, casts some doubt upon the validity of Trubetzkoy's separation of tonal systems and intensity systems into distinct classes. If the accentual system of Czech can also be shown to lend itself to treatment in terms of underlying tonal features, no motivation will remain for applying Trubetzkoy's distinction between pitch and intensity to the systematic phonemic level.

We are still left with Trubetzkoy's claim that the syllable is the basic prosodic unit in intensity systems and that the mora is the basic prosodic unit in tonal systems. Trubetzkoy himself does not explicitly motivate the claim that syllables and moras can serve as feature-bearing units, but this task has been attempted by subsequent researchers, whose arguments are considered directly below.

6.2. Wang's arguments for tones on syllables.

One of the most comprehensive and most frequently cited references on tone, Pike (1948), defines a tone language in terms of the syllable. Pike recognizes the fact that tone may be represented on larger units, saying (p.5):

> ... there may exist languages which one desires to call tonal because, although they do not have contrastive pitch on each syllable, they do have lexically significant or contrastive pitch spread over entire words or morphemes. In this book, however, the syllable type of toneme must be present for a language to be labeled tonal.

Pike does not discuss the possibility that tone is a segmental feature, but evidently would advocate expressing tone as a feature on syllables in those languages for which Woo (1969) has argued for lexical representation of tone on vowels. Wang (1967) presents some arguments which might appear to favor Pike's proposed representation over Woo's, but these arguments, especially when interpreted in the light of the suprasegmental proposal outlined in preceding chapters, appear unconvincing.

Wang argues, first of all, that if tone features were to be placed in a matrix along with segmental features, the decision as to which segmental matrix in a syllable these tone features were to be placed would be arbitrary. He observes (p. 95) that "In languages like Chinese the tone features are sometimes relevant for the initial consonant, sometimes for the nuclear vowel, and sometimes for the final consonant in various phonological rules." Secondly, he claims that segmental features are usually not relevant in the various types of tone sandhi. Finally, he notes that the domain of a tone is phonetically over the entire voiced portion of the syllable, rather than being over a single segment.

The validity of Wang's first argument depends on the correctness of the feature theory in which one is operating. If

we assume that tone is represented in some languages as a segmental feature, the decision as to which segment should bear the feature is not necessarily arbitrary. For example, if one adopts the framework proposed by Halle and Stevens (1971), in which it is maintained that a set of features which express the voicing of obstruents also express the tone of vowels, the decision to represent tone features on vowels is automatic. One can conceive of other theories in which the decision would be equally nonarbitrary.

Wang's second argument, which says, in effect, that the irrelevance of segmental features for the operation of certain tone sandhi rules can be explained by positing tone as a feature on an entity which does not contain segmental features, can be answered in the following way: in cases where this restriction on the environment of tone sandhi rules occurs, it appears to be possible to explain this fact by positing tone as a feature on morphemes or words--a position which is independently motivated by consideration of restrictions on the distribution of underlying tones which undergo such sandhi rules. In other cases, where tone sandhi sometimes does and sometimes does not take segmental information into account, there is nothing in itself wrong with the proposal that tone is here to be regarded as a segmental feature. There are known instances of rules which alter a feature in an environment unspecified for other segmental information, such as word-final obstruent devoicing or a nasalization rule operat-

ing on a segment followed by a nasal. In view of this, we should expect that some sandhi rules involving segmental tone features will also operate independently of other segmental information in their environment, for example converting a tone to H before any H.

The third argument, based on the phonetic domain of tone, would, if valid, also argue for the representation of the feature [nasal] on syllables, since any syllable final nasal induces some nasalization on an immediately preceding vowel. In addition, nasal vowels typically exert influences on surrounding segments. Apart from this, however, there would be no reason to expect nasalization to be represented on syllables. Hence, it is plausible to suggest that the phonetic domain of tone and of nasalization does not necessarily correspond to its underlying domain but rather results from phonetically automatic or phonologically conditioned spreading of a tone or nasalization feature from a single segment onto surrounding segments.

To deny the validity of Wang's arguments is not, of course, to claim that tone is always represented as a segmental feature. The actual differences which distinguish the behavior of tone from that of segmental features have been shown to point to a suprasegmental representation for tone. In the actual cases examined, it was seen that the sort of suprasegmental unit which functioned as the domain of tone was either the morpheme or the word. As the ensuing discussion shows, the proposal that syllables can function as the domain

of phonological features leads to apparently insurmountable problems. In view of this, it seems fair to say that, insofar as Wang's observations point up real differences between tone and segmental features, they support the suprasegmental representation of tone but not the establishment of the syllable as the domain of tone.

6.3. Lehiste's definition of suprasegmentals.

Lehiste (1970) surveys the literature on quantity, tone, and stress, all of which she considers to be suprasegmentals. She indicates (p. 84) acceptance of Wang's arguments, cited above, and proposes two arguments for distinguishing quantity, tone, and stress from segmental features. The validity of these arguments, however, is debatable. The first is that pitch, stress, and quantity "are, in a way, a secondary, overlaid function of voicing" (p. 2). Voicing itself is, according to Lehiste, an inherent, segmental feature. Lehiste does not explain why this difference should point to a suprasegmental representation for the features discussed. Furthermore, her criterion would seemingly rule out the possibility of suprasegmental representation for nasalization, for which evidence was presented in chapter 5. Nasalization is not an overlaid function of voicing or of any other segmental feature. The movement of the velum does not appear to be crucially different from any other articulatory gesture, and yet nasalization does appear to function as a suprasegmental in some cases.

The second difference which Lehiste notes between her suprasegmentals and segmental features is (p. 2):

> that suprasegmental features are established by a comparison of items in sequence (i.e., syntagmatic comparsion), whereas segmental features can be defined without reference to the sequence of segments in which the segment appears, and their presence can be established either by inspection or paradigmatic comparison (i.e., comparison of an item with other items in the phonological inventory).

As an example, she notes that "the rounding of a vowel in a sequence of rounded vowels can be established for each vowel without necessary reference to adjacent sounds." This she compares to the amount of stress on a vowel, which "cannot be established without comparing the vowel with another segment in the sequence." But here, too, Lehiste does not justify the choice of this difference as a criterion for separating her suprasegmentals from the segmental features. Furthermore, it appears that in a tone language without downdrift, in which the pitch range of a high tone would not generally intersect the pitch range of a low tone for a given speaker, it would be possible to establish the tone of a given vowel without comparing it to another segment in the sequence. Languages with ideophones, pronounced invariably on an extra-high pitch, present a problem for Lehiste's proposal, since these tones can be established without comparison to tones on surrounding segments, and yet these tones are, like any others, expressed in terms of features which are an overlaid function of voicing. Finally, in many cases, the

tonal melodies associated with a given set of lexical items are, like Lehiste's segmental features, distinguishable from other tonal melodies by paradigmatic comparison; this is precisely how the possible contours for Mende, Tiv, Maninka, and Bambara words were arrived at in preceding chapters.

All of this does not argue, of course, that Lehiste's suprasegmentals are to be identified with segmental features. Rather, it merely shows that the criteria she proposes do not appear to properly separate one from the other.

6.4. Syllable and mora in accentuation rules.

6.4.1. In a modification of Trubetzkoy's treatment of the syllable and mora as prosodic units, McCawley (1968) distinguishes between syllable-counting languages--languages in which the location of an accent is specified by counting syllables--and syllable languages--languages in which the domain of the accent (i.e. the prosodic unit) is the syllable. He opposes syllable-counting languages to mora-counting languages, and opposes syllable languages to mora languages. He identifies a language in which the mora is the basic prosdic unit as generally being "a language in which there are two possible accentuations for long syllables but only one possible accentuation for short syllables" (p. 59). Classical Greek is given as an example of a mora-counting mora language, while Classical Latin is termed a mora-counting syllable language. Classical Greek, McCawley notes, has a contrast between rising and

falling pitch on a long stressed syllable, but not on a short syllable or on an unstressed syllable. In view of this, he proposes that rising pitch be interpreted as stress on the second mora, while falling pitch is to be interpreted as stress on the first mora. This situation, he claims, is distinct from that in Latin, where there is no contrast between types of accentuation on accented long syllables; rather, long syllables, like short ones, are simply either accented or unaccented.

6.4.2. One might imagine that these distinctions could provide a basis for defining the syllable and the mora as phonological units, but upon closer examination, this no longer appears to be true. Consider McCawley's account of stress assignment in Latin. He observes that the Latin stress rule must produce the results sketched in (3), where each of the examples represents the end of a hypothetical word.

(3) a. -acā́tus
    b. -acáptus
    c. -acā́ptus
    d. -ácatus

An observational account of Latin stress assignment would express these facts by saying that stress is put on the second syllable from the end if this syllable is long (that is, if its vowel is long or is followed by two consoants) and on the third syllable from the end otherwise. But, McCawley notes, this account, which consists of two separate statements,

can be collapsed into a single rule if the rule is permitted to refer to moras and syllables. The rule would simply assign stress two moras before the last syllable, as in illustrated in (4).

(4) a. a cá a tus

b. a cá p tus

c. a cá ap tus

d. á ca tus

6.4.3. There are two problems with this formulation. First of all, although the mora is said to be the unit of phonological distance in Latin, McCawley's rule would also have to count syllables, since the rule must be able to ignore the number of moras in the last syllable;[1] that is, the rule must also produce the results in (5), where the hypothetical examples end in a one-mora syllable.

(5) a. a cá a ta

b. a cá p ta

c. a cá ap ta

d. á ca ta

This shows that the mora cannot be considered the only unit of phonological distance in a mora-counting language, for the

word-final syllable must also be counted as a unit of distance in McCawley's description of Latin. A second problem concerns the formalization of the Latin stress rule. We might first attempt to represent McCawley's rule in the following manner, with the mora and the syllable represented as M and S, respectively.

(6) LATIN STRESS RULE

$$M \rightarrow [+\text{stress}] \; / \; \_\_ \; M \; S \; \#$$

This rule puts stress two moras before the last syllable in a word. But it must be incorrect as it is stated, since it places stress on a mora, while it is the syllable that is supposed to be the prosodic feature-bearing unit in Latin. Thus, we must find a formalism capable of saying that a syllable receives stress when it contains a mora that is two moras from the final syllable in a word. Alternatively, we may abandon McCawley's claim that the syllable is the prosodic unit of Latin. I believe that it is this latter course that must be taken. First of all, consider the following restatement of the Latin stress rule, which does not make use of mora or syllable notation:

(7) REVISED LATIN STRESS RULE

$$V \rightarrow [+\text{stress}] \; / \; \_\_ \; C_o(\breve{V}C_o^1)VC_o\#$$

This rule operates in two disjunctively ordered environments,[2]

spelled out in (8).

(8) a. __ $C_o\breve{V}C_o^1VC_o\#$

b. __ $C_oVC_o\#$

The environment (8a) is met by the forms in (4d) and (5d), where the penultimate vowel is short and followed by only one consonant; in these cases, rule (7) correctly places stress on the antepenultimate vowel. Since the remaining forms in (4) and (5) do not satisfy the environment (8a), the other subpart of (7) is applicable, and so these forms will correctly be stressed on the penultimate vowel.

6.4.4. Now we must ask whether any generalization is expressed by (6)--or, rather, by the formally appropriate reformulation of (6)--that is not captured by (7). Obviously, the latter version of the rule requires more symbols than the former, but this could hardly be considered a valid objection in this case, especially since the symbols employed in the latter version are known to occur in phonological rules on independent grounds, while those in the former version are not. However, even if this type of objection were valid, it could be essentially overcome by renaming the sequence $\breve{V}C_o^1$ as M and the sequence VC_o as S; this type of renaming takes place anyway on McCawley's account, since it is sequences of segments that he proposes to re-interpret as moras and syllables for the operation of certain rules.[3]

Another difference that might be cited between the formulation in (6) and that in (7) is that the latter has two subparts while the former is a single rule. It would be difficult to judge or to answer such an objection without reference to specific linguistic evidence, but in the present case, the hypothetical objection is easily overcome. Observe that rule (7) correctly predicts the stress in a two-syllable word whose first vowel is short and is followed by no more than one consonant: such a word is stressed on the first vowel. Rule (6), on the other hand, leaving aside the other problems noted with its precise formulation, would have to be modified in order to stress words of this sort. The modification might take the following form:

(9) M $\longrightarrow$ [+stress] / $\_\_$ (M) S#

Thus, a slightly more adequate version of the rule expressed in terms of syllables and moras also has two subparts. Finally, consider stressed monosyllabic words in Latin. These would be generated by including another set of parentheses in (7), resulting in (10):

(10) REVISED STRESS RULE (Latin)

$$V \longrightarrow [+\text{stress}] \;/\; \_\_\; C_0((\breve{V}C^1_0)VC_0)\#$$

How would the appropriate generalization be stated in McCawley's account? Recall that what his first formulation was intended to express was that stress was placed on the syllable which was

two moras before the last syllable. This must now be revised to allow for cases in which only one mora precedes the last syllable and for cases in which only a single syllable is present. I believe that the foregoing discussion shows that the most that could be expected of a revision of McCawley's proposal is that it could be brought up to the same level of adequacy that is already attained by the formulation in (9). An observation made below in section 6.4.7 shows that not even this degree of adequacy will be easily attained in a theory which posits the syllable or mora as a feature-bearing unit.

6.4.5. A rather extreme example of the purely notational character of some of the proposals involving the use of the syllable as a prosodic unit is provided by the treatment of the Latin stress rule in Spanish suggested by Hooper (1972) and modified by Vennemann (1972). Hooper argues that this rule can be simplified if phonological theory is expanded to permit features on syllables. By assuming that Spanish stress is expressed on syllables, Hooper arrives at the following formulation, in which the symbol S stands for a syllable and $ stands for a syllable boundary.

(11) STRESS (Spanish)

$$S \longrightarrow [1\ \text{stress}] \;/\; \_\_\; ((C\check{V}\$)S)\#]_{N,A}$$

The parenthesized $\underline{C\check{V}\$}$ stands for a single mora; it is designed to capture the fact, analogous to the Latin case, that stress

is on the antepenultimate syllable if the penultimate syllable has a short vowel followed by no more than one consonant. Certain cases in which a sequence of two consonants is permitted to follow the penultimate short vowel, which are also accounted for by this rule, are handled in the same manner as the analogous Latin facts, referred to in fn. 2. As was remarked above, the proposal that syllables can be referred to in phonological rules will involve renaming certain sequences of segments as syllables. Vennemann carries this procedure a step further by introducing the symbol $\check{S}$, for an open syllable --that is, a syllable ending in a short vowel. This permits the following reformulation of Hooper's stress rule:

(12) REVISED STRESS (Spanish)

$$S \longrightarrow [1 \text{ stress}] \; / \; \_\_ \; ((\check{S})S)\#]_{N,A}$$

No justification is offered for defining this new entity. It is employed as an abbreviatory device. No new claim is made in the account in (12). Introduction of a new symbol could be justified under these circumstances only with an extremely simplistic notion of economy--the new construct permits a rule to have fewer symbols than in (11), and the need for defining the construct does not count toward the complexity of the solution.

If such manipulation of symbols is tolerated, one wonders what principle could then stop the linguist from manipulating further. Suppose that we next defined the symbol Σ as representing the sequence $((\check{S})S)\#$. Could we then claim to have

accomplished something by noting that this permits us to re-express (12) in the "simpler" form (13)?

(13) $S \longrightarrow$ [1 stress] / $\_\_\ \Sigma\ ]_{N,A}$

Suppose now that we define a symbol $\vec{\Sigma}$ to designate the entire rule expressed in (13). This would permit us the "saving" of expressing this rule as in (14).

(14) $\vec{\Sigma}$

Clearly, all of the abbreviatory innovations considered here are purely notational, based at most on the anticipation of generalizations rather than on the capturing of them. They are distinguished from the accepted notational proposals in phonology, such as the conventions which permit the collapsing of rules with braces or parentheses, in that the latter make claims that are in principle falsifiable: rules with similar environments tend to be ordered together in a grammar, rules capable of being abbreviated with parenthesis notation apply disjunctively, and so on.

6.4.6. Jakobson (1937), after demonstrating convincingly that previous accounts of ancient Greek accentuation either missed generalizations or led to incorrect predictions, proposes accent rules which appear to make crucial use of the notions "mora" and "syllable". He says, essentially, that tonic words in ancient Greek were marked to undergo one of the following two rules. Which rule a given word was to

undergo was unpredictable and therefore must be marked in the lexicon.[4]

(15) ACCENT (Ancient Greek)

a. The accent falls on the first or only mora of the syllable which contains the pre-final mora of the word.

b. The accent falls on the second or only mora of the syllable preceding the syllable which contains the pre-final mora of the word.

Examples of words obeying (15a) are given in (16a), and for (15b), in (16b). On the right, the facts are schematized. All circumflexed vowels on the left are long and are represented as V́V on the right. The acute accent on the left represents an accent on the second V of a VV sequence or on the only V in C_oVC_o.

(16) a. i. γαμέτις — V́ - V

ii. καλῶς — V́V

iii. πολῖτις — V́V - V

b. i. μέλανος — V́ - V - V

ii. μελάνων — V́ - VV

iii. πρόσωπον — V́ - VV - V

iv. ἤγαγον — VV́ - V - V

v. τιθείσης — VV́ - VV

vi. θήρειος — VV́ - VV - V

In addition, Jakobson mentions the impossibility of certain accentual patterns, represented schematically in (17):

(17) *V́V - V - V
*V́V - VV - V
*V́ - V - VV
*V́V - VV

Jakobson justifies the division reflected by the two parts of of rule (15) on the basis of the fact that this classification permits one to posit a single accentual class for a given root, even though its accentuation is different with different endings. Members of the first class exhibit only the accentual patterns in (16a) and so are subject only to (15a); members of the second class exhibit only the accentual patterns in (16b) and so are subject only to (16b). For example, (16b.i) and (16b.ii) have the same root but different case endings; μελαν- is subject to subpart b of rule (15). In short, Jakobson's system predicts that no ending on this root will cause it to fall in the class illustrated in (16a).

Jakobson's proposal applied to syllables and moras, runs into the same formal problem encountered by McCawley's account of Latin: a notation must be developed for expressing notions like "mora of the syllable which contains the pre-final mora of the word." But this problem does not arise, and Jakobson's generalization is still stated, if the rule is expressed in terms of vowels and consonants. Observe, first of all, that the first three examples in (16b) are essentially the same as the last three: the only difference is that the latter three

are preceded by an additional V, whose presence makes no difference for the accentuation rule. Next, note that the difference between the (a) and (b) examples in (16) is that the (b) examples are accentuated one vowel to the left of the corresponding (a) examples. The subparts of rule (15) can be re-expressed as (18a) and (18b), respectively.

(18) REVISED ACCENT (Ancient Greek)

a. $V \longrightarrow [+acc] / \_\_ (V)C_o(VC_o)\#$

b. $V \longrightarrow [+acc] / \_\_ C_oV(V)C_o(VC_o)\#$

Example (16a.i) is obtained by ignoring (V) in (18a); (11a.ii), by ignoring (VC_o); (11a.iii) is given by the entire environment of (18a), with parentheses removed. The examples of (16b) are obtained in the same manner from (18b). The impossible accentual pattern in (17) are correctly excluded by (18). From this account, we see that the only difference between the two accentual classes of ancient Greek involves the presence or absence of the expression C_oV from the beginning of the environment of the accentuation rule that they are subject to.

Thus, although these examples at first appeared to present evidence for the formalization of the notions "syllable" and "mora", and for the claim that these entities are feature-bearing units, an explicit account is possible employing the independently available elements C and V, with no additional requirement for defining new notions like "mora of the syllable which contains the pre-final mora of the word".

6.4.7. The proposal that features be expressed on syllables is a proposal to weaken phonological theory. Even worse, if accepted, it would pose a serious paradox. If syllables were allowed to bear features, they would be the only feature-bearing units whose extension was completely predictable by an algorithm referring to other linguistic units. For example, Hooper (1972) proposes that syllables in a phonological string can be isolated by conventions which scan the segments in the string and place syllable boundaries in the appropriate places. This introduces the following problem: if a given syllable feature had to be lexically specified--say, stress in a language in which stress was not entirely predictable, there would be no unit capable of bearing that feature in underlying phonological representations. The algorithm might be able to mark the appropriate syllable divisions in a phonological string, but prior to the operation of the algorithm, the syllable features would have no domain! Thus, we must in any event expect that the features in question are to be represented on single segments, on morphemes, or on lexical entries in lexical representations, a position which is completely in line with that expounded in section 6.1. What, then, would ever be the motivation for representing these features on syllables? I believe that the foregoing discussion of arguments presented in favor of representing features on syllables shows that the motivation has been extremely weak.

FOOTNOTES TO CHAPTER SIX

[1]I am indebted to Stephen R. Luckau for this observation and for suggesting the implications of the Latin example.

[2]Vennemann (1972) makes an interesting observation showing that C_o^1 in (7) must also be interpreted as describing clusters of stop plus liquid, along with qu or gu. He takes this as an indication that syllabication conventions must apply before the stress rule, permitting the rule to count syllables instead of segments. However, in Leben (1973), a reinterpretation of Vennemann's proposal is suggested, involving a convention which counts certain CC clusters as a single consonant, and it is shown that this alternative makes a more interesting, and apparently correct, prediction about possible phonological systems, while avoiding the necessity of incorporating syllable notation into phonological rules.

[3]In fact, as noted in Leben (1973), it is mere relabelling --rather than empirical considerations of any sort--that is at the heart of a number of recent proposals assigning phonological status to the syllable.

[4]Incidentally, note that neither Trubetzkoy's nor McCawley's classifications would predict that this is a possible natural language, since the accentuation rule needs to count both syllables and moras.

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BIOGRAPHICAL NOTE

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