4 Phonological Sketches

In this chapter we illustrate how the concepts and principles introduced in the previous chapters are applied to the analysis of selected aspects of the phonological structure of four widely divergent languages. Primary consideration is given to the motivation of underlying representations and the interrelationships between the rules. Details of rule formalism are largely ignored. These sketches illustrate the characteristic problems the phonologist encounters in actual descriptive practice. We shall repeatedly refer to various aspects of these analyses in later chapters which deal with more theoretical issues.

The Yawelmani Dialect of Yokuts

In this section the morphophonemics of the verbal system of the Yawelmani dialect of Yokuts (an American Indian language of California) will be examined in some detail. The phonological rules that specify the phonetic shape of Yawelmani verbal words are also operative in the nominal system, but since the nouns provide little additional insight into the workings of Yawelmani phonology, we shall ignore them in our

discussion. The data discussed here are taken from Stanley Newman's (1944) description. An early generative treatment is to be found in Kuroda (1967). Various theoretical aspects of Yawelmani phonology have been discussed by Kisseberth (1969, 1970). It should be pointed out that not all of the forms cited in this section, nor in previous generative analyses of Yawelmani, are actually attested in Newman's grammar, the only published source on the language. All nonattested forms are, however, completely parallel in behavior and patterns of alternation to forms that are amply attested in Newman's description. Finally, a note on the transcription is in order. The voiced stop letters (*b*, *d*, etc.) represent unaspirated voiceless lax consonants, while the voiceless stop letters (*p*, *t*, etc.) stand for tense, voiceless, aspirated consonants. A raised comma indicates glottalization, while a dot under a letter indicates an apical alveolar point of articulation. Finally, for typographical convenience, the short and long open mid vowels [ɛ] and [ɔ] are represented as *e* and *o*.

VOWEL HARMONY

Almost without exception, suffixes in Yawelmani have varying pronunciations involving an alternation between non-round and round vowels. To begin with, just alternations involving the short vowels *i*/*u* and *a*/*o* will be examined. Take the non-future (i.e., either past or present) suffix as an example. It appears in two forms: *-hin* and *-hun*.

(1)

xat-hin	'eats'	*max-hin*	'procures'
bok'-hin	'finds'	*k'o?-hin*	'throws'
xil-hin	'tangles'	*giy'-hin*	'touches'
dub-hun	'leads by the hand'	*hud-hun*	'recognizes'

The examples in (1) suggest that the alternation between *-hin* and *-hun* is rule governed. If the preceding vowel is *i*, *a* or *o*, then *-hin* appears; if the preceding vowel is *u*, then *-hun* is used.

The pattern of alternation exhibited by the nonfuture suffix is in no way limited to this particular morpheme. Compare (2) and (3):

(2)

xat-mi	'having eaten'
bok'-mi	'having found'
xil-mi	'having tangled'
dub-mu	'having led by the hand'

(3)

xat-nit	'will be eaten'
bok'-nit	'will be found'
xil-nit	'will be tangled'
dub-nut	'will be led by the hand'

There are no suffixes in Yawelmani which have, invariably, *i* as their first vowel; neither are there suffixes which have, invariably, *u* as their first vowel. If a suffix has a high vowel as its first vowel, then that vowel will always appear as *i* or *u* according to the pattern stated above. Given this fact, there is no underlying contrast between suffixes with *i* as their first vowel and those with *u* (cf. the case in Russian discussed earlier, where a contrast between stems ending in voiced as opposed to voiceless obstruents could be established), and thus there is no direct evidence as to which form of these suffixes should be regarded as basic and which derived by a rule.

If we take *-hin*, *-mi*, *-nit* as the basic form of the morphemes in question, then a rule of vowel harmony can be stated as in (4):

(4) *A high vowel is rounded (and backed) if the vowel that precedes it in the word is a high round vowel.*

(Notice that we have not restricted the above rule just to a suffixal vowel, even though all of the examples given so far have involved suffixal vowels. Evidence that other vowels undergo this harmonizing process will emerge later.) The vowel harmony rule expressed in (4) will convert the basic representation /hin/ to [hun], /mi/ to [mu], /nit/ to [nut], when an *u* vowel precedes in the word.

If, on the other hand, *u* were taken as basic, a rule such as (5) would be required to account for harmony:

(5) *A high vowel is unrounded (and fronted) if preceded in the word by a nonround vowel or by a nonhigh vowel.*

In (5), there is no single phonetic class of segments conditioning the alternation, rather a conjunction of two separate classes (nonround vowels and nonhigh vowels). There does not seem to be any phonetic motivation for nonhigh vowels to cause *u* to shift to *i*. In (4), on the other hand, it is the high round vowel *u* that causes a following *i* to become *u*—a clear instance of assimilation. We see then that different choices of basic representations lead to different rules, and sometimes one of the rules is more reflective of a natural phonetic process.

For the reasons suggested above, an analysis that takes *i* as the basic vowel and hypothesizes the existence of a rule such as (4) seems closer to a correct characterization of these data than an analysis that takes *u* as basic and hypothesizes rule (5). Our evidence, however, is rather tenuous.

The examples in (1)–(3) illustrate suffixes containing a single vowel, where that vowel is phonetically a high vowel. Other suffixes in Yawel-

mani containing just one vowel vary in pronunciation between *a* and *o*. The examples in (6) illustrate such a suffix.

(6)	*xat-al*	'might eat'	*max-al*	'might procure'
	dub-al	'might lead by the hand'	*hud-al*	'might recognize'
	xil-al	'might tangle'	*giy'-al*	'might touch'
	k'o?-ol	'might throw'	*bok'-ol*	'might find'

The dubitative suffix *-al/-ol* clearly shows a pattern of alternation highly reminiscent of the alternation pattern of the high vowel suffixes in (1)–(3). Let us refer to the suffixal shapes *-hin* and *-al* as the nonround vowel alternants, and the shapes *-hun* and *-ol* as the round vowel alternants. We can then say that a nonround vowel alternant always appears if the preceding vowel is nonround (*i* or *a*). It is not possible, however, to say that the round vowel alternant always appears when the preceding vowel is round. In the case of the high round vowel alternants (*-hun*, for example), the preceding vowel must not only be round, but also high. In the case of the nonhigh round vowel alternants (*-ol*, for example), the preceding vowel must not only be round, but also nonhigh.

The pattern of alternation exhibited by the dubitative suffix is representative of a number of other suffixes in Yawelmani, as the following examples reveal.

(7)	*xat-xa*	'let us eat'
	giy'-xa	'let us touch'
	dub-xa	'let us lead by the hand'
	bok'-xo	'let us find'
(8)	*xat-taw*	'eating'
	giy'-taw	'touching'
	dub-taw	'leading by the hand'
	bok'-tow	'finding'

(*-taw/-tow* is a gerundial suffix, but we have not attempted in the glosses to indicate its precise usage).

The same motivation for adopting *i* as the basic vowel of a suffix like *-hin* leads to the adoption of *a* as the basic vowel of a suffix like *-al*. In order to account for the *o* pronunciation, we require the rule given in (9).

(9) *A nonhigh vowel is pronounced round when a nonhigh round vowel precedes in the word.*

Rules (4) and (9) are highly similar; indeed, intuitively they appear to be instances of a single principle, which is given as (10).

(10) *A vowel is pronounced round (and back) if immediately preceded by a round vowel of the same height.*

The question of whether two processes (such as the shift of *i* to *u* and of *a* to *o* in the present example) are in fact instances of a single process is often a very difficult one to answer; the question will be studied more closely in Chapter 9. For the present, we will simply assume that the extreme parallelism of (4) and (9) warrants the assumption that they are in fact instances of a general principle such as (10).

The examples considered so far have been restricted to cases where one monosyllabic suffix is attached to a monosyllabic verb root. We now turn to more complex cases. There are suffixes that may occur between the verb root and those suffixes (such as *-hin* and *-al*) which occur finally in the word, for example the indirective suffix *-sit-* 'to, into, for'.

(11)	*k'o?-sit-hin*	'throws to'
	max-sit-hin	'procures for'
	xip'wiy-sit-hin	'makes a rubbing motion for'
	t'ul-sut-hun	'burns for'

The interesting example here is *tul-sut-hun*, where it will be noted that both of the *i* vowels in the suffixes are pronounced *u*. The UR of the word is /t'ul+sit+hin/. In order for rule (10) to account for *tul-sut-hun*, we must assume that in some sense it operates twice: First, (10) rounds the *i* vowel in /sit/ since it is preceded by a round vowel; then, (10) rounds the *i* vowel in /hin/ since, as a result of the first application of (10), a high round vowel precedes. (cf., Chapter 8 for discussion of the problem posed by the multiple application of a single rule.) Another example of the same sort is *dub-wus-mu* 'having led each other by the hand', which consists of the verb root *dub-*, the reciprocal-reflexive suffix *-wis-*, and the consequent gerundial suffix *-mi*. Again, both suffixal vowels undergo the harmony rule.

Notice that (10) claims that a vowel harmonizes with the immediately preceding vowel in the word. Consequently, an *a* (or *i*) vowel in a final suffix will not harmonize with an *o* (or *u*) vowel in the verb root if another suffix intervenes containing a vowel of the opposite height. For example, the imperative suffix is *-k'a*, and it harmonizes in an example such as

bok'-k'o 'find (it)!', but not in *bok'-sit-k'a* 'find (it) for (him)!'. The *i* vowel in /sit/ does not harmonize since the preceding round vowel is not of the same height as *i*; the *a* vowel in *-k'a* does not harmonize either, since it is not preceded by a round vowel of the same height.

Our analysis so far has been restricted to monosyllabic suffixes; examination of disyllabic suffixes confirms the analysis we have presented. (10) predicts that if a suffix has two vowels of the same height, then either both will harmonize or neither will, depending on whether the vowel preceding the suffix is a round vowel of the same height as the suffixal vowels in question. If the disyllabic suffix contains two vowels unlike in height, (10) predicts that the first will harmonize if the preceding vowel is round and of the same height, but the second vowel of the suffix will never harmonize. These predictions are indeed correct.

For instance, the suffix *-iwis*, reciprocal/reflexive, occurs in the following two verbal nouns: *ʔoyowx-iwis* 'one who feels sorry for himself' and *t'uy-uwus* 'act of shooting at one another'. In the first example neither *i* vowel in the suffix harmonizes, since the final vowel of the preceding stem is not one that conditions harmony for *i*; in the second example, both *i* vowels in the suffix harmonize. An example of a suffix with two unlike vowels is *-ʔin'ay*, a gerundial suffix. Compare *dos-ʔin'ay* 'reporting' with *dub-ʔun'ay* 'leading by the hand'. In these examples, *i* harmonizes after *dub-* but not after *dos-*; in neither case does the *a* harmonize, since it is never preceded by a vowel that can cause it to harmonize.

Given what has been said so far, there are some suffixes that appear not to obey the vowel harmony principle formulated in (10). The future morpheme is a case in point. Observe the following examples:

(12)

bok'-en	'will find'
dub-on	'will lead by the hand'
xat-en	'will eat'
giy'-en	'will touch'

This suffix is an apparent anomaly in that, although it seems to contain a nonhigh vowel, it has the round variant of that nonhigh vowel when the high vowel *u* precedes, and does not have the round variant when *o* precedes. In other words, *-on* appears in the same contexts as *-hun*, and not in the contexts where *-ol* appears. The future suffix thus appears to be a systematic violation of the principle that has been claimed to govern vowel harmony in Yawelmani, namely (10). The anomalous behavior of this suffix, as well as others like it, will be reconsidered later and will be shown to be ultimately regular.

VOWEL SHORTENING

Up until this point, our attention has been restricted to alternations in the quality of suffixal vowels. Verb roots in Yawelmani show certain alternations that must now be examined before we can profitably return to a consideration of the operation of vowel harmony in a wider class of cases. One pervasive alternation in verb roots is in the length of the root vowel. In all of the previous examples, the root vowel was invariably short, whatever the nature of the following suffix. There are, however, many roots which show an alternation in vowel length. The examples in (13) are representative.

(13)

Nonfuture	Imperative	Dubitative	Future	Gloss
ṣap-hin	*ṣap-k'a*	*ṣa:p-al*	*ṣa:p-en*	'burn'
dos-hin	*dos-k'o*	*do:s-ol*	*do:s-en*	'report'
lan-hin	*lan-k'a*	*la:n-al*	*la:n-en*	'hear'
mek'-hin	*mek'-k'a*	*me:k'-al*	*me:k'-en*	'swallow'
won-hin	*won-k'o*	*wo:n-ol*	*wo:n-en*	'hide' (tr.)

The above examples show that whereas some roots may be invariably CV̆C-, others have a CV:C- alternant under some conditions and a CV̆C- alternant under others. What the relevant conditions are will be investigated immediately below. But first two observations need to be made, although their significance will not become clear immediately. First, there are no verb roots that have the invariable shape CeC-. Second, there are no verb roots that have the shapes Ci:C- or Cu:C- in any of their realizations.

Is there some principle that determines when a CV:C- alternant will occur as opposed to a CV̆C- alternant? Note that *ṣa:p-*, for example, occurs before the vowel-initial suffixes *-al* and *-en*, while *ṣap-* occurs before the consonant-initial suffixes *-hin* and *-k'a*. A generalization thus emerges: The long vowel alternant occurs when the vowel is in the environment ___CV (as in *ṣa:p-al*, *ṣa:p-en*), while the short vowel alternant occurs when the vowel is in the environment ___CC (as in *ṣap-hin*, *ṣap-k'a*). Examination of a variety of other languages reveals that alternations in vowel length typically revolve around differences in the consonant–vowel structure of words, with long vowels preferred in 'open syllables' (___CV) and short vowels preferred in 'closed syllables' (___CC).

Having isolated the relevant conditions for the vowel-length alterna-

tion, we must ask what the underlying representation of these alternating verb roots is. In particular, is their vowel underlyingly long or short? If it is claimed that the vowel is basically short, the representations will be /ṣap/, /dos/, /mek'/, etc. A rule such as (14) would then be required.

(14) $$V \longrightarrow [+long]/\_\_CV$$

/ṣap + al/ would undergo (14), yielding *ṣa:p-al*; /ṣap + hin/ would of course not be susceptible to (14). Such an account of the data runs into difficulty when we take into consideration examples such as *xat-al*, *dub-al*, *giy'-en*, etc., since (14) predicts that the root vowel in these examples should be lengthened.

Suppose that we adopt the alternative position that alternating roots such as *ṣa:p-/ṣap-* have a basic long vowel. Nonalternating roots, of course, such as *xat-*, would have a basic short vowel. A rule like (15) would then be needed.

(15) $$V \longrightarrow [-long]/\_\_CC$$

This rule would operate on /ṣa:p + hin/ to derive *ṣap-hin*, but would not affect /ṣa:p + al/, where the basic long vowel is not followed by a consonant cluster. There are no roots in Yawelmani that provide a counterexample to (15) since there are no roots that maintain the shape CV:C- invariably, whether a vowel-initial or a consonant-initial suffix follows. The absence of invariant CV:C- roots follows from a general principle, if we postulate the operation of (15).

Notice that (15) presupposes that the difference between alternating and nonalternating roots is that the former possess basic long vowels while the latter possess basic short ones. Let us reconsider rule (14) again. Recall that it is beset by the problem that it is too general. It will incorrectly lengthen the root vowel in *xat-al*, for example, giving **xa:t-al*. In order to maintain an analysis incorporating (14), it would be necessary to assume that /xat/ is somehow different from /ṣap/, since only the latter has a long vowel alternant. It would be possible to assign some arbitrary mark to the vowel of /ṣap/ that would differentiate it from /xat/, and then formulate (14) so that it operates only on a vowel that possesses the relevant mark. In Chapter 3 we referred to this sort of analysis as a **lexical** solution in contrast to **phonological** solutions such as the one that postulates an underlying contrast in length. The reasons for accepting the phonological solution over the lexical one in the present case are relatively clear. Roots such as *ṣa:p-/ṣap-* and *xat-* clearly must contrast somehow in the underlying representation. There is also a phonetic contrast. The former has a long vowel when prevocalic, the latter does not. There is then an actually occurring phonetic contrast associated with these morphemes which is available to distinguish them underlyingly. To prefer arbitrary marks in such a situation is gratuitous, resulting ultimately in permitting any phonetic contrast to be the result of a contrast in an arbitrary mark. Since the arbitrary mark must ultimately be 'translated' into a phonetic contrast, why not begin with the phonetic contrast and neutralize it in the relevant positions? (See Kenstowicz and Kisseberth 1977 for further discussion of this point.)

VOWEL EPENTHESIS

We have restricted the data considered so far to verb roots of the structure CVC (where V may be either short or long). Not all verb roots are of this type, though the kinds of verb roots that one encounters in Yawelmani *are* severely restricted. The data in (16) illustrate an additional type of root.

(16)

paʔṭ-al	'might fight'	*paʔiṭ-hin*	'fights'
ʔilk-al	'might sing'	*ʔilik-hin*	'sings'
logw-ol	'might pulverize'	*logiw-hin*	'pulverizes'
ʔugn-al	'might drink'	*ʔugun-hun*	'drinks'
ʔayy-al	'might pole a boat'	*ʔayiy-hin*	'poles a boat'
lihm-al	'might run'	*lihim-hin*	'runs'
t'oyx-ol	'might give medicine'	*t'oyix-hin*	'gives medicine'
luk'l-al	'might bury'	*luk'ul-hun*	'buries'

Roots of this type reveal an alternation between the shape CVCC- and CVC*i*C- (the *i* being pronounced as *u* in certain cases; see below for discussion); the former alternant appears before *-al*, and other vowel-initial suffixes, while the latter occurs before *-hin*, and other consonant-initial suffixes. Confirmation of the claim that it is the initial segment of the suffix (vowel or consonant) that determines the shape of the root is provided by the examples in (17), where once again we find CVCC- in prevocalic position and CVC*i*C- in preconsonantal position.

(17)

paʔṭ-en	'will fight'	*paʔiṭ-mi*	'having fought'
lihm-en	'will run'	*lihim-mi*	'having run'
logw-en	'will pulverize'	*logiw-mi*	'having pulverized'
ʔugn-on	'will drink'	*ʔugun-mu*	'having drunk'

Before analyzing the data in (16) and (17), two observations need to

be made about Yawelmani phonological structure. First, words in this language neither begin nor end in a consonant cluster, and within a word the maximum number of consecutive consonants is two. Second, there are no verb roots in Yawelmani of the shape CV_1CV_2C-, where V_1 and V_2 are both short vowels, that do not have the vowel *i* in the V_2 position. And every verb root that *does* have the shape CV_1CV_2C- has this shape before consonant-initial suffixes, and has the alternant CV_1CC- before vowel-initial suffixes.

Let us turn now to the question of what basic form to assign these verb roots. If they are basically CVCiC-, then we need a rule dropping the underlying *i* vowel in case a vowel-initial suffix follows. The environment for this deletion rule might possibly be something like VC____CV (a preceding vowel must be mentioned in order to prevent /giy' + al/ from being converted to **gy' + al*). In the examples given a morpheme boundary is present, the actual context being VC____C + V; but from the data inspected so far there is no evidence bearing upon whether the presence of a morpheme boundary at this point in the structure is necessary. Furthermore, given the examples cited so far, there is no evidence that the deletion would need to be restricted to just *i*. Consequently, a general rule such as (18) might be possible.

(18) $$V \longrightarrow \emptyset / VC\_\_\_\_CV$$

(18) would operate upon a representation such as /lihim + al/ to derive *lihm-al*, but would leave /lihim + hin/ unaffected, since there is no vowel in this form that meets the environment of (18).

An alternative to (18) would be to take the basic form of the roots in question to be of the shape CVCC-, with a rule that inserts the vowel *i*. The rule would presumably be that given in (19).

(19) $$\emptyset \longrightarrow i / C\_\_\_\_CC$$

Rule (19) would operate upon a representation like /lihm + hin/ to yield *lihim-hin*, but would leave /lihm + al/ unaffected since there is no three-consonant cluster present.

On what grounds can we choose between these two solutions? As formulated, both analyses will predict the correct phonetic shapes for the data considered. One significant fact is that if we decide to assign these roots the basic shape CVCiC-, they will be the only disyllabic roots in the language whose second vowel is a short vowel. In other words, we will have a curious asymmetry: CVCiC- will be a rather common shape in underlying forms, but CVCaC-, CVCuC-, CVCoC- will never occur.

Another significant fact is that if we decide that the roots in question have the basic shape CVCiC-, there will be no roots of the shape CVCC- in underlying representation. Recall also that in Yawelmani three-consonant clusters do not occur phonetically. An analysis incorporating the epenthesis rule (19) would account for the absence of three-consonant clusters, since an *i* vowel would be inserted whenever three consonants come together in the underlying form. The existence of such a rule would also account for why CVC*i*C- appears phonetically, but not CVC*a*C-, CVC*u*C-, etc. Disyllabic verb roots whose second vowel is short would be claimed to not exist at all in underlying form; verb roots ending in a consonant cluster would occur, however. The epenthesis rule (19) would convert CVCC- roots to CVCiC- when followed by a consonant-initial suffix.

One very general methodological principle underlies the above discussion; namely, if there is a 'pathological' phonetic pattern (i.e., a pattern that disobeys general principles of the language, as in the case under discussion, where CV_1CV_2C- is generally disallowed except if V_2 is *i*), then it is likely that this pattern is the consequence of a rule, rather than a property of the underlying form of the language. A general principle of this sort is not, of course, infallible, and one would like to find language-particular evidence as well favoring (19) over (18). One confirming piece of evidence can be mentioned briefly here. A verb root such as *xat-* 'eat' may be reduplicated to express repeated action: *xatxat-* 'eat repeatedly', as in *xatxat-al*. Before certain suffixes, the reciprocal-reflexive suffix *-iwis* for example, such reduplicated verb roots have a special shape. *xatxat-*, for example, is realized as *xatixt-*; *koykoy-* 'butt repeatedly' is realized as *koyiky-*, and so on. These forms seem to involve a zeroing of the root vowel in the second part of the reduplicated form: /xatxat/ ⟶ /xatxt/, /koykoy/ ⟶ /koyky/. The three-consonant cluster that results from this zeroing is broken up by an insertion of the vowel *i* between the first two consonants. /xatxat+iwis/ 'act of eating repeatedly' is thus realized as *xatixt-iwis*. The insertion of *i* in examples of this sort follows automatically (given the zeroing of the root vowel in the second member of the reduplicated form) if we posit rule (19); rule (18) does not make any prediction whatsoever about the shape of these forms.

Let us assume, then, the correctness of (19) and of URs such as /pa?t/, /?ilk/, /logw/, etc. The interplay between (19)—vowel epenthesis—and the rules of vowel harmony and vowel shortening discussed in preceding sections will now be examined.

Consider first *?ugun-hun* 'drinks', which will have the basic form /?ugn + hin/. Since the *i* that is inserted by vowel epenthesis is pronounced as *u* in the PR, it is necessary that we construct the grammar of

Yawelmani so that the inserted *i* vowel may undergo vowel harmony just like an underlying *i* vowel. (We are assuming here that it is correct to view the fact that the inserted vowel in *ʔugun-hun* is pronounced as *u* as being due to the operation of vowel harmony. This will be discussed further below.) This can be achieved by applying the rule of vowel epenthesis before applying the rule of vowel harmony. Thus /ʔugn + hin/ will first undergo vowel epenthesis, resulting in /ʔugin + hin/; vowel harmony will then apply to this inserted vowel, deriving /ʔugun + hin/, and will then apply also to the suffixal vowel, giving the correct surface form *ʔugun-hun*.

Confirmation of this ordering of the rules can be found in such examples as *logiw-xa* 'let's pulverize', from underlying /logw + xa/. Observe that in the underlying form, the suffixal *a* meets the conditions for vowel harmony, and one would expect it to be pronounced as *o*, all other things being equal. But if vowel epenthesis does apply before vowel harmony, /logw + xa/ will be converted to /logiw + xa/ before the latter rule has a chance to apply. Once /logiw + xa/ is derived, the conditions for vowel harmony are no longer present: The presence of the epenthetic *i* means that the suffixal vowel is no longer preceded by an *o* vowel. Ordering vowel epenthesis before vowel harmony simultaneously predicts that epenthetic *i* will be rounded to *u* if preceded by *u*, and also that it will inhibit harmony when it separates *a* from a preceding *o*.

The examples in (20) provide crucial data bearing on the interplay of vowel epenthesis and vowel shortening.

(20)

sonl-ol	'might put on the back'
so:nil-mi	'having packed on the back'
ʔaml-al	'might help'
ʔa:mil-hin	'helps'
moyn-ol	'might become tired'
mo:yin-mi	'having become tired'
ṣalk'-al	'might wake up'
ṣa:lik'-hin	'wakes up'

The verb roots in (20) reveal two alternants: CV̆CC- and CV:CiC-, the former before vowel-initial suffixes and the latter before consonant-initial suffixes. Although this particular alternation pattern has not occurred elsewhere, it is clear that it is a combination of alternations we have already encountered. In particular, it consists of the V:/V̆ alternation found in examples such as *do:s-ol* 'might report', *dos-hin* 'reports' and the Ø/*i* alternation found in *ʔilk-al* 'might sing', *ʔilik-hin* 'sings'. Given

that the alternation pattern in (20) appears to be a result of the alternation patterns that vowel epenthesis and vowel shortening account for, it is natural to account for the alternations in (20) by these rules as well. This can be done if we derive the *i* vowel in an alternant like *so:nil-* from vowel epenthesis, and if we derive the short vowel in *sonl-* from vowel shortening. The UR of the verb root must therefore be /so:nl/.

Postulating underlying forms such as /so:nl/, /ʔa:ml/, /mo:yn/, /ṣa:lk/ is not sufficient: we must also assume that the rules are applied in a particular sequence—namely, vowel epenthesis before vowel shortening. Consider underlying /so:nl + hin/. If vowel shortening applied first, it would give /sonl + hin/ as output; vowel epenthesis would then apply, with the result being the incorrect form **sonil-hin*. To obtain the correct results, /so:nl + hin/ must first undergo vowel epenthesis, deriving /so:nil + hin/; vowel shortening would not then be able to apply, since no long vowel is followed by a consonant cluster in this example.

It is of some interest to note that up to this point, each underlying form of a morpheme has been identical to one of the phonetic realizations of the morpheme. /giy'/ occurs in *giy'-al*; /do:s/ occurs in *do:s-ol*; /logw/ occurs in *logw-ol*. But in the case of /so:nl/, /ʔa:ml/, etc., the UR never surfaces directly in any one alternant of the morpheme. It is absolutely necessary to postulate such 'unpronounced' underlying forms if we are to account for the alternation pattern in (20) by the rules of vowel epenthesis and vowel shortening. Suppose we were to select /sonl/ as basic: we could not then account for the lengthened form of the vowel in the CV:CiC- alternant by means of vowel shortening. A separate lengthening rule would be needed. Such a lengthening rule could not be general, of course, since there are examples like *ʔilik-hin* 'sings' where the first vowel is not long. Similarly, if we were to select /so:nil/ as basic, then we would be permitting an otherwise nonoccurring type of underlying representation; in addition, a special rule deleting the *i* would be needed to obtain the alternant lacking this vowel. Only a representation like /so:nl/ permits independently motivated rules to account for the alternant pronunciations of the morphemes in question.

VOWEL HARMONY REEXAMINED

The rule of vowel harmony formulated in the first section, despite its ability to account for a wide range of facts about the pronunciation of Yawelmani suffixes, superficially appears to be unable to account for a rather significant number of examples. Table (21) illustrates some of the problematic examples.

(21)

A		B	
c'o:m-al	'might destroy'	*do:s-ol*	'might report'
ç'om-hun	'destroys'	*dos-hin*	'reports'
şo:g-al	'might pull out the cork'	*wo:n-ol*	'might hide'
şog-hun	'pulls out a cork'	*won-hin*	'hides'
wo?y-al	'might fall asleep'	*sonl-ol*	'might pack on the back'
wo:?uy-hun	'falls asleep'	*so:nil-hin*	'packs on the back'
doll-al	'might climb'	*hotn-ol*	'might take the scent'
do:lul-hun	'climbs'	*ho:tin-hin*	'takes the scent'

The examples in column B are perfectly regular with respect to our postulated rule of vowel harmony, while those in column A are systematically irregular. If the underlying form of the verb roots in column A are /c'o:m/, /şo:g/, /wo:?y/, /do:ll/, the following suffixal *a* vowels should round (unless separated from the root vowel by an epenthetic *i*) and following *i* vowels should not. But we find exactly the reverse. In *c'o:m-al*, suffixal *a* does not round (cf., *do:s-ol*). In *c'om-hun*, suffixal *i* is rounded (cf., *dos-hin*).

There are, initially, two reasons for hesitating to accept that the examples in A are simply exceptions to the vowel harmony rule. First, examination of a broad range of data reveals that there are, roughly speaking, as many examples like A as like B. In other words, the 'exceptions' are about as frequent as the 'regular' cases (with respect to verb roots whose root vowel appears on the surface as *o:* alternating with *o*). Second, the examples in A are bidirectionally exceptional; that is, it is not simply the case that *c'o:m-* fails to act like such verbs as *do:s-*, *logw-*, etc., in causing a following *a* to become *o*; in addition, *c'o:m-* does act like such roots as *hud-*, *dub-*, and so on, in causing a following *i* vowel to become *u*. This is a type of exceptionality rather different from the usual case, where some morpheme simply is not affected by a particular rule (cf., Chapter 10 for a discussion of exceptions to rules).

At this point we need to recall an observation made earlier—namely, just three long vowels occur in phonetic representations in Yawelmani: *e:*, *a:*, and *o:* (this is not entirely correct; the vowels *i:* and *u:* also occur phonetically as the result of certain phonological rules which will be ignored until later in the exposition). There are, on the other hand, four short vowels in underlying forms: *i*, *a*, *o*, *u* (the vowel *e* occurs only as the shortened version of *e:*). A solution to the problem is suggested by the lack of parallelism between the basic short vowels and the surface long vowels. Suppose we were to postulate that the verb roots in A have a different underlying vowel from the verb roots in B; in particular, that the

A forms have basic *u:* whereas the B forms have basic *o:*. If we then claimed that vowel harmony operates in terms of the underlying vowel quality, the data in (21) becomes perfectly regular. In *c'o:m-al*, for example, the suffixal *a* is unrounded due to the fact that it is preceded by a high round vowel *u:* in the underlying form /c'u:m + al/; in *do:s-ol* the suffixal vowel is rounded since it is preceded by a non-high round vowel *o:* in the underlying form /do:s + al/. *c'om-hun* shows the high suffixal vowel being rounded as a consequence of being preceded by a high round vowel in the underlying representation /c'u:m + hin/. *dos-hin* does not have the suffixal vowel rounded since the correct environment is not present in /do:s + hin/.

We must assume that subsequent to the operation of vowel harmony there is a rule of vowel lowering, which specifies basic *u:* as *o:*. The possibility of maintaining the existence of a rule such as vowel lowering depends upon the absence of any basic *u:* vowels that must not be lowered to *o:*. Since, as mentioned above, the only phonetic *u:* vowels in the language arise from other phonological rules, there is nothing preventing us from maintaining the existence of a vowel lowering rule. The rule obviously must be restricted to long *u:*, since the short *u* of *hud-al* and *dub-hun* does not lower to *o*.

By analyzing the A examples as containing basic *u:*, we are claiming that phonetic *o:* has two underlying sources: *u:* and *o:*. The long vowel system underlyingly is now *e:*, *a:*, *o:*, and *u:*, whereas the short vowel system is *i*, *a*, *o*, and *u*. The only difference in the vowel systems is that the front vowel is the high vowel *i* when short and the non-high vowel *e:* when long. The two systems would be more symmetrical if phonetic *e:* were analyzed as being basically *i:*, with the rule of vowel lowering being responsible for the phonetic quality of the vowel. *me:k'-al* 'might swallow' would thus be /mi:k' + al/ basically. The form of vowel lowering would be that in (22).

(22)
$$\overset{V}{[\,+\,\text{long}]} \longrightarrow [\,-\,\text{high}]$$

A rule like (22) would permit the examples in (21) to be treated as regular, and would also explain the asymmetry between the phonetic short and long vowel systems in terms of symmetrical underlying systems. But are these sufficient reasons for believing that the verb roots *c'o:m-* and *me:k'-* are in fact basically /c'u:m/ and /mi:k'/? Obviously we are achieving 'regularity' and 'symmetry' only at a certain cost: namely, setting up underlying representations with a vowel whose underlying quality is never (in the examples discussed so far at least) directly

manifested in the surface. Underlying /c'u:m/ has the two alternants *c'o:m-* and *c'om-*, and in neither alternant do we find a direct manifestation of the underlying highness of the vowel. The manifestation of the highness of the vowel is its effect on a following vowel. And in the case of /mi:k'/, there is no manifestation of the basic highness of the vowel in either the realizations of the morpheme—*me:k'-* and *mek'-*—or in its effect on a following vowel. Thus we have only 'symmetry' suggesting that *e:* is basically *i:*, and both symmetry and the evidence from vowel harmony to suggest that some *o:* vowels are basically *u:*. Fortunately, there is a good deal of additional evidence that can be brought to bear upon the question of how to analyze the data in (21), and we are not forced in this case to decide whether the evidence given thus far is adequate to motivate underlying *i:* and *u:*.

We have postulated the following types of verb bases: CV̆C- (e.g., /dub/), CV:C- (e.g., /do:s/), CV̆CC- (e.g., /logw/), and CV:CC- (e.g., /ʔa:ml/). There are, in addition, two other types of verb roots to be found in Yawelmani. They are exemplified in (23) and (24).

(23)	*p'axa:t'-al*	'might mourn'	*p'axat'-hin*	'mourns'
	hiwe:t-al	'might walk'	*hiwet-hin*	'walks'
	ʔopo:t-ol	'might arise from bed'	*ʔopot-hin*	'arises from bed'
	ṣudo:k'-al	'might remove'	*ṣudok'-hun*	'removes'
	yawa:l-al	'might follow'	*yawal-hin*	'follows'
	hibe:y-al	'might bring water'	*hibey-hin*	'brings water'
	yolo:w-ol	'might assemble'	*yolow-hin*	'assembles'
	ṭ'uno:y-al	'might scorch'	*ṭ'unoy-hun*	'scorches'

(24)	*pana-l*	'might arrive'	*pana:-hin*	'arrives'
	ʔile-l	'might fan'	*ʔile:-hin*	'fans'
	hoyo-l	'might name'	*hoyo:-hin*	'names'
	c'uyo-l	'might urinate'	*c'uyo:-hun*	'urinates'
	taxa-l	'might bring'	*taxa:-hin*	'brings'
	nine-l	'might get quiet'	*nine:-hin*	'gets quiet'

One interesting point that can be made about the verb roots in (23) and (24) is that although they are disyllabic in all their alternants, the two vowels are not independently selectable. Verb roots of this sort have the following possible patterns, and only these:

a. *CaCa*:(C)-
b. *CiCe*:(C)-
c. *CoCo*:(C)-
d. *CuCo*:(C)-

(The long vowels in (a)–(d) are shortened, of course, when a consonant cluster follows.) In other words, if the first vowel of these disyllabic roots is *a*, then the second is *a:*; if the first vowel is *i*, the second is *e:*, etc. Examination of additional data reveals that the (c) and (d) patterns differ systematically in their vowel harmony properties: namely, in the case of verb roots of the (c) type, a following *a* vowel is rounded to *o* but a following *i* vowel is unaffected; in the case of verb roots of the (d) type, a following *i* is rounded to *u*, but a following *a* is unaffected. Thus *ʔopo:t-ol* versus *ṣudo:k'-al*, but *ʔopot-hin* versus *ṣudok'-hun*.

Notice that if we are correct in suggesting that *o:* vowels which require a following high vowel to round, and do not require a following nonhigh vowel to round, are properly represented as /u:/ in underlying form, then pattern (d) is really, at a more abstract level, *CuCu*:(C)-. Furthermore, if we are correct in suggesting that *e:* derives from underlying /i:/, then the pattern (b) is *CiCi*:(C)- at a more abstract level. We thus have the following patterns:

a'. CaCa:(C)-
b'. CiCi:(C)-
c'. CoCo:(C)-
d'. CuCu:(C)-

An obvious generalization holds for these verbs: the first vowel is a short version of the second vowel, the latter always being long (prior to the operation of vowel shortening, of course). Verb roots in Yawelmani which are invariably disyllabic always obey this constraint.

We will leave open the question of how this constraint on the selection of the vowels is to be incorporated into a systematic account of Yawelmani phonology (cf., Chapter 10). Let us simply refer to verb roots of this type as echo verbs. The important point is that only the assumption of a rule such as vowel lowering operating upon underlying /i:/ and /u:/ turning them into *e:* and *o:* makes it possible to formulate any generalization at all for the echo verbs. This analysis permits us to relate (in a non-ad hoc way) the fact that verb roots of the (d) type not only have *u* as their first vowel but also condition harmony in the same way as verb roots with an underlying high vowel. Echo verbs consequently provide an additional piece of support for the analysis proposed above for dealing with the surface exceptions to vowel harmony involving *o:*.

Before turning to some additional data that support postulating underlying /i:/ and /u:/ vowels, there are certain aspects of the pronunciation of the verb roots in (24) which we have not yet accounted for. Observe the dubitative forms *pana-l*, *ʔile-l*, *c'uyo-l*, *hoyo-l*. Although the dubitative suffix has the shape *-al* in all of the examples encountered

earlier, it is simply *-l* in the case of verb roots of the form CVCV:-. Similarly, although the passive suffix generally has the shape *-it*, after the vowel-final roots of (24) it has the shape *-t*. This absence of the initial vowel of the suffix can be accounted for by postulating the rule of truncation in (25).

(25) $$V \longrightarrow \emptyset / V\_\_$$

This rule will operate upon a representation such as /ʔili: + al/ to yield /ʔili: + l/.

However, we have not yet accounted for the final pronunciation of the dubitative and passive forms. The second vowel of the verb root is pronounced as a short vowel in these forms, even though basically a long vowel. Recall that we already have a rule of vowel shortening that operates in the environment ___CC; if we include ___C# as an additional context in which basic long vowels shorten, then the data under consideration have a straightforward explanation. In order to obtain the correct outputs from our rules, we must impose a particular sequence upon their application. Obviously, truncation must be applied prior to vowel shortening, since the rule of truncation creates the context for the latter rule to apply. In addition, it is essential that the rule of vowel lowering be applied before the vowel shortening rule; if the reverse sequencing obtained, /ʔili: + l/ would be converted to /ʔili + l/ by vowel shortening, and then vowel lowering would be inapplicable since it affects just long vowels. Incorrect **ʔili-l* would result. To obtain *ʔile-l*, vowel lowering must be applied first, as in the following derivation:

(26)		
	/ʔili: + al/	Underlying representation
	ʔili: + l	Truncation
	ʔile: + l	Vowel lowering
	ʔile + l	Vowel shortening

(In the above derivation, we showed truncation being applied prior to vowel lowering, but there is no evidence relevant to determining whether this is correct.) Shortening before two consonants also follows vowel lowering. The derivation of *ṣudok'-hun* 'removes' must be that given as follows:

(27)		
	/ṣudu:k' + hin/	Underlying representation
	ṣudu:k' + hun	Vowel harmony
	ṣudo:k' + hun	Vowel lowering
	ṣudok' + hun	Vowel shortening

In order to obtain *ṣudok'-hun* from basic / ṣudu:k' + hin / it is crucial that vowel harmony be applied before vowel lowering; otherwise, the following incorrect derivation would result:

(28)		
	/ṣudu:k' + hin/	Underlying representation
	ṣudo:k' + hin	Vowel lowering
	inapplicable	Vowel harmony
	**ṣudok'* + hin	Vowel shortening

Similarly, it is crucial that vowel lowering be applied before vowel shortening, otherwise we would have the incorrect derivation:

(29)		
	/ṣudu:k' + hin/	Underlying representation
	ṣudu:k' + hun	Vowel harmony
	**ṣuduk' + hun*	Vowel shortening
	inapplicable	Vowel lowering

Vowel lowering would be inapplicable since it affects just long vowels.

All of the data in (23) and (24) have now been accounted for by the three rules of vowel harmony, vowel lowering, and vowel shortening, applied in that sequence. We can now return to an examination of additional data bearing on the correctness of the analysis presented here. It turns out that verb roots such as *c'uyo:-* 'urinate' and *hoyo:-* 'name' differ not only in that the former behaves, with respect to vowel harmony, as though it ends in a high vowel and the latter in a non-high vowel, but in another interesting respect as well. Verb roots of the shape CVCV:- take a future suffix that consists just of a glottal stop. Examples are cited in (30).

(30)		
	pana-ʔ	'will arrive'
	ʔili-ʔ	'will fan'
	hoyo-ʔ	'will name'
	c'uyu-ʔ	'will urinate'

Before the future suffix, the second vowel of verb roots of the shape CVCV:- appears phonetically as a short vowel. In the (a) type of verb root, this vowel is pronounced as *a*; in the (b) type, as *i*; in the (c) type, as *o*; and in the (d) type, as *u*. These examples involve a special shortening process which, examination of additional data shows, operates before word-final suffixes consisting of a glottal stop (the future suffix and a nominal case ending are the only examples). The interesting thing about these data is that the quality of the resulting short vowels in *ʔili-ʔ* and *c'uyu-ʔ* is not identical to the phonetic quality of the corresponding long

vowels in *ʔile:-hin* and *c'uyo:-hun*. But the quality of the short vowel is identical to that of the vowel that has been suggested as the underlying vowel: *ʔili-ʔ* would be derived from /ʔili: + ʔ/ and *c'uyu-ʔ* from /c'uyu: +ʔ/. Thus if the rule that shortens a long vowel before the glottal stop of the future morpheme operates prior to the application of vowel lowering, the quality of the resulting short vowel will be an automatic consequence of the quality of the underlying vowel.

The evidence for postulating underlying /i:/ and /u:/ which (30) provides is totally independent of the evidence from vowel harmony. For verb roots of the shape CVCV:- we can find actual examples of pronunciations of the second vowel where its underlying highness is realized as phonetic highness.

One additional argument supporting underlying /i:/ and /u:/ will be given here. Certain types of verb roots in Yawelmani may be used as nouns without the addition of an overt nominalizing suffix, though certain phonological modifications are associated with this usage. Example (31) shows some of these verbal nouns; the basic form of the verb root that we suggest is indicated in parentheses.

(31)			
	bok'	'finding'	(/bok'/)
	ʔuṭ'	'stealing'	(/ʔu:ṭ'/)
	ʔidil	'getting hungry'	(/ʔi:dl/)
	logiw	'pulverizing'	(/logw/)
	moyin	'getting tired'	(/mo:yn/)
	ʔutuy	'falling'	(/ʔuty/)
	wuʔuy	'falling asleep'	(/wu:ʔy/)

All of the verb roots that end in a consonant cluster in their basic representation have that consonant cluster separated by an *i* vowel (alternating with *u* by virtue of vowel harmony). Since no words in Yawelmani end in a consonant cluster, this *i* can be predicted by simply modifying the rule of vowel epenthesis so that it inserts *i* not just in the environment C____CC, but also in the environment C____C#. As was discussed earlier, the vowel epenthesis rule must be applied prior to the operation of vowel harmony. So underlying /ʔuty/ will first undergo vowel epenthesis, yielding /ʔutiy/, and then vowel harmony, with the correct *ʔutuy* resulting.

One other fact about the pronunciation of the verbal nouns in (31) should be noted: the first vowel is invariably short, even if it is basically a long vowel. Thus /mo:yn/ is pronounced *moyin*, and is not pronounced in this way by virtue of any general principle in the language—other than that verbal nouns of the sort under consideration always begin with a

short vowel. The rule that shortens /mo:yn/ to /moyn/ is therefore a special process of very limited scope and of little general interest in itself. What is of interest is the quality of the resulting short vowel. In each case, we find the short vowel that corresponds to the suggested underlying representation. Thus /ʔu:ṭ'/, which was postulated as having a basic high vowel in order to account for its behavior with respect to vowel harmony, turns out to have a high vowel in the verbal noun *ʔuṭ'*. /mo:yn/, on the other hand, which was postulated to have a basic nonhigh vowel in order to account for its behavior with respect to vowel harmony, is pronounced with a nonhigh vowel in the verbal noun *moyin*. Similarly, basic /ʔi:dl/ is actually pronounced with a high vowel in the verbal noun *ʔidil*, even though its more common pronunciation is with a nonhigh vowel (cf., *ʔedl-al* 'might get hungry', *ʔe:dil-hin* 'gets hungry').

The pronunciation of verbal nouns like those of (31) follows automatically given the underlying representations suggested by vowel harmony considerations, provided the special shortening process associated with verbal nouns is applied prior to the operation of vowel lowering. These data provide, then, another independent source of evidence for the analysis.

At the end of the first section we noted that certain suffixes appear to violate the rule of vowel harmony. These suffixes contain low vowels that behave as though they were high vowels: The future morpheme *-en/-on* is a case in point. Such examples as *bok'-en* 'will find' versus *dub-on* 'will lead by the hand' appear to be anomalous until we will realize that the basic shape of the suffix must be /i:n/, since phonetic *e* in Yawelmani arises only from underlying /i:/ in our analysis. Given this underlying representation of the morpheme, the correct surface form follows from the rules we have posited:

(32)	/bok' + i:n/	/dub + i:n/	
	inapplicable	*dub + u:n*	Vowel harmony
	bok' + e:n	*dub + o:n*	Vowel lowering
	bok' + en	*dub + on*	Vowel shortening

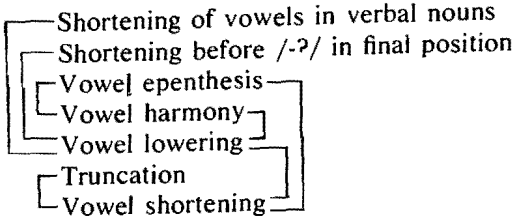
It is of some interest to note that this account of the morphophonemics of the suffix /i:n/ claims that the underlying vowel is basically long, even though in all phonetic realizations of the morpheme the vowel is pronounced short. In addition, the analysis claims that the vowel is underlyingly high, even though it is always pronounced as nonhigh. (The same is not true of the verb roots like /ʔu:ṭ'/ or /c'uyu:/ which are, at least in some forms, pronounced with a high vowel rather than with *o:*.) These claims appear to be well-founded given the data examined here. We return

to some of these points later in Chapter 6, where the issue of abstractness in phonology is discussed.

ADDITIONAL RULES

In analyzing the phonological system of Yawelmani verbs, the following rules have been developed. The lines connect those rules that require a particular sequence of application in order to obtain the correct phonetic output. If two rules are connected by a line, the rule higher in the list must be applied before the rule lower in the list.

(33)



Certain other rules in Yawelmani phonology critically interact with the rules listed above. Consider the examples in (34).

(34)

ʔile-k'	'fan!'	(cf., *giy'-k'a* 'touch!')
c'uyc-k'	'urinate!'	(cf., *dub-k'a* 'lead by the hand!')
taxa-k'	'bring!'	(cf., *xat-k'a* 'eat!')
ʔile-m	'having fanned'	(cf., *giy'-mi* 'having touched')
c'uyo-m	'having urinated'	(cf., *dub-mu* 'having led by the hand')
taxa-m	'having brought'	(cf., *xat-mi* 'having eaten')

Word-final suffixes of the shape -CV have a vowelless alternant after verb roots of the structure CVCV:- (i.e., after the only vowel-final roots of the language). Thus *-k'a* has the alternant *-k'*, *-mi* has the alternant *-m*, *-xa* has the alternant *-x*. These data are readily accounted for by positing a rule of vowel drop, as in (35).

(35) $$V \longrightarrow \emptyset / V + C\_\_\_\#$$

Evidence that a morpheme boundary must be present in the position indicated is provided by the gerundial suffix *-e:ni* basically /i:ni/) in such examples as *xat-e:ni* 'in order to eat', *ʔa:x-e:ni* 'in order to stay overnight', *ṣalk'-e:ni* 'waking up', where the final vowel is retained even though in the environment VC____#. A final vowel drops just in case the preceding consonant is morpheme initial.

Rule (35) operates on an underlying form like /taxa: + k'a/ to yield /taxa: + k'/. To obtain the correct phonetic shape, vowel shortening must be applied to the output of vowel drop. There are no other rules which vowel drop must either precede or follow in the sequence of rule application.

As mentioned earlier, there are phonetic high long vowels in Yawelmani; we turn now to a brief consideration of one source of such high vowels. The reflexive/reciprocal suffix *-iwis-* is added to a verb root to form a verbal noun; the full form of the suffix shows up in the nominative case, where no suffix is added. Thus we get *wagç-iwis* 'act of dividing'. When the objective case suffix *-a* is added, the sequence *iwi* contracts to *i:*, as in *wagç-i:s-a*; similarly, there is *huwṭ-uwus* 'a shell game', but *huwṭ-u:s-a*. Although these data are limited enough to make any proposed analysis very tentative, one possible account of the facts goes as follows. The suffix has the basic shape /iws/. *wagç-iwis* arises from the operation of vowel epenthesis, which recall will insert *i* in the environment C____C#. In *huwṭ-uwus*, vowel harmony applies to the structure /huwṭ + iwis/, which is itself the result of vowel epenthesis. Considering the objective case forms, the presence of the suffix *-a* will inhibit vowel epenthesis. A rule of contraction must be posited, such as (36).

(36) $$\begin{Bmatrix} iw \\ uw \end{Bmatrix} \longrightarrow \begin{Bmatrix} i: \\ u: \end{Bmatrix} / \_\_\_\_C$$

This rule must be restricted to the reflexive/reciprocal suffix, since the sequences *-iw-* and *-uw-* occur elsewhere in preconsonantal position (compare, for instance, the root *huwṭ-* above).

Rule (36) will apply to /wagç + iws + a/ to yield *wagç-i:s-a*, the correct form. Notice that it is necessary that vowel epenthesis be applied before contraction. Otherwise /wagç + iws / will become */wagç + i:s/. Furthermore, it is necessary that contraction be applied after vowel lowering, so that /wagç + i:s/ is not lowered to */wagç + e:s/. The derivation of *huwṭ-u:s-a* as follows indicates the correct order of application of the rules:

(37)

/huwṭ + iws + a/	
inapplicable	Vowel epenthesis
huwṭ + uws + a	Vowel harmony
inapplicable	Vowel lowering
huwṭ + u:s + a	Contraction

Slovak

In this section we will examine the rather intricate interaction among several rules in the phonology of Slovak, a West Slavic language

closely related to Czech. Since we will be citing forms in the native Slovak orthography, several remarks concerning the phonetic interpretation of the letters are in order. All of the letters employed have their usual broad phonetic interpretation, except that *y* = [i], *ä* = [æ], *ô* = [uo], and *ch* = [x]. Also the phonetic devoicing of word final obstruents is not indicated in the writing system. Finally, the acute accent sign over a vowel or a liquid indicates *length*. Thus, *á* = [a:], *ŕ* = [r:]. The acute accent sign does not indicate stress, which is always on the first vowel of the word in Slovak.

Most of the rules we shall be concerned with involve syllabic elements. The following table indicates the syllabic sounds that are to be found in phonetic representations of Slovak utterances.

(38)

Short	Long	Rising diphthongs
i u	í ú	
e o	(é) (ó)	ie uo
ä a	á	ia
l,r	ĺ,ŕ	

The long mid vowels are placed in parentheses because they are quite rare in native Slovak words. The vowel *é* only occurs in the word *dcéra* 'daughter' and the adjectival suffix /-é/: cf. *dobr-é*, *dobr-é-ho*, the neuter nominative and genitive forms of 'good'. The vowel *ó* is limited to interjections.

If the rare *é* and *ó* are ignored, the reader will note a peculiar patterning of the long and short syllabics in (38). The short vowels *i*, *u*, and *a* and the liquids *l* and *r* can be paired with long phonetic counterparts. But *e*, *o*, and *ä* have no long phonetic counterparts. Furthermore, the diphthongs *ie*, *ô* (= [uo]), and *ia* are the only rising diphthongs in the language. A reasonable hypothesis here is that the rising diphthongs derive from underlying long *é*, *ó*, and *ä́*. Such an analysis would regularize the pattern to a symmetrical system of eight pairs of short and long syllabic elements. Recall from our discussion of Yawelmani that asymmetrical phonetic inventories often arise from more balanced underlying ones via phonological rules that obscure the underlying pattern. This seems to be especially true with an underlying long/short contrast. In many languages long and short vowels pair up quite neatly in underlying representations, but then phonological rules obscure the pattern by modifying the quality of some of the underlying vowels (typically the long ones). Consequently, in our examination of Slovak, we might expect to find independent evidence supporting an analysis that derives the rising

diphthongs *ie*, *ô*, and *ia* from underlying *é*, *ó*, and *ä́* by a rule of diphthongization.

In fact, there is considerable evidence to indicate that this is the case. The numerous lengthening rules in the language support this interpretation of the diphthongs. In each case where an *i*, *u*, *a*, *l*, or *r* is lengthened, the vowels *e*, *o*, and *ä* are replaced by diphthongs. For example, there is a very general rule that lengthens the final vowel or liquid of a feminine or neuter noun stem in the genitive plural.

(39)

Nom. sg.	Gen. pl.	Gloss
lipa	*líp*	'linden tree'
mucha	*múch*	'fly'
lopata	*lopát*	'shovel'
srna	*sŕn*	'roe, deer'
žena	*žien*	'woman'
kazeta	*kaziet*	'box'
hora	*hôr*	'forest'
sirota	*sirôt*	'orphan'
päta	*piat*	'heel'
mäta	*miat*	'mint'

Another such rule is the one that lengthens the final vowel or syllabic liquid of a stem when the diminutive suffix *-ok* is added: *hrad*, *hrádok* 'castle'; *list*, *lístok* 'leaf'; *chlp*, *chĺpok* 'hair'; but *kvet*, *kvietok* 'flower'; *hovädo*, *hoviadok* (gen. pl.) 'beast'.

If the diphthongs are not derived from underlying long vowels, then each lengthening rule in Slovak would require the peculiar condition that it convert basic short *e*, *o*, and *ä* to the corresponding diphthongs, while simply lengthening the remaining syllabics. But why should each of these rules have this peculiar wrinkle? This is explained if we say that these rules merely assign the feature [+ long] to each syllabic element and are followed by a later rule of diphthongization:

(40) [é, ó, ä́] ⟶ [ie, uo, ia]

This rule can also be used to derive the nonalternating diphthong in a word like *trieda* 'class' from basic /é/.

The analysis we have just proposed implies derivations like the following for forms like *lipa*, *líp*; *žena*, *žien*; and *trieda*.

(41)

/#lip-a#/	/#lip#/	/#žen-a#/	/#žen#/	/#tréd-a#/	
-------	*líp*	--------	*žén*	---------	Lengthening
-------	-----	--------	*žien*	*tried-a*	Diphthongization

This analysis which treats the diphthongs as derived from long vowels is also supported by the many shortening rules in Slovak. In each instance where a long vowel or liquid is shortened, a diphthong appears without its initial onglide. For example, the imperfectivizing suffix *-ova* causes a shortening of the stem final syllable.

(42)

Perfective	Imperfective	Gloss
odlísit'	*odlisovat'*	'to distinguish'
kúpit'	*kupovat'*	'to buy'
ohlásit'	*ohlasovat'*	'to announce'
predĺžit'	*predlžovat'*	'to extend'
oblietat'	*obletovat'*	'to fly around'
uviazat'	*uväzovat'*	'to bind'

To cite just one more example of this type, the root vowel of a monosyllabic adjective is shortened before the comparative suffix *-ší: blízky, bližší* 'near'; *úzky, užší* 'narrow'; *krátky, kratší* 'short'; but *biely, belší* 'white'; *riedky, redší* 'rare'. Once again, if the diphthongs are not derived from long vowels, there is no straightforward way to explain why they lose their initial onglide in the same contexts where other syllabics shorten. But in the analysis we have proposed, the absence of the onglide is automatically predicted. At the point where the shortening rule applies the diphthong is an underlying long vowel. When this vowel is shortened, the subsequent diphthongization rule can no longer apply. Hence, the initial onglide is not generated. This analysis implies derivations like the following.

(43)

/#kúp-it'#/	/#kúp-ovat'#/	/#uväz-at'#/	/#uväz-ovat'#/	
---------	*kup-ovat'*	----------	*uväz-ovat'*	Shortening
---------	----------	*uviaz-at'*	----------	Diphthongization

To summarize, we have proposed an analysis for Slovak in which the rising diphthongs *ie*, *uo*, and *ia* are derived from the underlying long vowels *é*, *ó*, and *ä́* regardless of whether or not they alternate with a short vowel. This permits us to regularize the underlying system of syllabics to a balanced system of eight members, each of which can contrast in length.

(44)

Long	Short
í ú	i u
é ó	e o
ä́ á	ä a
ĺ,ŕ	l,r

The few forms containing a long mid vowel such as *dcéra* will simply be marked as exceptions to the diphthongization rule.

The next rule to be discussed was alluded to above, namely the rule that lengthens the last syllable of a stem in the genitive plural. This rule operates in the feminine and neuter declensions.

(45)

	Sg.	Pl.	Sg.	Pl.
Nom.	*žen-a*	*žen-y*	*mest-o*	*mest-á*
Gen.	*žen-y*	*žien*	*mest-a*	*miest*
Dat.	*žen-e*	*žen-ám*	*mest-u*	*mest-ám*
Acc.	*žen-u*	*žen-y*	*mest-o*	*mest-á*
Instr.	*žen-ou*	*žen-ami*	*mest-om*	*mest-ami*
Loc.	*žen-e*	*žen-ách*	*mest-e*	*mest-ách*
Gloss	'woman'		'town'	

Examples of this rule's application in the feminine declension were cited in (39) above. To these we may add *pižama, pižám* 'pajama' and *nuansa, nuáns* 'nuance', showing that foreign borrowings also undergo the rule. Additional examples of the rule's operation in the neuter declension follow in (46).

(46)

Nom. sg.	Gen. pl.	Gloss
kopyto	*kopýt*	'hoof'
brucho	*brúch*	'belly'
blato	*blát*	'mud'
salto	*sált*	'somersault'
embargo	*embárg*	'embargo'
jablko	*jabĺk*	'apple'
koleso	*kolies*	'wheel'
lono	*lôn*	'lap, bosom'
hovädo	*hoviad*	'beast'

If the final syllable of the stem contains a basic long syllabic, it is unmodified in the genitive plural, as the examples in (47) show.

(47)

Nom. sg.	Gen. pl.	Gloss
vláda	*vlád*	'government'
blúza	*blúz*	'blouse'
čiara	*čiar*	'line'
trieda	*tried*	'class'
dláto	*dlát*	'chisel'
víno	*vín*	'wine'
hniezdo	*hniezd*	'nest'

This lengthening process may be formulated as follows (we use *V* here as a cover symbol to include both vowels and syllabic liquids).

(48) $$V \longrightarrow [+ \text{long}] / \_\_ C_1 \#$$

Although this rule must be restricted to operate in only certain morphological contexts, we shall leave the rule in its present general state, since these restrictions are not relevant to our present purposes.

Another rule of Slovak, traditionally referred to as the "rhythmic law," shortens an underlying long vowel or liquid when the preceding syllable contains an underlying long syllabic element. The effects of this rule are most clearly seen by examination of the following partial paradigms of some neuter nouns.

(49)

Nom. sg.	Gen. sg.	Nom. pl.	Dat. pl.	Loc. pl.	Gloss
mesto	*mesta*	*mestá*	*mestám*	*mestách*	'town'
blato	*blata*	*blatá*	*blatám*	*blatách*	'mud'
hovädo	*hoväda*	*hovädá*	*hovädám*	*hovädách*	'beast'
písmeno	*písmena*	*písmená*	*písmenám*	*písmenách*	'letter'
zámeno	*zámena*	*zámená*	*zámenám*	*zámenách*	'pronoun'
dláto	*dláta*	*dláta*	*dlátam*	*dlátach*	'chisel'
víno	*vína*	*vína*	*vínam*	*vínach*	'wine'
hniezdo	*hniezda*	*hniezda*	*hniezdam*	*hniezdach*	'nest'

Comparison of the gen. sg. with the nom. pl. ending shows that the former is a constant short *a*, while the latter varies its length. It is short after a syllable containing a long vowel, and long after a syllable containing a short vowel. In order to predict this alternation in phonological terms, the long variant of the nom. pl. suffix must be selected as underlying. Otherwise there would be no way to distinguish its behavior from the gen. sg. suffix which does not alternate. Forms such as *písmená* and *zámená* show that the rhythmic law only shortens a vowel if the immediately preceding syllable is long. Finally, words like *hniezda* 'nests' show that the rhythmic law must apply before diphthongization in a derivation like the following.

(50)

/#hnézd-á#/	
hnézd-a	Rhythmic law
hniezd-a	Diphthongization

If the root vowel *é* were broken to *ie* first, the rhythmic law would not apply because the root would no longer contain a long vowel.

The rhythmic law may be formulated as follows (again we use *V* as a cover symbol to include both the vowels and syllabic liquids).

(51) $$V \longrightarrow [- \text{long}] / \acute{V} C_0 \_\_$$

The interaction between vowel lengthening (VL) and the rhythmic law (RL) may be determined by inspection of disyllabic stems of the structure *CV́CVC*, that is, stems with an initial long vowel and a final short vowel. When these forms appear in the genitive plural, the final vowel will be subject to two competing principles: according to VL, the final vowel should be lengthened; but if it is lengthened, a sequence of two successive long syllables will result, contrary to RL. Therefore, one of the two mutually contradictory principles must take precedence over the other. The following data show that RL prevails, indicating that it must be ordered after VL.

(52)

Nom. sg.	Gen. pl.	Gloss
záhrada	*záhrad*	'garden'
nížina	*nížin*	'hollow, lowland'
zátoka	*zátok*	'inlet'
písmeno	*písmen*	'letter'
zámeno	*zámen*	'pronoun'
liečivo	*liečiv*	'drug'

At this point the following ordering relations have been established: VL precedes RL; VL precedes diphthongization; RL precedes diphthongization. To show how these rules work we provide derivations for the following words: *blatá* 'bogs', *čísla* 'numbers', *písmená* 'letters', *hniezda* 'nests', *žien* 'woman' (gen. pl.), and *písmen* 'letter' (gen. pl.).

(53)

/#blat-á#/	/#čísl-á#/	/#písmen-á#/	
---	---	---	Vowel lengthening
---	*čísl-a*	---	Rhythmic law
---	---	---	Diphthongization
/#hnézd-á#/	/#žen#/	/#písmen#/	
---	*žén*	*písmén*	Vowel lengthening
hnézd-a	------	*písmen*	Rhythmic law
hniezd-a	*žien*	---	Diphthongization

Before proceeding to a brief discussion of the Slovak verb, we will

consider one additional alternation in the nouns, the vowel–zero alternation evident in the following data.

(54)

Nom. sg.	Gen. pl.	Gloss
ikra	*ikier*	'roe'
ihla	*ihiel*	'needle'
dogma	*dogiem*	'dogma'
sosna	*sosien*	'pine tree'
bedro	*bedier*	'hip'
radlo	*radiel*	'plough'

All of these stems end in consonant clusters whose final member is a sonorant. A similar alternation appears in stems that end in obstruent clusters (cf., *hradba*, *hradieb* 'rampart'), but appears to be less regular (cf., *doska*, *dosiek* 'board' versus *hradisko*, *hradisk* 'castle hill'). In any case, we know of no exceptions when the stem ends in a sonorant. Forms like *písmeno*, *písmen* show that this alternation must be analyzed as a case of epenthesis, if it is to be described in purely phonological terms. Finally, for the data cited so far it appears that we have two choices as to the length of the inserted vowel. We can simply insert a long *é* and have the subsequent diphthongization rule yield *ie*, or we can order the epenthesis of short *e* before VL, which will lengthen it to *é*, and the diphthongization rule will subsequently break the vowel to *ie*. There are two reasons for selecting the latter analysis. First, in most languages epenthetic vowels are short. More importantly, stems terminating in a consonant + sonorant cluster also undergo epenthesis when certain consonant initial derivational suffixes are added. Here the underlying shortness of the inserted vowel emerges on the surface, since it is not in the final syllable of the word and hence escapes VL which obscures its underlying quantity: compare, *ikra*, *ikier*, but *ikernatý* 'abounding in roe'.

We will ignore insertion in other than word final consonant + sonorant clusters. With this limitation, the rule can be formulated as follows.

(55) $\emptyset \longrightarrow e / C\_\_\_[+ \text{sonorant}]\ \#$

A form like *ikier* thus receives the following derivation.

(56)

/#ikr#/	
iker	Epenthesis
ikér	Vowel lengthening
—	Rhythmic law
ikier	Diphthongization

So far the discussion of epenthesis has been limited to stems containing short root vowels. In stems whose final syllabic is long, the epenthetic vowel has two alternant pronunciations.

(57)

Nom. sg.	Gen. pl.	Gloss
krídlo	*krídel ~ krídiel*	'wing'
číslo	*čísel ~ čísiel*	'number'
pásmo	*pásem ~ pásiem*	'zone, line, area'
vlákno	*vláken ~ vlákien*	'fiber'
plátno	*pláten ~ plátien*	'linen'

The variants with the short epenthetic vowel seem to show the precedence of RL over VL. *krídel* would receive the following derivation.

(58)

/#krídl#/	
krídel	Epenthesis
krídél	Vowel lengthening
krídel	Rhythmic law
---------	Diphthongization

The variants with the long epenthetic vowel are the innovating pronunciation. This innovating pronunciation appears to be limited to the epenthetic vowel. The underlying root vowel /e/ in a form such as *písmeno*, *písmen* 'letter' is never lengthened.

The alternants in (57) with a long epenthetic vowel could be generated by simply requiring that the rhythmic law precede the vowel lengthening rule. Under this analysis, *krídiel* would be derived as in (59).

(59)

/#krídl#/	
krídel	Epenthesis
—	Rhythmic law
krídél	Vowel lengthening
krídiel	Diphthongization

Note that if this analysis is accepted, the ordering relation "rhythmic law precedes vowel lengthening" would have to be limited to just forms with the epenthetic vowel (in the innovating style). In all other cases the rhythmic law follows vowel lengthening. (See Kenstowicz 1972 for further discussion of the problem posed by these data.)

We will now briefly consider how some of the rules that we have formulated for the nouns apply in the verbs. In the present tense, Slovak verbs are composed of three major constituents: a verb stem, a present

tense thematic vowel, and person/number endings. The Slovak verbs are also divided into several conjugation classes depending upon what particular vowel appears as the realization of the present tense theme. Which vowel a given verb stem takes as its theme is largely unpredictable and must be provided for in the lexicon. In the following table we give several examples for the *e*-conjugation and the *i*-conjugation.

(60)

	e-conjugation			
Singular				
1	*nesiem*	*rastiem*	*leziem*	*môžem*
2	*nesieš*	*rastieš*	*lezieš*	*môžeš*
3	*nesie*	*rastie*	*lezie*	*môže*
Plural				
1	*nesieme*	*rastieme*	*lezieme*	*môžeme*
2	*nesiete*	*rastiete*	*leziete*	*môžete*
3	*nesú*	*rastú*	*lezú*	*môžu*
Gloss	'carry'	'grow'	'crawl'	'be able'
	i-conjugation			
Singular				
1	*robím*	*vidím*	*kúpim*	*hlásim*
2	*robíš*	*vidíš*	*kúpiš*	*hlásiš*
3	*robí*	*vidí*	*kúpi*	*hlási*
Plural				
1	*robíme*	*vidíme*	*kúpime*	*hlásime*
2	*robíte*	*vidíte*	*kúpite*	*hlásite*
3	*robia*	*vidia*	*kúpia*	*hlásia*
Gloss	'work'	'see'	'buy'	'announce'

Subtracting away the stem and the theme, we find the following endings: *-m*, *-š*, *-∅*, for the singular; and *-me*, *-te*, and *-ú* or *-ia* (from underlying /-ắ/) for the plural. The choice of the 3 pl. ending is dependent upon the theme vowel. If the theme is /-é/, the 3 pl. is /-ú/. If the theme is /-í/, the 3 pl. is /-ắ/.

The only new rule that we need to describe these data is one to account for the distribution of the theme vowels *-é* and *-í*. The generalization is that these vowels appear everywhere except before the 3 pl. suffix. Since the 3 pl. suffixes begin with a vowel, while all of the other endings begin with a consonant, the alternation can be accounted for by the vowel truncation (VT) rule of (61).

(61) $V \longrightarrow \emptyset / \_\_ V$

This rule must apply before RL, as shown by *nesú* from /#nes-é-ú#/. If RL applied first, the /-ú/ would shorten since it is preceded by the long *é*. The /-ú/ will, however, shorten by RL if a long root vowel comes to immediately precede this suffix as a result of truncation, as in *môžu*. The following derivations show how truncation interacts with the earlier rules to explain the alternations in (60).

(62)

/#nes-é-m#/	/#nes-é-ú#/	/#móž-é-m#/	/#móž-é-ú#/	
----------	*nes-ú*	----------	*móž-ú*	Vowel truncation
----------	---------	*móž-e-m*	*móž-u*	Rhythmic law
nes-ie-m	---------	*muož-e-m*	*muož-u*	Diphthongization

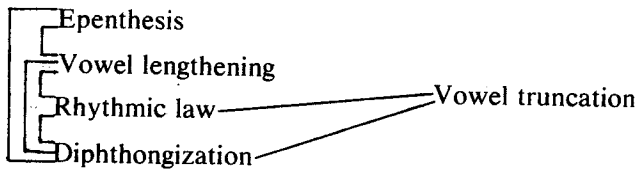
Turning to the *i*-conjugation forms in (60), we see that the rhythmic law shortens the theme vowel in the paradigms of *kúpim* and *hlásim*. However, the 3 pl. ending *-ia* from basic /-ắ/ appears phonetically long (actually diphthongized via diphthongization) regardless of the length of the preceding vowel. Although one might pursue an analysis in which *-ia* is treated as some combination of the theme vowel *-i* plus either a long or short *a* or *ä*, and then somehow combine them into *ia* after the rhythmic law has applied, further research into the problem indicates that this line of analysis cannot be supported. Thus, the 3 pl. ending of the *i*-conjugation must simply be marked in the lexicon as an exception to the rhythmic law (cf., Chapter 10 for further discussion). If this is done, we have derivations like the following for the 1 sg. and 3 pl. forms of 'work' and 'buy'.

(63)

/#rob-í-m#/	/#rob-í-ắ#/	/#kúp-í-m#/	/#kúp-í-ắ#/	
----------	*rob-ắ*	----------	*kúp-ắ*	Vowel truncation
----------	---------	*kúp-i-m*	---------	Rhythmic law
----------	*rob-ia*	----------	*kúp-ia*	Diphthongization

The fairly complex set of alternations exhibited by the Slovak data can thus be accounted for by five simple phonological rules. However, this is only possible if the rules are ordered in the fashion depicted in (64).

(64)



Lardil

Lardil is an Australian language spoken on Mornington Island in the Gulf of Carpentaria. Our analysis follows closely that of Hale (1973), the

root is analyzed as /papi/ underlyingly, then the uninflected alternant *pape* can be accounted for by simply extending the lowering rule so that it lowers /i/ to /e/ word-finally in addition to lowering /u/ to /a/. Such an extension is further justified by the observation that there are no disyllabic roots that are pronounced with a final /i/ in both the inflected and the uninflected forms. Furthermore, if one were to try to take the uninflected form *pape* as underlying, it would not be possible to predict why *pape* raises its final vowel when inflected but *tjempe* does not. The lowering rule that we propose is stated as (70).

(70) $$V \longrightarrow [+ \text{low}] / \_\_\_\_ \#$$

Consider next the V ~ ∅ alternation present in (71).

(71)

yalul	*yalulu-n*	*yalulu-ṛ*	'flame'
mayar	*mayara-n*	*mayara-ṛ*	'rainbow'
wiwal	*wiwala-n*	*wiwala-ṛ*	'bush mango'
karikar	*karikari-n*	*karikari-wuṛ*	'butter-fish'
yiliyil	*yiliyili-n*	*yiliyili-wuṛ*	'oyster sp.'

These stems have the suffixal shapes that are expected after vowel-final stems. And indeed a vowel does precede the suffixes in the inflected forms. However, this vowel is absent in the uninflected form. If this vowel is considered a part of the UR of the stem, a rule to convert /yalulu/ to /yalul/ is required. Comparison of the data in (71),where the vowel ~ ∅ alternation appears,with the data in (67),where it does not,reveals that the former stems are all trisyllabic or longer in the inflected form, while those in (67) are disyllabic. The stems may thus be differentiated on the basis of their phonological shape by a rule of apocope that deletes the final vowel of a word that is preceded by at least two vowels. Rule (72) states this principle of apocope.

(72) $$V \longrightarrow \emptyset / VC_1VC_1 \_\_\_\_ \#$$

An additional point in favor of the analysis we have suggested is that forms such as *karikar* from /karikari/ are clearly reduplications. The fact that the final /i/ is missing from the uninflected form follows from the rule of apocope.

The data in (73) require a new rule.

(73)

yukar	*yukarpa-n*	*yukarpa-ṛ*	'husband'
wulun	*wulunka-n*	*wulunka-ṛ*	'fruit sp.'
wuṭal	*wuṭaltji-n*	*wuṭaltji-wuṛ*	'meat'
kantukan	*kantukantu-n*	*kantukantu-ṛ*	'red'
karwakar	*karwakarwa-n*	*karwakarwa-ṛ*	'wattle sp.'

Once again the UR of the stem is to be indentified with the inflected alternant. Upon deletion of the final vowel by apocope, a consonant cluster is created, whose final member is absent phonetically. A rule of cluster simplification is required.

(74) $$C \longrightarrow \emptyset / C \_\_\_\_ \#$$

Once again the behavior of reduplicated stems such as /kantukantu/ support the proposed analysis. If apocope is ordered before cluster simplification, the absence of the final two sounds of the reduplicated form /kantukantu/ in the uninflected form is accounted for, as the following derivation shows.

(75)

/#kantukantu#/	
kantukant	Apocope
kantukan	Cluster simplification

Recall that the only examples of consonant-final stems given so far—those of (66)—all ended in apical consonants. It is a general trait of Lardil phonetics that no word may end in a nonapical consonant. When a nonapical consonant appears in final position, either (a) in the UR, or (b) as a result of apocope, or (c) as a result of both apocope and cluster simplification, that nonapical consonant is deleted. The examples in (76) illustrate stems from each of these three categories.

(76)

a.	*thurara*	*thuraraŋ-in*	*thuraraŋ-kuṛ*	'shark'
	ŋalu	*ŋaluk-in*	*ŋaluk-uṛ*	'story'
b.	*putu*	*putuka-n*	*putuka-ṛ*	'short'
	murkuni	*murkunima-n*	*murkunima-ṛ*	'nullah'
	ŋawuŋa	*ŋawuŋawu-n*	*ŋawuŋawu-ṛ*	'termite'
	tipiti	*tipitipi-n*	*tipitipi-wuṛ*	'rock-cod sp.'
	thapu	*thaputji-n*	*thaputji-wuṛ*	'older brother'
c.	*muŋkumu*	*muŋkumuŋku-n*	*muŋkumuŋku-ṛ*	'wooden axe'
	tjumputju	*tjumputjumpu-n*	*tjumputjumpu-ṛ*	'dragon-fly'

Clearly a rule deleting word-final nonapical consonants is required. Rule (77) states this principle of Lardil phonology.

(77) $$\begin{matrix} C \\ [-\text{apico}] \end{matrix} \longrightarrow \emptyset / \_\_ \#$$

This rule of nonapical deletion (NAD) must be ordered after vowel lowering since high vowels that come to stand at the end of a word as the result of the deletion of a nonapical consonant do not lower (cf., *ŋalu* from /ŋaluk/). It must also be ordered after apocope as shown by a form such as *putu* from /putuka/. Finally, it must be ordered after cluster simplification, as shown by *muŋkumu* from /muŋkumuŋku/. The derivations in (78) illustrate the relationship of NAD to the other rules of Lardil phonology.

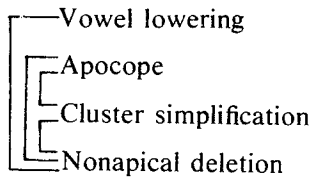
(78)

/#ŋaluk#/	/#putuka#/	/#muŋkumuŋku#/	
---------	---------	*muŋkumuŋka*	Vowel lowering
---------	*putuk*	*muŋkumuŋk*	Apocope
---------	---------	*muŋkumuŋ*	Cluster simplification
ŋalu	*putu*	*muŋkumu*	Nonapical deletion

The careful reader may be wondering whether the rule of cluster simplification could be eliminated from the grammar by allowing NAD to apply twice in the derivation of *muŋkumu* from underlying /muŋkumuŋku/. That is, since both *ŋ* and *k* are nonapical sounds, cannot their deletion be attributed entirely to the principle that words do not end in nonapicals rather than invoking a separate principle of cluster simplification? Although it might be possible to dispense with cluster simplification in the case of *muŋkumu*, it is not possible to do so in the case of *kantukan* from underlying /kantukantu/. Since *t* is an apical sound, its deletion in *kantukan* cannot be attributed to the principle that words do not end in nonapical consonants. The only explanation for the loss of *t* here is the cluster simplification principle. Given that cluster simplification is independently motivated, we have allowed it to delete not only the second member of an apical cluster (such as *nt*), but also the second member of a nonapical cluster (such as *ŋk*). This simplification of final clusters is applied prior to NAD. When /nt/ is reduced to /n/ by simplification, NAD will not apply to the apical sound *n*; but when /ŋk/ is reduced to /ŋ/ by simplification, the resulting nonapical sound /ŋ/ will be deleted since it is in final position and thus subject to NAD.

We assume, then, the following rules and crucial orderings for our description of Lardil.

(79)



The principles of Lardil phonology discussed above have largely the effect of truncating trisyllabic and longer words. It is perhaps of some interest to note that Lardil, like most Australian languages, has a constraint that all words must be at least two syllables long phonetically. This constraint explains why the apocope rule is limited to trisyllabic or longer words. However, this prohibition against monosyllabic words does not mean that there are no monosyllabic stems in underlying representations in Lardil. Consider the data in (80).

(80)

ṛilta	*ṛil-in*	*ṛil-uṛ*	'neck'
maṛṭa	*maṛ-in*	*maṛ-uṛ*	'hand'
ṭuṛṭa	*ṭuṛ-in*	*ṭuṛ-uṛ*	'excrement'
wunta	*wun-in*	*wun-kuṛ*	'rain'
kaṇṭa	*kaṇ-in*	*kaṇ-kuṛ*	'grass'
ṭera	*ṭer-in*	*ṭer-uṛ*	'thigh'
yaka	*yak-in*	*yak-uṛ*	'fish'
ṛelka	*ṛelk-in*	*ṛelk-uṛ*	'head'

These forms have the inflectional endings that would be expected after consonant-final stems. But in the uninflected forms they are augmented by an extra syllable to render them disyllabic. The augment consists of *-a* after stems ending in an obstruent (*k* in the above examples) or *r* (phonetically a flap) and as *-Ca* if the stem ends in any sonorant but *r*. The consonant in the *-Ca* augment is a stop that is homorganic with the preceding consonant.

The augmentation process illustrated in (80) guarantees that underlying monosyllabic roots, when uninflected, will be pronounced as disyllabic and thus conform to the constraint that all words in the language be at least two syllables in length. The addition of an affix to monosyllabic roots yields a word of two syllables and thus renders the augmentation process unnecessary.

Makua (Bantu)

In this section we examine certain aspects of the tonal structure of Makua, a Bantu language spoken in southern Tanzania and in Mozam-

bique. The analysis presented here is based on data elicited from a speaker born in the Tunduru district of Tanzania; there are no published descriptions of the tonal patterns of other dialects, thus we do not know to what extent the data presented here conform to the other dialects of Makua.

Makua, like most Bantu languages, makes a significant use of tone (i.e., the relative pitch of the voice at which a syllable is uttered) to distinguish between wordforms. For instance, the items *waápa* 'to whisper' and *wáapa* 'to whisper about him' differ just in that the former has a long vowel with rising tone and the latter has a long vowel with a falling tone. The situation in Makua can be contrasted with, say, the situation in English, where tone is used to distinguish not wordforms so much as sentences (which may happen to consist of a single word, of course). Thus English utilizes different pitch patterns to distinguish between a statement such as *There's an elephant in the backyard* and a question like *There's an elephant in the backyard?*

Before looking at the data from Makua, a few introductory remarks are required. The language contrasts long and short vowels. We will represent the long vowels as sequences of two identical short vowels. (See Chapter 9 for discussion of this treatment of vowel length.) This decision is strongly motivated by the tonal patterns that will be described below. The language permits no more than two successive vowels. Sequences of more than two vowels may occur in underlying structure, but all such sequences are affected by rules that have the result that no more than two vowels occur in succession. The language has five distinctive vowel qualities which we represent by the symbols *i*, *e*, *a*, *o*, and *u*. The acute mark over a vowel (V́) indicates a high-toned vowel, while no mark over a vowel indicates a low-toned vowel. The sequences $\acute{V}_iV_i$ and $V_i\acute{V}_i$ are to be interpreted as a long vowel with a falling tone and rising tone respectively. $\acute{V}_i\acute{V}_i$ represents a long vowel with a high level tone and V_iV_i represents a long vowel with a low level tone.

We will begin our examination of Makua tonal structure by examining the infinitive form of the verb.

(81)	*u-nón-á*	'to sharpen'	*u-th^{h}úm-á*	'to buy'
	u-váh-á	'to give'	*u-hún-á*	'to hurt s.o.'
	u-pát^h-á	'to get'	*u-kúš-á*	'to carry'

(In our Makua transcriptions *th* denotes a dental stop, while *t* is alveolar; aspiration is marked by a raised *h*. Thus, *t*^{h} represents an aspirated alveolar stop and *th*^{h} represents an aspirated dental stop. The acute accent denotes high tone and a vowel without an accent sign is low-toned. Also,

the examples in (81) indicate the pronunciation that would be found when the infinitive occurs phrase-medially rather than phrase-finally; we discuss below the effect that phrase-final position has on pronunciation of words. All of the examples cited in this section represent phrase-medial pronunciation unless there is a specific statement to the contrary.)

Infinitives in Makua are characterized by the prefix *u-* and a final vowel *-a*. The verb stems in (81) are all of the structure -CVC-. Notice that in each of these examples the vowel of the verb stem bears a high tone, as does the final vowel *-a*. The infinitive prefix is low-toned. All verb stems with a -CVC- structure exhibit the same tonal pattern as the stems in (81). Clearly, then, the tonal structure of such items can be predicted by rule. In fact, it turns out that the tonal structure of all verbal forms in the language is predictable and does not need to be entered in the lexicon. Given just the data presented so far, the nature of the rule involved is naturally far from clear. Before looking at additional data, it should be noted that the pronunciation of the infinitives in (81) changes when they appear in phrase-final position. In particular, the high tone on the final vowel *-a* is replaced by a low tone. This fact suggests the possibility of a rule something like (82).

(82) Final lowering $\quad V \xrightarrow{H \quad L} V / \_\_\_\$$

(where H = high tone, L = low tone, $ = phrase boundary). Consider next the following infinitive forms.

(83)	*u-lówól-a*	'to carry'	*u-húkúl-a*	'to sieve beer'
	u-páŋgác-a	'to make'	*u-cérέw-a*	'to be late'
	u-kápát-a	'to carry on the lap'	*u-térék^h-a*	'to cook'

The verb stems in (83) have the structure -CVCVC-; all verb stems of this structure illustrate the same tonal pattern: a high tone on both vowels of the verb stem, with the infinitive prefix *u-* and the final vowel *-a* both low-toned. Furthermore, infinitives like those in (83) have the same pronunciation in phrase-final position as they do in phrase-medial position.

At this point, we would like to propose an analysis for the data in (81) and (83). The motivation behind this analysis may not be immediately obvious, though we hope in subsequent discussion to specify some of the facts leading to the proposed analysis. We assume that the infinitive prefix is basically low-toned; since it appears in these data with a low tone, this analysis is rather straightforward. We also assume that the final vowel of the infinitive form, *-a*, is basically low-toned. This vowel appears with a high tone in the data in (81), but with a low tone in (83). Thus if we take the

basic tone to be low, we will need a rule to assign this vowel a high tone in (81) but not in (83). The rule that we propose is stated in (84).

(84) Tone doubling

$$\begin{matrix} L & H\ H \\ V \longrightarrow & V/VC_0\_\_ \end{matrix}$$

The rule of tone doubling says simply that a low-toned vowel will become high-toned if the preceding vowel is high-toned. (This rule must not reapply to its own output, unlike the vowel harmony rule in Yawelmani; in other words, given a sequence of low-toned vowels after a high-toned vowel, only the first low-toned vowel will be raised to a high tone.) In order to make this rule work correctly, it is necessary to assume that the *-a* vowel is preceded by a high-toned vowel in (81) but not in (83). On the surface, the *-a* is preceded by a high tone in both sets of data. We would like to claim, however, that in an example like *u-lówól-a* the high tone that precedes *-a* is itself the result of tone doubling (and is thus not a high tone at the point in the derivation where tone doubling applies). If this claim is accepted, then we arrive at the conclusion that it is only the first vowel of the verb stem in both (81) and (83) that bears a high tone prior to tone doubling. This high tone is itself predictable, and can be assigned by the rule stated informally in (85).

(85) TONE ASSIGNMENT: *Assign a high tone to the first vowel of a verb stem.*

(We assume that all the vowels of a verb stem are underlying low-toned.) In (86) we illustrate the derivation of *u-nón-á* 'to sharpen' and *u-lówól-a* 'to carry'.

(86)

L L L	L L L L	
u-non-a	*u-lowol-a*	Underlying representation
L H L	L H L L	Tone assignment
L H H	L H H L	Tone doubling

Recall that in phrase-final position 'to sharpen' is pronounced *u-nón-a*. If we assume a rule like final lowering, (82), then this rule must be applied after tone doubling; final lowering will have the effect of lowering the high tone on the final *-a* (which resulted from tone doubling) just in case that *-a* is in phrase-final position. An alternative to such an approach would be to constrain tone doubling so that it does not apply to a phrase-final vowel. For ease of presentation, we will continue to assume the existence of a separate rule of final lowering, rather than complicating

the statement of tone doubling. We have no evidence that chooses between the two approaches.

The data in (81) and (83) can, of course, be described without invoking a rule such as tone doubling. However, it should be pointed out that an examination of Makua surface structures strongly suggests that a principle such as tone doubling is operating in the language. High tones in Makua almost always come in pairs if one disregards the effect of final lowering; where there are exceptions to this pattern on the surface, an explanation can be found in terms of the underlying structure of the utterance and the application of phonological rules. Examples of such apparent exceptions will be discussed later.

Additional motivation for tone doubling will be given later, but let us look further into the problem of tone assignment for verbs in Makua. In (87) we illustrate the tonal pattern of verb stems of the shape -CVCVCVC- and in (88) we illustrate -CVCVCVCVC- stems.

(87)

u-lókót^{h}él-á	'to pick up for'
u-páp^{h}árúl-á	'to separate'
u-tíkít^{h}él-á	'to rub'
u-púkútík-á	'to drop off (leaves, hair)'

(88)

u-lókótáníh-a	'to pick up'
u-kákámálíh-a	'to strengthen'
u-kíríkítél-a	'to struggle for s.t.'
u-kútíhérán-a	'to heat for one another'

Up to this point we have claimed that the final vowel *-a* will be high-toned just in case it receives a high tone as a result of tone doubling. This means that there must be a high tone not only on the first vowel of a verb stem like /lokot^{h}el/, but also on the third vowel. Furthermore, to account for the failure of the final *-a* to have a high tone in an example like *u-lókótáníh-a*, it must be the case that the fourth vowel of a verb stem like /lokotanih/ does not have a high tone. The pronunciation of *u-lókótáníh-a* is, however, consistent with the claim that the first and third vowel of all verb stems have a high tone. We propose therefore to restate the tone assignment rule for verbs as in (89).

(89) TONE ASSIGNMENT: *Assign a high tone to the first and the third (if there is one) vowel of a verb stem.*

The derivation of *u-lókót^{h}él-á* and *u-lókótáníh-a* is given in (90).

(90)

L L L L L	L L L L L L L	
u-lokot^{h}el-a	*u-lokotanih-a*	Underlying representation
L HL HL	L HLHL L	Tone assignment
L HH HH	L HHHH L	Tone doubling

(If *u-lókót^{h}él-á* appears in phrase-final position, final lowering will lower the final vowel *-a* to a low tone.)

Given the data presented so far, one might think that tone assignment would actually assign a high tone to every other vowel in the verb stem. But this is not correct. It is just the first and third vowels that are assigned a high tone. To see this, consider the following stems which are even longer than those previously cited.

(91)

u-kákámálíher-a	'to use s.t. to strengthen s.t.'
u-kákámálíherac-a	(same meaning as above)
u-lókótáníhac-a	'to pick up things'
u-lókótáníherac-a	'to pick up things for'

The first four vowels of these verb stems have phonetic high tones, and all of the remaining vowels of the stem as well as the final vowel *-a* are low-toned. The analysis proposed here accounts for these pronunciations since it assumes that all the vowels of a verb stem are basically low-toned, as is the final *-a*, and that tone assignment places a high tone only on the first and the third vowel of the stem. These high tones are then doubled onto the following vowels.

So far we have restricted our attention to verb stems with short vowels. As mentioned earlier, Makua also has long vowels. In (92) we illustrate the tonal structure of verb stems containing long vowels.

(92)

Phrase-medial position	Phrase-final position	
u-lééh-a	*u-léeh-a*	'to say farewell'
u-máál-a	*u-máal-a*	'to be quiet'
u-híih-a	*u-hüh-a*	'to cause to leave'
u-máálíh-á	*u-máálíh-a*	'to make quiet'
u-lééhér-á	*u-lééhér-a*	'to order s.t.'
u-hóméér-á	*u-hóméér-a*	'to insert s.t. sharp'
u-líkáán-á	*u-líkáán-a*	'to resemble'
u-k^{h}únéél-á	*u-k^{h}únéél-a*	'to cover s.t.'

Let us look first of all at *u-máál-a*. This form makes it clear why we have chosen to represent long vowels as a sequence of two identical short vowels. If we considered a long vowel to be simply one vowel, then we would have expected a pronunciation such as **u-máál-á*. That is, we would have expected the final vowel *-a* to receive a high tone via tone doubling the same as it does in an example such as *u-nón-á*. By assuming the vowel sequence representation for long vowels, the pronunciation *u-máál-a* follows automatically from our rules.

(93)

L LL L	
u-maal-a	Underlying representation
L HL L	Tone assignment
L HH L	Tone doubling

The phrase-final pronunciation *u-máal-a* is not accounted for by the analysis developed so far. The problem posed by these data is the fact that while *-máál-a* is converted to *-máal-a* when phrase-final, *-hóméér-á* is converted to *-hóméér-a* not **-hóméer-a*. The latter example shows that there is no phonetic constraint that a long level high tone cannot appear in the context ____CV\$ (where \$ indicates a phrase boundary). One description of these data would involve postulating a rule something like (94), ordered to apply before final lowering.

(94) High fall

$$\begin{matrix} H \\ V \end{matrix} \longrightarrow \begin{matrix} L\ H \\ V/V \end{matrix} \underline{\quad\quad} C_0\ V\ \$ \qquad \begin{matrix} \\ L \end{matrix}$$

This rule says that a long level high tone will be replaced by a falling tone when it precedes a low-toned vowel that is in phrase-final position. This rule has to apply prior to final lowering, since as a result of this lowering a form such as *u-hóméér-á* will become *u-hóméér-a* and will then satisfy the conditions for (94). Example (95) shows the derivation of the phrase-final form of *u-máál-a* versus the phrase-final form of *u-hóméér-á*.

(95)

L LL L	L L LL L	
u-maal-a\$	u-homeer-a\$	Underlying representation
L HL L	L H LH L	Tone assignment
L HHL	L H HH H	Tone doubling
L HL L	inapplicable	High fall
L HL L	L H HH L	Final lowering

An alternative description of the data would involve placing a constraint on tone doubling which would prevent a high tone from doubling when in the environment ____ V C_0 V\$. For convenience, we will assume the analysis that utilizes the rule stated in (94), though the analysis employing a constraint on tone doubling will work just as well.

Examples like *u-máálíh-á* and *u-hóméér-á* both provide additional support for the claim that long vowels are structurally two short vowels and for the rule of tone assignment stated in (89). Notice that in

u-máálíh-á the final vowel *-a* has a high tone; this high tone is the result of tone doubling, in our analysis. Consequently, there must be a high tone on the *i* vowel in the stem /maalih/. Tone assignment predicts that there will be a high tone on the *i* vowel, provided that the long *aa* vowel is counted as two vowels rather than one. Similarly, the final *-a* vowel in *u-hóméér-á* is also high-toned; in order to account for this high tone by doubling, it is necessary to assume that it is preceded by a vowel bearing a high tone (arising from tone assignment). Given a stem like /homeer/, the only way that tone assignment can assign a high tone to the last vowel of the stem is if the long /ee/ is regarded as two vowels rather than one. If the long /ee/ were regarded as a single vowel, tone assignment would place a high tone on the first vowel of the verb stem but there would be no third stem vowel to receive high tone. If long /ee/ is regarded as a sequence of two vowels, then the second of those vowels will be counted as the third stem vowel in /homeer/ and will thus be assigned high tone.

Many of the long vowels in Makua are derived by phonological rules. Some such derived long vowels can be found in infinitive forms. They arise as the result of the prefixation of the *u-* infinitive prefix to verb stems that have an initial vowel. Examples are given in (96).

(96)

w-aáp-á	'to whisper'	*w-eét-á*	'to walk'
w-oóp-á	'to beat'	*w-uúr-á*	'to keep'
w-ɨ́w-á	'to come uninvited'		
w-aáthál-a	'to spread out'	*w-eémél-a*	'to stand'
w-oóŋgóm-a	'to sit'	*w-ɨ́hán-a*	'to call'
w-uúpúwél-á	'to remember'	*w-eérékél-á*	'to cut'

Notice that the *u-* infinitive prefix assumes the shape *w-* before vowel initial verb stems. Presumably a rule of glide formation is at work, converting the vowel /u/ to the corresponding glide /w/ in prevocalic position. The vowel that follows this glide is always a long vowel; a short vowel cannot occur in this position (unless derived from a rule not discussed here that shortens a long vowel before a consonant cluster). This long vowel appears to be the consequence of the glide formation process, since it is possible to have a short vowel after a glide if that glide does not result from glide formation. Rule (97) gives a schematic representation of the rule of glide formation.

(97) Glide formation

$$\begin{array}{ccc} u & V & \\ 1 & 2 & \longrightarrow \quad 1 \quad 22 \\ & & [-\ \text{syll}] \end{array}$$

This rule says that given a sequence of *u* plus a vowel, change *u* to a nonsyllabic sound (i.e., *w*) and make the following vowel long (remember, length is being represented as a sequence of two vowels).

The long vowel that arises from glide formation is pronounced with a rising tone. Let us see how our analysis of Makua tone can account for this pronunciation. Consider an example like *w-aáp-á*. The underlying structure is /u-ap-a/. Tone assignment would be expected to convert this structure to /u-áp-a/. Tone doubling would then yield /u-áp-á/. In order to achieve the correct phonetic form, it is necessary that when glide formation converts the sequence *u-a* to *w-aa* the underlying tone contour of the input vowel sequence (namely, L-H) is retained on the derived long vowel. We will account for these facts by revising glide formation as in (97)′.

(97)′ Glide formation

$$\begin{array}{ccc} \begin{bmatrix} u \\ \alpha T \end{bmatrix} & V & \\ 1 & 2 & \longrightarrow \quad \begin{bmatrix} 1 \\ -\text{syll} \end{bmatrix} \quad \begin{bmatrix} 2 \\ \alpha T \end{bmatrix} \quad 2 \end{array}$$

This rule says that given a sequence of *u* plus a vowel, the *u* will become nonsyllabic and the following vowel will be doubled. The first element of the doubled vowel is assigned the same tone as the *u* vowel, while the second element retains the original tone. (See Chapter 7 for some discussion of an alternative way of describing cases where a tone associated with a vowel remains even though the vowel itself is either lost or devocalized.)

The principles that have been sketched up to this point account quite well for the pronunciation of infinitives having the structure *u*-verb stem-*a*. Examination of more complex infinitive structures provides additional evidence for the proposed analysis, but also requires the postulation of an additional rule, a rule of considerable importance in Makua tonology. Let us look at infinitive verbs that contain an object prefix between the *u-* prefix and the verb stem. The examples in (98) illustrate most of the object prefixes that occur in Makua (we have omitted two object prefixes that involve complexities not directly relevant to the present discussion).

(98)

u-váh-á	'to give'
u-kí-váh-a	'to give me s.t.'
w-uú-váh-a	'to give you (child) s.t.'
w-aá-váh-a	'to give him/them (adult) s.t.'
u-ní-váh-a	'to give us s.t.'
w-aá-váh-ac-a	'to give them (children) s.t.'

The object prefixes in (98) can be analyzed as /ki/ 1 sg., /u/ 2 sg. and pl., /a/ 3 sg. and pl., and /ni/ 1 pl. Further distinctions between singular and plural and between initiated (adult) and uninitiated (child) objects are conveyed by affixes added to the end of the verb stem (for example, the suffix *-ac-* in *w-aá-váh-ac-a* indicates a plural, uninitiated object).

The infinitive prefix remains *u-* before the object prefixes with an initial consonant (/ki/ and /ni/), but glides to *w-* before vowel-initial object prefixes (/u/ and /a/). This gliding to *w-* is accompanied by a lengthening of the following vowel. Clearly, then, the infinitive prefix undergoes the rule of glide formation (97)′ before vowel-initial object prefixes just as it does before vowel-initial verb stems.

Turning to the tone pattern exhibited by the forms in (98), it is readily apparent that the object prefixes all bear a high tone. The vowel after the object prefix is also high toned, but the following vowel is low toned. Given the analysis that we have developed to this point, it seems reasonable to assume that the high tone on the vowel after the object prefix is the consequence of tone doubling. The object prefix must itself be assumed to bear a high tone. It is not the case that object prefixes are always high toned in Makua; rather, they are high toned just in certain specifiable verbal constructions, including the infinitive. We assume therefore that the object prefixes are assigned their tone as part of the morphology; the result of the morphology will be that in infinitive constructions the object prefix is high toned.

It will be noted that when the vowel-initial prefixes /u/ and /a/ are lengthened as a consequence of glide formation, the long vowel is pronounced with a rising tone. Once again, this rising tone reflects the underlying tone sequence of a low on the infinitive prefix *u-* and a high on the vowel of the object prefix. The rising tone of *w-aá-váh-a* thus reflects the same principle as is at work in *w-aáp-á* 'to whisper'.

The forms in (98) pose a significant problem that has not yet been examined. We have formulated a tone assignment rule that places a high tone on the first and third (if there is one) vowel of a verb stem. This high tone will double onto a following vowel. Why, then, in an example such as *u-kí-váh-a* isn't there a high tone on the final vowel *-a*? We have already implicitly suggested an explanation. We noted that it was possible to regard the high tone on the root /vah/ in *u-kí-váh-a* as arising from tone doubling; if so, we would not expect such a high tone to double onto the following vowel. But in order to maintain this explanation of the tonal patterns in (98), it is necessary to explain why the root /vah/ in *u-kí-váh-a* does not have the high tone that tone assignment would predict it to have (a high tone that *would* double onto the following vowel). In other words, why does the root have just the phonetic high tone resulting from doubling

and not the more fundamental high resulting from tone assignment? We offer the following explanation: A rule of tone lowering is operative in the language which has the form given in (99).

(99) Tone lowering $\quad \overset{H}{V} \longrightarrow \overset{L\ H}{V/VC_0\_\_}$

Tone lowering says that a high-toned vowel will become low-toned if it is preceded by another high-toned vowel. This rule must be applied after tone assignment but before tone doubling. Given such a rule, the derivation of *u-kí-váh-a* will be as in (100).

(100)

L H L L	
u-ki-vah-a	Underlying representation
L H H L	Tone assignment
L H L L	Tone lowering
L H H L	Tone doubling

This analysis accounts for the failure of the final vowel *-a* in *u-kí-váh-a* to receive a high tone as follows: Since the high tone on the verb stem /vah/ resulting from tone assignment is lost as a result of tone lowering, there is no high tone on the verb stem that can be doubled onto the final vowel. The tone doubling principle then places a high tone on the verb stem, since it follows the high-toned object prefix, but this phonetic high tone does not itself trigger doubling.

At first glance, the above analysis might appear to be a rather roundabout way to account for the data in (98). Nevertheless, there is considerable support for this kind of analysis. Look at the data in (101).

(101)

u-kí-húkulél-á	'to sieve beer for me'
u-kí-lókotániher-a	'to pick up for me'
u-kí-lókotánítherac-a	'to pick up things for me'

These data will follow automatically from the analysis developed here. The derivation of *u-kí-lókotánítherac-a* is shown in (102).

(102)

L H L L L L L L L	
u-ki-lokotaniherac-a	Underlying representation
L H H L H L L L L	Tone assignment
L H L L H L L L L	Tone lowering
L H H L H H L L L	Tone doubling

Further support for the rule of tone lowering is provided by infinitive

forms containing the diminutive prefix *-ši-*. This prefix parallels the object prefixes in terms of its tonal behavior, as (103) illustrates.

(103)

u-ší-pátʰ-a	'to get s.t. little or a little of s.t.'
u-ší-lówol-a	'to carry s.t. small'
u-ší-lókotáníh-a	'to pick up s.t. small'

In these examples, *-ši-* bears a high tone and this high tone is doubled onto the following vowel (which is the first vowel of the verb stem). The first vowel of the verb stem does not manifest the high tone that would be assigned via tone assignment, but the third vowel (if there is one) does. Thus it is just the first vowel of the verb stem that must lose the high tone assigned by tone assignment. The proposed rule of tone lowering will in fact have the effect of lowering the high tone on the first vowel of the verb stem since it is preceded by the high-toned diminutive prefix. Clearly, our analysis of the data in (98) extends naturally to the data in (103).

It happens that it is possible to have *both* the diminutive prefix and also an object prefix. There is some flexibility in the order in which they occur, but the examples cited below in (104) show the diminutive prefix before the object prefix.

(104)

u-ší-kí-patʰel-a	'to get s.t. little for me'
u-ší-kí-papʰarúlél-a	'to separate s.t. small for me'
u-ší-kí-lokotáníher-a	'to pick up s.t. small for me'

The examples above follow automatically from our analysis as long as we make the following assumption about the way in which the tone lowering rule stated in (99) operates. This rule must operate so that in a sequence of high tones (not separated by a low tone), all but the first high tone is lowered. In other words, any number of successive high tones will be lowered after a high tone. (See Chapter 7 for some discussion of the general problem posed by examples such as this.) The derivation of *u-ší-kí-lokotáníher-a* is given in (105).

(105)

L H H L L L L L L	
u-ši-ki-lokotaniher-a	Underlying representation
L H H H L H L L L	Tone assignment
L H L L L H L L L	Tone lowering
L H H L L H H L L	Tone doubling

Let us now look at the combination of the object prefixes with vowel-initial verb stems:

(106)

w-eéméš-a	'to stand s.t. up'
u-ké-émeš-a[1]	'to stand me up'
u-w-éémeš-a	'to stand you (child) up'
w-é-émeš-a	'to stand him/them (adult) up'
u-né-émeš-a	'to stand us up'
w-é-émeš-ác-á	'to stand them (children) up'

Taking the consonant-initial object prefixes /ki/ and /ni/ first, we see that the *i* vowel of these prefixes is absent on the surface but that the initial *e* of the verb stem /emeš/ appears in a lengthened form. There is considerable additional evidence in the language that the sequence *ie* is always replaced by *ee*. Turning to the vowel-initial object prefixes, we can readily see that the /u/ prefix glides to *-w-* before a vowel-initial verb stem and lengthens the following vowel in doing so. This gliding is of course expected, given the existence of the glide formation rule stated as (97)′. It should be pointed out, however, that there is one problem that must be worked out in a complete analysis of Makua. Given the underlying representation /u-u-emeš-a/, both the infinitive *u* and the object *u* satisfy the conditions for glide formation. It is necessary to guarantee somehow that glide formation applies first to the object prefix; when it does, it destroys the conditions for the infinitive prefix to undergo the rule.

One object prefix remains to be discussed; namely, the third person prefix /a/. Notice that in *w-é-émeš-a* 'to stand him/them up' the sequence *ae* (resulting from the juxtaposition of /a/ with the initial /e/ of the verb stem) is replaced by *ee*. The infinitive prefix *u-* glides to *w-* before this *ee* vowel. Recall that ordinarily when *u-* glides to *w-* it induces doubling of the following vowel. If this doubling occurs in the example under discussion, a form like **w-eé-émeš-a* would result. But Makua never allows more than two vowels in succession within a word. There are two approaches to preventing a form such as **w-eé-émeš-a*. The first approach would say that glide formation has the effect of doubling the following vowel only when that vowel is not followed by another vowel. The second approach would allow glide formation to induce the doubling of any following vowel, but would postulate a rule reducing a sequence of three (or more) successive vowels to two. Either of these approaches is feasible; but since there are cases in the language where a sequence of three or more successive underlying vowels must be reduced to two, we will assume that the second analysis is independently motivated and will make use of it in our discussion. We refer to this rule as vowel reduction. It is stated as (107).

[1] The morpheme breaks between parts of a long vowel are meant merely to indicate in a rough way the morphological structure of the word. The placement of the breaks is not meant to suggest any theoretical claim.

(107) Vowel reduction $V_aV_a(V_a)^n_1 \longrightarrow V_aV_a$
where $(V_a)^n_1$ = one or indefinitely many successive occurrences of V_a

Rule (107) must apply after glide formation, since (107) will eliminate the extra unit of vowel length produced by glide formation, converting /w-eé-émeš-a/ to *w-é-émeš-a*.

We have now accounted for the segmental structure of the items in (106). But what about the tone? A form like *u-k-éémeš-a* is easily derived by the analysis we have given.

(108)

L H L L L	
u-ki- emeš-a	Underlying representation
L H H L L	Tone assignment
L H L L L	Tone lowering
L H H L L	Tone doubling
u-ké-émeš-a	*ie* ⟶ *ee*

u-w-éémeš-a can also be derived easily, but requires that the high tone associated with the object prefix /u/ be transferred to the following lengthened vowel. In other words, the structure /u-ú-émeš-a/ must, following glide formation, be realized as /u-w-éémeš-a/. The tonal pattern high–high exhibited by the object prefix /u/ and the following /e/ vowel must be retained on the sequence /wee/ resulting from glide formation.

It is not, however, the case that the tone of a /u/ vowel that undergoes glide formation is always maintained on the following vowel. This can be seen from *w-éémeš-a* 'to stand him/them up'. The underlying representation of this form is /u-á-emeš-a/. Tone assignment will place a high tone on the first vowel of the verb stem, but tone lowering will in turn lower that high. Tone doubling will copy the high of the object prefix /a/ onto the following /e/ vowel. The sequence /ae/ is assimilated to /ee/. The *u-* of the infinitive prefix must glide to *w-*, but the low tone of the infinitive is lost entirely from the surface form. We would like to offer the following explanation for this fact. Recall that the rule of vowel reduction must reduce three or more identical vowels to two. In Makua, a single vowel may in general bear only one tone: high or low. Thus when a three vowel sequence is reduced to two, the three tones of these vowels must be reduced to two. We propose the following principle for how this tone reduction is to be accomplished.

(109) HIGH TONE PRESERVATION PRINCIPLE: *When vowels undergo vowel reduction, a high tone is never deleted as long as there is a low tone available to be deleted.*

The high tone preservation principle says that if a structural tone must be lost due to the need to compress three tone-bearing elements to two, a low tone will drop out rather than a high tone. The high tone preservation principle is in effect part of the vowel reduction process, specifying the precise manner in which a sequence of vowels (and their tones) will be reduced.

The derivation of *w-é-émeš-a* 'to stand him/them up' will now be as in (110).

(110)

L HL L L	
u- a-emeš- a	Underlying representation
L HH L L	Tone assignment
L HL L L	Tone lowering
L HH L L	Tone doubling
u- e-emeš- a	ae ⟶ ee
LHH L L	
w-ee-emeš-a	Glide formation
HH L L	
w-e-emeš- a	Vowel reduction

In this derivation, the sequence *eéé* must reduce to *éé* since the high tone preservation principle says that a low tone will be deleted in preference to a high tone.

It is not possible here to even attempt to fully justify the high tone preservation principle. We will, however, cite a variety of cases which establish that the principle as stated plays a crucial role in deriving fairly complex tonal patterns.

The prefix *-hi-* is used in various negative verbal constructions in Makua. It is used, for instance, to form a negative infinitive. The examples in (111) illustrate the behavior of *-hi-*.

(111)

u-hí-váh-a	'to not give'
u-hí-hún-a	'to not hurt s.o.'
u-hí-lókot^{h}el-a	'to not pick up'
u-hí-lúpat^h-a	'to not hunt'
u-hé-émeš-a	'to not stand s.t. up'

It is readily apparent that the negative element *-hi-* bears a high tone in this construction and that this high tone doubles onto the following vowel. It is also apparent that the high tones assigned by tone assignment do not show up at all in these forms. The absence of the high tone assigned to the first vowel of the verb stem is expected, of course, due to the operation of tone lowering. But the absence of the high tone assigned to the third vowel of the verb stem (cf., *u-hí-lókot^{h}el-a*, not **u-hí-lókot^{h}él-á*) is unex-

pected. A special rule is required that lowers any stem high tone after the negative prefix *-hi-*. The derivation of *u-hí-lókotʰel-a* will be as in (112).

(112)

L H L L L L	
u-hi-lokotʰel-a	Underlying representation
L H H L H L	Tone assignment
L H L L L L	Tone lowering after *-hi-*
L H H L L L	Tone doubling

With this much background, let us turn to the forms that are relevant for the high tone preservation principle. Consider the tonal behavior of negative infinitives that contain an object prefix.

(113)

u-hí-kí-vah-a	'to not give to me'
u-hú-ú-vah-a	'to not give to you (child)'
u-hí-kí-lokotaniher-a	'to not pick up for me'
u-há-á-lokotaniher-a	'to not pick up for him'
u-hí-ké-emeš-a	'to not stand me up'
u-hé-é-meš-a	'to not stand him up'

It is readily apparent from *u-hí-kí-vah-a* and *u-hí-kí-lokotaniher-a* that the negative prefix once again is high-toned and doubles its high tone onto the following vowel (which is part of the object prefix). There is no trace of any other high tone: not the high tone typically associated with the object prefix itself (cf., *u-kí-váh-a* 'to give to me'), not the high tones typically assigned to the first and the third vowel of the verb stem. Thus we must assume that the *-hi* morpheme triggers lowering of all these high tones. Next notice that the *i* vowel of the negative prefix assimilates the quality of the following vowel: Thus *iu* yields *uu* and *ia* yields *aa*. This presumably represents a facet of the assimilation process noted earlier that converts *ie* to *ee* and *ae* to *ee*. Finally, consider *u-hé-é-meš-a* 'to not stand him up'. This form derives from /u-hí-á-emeš-a/, apparently via a derivation something like (114).

(114)

L HHL L L	
u-hi-a-emeš-a	Underlying representation
L HHH L L	Tone assignment
L HLL L L	Tone lowering after *-hi-*
L HHL L L	Tone doubling
u-hi-e-emeš-a	ae ⟶ ee
L HHL L L	
u-he-e-emeš-a	ie ⟶ ee
L HH L L	
u-he-e-meš-a	Vowel reduction

Vowel reduction in this example reduces the sequence *ééé* to *éé*. This is just what the high tone preservation principle predicts. We have thus seen that the sequences *eéé* and *ééé* both reduce to *éé*. A low tone deletes rather than a high tone.

The long vowel *-aa-* is used in Makua as a tense/aspect marker and is placed between the subject prefix (which obligatorily appears on all finite verbs in Makua as in other Bantu languages) and the verb stem. Thus we find examples like *y-aa-lúpátʰ-a* 'he was hunting'. The *-aa-* tense/aspect marker here is low-toned. The first vowel of the verb stem is high toned (and this high tone is doubled onto the following vowel). It appears then that the tone assignment principle that operates on infinitives is also at work in this verb tense. This hypothesis is confirmed by an example such as *y-aa-lókótániher-a* 'he was picking up', where we see that both the first and the third vowel of the verb stem bears a high tone (doubled onto the following vowel). Consider next an example like *y-aa-kí-páŋgacér-á* 'he was making s.t. for me'. As expected, the object prefix *-ki-* is high-toned, just as in the infinitive. The high tone of the object prefix induces the lowering of the high that would be assigned to the first vowel of the verb stem by tone assignment. The high tone assigned to the third vowel of the verb stem is retained, however. Consider now *y-a-á-páŋgacér-á* 'he was making s.t. for him', which results from the derivation in (115).

(115)

LLH L L L L	
y-aa-a-paŋgacer-a	Underlying representation
LLH H L H L	Tone assignment
LLH L L H L	Tone lowering
LLH H L H H	Tone doubling
LH H L H H	Vowel reduction
y-a-a-paŋgacer-a	

The vowel reduction process in this case reduces the sequence *aaá* to *aá*. Once again it is a low tone that is lost rather than a high tone. Now suppose that instead of a consonant-initial verb stem like *-paŋgacer-* we had a vowel-initial verb stem like *-etetʰel-* 'to thresh for'. The data in (116) illustrate the behavior of such verb stems in the verb tense presently under discussion.

(116)

a. *y-e-ététʰél-á*	'he was threshing for' (from: /y-aa-ététʰél-á/)
b. *y-aa-ké-étetʰél-á*	'he was threshing for me' (from: /y-aa-kí-étetʰél-á/)
c. *y-é-étetʰél-á*	'he was threshing for him' (from: /y-aa-á-étetʰél-á/)

In (116a) the sequence *aaé* is converted to *eeé* by vowel assimilation and then to *eé* by vowel reduction. In (116b) the object prefix *-ki-* comes between the tense/aspect prefix *-aa-* and the initial vowel of the verb stem, thus no vowel reduction is necessary. Example (116c) exhibits a more complex case of vowel reduction than we have yet encountered, so its derivation will be shown in full.

(117)

LLHLL L L	
y-aa-a-etet^{h}el-a	Underlying representation
LLHHL H L	Tone assignment
LLHLL H L	Tone lowering
LLHHL H H	Tone doubling
y-ee-e-etet^{h}el-a	*ae* ⟶ *ee*[2]
HHL H H	
y-e-etet^{h}el-a	Vowel reduction

Here the sequence *eeéé* reduces to *éé*; in other words, four vowels reduce to two in such a way that both low tones are lost while the high tones are retained.

We have space only for one additional class of examples. Before turning to the relevant examples it is necessary to observe that the subject prefixes before the *-aa-* tense/aspect marker exhibit a special form. For example, *ki-* the 1 sg. prefix appears as *k-*, *mu-* the 2 p. (adult) prefix appears as *mw-*, and so on. It happens, however, that there is no overt prefix at all for a 3 sg. (child) subject. With this in mind, let us turn to examine what is often referred to by Bantu scholars as the consecutive tense. It consists of a prefix *k^{h}á-* followed by the subject prefix followed by the *-aa-* tense/aspect marker followed by the verb stem ending in *-a*. Thus we have *k^{h}á-mw-aa-t^{h}áw-á* 'and then you (adult) ran'. The tone of the *k^{h}á-* prefix is peculiar in that it does not copy onto the following vowel as expected; we have no explanation for this exceptional behavior. Now, if the subject of a verb in the consecutive tense is a 3 sg. child, no overt prefix occurs between the *k^{h}á-* prefix and the *-aa-* tense/aspect marker. We thus create a sequence of three consecutive *a* vowels. The result can be seen in *k^{h}á-a-t^{h}áw-á* 'and then he (child) ran'. Note that the sequence *áaa* reduces to *áa*. This is again just what the vowel reduction process in conjunction with the high tone preservation principle predicts.

Let us consider now what happens when the 3 sg. (adult) object prefix *-a-* occurs between the *-aa-* prefix and the verb stem. An example would

[2] This rule must either apply iteratively or be phrased to affect any number of *a* vowels before an *e* vowel.

be *k^{h}á-á-th^{h}úmel-a* 'and then he (child) bought it for him'. The derivation of this example is shown in (118).

(118)

H LLH L L L	
k^{h}a-ϕ-aa-a-th^{h}umel-a	Underlying representation
H LLH H L L	Tone assignment
H LLH L L L	Tone lowering
H LLH H L L	Tone doubling (note: *k^{h}á-* must be marked as not triggering tone doubling)
HH H L L	
k^{h}a-a-th^{h}umel-a	Vowel reduction

It can be seen from this example that the sequence *áaaá* reduces to *áá*. Once again, this is precisely the result predicted by vowel reduction plus the high tone preservation principle.

Finally, consider the case where the verb stem is vowel initial rather than consonant initial. An example is *-etet^{h}el-* 'to thresh for'. Compare *k^{h}éétét^{h}élá* 'and he (child) threshed for' with *k^{h}éétet^{h}élá* 'and he (child) threshed for him'. The derivations of these forms are shown in (119) and (120).

(119)

H LLLL L L	
k^{h}a-ϕ-aa-etet^{h}el-a	Underlying representation
H LLHL H L	Tone assignment
inapplicable	Tone lowering
H LLHH H H	Tone doubling (recall, *k^{h}á-* exceptionally fails to trigger doubling)
k^{h}e- ee-etet^{h}el-a	*ae* ⟶ *ee*
HH H HH	
k^{h}e-e-tet^{h}el-a	Vowel reduction

(120)

H LLHLL L L	
k^{h}a-ϕ-aa-a-etet^{h}el-a	Underlying representation
H LLHHL H L	Tone assignment
H LLHLL H L	Tone lowering
H LLHHL H H	Tone doubling
k^{h}e- ee-e-etet^{h}el- a	*ae* ⟶ *ee*
HHL HH	
k^{h}e-etet^{h} el-a	Vowel reduction

In (119), the sequence *éeeé* is reduced to *éé*, while in (120) the sequence *éeeéé* is reduced to *éé*. In the latter example five units of underlying vowel

length are reduced to two on the surface. The result is again a level high tone: In other words, the two low tones from the original sequence are lost entirely.

We have shown in the latter part of this section that vowel reduction and the high tone preservation principle will account for a wide range of cases where a sequence of three or more vowels in Makua reduces to just two. These examples have also shown that the analysis of Makua tone developed earlier is applicable not just to infinitive forms of verbs, but extends to other verbal forms as well (in particular, verb tenses marked by the prefix *-aa-*). Makua, like many other Bantu languages, utilizes tone in quite complex ways, and not all aspects of the tonal structure of Makua verbs have been treated here. Nevertheless, all of the tonal principles proposed here can easily be shown to come into play in all of the verbal forms of the language, as well as in other word classes. The principles enumerated here thus help to account for a large part of the rather intricate tonal patterns of Makua.

Exercises

1. Hebrew Itpa'el pattern.

   a. Assume that all verb roots in this exercise have the URs CVCeC or CVCCeC. Formulate rules to account for the *e*~*a* and voicing alternations in the following data.

1 sg.	3 sg. masc.	3 sg. fem.	Gloss
itparnasti	*itparnes*	*itparnesu*	'earn'
itparsamti	*itparsem*	*itparsemu*	'become famous'
idbalbalti	*idbalbel*	*idbalbelu*	'be confused'
idgalgalti	*idgalgel*	*idgalgelu*	'revolve'

   b. Formulate a syncope rule to account for the $e \sim \phi$ alternation.

itḥamakti	*itḥamek*	*itḥamku*	'turn away'
itlabašti	*itlabeš*	*itlapšu*	'get dressed'
idbadarti	*idbader*	*idbadru*	'make fun'
idgarašti	*idgareš*	*idgaršu*	'divorce'
itpalalti	*itpalel*	*itpalelu*	'pray'
itxamamti	*itxamem*	*itxamemu*	'warm'
itmotati	*itmotet*	*itmotetu*	'quake'
it?ošašti	*it?ošeš*	*it?ošešu*	'recover consciousness'
idbodati	*idboded*	*idbodedu*	'seclude oneself'

   c. The following data require two new rules which must be ordered with earlier ones.

istaparti	*istaper*	*istapru*	'get a haircut'	(cf., *sapar* 'barber'
istarakti	*istarek*	*istarku*	'comb hair'	(cf., *ma-srek* 'comb'
ištaparti	*ištaper*	*ištapru*	'improve'	(cf., *šipur* 'improvement'
ictalamti	*ictalem*	*ictalmu*	'have one's photo taken'	(cf., *calam* 'photographer'
izdakanti	*izdaken*	*izdaknu*	'age'	(cf., *zaken* 'old'
izdarasti	*izdarez*	*izdarzu*	'hurry'	(cf., *zariz* 'alert'
itamamti	*itamem*	*itamemu*	'feign innocence'	(cf., *tamim* 'innocent'
idardarti	*idarder*	*idarderu*	'decline'	(cf., *dirdur* 'rolling'

   d. The following data require three new rules ordered with earlier ones. (In the prestige dialect ʕ and *ḥ* do not appear phonetically. Our data reflect the nonprestige dialect.)

itmaleti	*itmale*	*itmal?u*	'become full'
itpaleti	*itpale*	*itpal?u*	'become surprised'
itnaseti	*itnase*	*itnas?u*	'feel superior'
itpataḥti	*itpateaḥ*	*itpatḥu*	'develop'
idgalaḥti	*idgaleaḥ*	*idgalḥu*	'shave'
itnacaḥti	*itnaceaḥ*	*itnacḥu*	'argue'
ištagati	*ištagea*	*ištagʕu*	'become mad'
itparati	*itparea*	*itparʕu*	'cause disorder'

2. Lomongo (Hulstaert 1957).

   a. Propose an ordered set of rules to account for the phonological and tonological alternations in the following data from this Bantu language. Transcription: ɛ̨ = [ɛ], ɔ̨ = [ɔ], acute accent is high tone, circumflex is falling, a vowel without a tone mark is low-toned. *j* = [*ǰ*] is in free variation with [dz] and *ts* is in free variation with [č]. Except for the first column all forms are present tense. Assume that the final *a* of these words is a verb suffix.

Imper.	1 sg.	2 sg.	3 sg.	1 pl.	2 pl.	3 pl.	Gloss
saŋgá	*ńsaŋga*	*ósaŋga*	*ásaŋga*	*tósaŋga*	*lósaŋga*	*básaŋga*	'say'
kambá	*ŋ̀kamba*	*ókamba*	*ákamba*	*tókamba*	*lókamba*	*bákamba*	'work'
jilá	*ńjila*	*ójila*	*ájila*	*tójila*	*lójila*	*bájila*	'wait'
ɛ̨́na	*ńjɛ̨́na*	*wɛ̨́na*	*ɛ́na*	*tswɛ̨́na*	*jwɛ̨́na*	*bɛ̨́na*	'see'
ísa	*ńjísa*	*wísa*	*ísa*	*tswísa*	*jwísa*	*bísa*	'hide'
iméjá	*ńjimeja*	*wîmeja*	*îmeja*	*tswîmeja*	*jwîmeja*	*bîmeja*	'consent'
iná	*ńjina*	*wîna*	*îna*	*tswîna*	*jwîna*	*bîna*	'hate'
bína	*m̀bína*	*óína*	*áína*	*tóína*	*lóína*	*báína*	'dance'
báta	*m̀báta*	*óáta*	*ááta*	*tóáta*	*lóáta*	*bááta*	'get'
bóta	*m̀bóta*	*óóta*	*áóta*	*tóóta*	*lóóta*	*báóta*	'beget'
mɛ̨lá	*m̀mɛ̨la*	*ǒmɛ̨la*	*ámɛ̨la*	*tǒmɛ̨la*	*lǒmɛ̨la*	*bámɛ̨la*	'drink'
lǫ́ma	*ńdǫ́ma*	*ǒlǫ́ma*	*álǫ́ma*	*tǒlǫ́ma*	*lǒlǫ́ma*	*bálǫ́ma*	'kiss'
lǫndá	*ńdǫnda*	*ǒlǫnda*	*álǫnda*	*tǒlǫnda*	*lǒlǫnda*	*bálǫnda*	'chase'
usá	*ńjusa*	*wûsa*	*ûsa*	*tswûsa*	*jwûsa*	*bûsa*	'throw'
asá	*ńjasa*	*wâsa*	*âsa*	*tswâsa*	*jwâsa*	*bâsa*	'search'

   b. The following data provide additional confirmation of some of the rules in a. The accent of the final vowel of the imperative obeys a polarity principle: it is always

the opposite of the tone of the preceding vowel. On the other hand, the tone of certain derivational suffixes, such as the applied /-el/, is always the same as the following vowel. How must these tonological rules be ordered to account for the data in b?

Imper.	Passive imper.	Causative imper.	Applied	Applied imper.	Causative applied imper.	Gloss
báka	*bákwa*	*bákya*	*-bákela*	*bákélá*	*bákéjá*	'fasten'
kotá	*kotswá*	*kotsá*	*-kotela*	*kotélá*	*kotéjá*	'perch'
mẹŋga	*mẹŋgwa*	*mẹŋgya*	*-mẹŋgẹla*	*mẹŋgélá*	*mẹŋgéjá*	'sway'
kondá	*konjwá*	*konjá*	*-kondela*	*kondélá*	*kondéjá*	'cover with sand'
kọfá	*kọfwá*	*kọfyá*	*-kọfẹla*	*kọfélá*	*kọféjá*	'have an accident'
túla	*túǰwa*	*túǰa*	*-túlela*	*túlélá*	*túléjá*	'forge'
bíla	*bíǰwa*	*bíǰa*	*-bílela*	*bílélá*	*bíléjá*	'pull'

3. Maltese Arabic (Brame 1972).

a. Formulate a stress insertion rule and a vowel elision rule to account for the alternations in the following perfect verb forms. Hint: order the stress rule before elision. Account for the *o*~*e* alternation as well. (acute accent = stress).

3 sg. m.	3 sg. f.	1 2 sg.	3 pl.	2 pl.	1 pl.	Gloss
tálab	*tálbet*	*tlábt*	*tálbu*	*tlábtu*	*tlábna*	'ask'
ḥólom	*ḥólmot*	*ḥlómt*	*ḥólmu*	*ḥlómtu*	*ḥlómna*	'dream'
ḥátaf	*ḥátfet*	*ḥtáft*	*ḥátfu*	*ḥtáftu*	*ḥtáfna*	'grab'
kórob	*kórbot*	*króbt*	*kórbu*	*króbtu*	*króbna*	'groan'
béza?	*béz?et*	*bzá?t*	*béz?u*	*bzá?tu*	*bzá?na*	'spit'

b. The following require a new rule. How must it be ordered with the rules of (a)?

lá?at	*lá?tet*	*il?átt*	*lá?tu*	*il?áttu*	*il?átna*	'hit'
róḥos	*róḥsot*	*irḥóst*	*róḥsu*	*irḥóstu*	*irḥósna*	'become cheap'
mášat	*máštet*	*imšátt*	*máštu*	*imšáttu*	*imšátna*	'comb'
néfa?	*néf?et*	*infá?t*	*néf?u*	*infá?tu*	*infá?na*	'spend'

c. In the imperfect nonderived roots take the underlying shape CCVC with a vowel that is generally different from that of the perfect. Do not attempt to relate the perfect and imperfect root shapes by rule. Account for the *i*~*o* alternation in the following imperfect forms, ordering the rule correctly with the rules already in the grammar.

1 sg.	2 sg.	1 pl.	2 pl.	Gloss
nímsaḥ	*tímsaḥ*	*nímsḥu*	*tímsḥu*	'wipe'
níṣḥa?	*tíṣḥa?*	*níṣḥ?u*	*tíṣḥ?u*	'smash'
níkteb	*tíkteb*	*níktbu*	*tíktbu*	'write'
nól?ot	*tól?ot*	*nól?tu*	*tól?tu*	'hit'
nórbot	*tórbot*	*nórbtu*	*tórbtu*	'tie'
nómšot	*tómšot*	*nómštu*	*tómštu*	'comb'
nónfo?	*tónfo?*	*nónf?u*	*tónf?u*	'spend'
nískot	*tískot*	*nísktu*	*tísktu*	'become silent'

nízbor	*tízbor*	*nízbru*	*tízbru*	'prune'
níǰbor	*tíǰbor*	*níǰbru*	*tíǰbru*	'pick up'
nídḥol	*tídḥol*	*nídḥlu*	*tídḥlu*	'enter'
nóbzo?	*tóbzo?*	*nóbz?u*	*tóbz?u*	'spit'
nófto?	*tófto?*	*nóft?u*	*tóft?u*	'unstitch'
nó?tol	*tó?tol*	*nó?tlu*	*tó?tlu*	'kill'

d. Formulate a rule to account for the following data, ordering it correctly with the preceding rules.

ná?sam	*tá?sam*	*ná?smu*	*tá?smu*	'divide'
ná?bez	*tá?bez*	*ná?bzu*	*tá?bzu*	'jump'
náḥsad	*táḥsad*	*náḥsdu*	*táḥsdu*	'reap'
náḥdem	*táḥdem*	*náḥdmu*	*táḥdmu*	'work'

e. The following forms require a new rule. Do you encounter any problems in ordering this rule with stress and elision? How is this rule ordered with the other rules?

níšrob	*tíšrob*	*nišórbu*	*tišórbu*	'drink'
nókrob	*tókrob*	*nokórbu*	*tokórbu*	'groan'
nítlob	*títlob*	*nitólbu*	*titólbu*	'pray'
náḥrab	*táḥrab*	*naḥárbu*	*taḥárbu*	'flee'
nífraḥ	*tífraḥ*	*nifírḥu*	*tifírḥu*	'rejoice'
nísra?	*tísra?*	*nisír?u*	*tisír?u*	'steal'
nó?mos	*tó?mos*	*no?ómsu*	*to?ómsu*	'kick'
nídnib	*tídnib*	*nidínbu*	*tidínbu*	'sin'