4 Syllabification in Yawelmani

4.1 Introduction

This chapter is devoted to Yawelmani, a dialect of Yokuts, spoken in the San Joaquin valley in South Central California. Yokuts has been classified as belonging to the Penutian family. Other dialects of Yokuts include Chawchila, Choynimni, Chukchansi, Gashowu, Wikchamni. The main source on Yokuts is Newman (1944). Other sources are Kroeber (1907), Newman (1946), Gamble (1978).

For phonologists, Yawelmani is a special language. More than any other language, apart from English, it has played an important role in discussion throughout the history of generative phonology. It has given rise to two theoretical dissertations (viz. Kisseberth (1969a), Archangeli (1984)), a monograph (Kuroda 1967) and numerous articles (e.g., Z. Harris (1944), Hockett (1967, 1973), Iverson (1975), Kisseberth (1969b, 1970b), Lapointe & Feinstein (1982), Archangeli (1983a,b, 1985a,b, 1989, 1991)). Apart from the discussions, Yawelmani has found uses in linguistics pedagogy:

Data from Yawelmani, particularly on verbs, used repeatedly in courses designed to train apprentice linguists in the analytic techniques of descriptive linguistics [...]. A consequence of this iterated and widespread pedagogical use is that a journal article on Yawelmani (or Yokuts) will now catch the eyes of a few linguists in every part of the world, most of whom will leaf silently past an article on any other aboriginal language of North America.
(Hockett 1973: 64)

Here, we will show that syllabification is the key to the understanding of the notorious conspiracies noted in Yawelmani. First, we will treat the early generative analyses by Kuroda and Kisseberth and the nonlinear analysis by Archangeli. In both cases, we will take a special look at the analysis of epenthesis.

4.2 Kuroda's and Kisseberth's accounts

In this section several rules proposed by Kuroda and Kisseberth will be given, which will be of interest to us later. These rules are the rules of Vowel Elision, Shortening, Verb-final Vowel Deletion, Epenthesis and Two Sided Open Syllable Deletion. The rules are given here in the formulation by Kuroda, except for the rule of Verb-final Vowel Deletion, which Kuroda does not give. Kisseberth's formulations are sometimes slightly different.
Kuroda (1967: 20) formulates the following rule of Vowel Elision which he terms “Truncation”:

(1) Vowel Elision
\[ V \rightarrow \emptyset / _{-}V \]

An example of this process is given in (2). i is a short diffuse vowel, which later in the derivation is turned into i. In \(hn\) the vowel is epenthetic (Kuroda, 1967: 20).

(2) /pana:+in+hn/ [paninhin] (pana:- ‘arrive’,
-\(in\)-, mediopassive,
-\(hn\), aorist)

The rule of Shortening is formulated by Kuroda (1967: 10) as:

(3) Shortening
\[ V \rightarrow [\text{-long}] / _{-}C \]

An example of the functioning of this rule is given in (4).

(4) /panaa+t/ [panat] (-\(t\), passive aorist)

We now come to the rule of Verb-final Vowel Deletion, which Kisseberth (1969a: 151, 1970b: 302) lists as:

(5) Verb-final Vowel Deletion
\[ V \rightarrow \emptyset / V + C \]

It is important to note that this rule refers to morphological information, because it applies to verb endings only. An illustration is provided in (6).

(6) /taxa:+k/ [taxak^] ‘bring it’ (taxa:, ‘bring’, -\(ka\), imperative)

This rule is needed to explain the alternation in the verb ending -\(ka\) (Newman 1944: 118), -mi (consequent-gerundial, Newman (1944: 134)), -xa (precative, Newman (1944: 119)). They show up postconsonantally as -\(ka\), -mi, -xa, but postvocically as -\(k\), -m, -x (our account of these alternations is given in section 4.4.6). A possible criticism to this rule is that another dialect of Yokuts than Yawelmani, viz. Chukchansi, where we also find the alternations -\(ka\)/-\(k\), -\(mi\)/-\(m\) and -\(xa\)/-\(x\) has a verb ending of the form -CV which does not alternate with -C, viz. the narrative aorist -\(ta\) (Newman, 1944: 125).

We now come to the rules of Epenthesis and Two Sided Open Syllable Deletion, cf. (7,8). We will consider the interaction between these rules. (The rule of Epenthesis
given in (7) is formulated by Kuroda in a slightly different way from Kisseberth’s version of the rule, presented by us in (1) of the Introduction).

(7) Epenthesis (Kuroda 1967: 23)
\[ \emptyset \rightarrow i / C__C \]

(8) Two Sided Open Syllable Deletion (Kuroda 1967: 33)
\[
\left[ \begin{array}{c}
V \\
- \text{long}
\end{array} \right] \rightarrow \emptyset / VC__CV
\]

An example of the application of the rule of “Two Sided Open Syllable Deletion” can be seen in (9) (Kuroda 1967: 21).

(9) xatnal (xat-, ‘eat’, -in-, mediopassive, -al, dubitative)

The rule of Epenthesis (7) is ordered before Two Sided Open Syllable Deletion (8). As the reader will notice, a vowel inserted by rule (7) will again be deleted by rule (8), whenever the environment happens to be followed by a vowel-initial suffix. As an illustration is given in the derivation in (10), an example mentioned by Kuroda (1967: 18).

(10) pa?t\footnote{fight}; -hn, aorist; -t, passive aorist

<table>
<thead>
<tr>
<th>Type</th>
<th>Underlying Representation</th>
<th>Epenthesis (7)</th>
<th>Two Sided Open Syllable Deletion (8)</th>
<th>Surface Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. pa?t+hn</td>
<td>pa?t+it</td>
<td></td>
<td>n.a.</td>
<td>pa?t+it</td>
</tr>
<tr>
<td>pa?t+hin</td>
<td>pa?t+it</td>
<td></td>
<td>pa?t+it</td>
<td>pa?t+it</td>
</tr>
</tbody>
</table>

In (10b), we see that an i is inserted and then deleted. Intuitively, it seems strange that a vowel is inserted by a phonological rule only to be deleted by a subsequent rule in a very large number of cases (unless there are very good reasons for this). It would seem preferable if one could devise a mechanism which would insert the i in only those places where it effectively surfaces. As noticed by Kisseberth (1969a: 37-38), the result of the interaction of the rules of Epenthesis and Two Sided Open Syllable Deletion is that the epenthetic vowel shows up on the surface only in those places where this is required by syllable structure conditions. Yawelmani allows three types of syllables, viz. CV, CVC, CV:. Epenthetic i only occurs in those places where otherwise a disallowed syllable structure would ensue. This state of affairs hints at a syllable related phenomenon, which early generative phonologists, because they ignored the syllable as a relevant phonological notion, were not able to capture formally.

As noted, the rule of “Two Sided Open Syllable Deletion” (8) is used in a very large number of cases just to undo the results of the Epenthesis rule in (7). This raises the question whether there are any grounds for assuming this rule at all. Also, the process is not noted by so observant a linguist as Newman, which seems strange. Furthermore, in Newman’s (1944) monograph, one can find many examples of short vowels in the
environment stated in this rule. Just in the short specimen of Yawelmani text at the end of the book alone, out of 32 different words containing three or more syllables, five have a short vowel in the environment VC CV. Also, the short vowels in the affixes -iyooz*, priorative (Newman 1944: 115) and -hanaa-, passive verbal noun (Newman 1944: 149), do not delete when in an environment of a “two sided open syllable”.

In spite of this, many authors have taken Kuroda’s statements for granted and have at most reformulated his rule. This may be due to the “enormously cumbersome descriptive machinery” (Hockett 1973: 63) used by Newman, which does not make his monograph on Yawelmani very accessible. As we will see below, apart from being required to counterbalance the overinsertion caused by his formulation of the epenthesis process in Yawelmani, Kuroda posited rule (8) chiefly in order to explain the behaviour of one single affix: mediopassive -in- (see note 1 and below).

4.3 Archangeli’s account

4.3.1 Syllabification, Epenthesis and Syncope

Let us look now at Archangeli’s (1984) analysis. Assuming that syllabification is partially underlying, syllable heads (i.e., nuclei) being present in the underlying representation, she posits the following syllabification algorithm:

(11) Core Syllabification (Archangeli 1984: 181)

a. Syllable Formation

\[ \sigma \]

\[ X \ X \]

b. Rime Formation/Shortening

\[ \sigma \]

\[ X (X) \ X' \]

\[ [ ] \]

In (11b) X’ stands for a skeletal slot which is not linked to syllabic structure. The process of shortening, formulated linearly by Kuroda as in (3), has been combined with

---

1 As we will see below in section 4.3.1, Archangeli (1984) treats the counter-examples as being the result of diacritical markings in the lexicon. The only real argument adduced in favour of the rule of “Two Sided Open Syllable Deletion” is the behaviour of the mediopassive morpheme -in-. Where -in- is preceded by a CVC verb stem and followed by a vowel, the i drops, because it is reanalysed as epenthetic. The assumption is corroborated by the fact that CVC+in behaves like a basic verb, which can assume all the possible template forms (cf. Newman 1944: 75-76). We will come back to this in section 4.3.3, when we discuss the template system of Yawelmani.

2 In two of these five examples the environment VC.CV constitutes a derived environment, viz. the examples numbered 27, 50 (Newman 1944: 240-247).
the process of Rime Formation by Archangeli. For Epenthesis, Archangeli posits the rule (1984: 183):

(12) *Epenthesis*

\[ \emptyset \rightarrow X / \_X' \]

Before we go on and look at the workings of these rules, a word must be said about the fact that rules (11b) and (12) refer to an element's status of not being linked to higher syllabic structure (i.e., the use of \( X' \)). It is not at all clear that this type of reference is necessary in phonology, and it seems that by allowing for reference to an element's unlinked status enriches the power of phonological devices and thus impoverishes the explanatory power of the phonological theory. One can realise this fully if one tries to translate the notations in (11) into SPE notation. An \( X \) (like the leftmost \( X \) in (11b)), a syllable, would be a \( V \), i.e., a segment specified as \([+\text{syll}]\). An \( \_X \) or an \( X' \), i.e., elements belonging to a syllable, but non-heads (like the second \( X \) in (11b)), would be segments specified as \([-\text{syll}]\). The expression \( X' \), as used in (11b) and (12) refers to a segment unspecified for [syllabic], i.e. \([\emptyset \text{ syllabic}]\). Because reference is made to the state of being unlinked to syllabic structure, using expressions like \( X' \) in fact boils down to the introduction of a third feature value. The objections that must be raised against this are notorious since publication of Stanley's (1967) article on unspecified features and redundancy rules. What is more, it is precisely Archangeli (1984) who discusses the objections raised by Stanley and devises a (rather far-fetched and powerful, in our opinion) mechanism to escape them in her theory of underspecification. We have just seen that the same point — making reference to three feature values — crops up (thusfar unnoticed, as far as we know) in Archangeli's account of Yawelmani. We will come back to this point in chapter 5, section 5.4.2, when we discuss a rule very similar to (12), proposed for Epenthesis in German.

Let us now look at how Core Syllabification (11) and Epenthesis (12) operate on the forms in (10).

**underlying forms**

<table>
<thead>
<tr>
<th>13</th>
<th>a. ( \sigma )</th>
<th>14</th>
<th>a. ( \sigma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( X X X X X X )</td>
<td>( X X X X X )</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( p )</td>
<td>? ( t ) h n</td>
<td>( p )</td>
<td>? ( t ) t</td>
</tr>
<tr>
<td>a</td>
<td>a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

3 The derivations given here are constructed in analogy to the derivations given by Archangeli (1984: 181-188).
After the application of epenthesis, core syllabification reapplies automatically (Archangeli, 1984: 183, 185). In this example, the glottal stop is resyllabified into the second syllable because Syllable Formation (11a) also operates on slots that are already syllabified (Archangeli 1984: 183). Apparently, the existing link to the first syllable is then severed (although Archangeli does not mention this explicitly).

The empty X's, (i.e. the X's not linked to a segmental slot) are in Archangeli's frame-
work automatically linked to default features, which produces the value $i$. In this way the intermediate forms $pa\text{pitihin}$, $pa\text{pitit}$ are created.\footnote{The default rules filling in the $i$'s in fact apply later in the grammar than the rules deleting the X's that are syllable heads (cf. below), but the form $pa\text{pitihin}$ is given here to illustrate the gross overinsertion caused by Archangeli's "core syllabification".}

We now come to Archangeli's version of the rule of "Two Sided Open Syllable Deletion". Instead of positing a linear rule, Archangeli constructs a tree according to the following parameters (1984: 187).

(15) Syncope
   i. Tree construction
      a. branching rimes must be heads
      b. bounded trees
      c. left dominant
      d. right to left
   ii. resyllabify within the tree
   iii. Bare rime deletion

   \[
   \begin{array}{c}
   \sigma \\
   \mathcal{X} \rightarrow \emptyset \\
   \end{array}
   \]

Let us now look at how these rules work on the forms in (13,14).\footnote{Like Archangeli, we abbreviate the X's linked to elements on the segmental tiers as the elements on that tiers (i.e. lower case characters), while X's unlinked to the segmental tiers are represented as "X".}

Tree construction (15i)

(13) g. \[
\begin{array}{c}
p\ a \ ? \ X \ \check{t} \ X \ h \ X \ n \\
\end{array}
\]

(14) g. \[
\begin{array}{c}
p\ a \ ? \ X \ \check{t} \ X \ t \\
\end{array}
\]

Resyllabification (15ii)

(13) h. \[
\begin{array}{c}
p\ a \ ? \ X \ \check{t} \ X \ h \ X \ n \\
\end{array}
\]

(14) h. \[
\begin{array}{c}
p\ a \ ? \ X \ \check{t} \ X \ t \\
\end{array}
\]

Bare Rime Deletion (15iii)

(13) i. \[
\begin{array}{c}
p\ a \ ? \ X \ \check{t} \ h \ X \ n \\
\end{array}
\]

(14) i. \[
\begin{array}{c}
p\ a \ ? \ \check{t} \ X \ t \\
\end{array}
\]
Syncope (15) is also used by Archangeli to account for those deletions, which Kisseberth accounted for with his rule of Verb-final Vowel Deletion (5). The example she gives (1984: 184) is presented here in (16) and involves the consequent-gerundial suffix -mi.

(16) /panaa + mi/  [panam] 'having arrived' (Newman, 1944: 135)

She then gives the result of Core Syllabification (11)

(17) a. \[\sigma \sigma \sigma \]
   \[XX \ XX \ XX \]
   \[| \ a \ a \ | \ i \]
   \[p \ n \ m \]

This form undergoes syncope tree formation (15i):

(17) b. \[\sigma \sigma \sigma \]
   \[\sigma \]
   \[pa \ na \ am \ i \]

Resyllabification (15ii) applies:

(17) c. \[\sigma \sigma \sigma \]
   \[\sigma \]
   \[pa \ na \ am \ i \]

And finally, Bare Rime Deletion (15iii):

(17) d. \[\sigma \sigma \]
   \[\sigma \]
   \[pa \ na \ am \]

Having outlined Archangeli’s account of Core Syllabification and Syncope, we will now treat some objections that can be raised against this proposal. First of all, note that Archangeli has to over-epenthesise even more than Kuroda. While Kuroda inserts and then deletes a vowel only in the underlying form \[pa?t+t\] (= (10b, 14)), Archangeli also inserts and subsequently deletes an epenthetic vowel (in her theory an \[\chi\] in the underlying form \[pa?t+hn\] (=10a, 13)). Consider also the position of the glottal stop in the syllable structure in (14). In (14c) the glottal stop is linked to the first syllable. Then, in (14e), it is incorporated into the second syllable. Finally, in (14h), it is reincorporated into the first syllable. This appears a rather cumbersome way to achieve the
desired goal. It should also be mentioned that tree building in (15) only takes place for the sake of deletion. The trees thus built are otherwise completely unmotivated. Archangeli refers to tree-based accounts for syncope given by Selkirk (1978), Anderson (1982) and Withgott (1982) for French, Prince (1980) for Estonian quantity, as well as Rappaport (1984a, 1984b) on Tiberian Vowel Reduction. These accounts, however, are metrically based. Not so the account by Archangeli. On the contrary, Archangeli declares (1984: 190) that

the trees necessary for stress are not the same as the trees necessary for syncope.

A second objection is that there appear to be a number of counter-examples to the proposal. Archangeli accounts for them by saying that the vowels which according to the proposal should be deleted but are not, are underlingly the head of the trees of the type set up by (15i). She thus cites the affixes \(-hanaa\)-, passive noun, and \(-iyoo\)-, priorative (Archangeli 1984: 207-208). She assumes the underlying representation as in (18).

\[(18)\]
\[
\begin{array}{ll}
\text{a.} & \sigma \sigma \\
\text{b.} & \sigma \sigma \\
& \text{hanaa} \\
& \text{iyoo}
\end{array}
\]

The assumption of underlying syncope tree heads is a completely ad hoc solution for cases which Archangeli's theory in fact cannot handle. Apart from these suffixes, the case affixes, \(-ni\), indirect objective, and the single vowel affixes \(-i\), \(-a\), object markers in certain paradigms, do not undergo Syncope either. This applies also to the already mentioned Chukchansi verbal affix \(-ta\), narrative aorist (cf. the discussion of Kisselberth's rule of Verb-final Vowel Deletion (5)). Although Archangeli mentions these cases herself (except \(-ta\), she has "nothing insightful to say about syllabification here" (1984: 209). One cannot but conclude that Archangeli's Syncope (15) creates more problems than it solves.

4.3.2 Cyclicality?

Somewhat later in her thesis than the account on which the above derivations are based (cf. note 3), Archangeli mentions that syllabification must be cyclic. She proposes this because the underlying form in (19) would otherwise produce the alleged wrong surface form (Archangeli, 1984: 192).

\[(19)\] \text{pa?t+mx+t (pa?t- 'fight', -mx- comitative, -t passive aorist)}

If syllabification is not cyclic, the resulting form would be \text{pa?tímxít}, instead of \text{pa?títmixít}, supposedly the correct form. However, the form is listed only by Kuroda (1967: 20) who has himself constructed it, as Archangeli herself admits. But "the forms
correspond to that described by Newman (1944), although examples are not found there" (Archangeli 1984: 192). If one does not wish to take this statement for granted, one has to look for the data in Newman's description of Yawelmani. We are then confronted here with the problem that, as Hockett (1973: 65) writes, "unfortunately Newman often fails to give the actual shape of a whole word just where the reader needs it". This raises the question of what exactly Newman is describing in this case. The only place where Newman writes about this is on page 72 of his 1944 monograph. After Newman has noted the influence of the syllable on the presence/absence of the epenthetic vowel (which he does not consider as such) and has mentioned that the situation he is describing occurs in all dialects of Yokuts, he goes on to say:

if -mix-, comitative, is suffixed to a vowel ending-stem, the resulting theme (i.e., stem + nonfinal morpheme, R.N.) behaves in accordance with type IIAb (i.e., a verbal theme with an open penult ...VCVC-, mentioned by Newman on p. 71, R.N.), but the same affix added to a consonant-ending stem creates a theme of type IIAa (i.e., a verbal theme with a closed penult, CVCCVC-, R.N.): e.g., Gashowu laga·mix-, (...VCdC-) (see note 6, R.N.), 'stay over night with ...', composed of mix- with laga· [...] 'stay over night', pc (=preconsonantally, R.N.) laga·mix-, pv (=prevocally, R.N.) laga[-]mx- (see note 7, R.N.), but Gashowu ?emix- (...CCdC-), 'swim with ...', composed of -mix- with ?e[-]p-, preconsonantal reduced stem of ?e·pi preconsonantally and prevocally ?epmix-.

In fact Newman does not mention an example of -mix- being attached to a stem the type of pa?ft, which he would list as CVCdC, pa?tit. This would be a case of one "dulled" vowel preceding another one. The only thing we can be sure of is that combined with lagaa-, the form is lagaamxit, because here -mx- stands in front of a vowel (in Newman's description i in -it, is a genuine vowel). This is in conflict with Archangeli's interpretation. If syllabification were cyclic, the form would have to be laga:mx, also prevocally. As mentioned the passage above is the only one where Newman speaks about alternation in the affix -mx-. If Archangeli states that her interpretation of the facts corresponds to that described by Newman, she should indicate what passage in Newman's text allows for this statement. As shown, the only passage on -mx- to be found in Newman's text disproves the alleged cyclicity. We therefore are forced to conclude that Archangeli's (and Kuroda's) interpretation of the facts is false and that the correct surface form should be pa?timxit.

But even if we admit this form for the sake of argument, cyclicity does not seem to be the way to derive it, because this leads to other problems. To see this, let us look at

---

6 By d in VCdV and CCdC Newman means the "dulled" vowel, which belongs to the class of "reduced vowel". These reduced vowels have been reanalysed as epenthetic by Kuroda and all linguists working on Yawelmani since. Newman indicated them, when using schemes, with lower case, while full vowels are written in upper case.

7 Newman actually uses a raised full stop, "•", to indicate a long vowel. By "[ ]" Newman means a shortened vowel. This process of shortening, which takes place before two consonants and before a single word final consonant, will be treated below.
the cyclic derivation Archangeli (1984: 193-195) gives of \textit{pa?imixit}. She assumes in accordance with the general assumptions in lexical phonology, that the first cycle starts in a derived environment, i.e., after the first morphological process.

(20) a. \textit{First Cycle}

underlying syllabification and core syllabification (11)

\[
\begin{array}{c}
\sigma \\
p a \; ? \; t \\
m \; x
\end{array}
\]

Epenthesis (12) and Core Syllabification (11)

\[
\begin{array}{c}
\sigma \\
p a \; ? \; X \; t \; X \; mX \; x
\end{array}
\]

Syncope Trees (15i)

\[
\begin{array}{c}
\sigma \\
p a \; ? \; X \; t \; X \; mX \; x
\end{array}
\]

Resyllabification (15ii)

\[
\begin{array}{c}
\sigma \\
p a \; ? \; X \; t \; X \; mX \; x
\end{array}
\]

Bare rime deletion (15iii)

\[
\begin{array}{c}
\sigma \\
p a \; ? \; X \; t \; m \; X \; x
\end{array}
\]

dead of the first cycle: \textit{pa?imix}

(20) b. \textit{Second Cycle}

underlying syllabification and core syllabification (11)

\[
\begin{array}{c}
\sigma \\
p a \; ? \; X \; t \; mX \; x \; t
\end{array}
\]

Epenthesis (12) and Core Syllabification (11)

\[
\begin{array}{c}
\sigma \\
p a \; ? \; X \; t \; mX \; x \; X \; t
\end{array}
\]

Syncope Trees (15i)

\[
\begin{array}{c}
\sigma \\
p a \; ? \; X \; t \; mX \; x \; X \; t
\end{array}
\]
Notice that at the end of the first cycle, the syncope trees are erased. The reason for this is that (1984: 194)

as noted in chapter 1, the trees are demolished at the end of the first cycle and structure is built anew. This is because the trees themselves have no phonetic correlates.

As we have seen above, the syncope trees have no independent motivation, which is of course the reason for (or is tautological to) having “no phonetic correlates”. Moreover, Archangeli implicitly claims that the underlying tree heads in hanaa and iyoo do not delete. It is difficult to see why the underlying tree heads in these suffixes do not delete, because they also do not have phonetic correlates. The reason why underlying elements or structures are normally not affected by structure changing rules is because of Strict Cyclicity, but it is precisely this principle which does not seem to be operative for the syncope trees.

In conclusion, it can be said that Archangeli’s Core Syllabification (11), Epenthesis (12) and Syncope (15) operate in a very complicated fashion, with even more over-insertion than in Kuroda’s framework. On top of that, besides lacking any empirical basis, the alleged cyclicity is theoretically problematic, because one has to assume that the syncope trees erected by Syncope (15) do not obey the Strict Cycle Condition: they are deleted at the end of every cycle even in underived environments.

Below, in section 4.4.1, when we present our own proposals on Yawelmani syllabification, we will show that if one assumes that regular syllabification is only postcyclic, epenthesis can be analysed as a result of this process. In this way, the fact noticed by Kisseberth (1969a: 37–38) (cf. also above), that the epenthetic vowel only shows up when it is required by syllable structure conditions, will find its natural explanation.

4.3.3 The template system

We now come to the template system of Yawelmani, as described by Archangeli (1983a, 1983b, 1984). In Yawelmani, the regular verb, which Newman refers to as the basic verb, consists of either two or three consonants. There are three possible consonant-vowel configurations, which are given here in (21).

(21) A1 A2 B
CVC(C) CVVC(C) CVCVV(C)
A1, A2 and B correspond to Newman’s classification. When combined with the majority of affixes, verbal stems take one of the forms listed above. Examples are given in (22).

<table>
<thead>
<tr>
<th>stem selected by the base</th>
<th>aorist (-hin)</th>
<th>passive aorist (-t)</th>
<th>gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA1 caw</td>
<td>cawhin</td>
<td>cawit</td>
<td>‘shout’</td>
</tr>
<tr>
<td>IA2 hiix</td>
<td>hexhin</td>
<td>heexit</td>
<td>‘be fat’</td>
</tr>
<tr>
<td>IB lagaa</td>
<td>lagaahin</td>
<td>lagat</td>
<td>‘spend the night’</td>
</tr>
<tr>
<td>IIA1 luKl</td>
<td>lukulhun</td>
<td>luKlut</td>
<td>‘bury’</td>
</tr>
<tr>
<td>IIA2 wuu?y</td>
<td>woo?uyhun</td>
<td>wo?yut</td>
<td>‘sleep’</td>
</tr>
<tr>
<td>IIB biniit</td>
<td>binethin</td>
<td>bineetit</td>
<td>‘ask’</td>
</tr>
</tbody>
</table>

In these forms the workings of several phonological processes in Yawelmani can be seen. A harmony process has taken place in the forms in IIA1 and IIA2. This process works directionally from left to right and rounds unrounded vowels if preceded by rounded vowels with the same specification for the feature [high]. The process has been formulated by Archangeli (1983b: 14, 1984: 33) as:

(23) Vowel Harmony (VH) [+round]  

Also, we can see the workings of the epenthesis process, formulated by Kuroda and Kisseberth as in (1), in the passive aorist forms of the verbs given under IA1, IA2, IIA1, IIA2 and IIB. In the cases of IA1 and IIA2, the inserted i’s have turned into u’s by the subsequent workings of VH. An i has also been epenthesised in the aorist form of IIA2, and has also subsequently been turned into u by VH.

Another process to be noted is Lowering, which lowers long high vowels. It is given here, in Archangeli’s (1984: 125) formulation, in (24).

(24) Lowering [a[high]] → [-high] / 

---

8 We have taken the vowel in aorist -hin, which Kuroda and Archangeli treat as epenthetic, as underlying, since it does not alternate with zero. In doing so, we can keep the derivations as transparent as possible.

9 These are intermediate forms, created by a morphological process according to one of the patterns given in (21).

10 Newman actually uses IA1, IA2, IB for biconsonantal verb roots and IIA1, IIA2, IIB for triconsonantal roots.
The workings of the process can be seen in the aorist and passive aorist forms of the verbs given as examples of types IA2 and IIA2. In the aorist form of the verb given as example of type IA2, the underlying \( ii \) has been changed to \( ee \) by Lowering. In the aorist form, \( ee \) has subsequently been turned to \( e \) due to the Shortening process given in (3). In the verb given as an example of type IIA2, the long \( uu \) has given rise to the harmony process, rounding high vowels in the following syllables, has then been lowered to \( oo \), and is finally shortened to \( o \) in the passive aorist case.

There are, however, a number of affixes which select a different consonant-vowel configuration for the verb stem than the one which, so to speak, 'belongs' to the verb in question. Examples are given in (25).

<table>
<thead>
<tr>
<th>stem selected by the base</th>
<th>desiderative-aorist</th>
<th>reflexive/reciprocal adjunctive</th>
</tr>
</thead>
<tbody>
<tr>
<td>IA1 caw</td>
<td>cawhatinhin</td>
<td>cawwseel-</td>
</tr>
<tr>
<td>IA2 hiix</td>
<td>hixhatinhin</td>
<td>hixwseel-</td>
</tr>
<tr>
<td>IB lagaa</td>
<td>laghatinhin</td>
<td>lagawseel-</td>
</tr>
<tr>
<td>IIA1 lu()l</td>
<td>lu()latinhin</td>
<td>lu()lwseel-</td>
</tr>
<tr>
<td>IIA2 wuu?y</td>
<td>wu?yatinhin</td>
<td>wu?oywseel-</td>
</tr>
<tr>
<td>IIB biniit</td>
<td>bintatinhin</td>
<td>bineetiwseel-</td>
</tr>
</tbody>
</table>

Archangeli gives the following account of the alternations of the verb stems in Yawelmani. She posits the three rules given in (26) (Archangeli 1983b: 356).

(26) a. insert CVCC  
   b. insert CVVC  
   c. insert CVCVVC  

The affixes which select a verb stem of their own carry a diacritic which triggers one of the rules in (26). The other affixes, like the aorist in (22), do not carry such a diacritic. Furthermore, according to Archangeli, the verbs themselves carry a diacritic triggering one of the rules in (26). This diacritic comes into action only if there is no affix with a diacritic of its own, otherwise the diacritic of the affix takes precedence by means of the Elsewhere Condition. One can thus speak of a 'default template' supplied by the verb. The \( h \) in \(-\text{hatn}-\) is present when it is preceded by only one consonant and is absent when preceded by two. We will come back to this in section 4.4.6.

11 We have taken here the reflexive/reciprocal adjunctive affix \(-\text{wsiil}-\), which is a non-final affix, to be in prevocalic position, or in a position followed by a consonant + vowel sequence. When in a position before a word-final consonant or before two consonants, the long \( ee \) is shortened to \( e \) due to the Shortening process for which Archangeli has formulated rule (11b).
In her 1984 dissertation, Archangeli has changed these rules to (27):

(27)  a. insert CxCC  
b. insert CxxCC  
c. insert CxCxxC

In (27), C's represent in, fact, unsyllabified slots of the skeleton while the x's are X's which are underlyingly syllable heads. After insertion of these templates, association takes place. The form caw- is taken here as an example (Archangeli 1984: 277).

(28)  a. c w  b. c w  c. c w  

\[
\begin{array}{ccc}
C & x & C & C + \\
a & & & \\
\end{array} \quad \begin{array}{ccc}
C & x & x & C & C + \\
a & & & \\
\end{array} \quad \begin{array}{ccc}
C & x & C & x & x & C + \\
a & & & \\
\end{array}
\]

In (28c), we see a second a attached to an x-position in the template. This is because Archangeli assumes a copying rule instead of a spreading rule. We will come back to this below, in section 4.4.4. Here the question is what happens to the final C in the template that is not linked to a segment. For this, Archangeli has to posit a specific rule of deleting this empty slot (1984: 278):

(29)  Slot Deletion  \( \times' \rightarrow \emptyset \)

The circle around the X' indicates that the slot is not linked to an element on the segmental tier. Archangeli has to assume that this rule precedes syllabification. This seems rather strange since she assumes syllabification to be an automatic process, applying at all times. The X' is not erased, however, if an affix of the type of -hatn- is added. In that case, we have the following representation, after the concatenation of the affixes (cf. Archangeli 1984: 280).

(30)  a. biconsonantal root  b. triconsonantal root

\[
\begin{array}{cccccccc}
\text{affix} & c & w & (h) & t & n & h & n \\
\text{&} & x & C & C & C & C & x & C & C & C \\
\text{root} & a & & & u & & & a \\
\text{template} & C & x & C & C & x & C & C & C \\
\text{&} & a & & & u & & & a \\
\end{array}
\]

It was for the alternation involving the h in -hatn- that Kisseberth formulated rule (2) in chapter 1, which we repeat here as (31).

\footnote{In order to allow her rule of Vowel Harmony (23) to operate, Archangeli assumes that the vocalic and consonantal segments are on different tiers.}
As mentioned, Kisseberth sees this rule as part of a conspiracy to avoid triconsonantal clusters. Given the fact that this restriction clearly has to do with syllable structure, it would be preferable to account for it in a syllable related way. However, this has not been done by Archangeli. In her theory it is merely accidental that the templates are all triconsonantal. This is in no way related in the theory with the fact that the verbs have either two or three consonantal segments. Slot Deletion (29) also seems ad hoc, given the fact that this deletion is at variance with the rest of Archangeli’s analysis of the morphology and phonology of Yawelmani, in which empty slots are filled by association and spreading.

We must now look at how the V’s in (26) (or the x’s in (27)) are linked with elements on the segmental (or melodic) tier. According to Archangeli (1984: 121-132) this is done by the copying rule in (32) and the syllable internal spreading rule in (33).

(32) **Copy**

(33) **Syllable Internal Spread**

\[
\emptyset \rightarrow [\text{F}] / [\text{F}] \\
\]

An example of the workings of these processes is given in (34), where the application of the rules in (27c) and the subsequent application of the rules of Copy (32), Syllable Internal Spread (33) and Lowering (24) are shown.

(34) a. underlying form

b. Template Insertion (27c) and universal association

c. Copy (32) and universal association

d. Syllable Internal Spread (33)

e. Lowering (24)

For the related dialect of Gashowu, Archangeli (1984: 133-134) assumes a spreading rule instead of the Copy rule (32), cf. (35):
This she does to account for the fact that in Gashowu, in a form with the shape CVCVVC the first vowel is also lowered. This can be achieved in the simplest way if it is assumed that the x's (or V's) in such a form are linked to a single feature matrix. The derivation for (34) in Gashowu would thus be as in (36).

\[ \text{(36) a. underlying form} \]
\[
\begin{array}{c|c|c|c|c|c}
| & | & C & x & C & x \\
\hline
| & | & i & & & \\
\hline
\end{array}
\]

\[ \text{b. Template Insertion (27c)} \]
\[
\begin{array}{c|c|c|c|c|c|c}
| & | & | & C & x & C & x & C \\
\hline
| & | & | & i & & & \\
\hline
\end{array}
\]

\[ \text{c. Spread (35)} \]
\[
\begin{array}{c|c|c|c|c|c|c}
| & | & C & x & C & x & C \\
\hline
| & | & i & & & \\
\hline
\end{array}
\]

\[ \text{d. Lowering (24)} \]
\[
\begin{array}{c|c|c|c|c|c|c}
| & | & C & x & C & x & C \\
\hline
| & | & | & e & & & \\
\hline
\end{array}
\]

4.3.4 Vowel Elision

The rule of Vowel Elision which Kuroda has formulated as in (1), is reformulated by Archangeli as in (37) (1984:196).

\[ \text{(37) Vowel Elision} \]
\[
\begin{array}{c|c|c|c}
| & | & \sigma \\
\hline
X & X & \Rightarrow \emptyset \rightarrow \_ \_ \_ \_ \_ \_ \_ X \\
\hline
\end{array}
\]

Since according to Archangeli there are no morphemes which end in a short rhyme the rule need not be complicated to also delete short rhymes. Examples of the functioning of this rule can be seen in (38) (Archangeli 1984:196-197).

\[ \text{(38) a. wilaldihni? < will + CXCxxC + d(aa) + ihnni} \]
\[ '\text{one who is always preparing to depart (subj.)}' \]

\[ \text{b. hoyinhin < hoyoo + in + hn} \]
\[ '\text{was named}' \]
Notice that Archangeli's rule (37) is far more complicated than Kuroda's rule (1). This complication is a result of the theory she uses, since she has to refer to the fact that the two X's that are to be deleted have to be linked to the same element on the (vocalic) segmental tier. Not referring to that tier would result in e.g., the first element of a long vowel being deleted. Of course, the deletion of vowels before other vowels can be seen in connection with the fact that Yawelmani allows neither hiatus nor diphthongs. In other words, this is directly connected to conditions on syllable structure. It is in fact part of the great "conspiracy" in Yawelmani. If we reverse the relationship between syllable structure and rules, and suppose that these rules are in fact the result of conditions on syllable structure, rules like the one in (37) would not be needed in this form in nonlinear phonology.

4.4 Syllabification in Yawelmani

4.4.1 The syllabification parameter settings and the processes of epenthesis, vowel elision and shortening

After having treated the proposals by Kuroda/Kisseberth and Archangeli, we now come to our own theory. We assume that syllabification in Yawelmani proceeds as follows:

(39) syllabification parameter settings for Yawelmani
    a. geometry parameter setting: three places
    b. obligatory incorporation parameter setting: C's and V's
    c. directionality parameter: RL
    d. cyclicity parameter: off

Comparing the above parameter settings with the ones of Tonkawa, we see that Yawelmani syllabification differs from Tonkawa syllabification on two points: the obligatory incorporation parameter, which is set to C's and V's, as well as the cyclicity parameter, which is set to 'off' here.

The fact that the geometry parameter is set to three places means that every time a syllable is projected onto the existing skeletal structure, three nodes are projected, regardless of the fact whether they can be connected with skeletal slots or not. The possible syllables of Yawelmani are given in (40).

(40) a. CV  b. CVC  c. CV: (CVₜVₜ)

The expression of the possible syllable in Yawelmani is:
We see here that the third position of the Yawelmani syllable, the coda, is subcategorized for consonants. The reasons why we analyse Yawelmani syllable structure in this way and do not allow for a structure like in (42) are several. In (42), the coda is not subcategorized for consonants.

One reason is that diphthongs are not allowed in Yawelmani. This prohibition is difficult to express if structures like the one in (42) are allowed: it would be of an extreme specificity (the V dominated by the Coda node should be linked to the same element on the vocalic melodic tier as the V dominated by the nucleus), whereas otherwise the Coda would be very liberal as to the choice of segments it may contain. It does not matter whether the element is a C or a V. If it were a C, there would be no restriction on the nature of the element on the consonantal tier which the C dominates. A further argument against (42) is that a CVVC syllable does occur in Yawelmani in some exceptional cases. A final reason is that the syllabically conditioned alternations to be treated in section 4.4.6 below cannot be explained in a syllabic framework if it is assumed that the third position of the syllable may contain a V. (Cf. the -hnül-case in (90), below).

Although according to (41), the nucleus may be empty, a nucleus filling epenthesis rule which fills empty nuclei is operative in Yawelmani.

Recall that the term Nucleus is used here only as an abbreviation for a geometrical position in the syllable, which is subcategorised for vowels. In (43), N thus means an
empty second position in the syllable. As with the German glottal stop insertion rule (15) of chapter 1, which inserts a glottal stop in an empty onset, this rule need in fact not be stated as an specific rule. It need only be stated that the V dominating i is the default value for the nucleus in Yawelmani.13

Let us now look at how the rule of Epenthesis works in conjunction with the syllabification mechanism. For this, we take the underlying forms for the two examples given in (13), (14). (In contrast to Archangeli, we assume that the underlying forms have no syllabic structure at all).

underlying forms

(44) a. C V C C C C
     p ? t h n
     a
(45) a. C V C C C C
     p ? t t
     a

syllabification (39)

(44) b. σ σ σ
       O N Cd O N Cd O N Cd
       C V C C C C
       p ? t h n
       a
(45) b. σ σ
       O N Cd O N Cd
       C V C C C C
       p ? t t
       a

Here, the nodes Coda, Rhyme, Onset are projected from right to left onto the skeleton. Because of the conjecture mentioned in chapter 1 (cf. (30) and (31) in chapter 1 and subsequent discussion) that the linking conventions of autosegmental phonology apply, the subsyllabic nodes are linked to skeletal slots wherever possible (viz. wherever permitted by the templates in (41), which are in fact positive output constraints for syllabification). The empty subsyllabic nodes in (44b, 45b) are the result of the fact that the nucleus (or, more correctly in geometrical terms, the second position in the syllable) cannot be linked to a consonant, and that the coda (or third position) cannot be linked to a single vowel. After syllabification, Epenthesis (43) takes effect, and the following form is produced:

13 We may go one step further and say that V is the default value for the nucleus (in fact the only possible value) and i the default value for V. In this way, the filling of an empty nucleus is analysed as the result of two successive local level processes, one filling a nucleus with V and a second one filling a V with i. These default value assignments should be late processes. Unsyllabified empty V's which, as we will see in section 4.4.5 (see (101b) and note 22, below), may result from certain processes in Yawelmani, have already been deleted by the convention of stray deletion before default value assignment applies. See chapter S, section 5.6 for a similar two-step default assignment to empty nuclei in German, where the default value of V is ø.
Epenthesis (43)

(44) c. \[ \sigma \quad \sigma \quad \sigma \]
\[ C \quad V \quad C \quad C \quad V \quad C \]
\[ a \quad ? \quad t \quad h \quad n \]

(45) c. \[ \sigma \quad \sigma \]
\[ C \quad V \quad C \quad C \quad V \quad C \]
\[ a \quad ? \quad t \quad i \quad t \]

phonetic outcome

(44) d. pa?i??in
(45) d. pa?i??it

We thus see that our very general rule of epenthesis, which refers exclusively to a subsyllabic node, can predict the exact epenthesis sites, without over-insertion. Recall that Kuroda's analysis over-epenthesises (and subsequently deletes the superfluous vowel in the form in (44) (cf. (10) of chapter 1) and that in Archangeli's analysis there is over-epenthesis and deletion in both (44) and (45) (cf. (13,14)). If syllabification were to take place from left to right, the ensuing syllabic structure for (44) would be:

(44) e. \[ \sigma \quad \sigma \quad \sigma \]
\[ C \quad V \quad C \quad C \quad C \]
\[ a \quad ? \quad t \quad h \quad n \]

phonetic outcome, after epenthesis (43): (46) *pa?i??in

We thus see that because of the RL directionality, the correct epenthesis sites are produced.14 Another, theoretical reason for the RL directionality is that the reverse direction, LR, would give rise to complications. If the mechanism applied from left to right, and encountered a postvocal C, it could not be determined to which syllabic node this element should be connected. For this, it would have to be known whether

14 Archangeli (1984: 186, fn. 32), referring to Noske (1985), rejects our analysis of directionality of syllabification as an explanation for Yawelmani Epenthesis. However, in later papers (1989: 3-4, 1991: 235, 245), Archangeli has adopted this position, this time without reference to our 1985 analysis: “Syllabification (...): map from right to left” (1989: 3). “... in Yawelmani syllabification is from right to left” (1991: 235). “The effect of epenthesis in Yawelmani is to allow syllabification of consonants which cannot otherwise syllabify, a straightforward prosodic function. As such epenthesis is best represented as a result of syllabification itself” (1989: 4). “… [Yawelmani] epenthesis is not the result of a separate rule, but rather is intrinsic to the general syllabification process in the language” (1991: 245). Unfortunately, in these papers, she uses Hayes’ moraic model of syllable structure, which, as demonstrated in chapter 2, is flawed.
the element following the C was a C, or a V. In the first case, the C would be assigned to the coda (of the former syllable), in the second case to the onset (of the latter syllable). This means that the mechanism would have to look ahead. Application from right to left, however, yields no such problems. In that case, the mechanism will project an onset and link it with C, if the last projected node was a nucleus, and it will project a right coda and link it with C, if the last projected node was an onset. Recall from (41) that the first node of the syllable, (for mnemonic reasons referred to as onset) cannot be empty, hence the situation in (47) cannot occur.

\[
(47) \quad * \quad \sigma \quad \sigma
\]

\[
\begin{array}{c}
\text{Cd} \\
\text{O} \\
\text{N} \\
\text{C} \\
\text{C} \\
\text{v} \\
\text{v}
\end{array}
\]

The third reason for the RL directionality is the vowel elision phenomena in Yawelmani, for which Kuroda has formulated the rule in (1), and Archangeli the rule in (37). In our theory this elision can be explained in a principled way. Let us consider what happens when a vowel is preceded by another vowel. When the rightmost vowel has been syllabified, i.e. the nucleus node has been linked with the V, the onset is projected. However, there is no C to which this node can be linked, which the templates in (41) require. We propose that in this case an emergency measure of the same category as the ones proposed for Tonkawa (cf. (21) of chapter 3) be taken. As in Tonkawa, these measures consist of an operation that is normally not available to the language, but which is an option in Universal Grammar. In situations where otherwise no solution is available these recessive operations become available to a particular language for which they are normally unavailable. We propose that here the emergency measure consists of the skipping of V's, by the syllabification mechanism:

\[
(48) \quad \text{measure taken when syllabification fails}
\]

If the right-to-left applying mapping mechanism which establishes one-to-one links between the subsyllabic nodes and the skeletal elements reaches an onset node (on the subsyllabic node level) and a V (on the level of the skeleton), and as a result the linking is blocked by the syllable structure conditions expressed in the templates in (41), then it should ignore the V and try to link the next skeletal element to the left.

This is normally not allowed in Yawelmani, but it is permitted in Tonkawa as we have seen in chapter 2, because in that language, V's are not syllabification triggering elements. Let us see how this exceptional skipping of V's takes place. For this we take the example in mentioned above in (38b), [hoyinhin] \(< /hoyoo+in+hn/>. 
The structure in (49b) shows the stage of the syllabification process when the onset of the second syllable from the right should be linked with a C. It is at this point that emergency measure (48) comes into play. By virtue of (48), the two Vs are skipped.

In (49c), the coda is not linked to a skeletal slot, because there is no suitable element available (which are either a C or the rightmost V of a long vowel). In contrast to the onset node, the coda node may be empty according to the templates in (41). Because the two rightmost Vs of the stem were skipped by the syllabification, they are not phonetically realised.

Note that we cannot simply state that in Yawelmani the vowels are not triggers of syllabification. In contrast to Tonkawa, word final vowels preceded by VC are not deleted, which they otherwise would be.

The same explanation as was given for vowel elision can be given for the shortening phenomena, for which Kuroda has given the rule in (3), and which Archangeli has integrated into her Rime Formation/Shortening (11b) by means of the delinking of the syllable node and the second V. We show here the functioning of our syllabification (39) in conjunction with emergency measure (48) employing the example used by Kuroda, given in (4) and repeated here as (50).
In (50b), after the rightmost V has been linked to the nucleus node, syllabification comes to a standstill because the onset cannot be linked to the second V. Then, emergency measure (48) takes effect, the second V is skipped and the onset node is linked to the following C.

We thus see that by positing emergency measure (48) we have been able to capture two apparently disparate phenomena of vowel alternation in Yawelmani, and to relate them to syllabification.

4.4.2 Excursus on the syllabic processes in Tigrinya

We have seen above that in Yawelmani the direction of syllabification determines the exact epenthesis site in a sequence of consonants (i.e. C \( \{C\} \)). It also determines which vowel out of two adjacent vowels is deleted. Because of the RL directionality, it is the leftmost vowel that is deleted. As we have seen in chapter 3, this latter argument also pertains to the vowel deletion phenomena in Tonkawa. With the general assumption that syllabification takes place directionally (see section 1.5 of chapter 1), the setting of the directionality parameter will determine in which direction syllabification actually takes place. Below we will show that there is a language not unlike Yawelmani in the relevant respects, in which syllabification indeed takes place in the LR direction. Tigrinya, a South Semitic language of northern Ethiopia, possesses an epenthesis process which can operate word-externally as well as word-finally. Pam (1973) mentions two different rules, which he later combines. The first rule is given in
(51) (1973: 116):

(51)  \( \emptyset \rightarrow \iota \) / CC\( \_\_\_\_\_\)(C)\# \\

The functioning of this rule can be seen in (52) (1973: 114):

(52)  

a. /kalb+n/ [kAlb+n] 'dog' + suffixed conjunction 

b. /kalb/ [kAlbi:] 'dog'

In (52b) the \( \iota \) has been lengthened by a rule given in (53) (1973: 115):

(53)  \( \iota \rightarrow \iota / \_\_\# \)

The second epenthesis rule is given in (54) (1973: 111):

(54)  \( \emptyset \rightarrow \iota / \#C\_\_\_\_\_ \)

An example of the functioning of this rule can be seen in (55):

(55) /sbar/ [sibAr] 'break'

Pam combines these two rules as in (56) (1973: 117):

(56)  \( \emptyset \rightarrow \iota / [-\text{syl}] [-\text{syl}] \_\_ [-\text{syl}] \)

Pam thus has to resort to the feature specification [-syl], i.e. he has to treat word boundaries on a par with consonants. He thus has to specify these elements negatively with regard to their syllabicity. This is not very satisfying, for in fact word boundaries and consonants have nothing in common. Word boundaries refer to the way segments are organised, while consonants are segments themselves. In modern phonological theory, the organisational aspect is expressed in hierarchical structure. The only thing that 'boundaries' and consonants have in common is, as we will see, that they can have a similar impact on syllabification. Their 'similarity' is thus one of function, not one of substance. This is the reason why phonologists have stopped referring to word boundaries as [-syl] (In fact, this feature has been abolished altogether, because its specification expresses whether or not an element is the peak of the syllable, something which is expressed precisely by hierarchical syllabic structure).

One can now ask the question whether in Tigrinya, as in Yawelmani, the epenthesis process can be analysed as the result of the process of syllabification. For this, it is necessary to know what the maximal syllable in Tigrinya is, and whether epenthesis takes place only if the process of syllabification is confronted by an otherwise unsyllabifiable sequence.

The answers to both questions are straightforward: the syllable structure of Tigrinya is CV(V)(C), the maximal syllable thus being CVVC, and Epenthesis operates only in those structures where otherwise a more complex consonantal syllabic structure than CVVC would ensue.
We can now see that the rules in (51) and (54) can be dispensed with if we assume a left-to-right syllabification, in the same way as the right-to-left syllabification in Yawelmani we proposed above: if during syllabification a nucleus is projected and then a C is encountered by the syllabification mechanism, the nucleus V is left empty, and later filled by the neutral vowel (in the case of Tigrinya an \( \bar{V} \)). Cf. the derivations (57) and (58) for the forms in (51) and (55) respectively:\(^{15}\)

<table>
<thead>
<tr>
<th>underlying forms</th>
<th>left to right syllabification</th>
</tr>
</thead>
<tbody>
<tr>
<td>(57) a. ( {\text{C V C C}} )</td>
<td>(57) b. ( {\text{O N Cd O N Cd}} )</td>
</tr>
<tr>
<td>b. ( {\text{k l b}} )</td>
<td>b. ( {\text{k l b}} )</td>
</tr>
<tr>
<td>(58) a. ( {\text{C C V C}} )</td>
<td>(58) b. ( {\text{O N Cd O N Cd}} )</td>
</tr>
<tr>
<td>b. ( {\text{s b r}} )</td>
<td>b. ( {\text{s b r}} )</td>
</tr>
</tbody>
</table>

(An explanation will be given shortly for the fact that the coda of the first syllable in (58b) is left empty, and that C dominating \( b \) is linked to the onset of the second syllable.) If we adopt such an analysis of Tigrinya epenthesis as a result of syllabification, we can express this major process in a unitary way, without having to resort to references to \([-\text{syll}].\) The only difference from the Yawelmani case is that the directionality of syllabification is reversed.

Not only does the epenthesis process provide motivation for the directionality of the syllabification process, but this is also the case with a process of vowel deletion, operating in an opposite fashion to Yawelmani and Tonkawa. This is formulated by Pam (1973: 76) as in (59).

(59) **Vowel Elision** (Pam 1973: 76)

\[ V \rightarrow \emptyset / \left[ \bar{V} +\text{long} \right] \]

---

\(^{15}\) Like in Yawelmani, we have represented the vowel and consonant melodies on different tiers here. We have done so in analogy to the similar representation used by McCarthy (1979b, 1981), bearing in mind the pervasiveness of the morphological 'binyam' system (which McCarthy analyses) throughout the Semitic languages. The configuration, however, is not crucial to the point we are making here.
The structural description of this rule is the mirror image Archangeli's rule (37) for Yawelmani (if we reformulate it in a linear way) and the near mirror image of Kuroda's rule (1) for Yawelmani (the only difference being its requirement that the vowel be long, which follows from the fact that Tigrinya allows two V's in a closed syllable (the two V's represent a long vowel or a diphthong)). An example of the application of rule (59) is given in (60) (Pam 1973: 77):

(60) Base r i?s
    a* - prefixation a+
    Infixation a:
    Vowel Elision Ø
    Output a+ra:i?s 'heads'

This form surfaces as [ʔara:ʔi?s]. (The place where the epenthesis takes place seems to contradict rule (51), as well as our reanalysis of it. However, Pam (1973: 17-18) points out that the epenthesis site is exceptional and is restricted to the class of words to which the form in (60) belongs, thus there seems to be a morphological conditioning here.)

We will come back to the fact that C dominating b in (58) is linked to the onset of the second syllable and in conjunction with this, we will make a final point concerning the directionality here. Given the presence of directionality in the syllabification mechanism, one would expect it to be right-to-left rather than left-to-right because of the fact that in the latter case, the mechanism has to look ahead. To see this, it is necessary to consider what happens if when going from left to right a third position (coda) in the syllable is imposed, this C will be linked to this node. However, if like in Yawelmani the onset must be obligatorily filled, the mechanism has to ‘know’ whether the C is followed by a C or a V. In this latter case it would leave the coda empty, and link the C with the following onset that will be projected. This is the situation in (58). The mechanism has to look ahead in its direction of application (i.e., rightward). Syllabification in the reverse direction, however, yields no such problems, and the mechanism can be kept as simple as possible. The right-to-left directionality thus constitutes the unmarked case. In fact the so-called maximal onset principle (which has been shown to be very general but not universal, see e.g. Kiparsky (1979), for counterexamples from Finnish) could be related to this markedness principle.

This conjecture seems indeed to be confirmed by the facts. There are many CVC languages where — {C} is the environment for syllable repair. A situation such as the one in Tigrinya, however, where the environment for syllable repair could be formulated as [{C}], seems to be very rare, and must be assumed to be the marked case. This conjecture is confirmed if we look at the situation in languages closely related to Tigrinya, e.g., Tigre. In Tigre, the equivalent of (52b) is as in (61):

(61) [kɑlib]
This form is also found in other related languages. Hence it must be concluded that in Tigre, syllabification takes place from right to left, in the unmarked direction, and that Tigrinya is exceptional in its left-to-right syllabification. We will come back to the question of the markedness of the direction of syllabification in chapter 6, section 6.7, when we treat syllabification in French.

4.4.3 Verb stem morphology

4.4.3.1 Mora insertion and translation

We now come back to the morphological alternations of the verb stem. We gave a summary Archangeli's analysis of these alternations in section 4.3.3. Recall (see (26)) that Archangeli posits three templates for Yawelmani verbs, viz. CVCC, CVVCC and CVCVVC. If we take a closer look at the different templates, it seems that it is the syllable structure that is different for the templates. Using the same trinodal syllable type as the one which shows up postlexically, we can distinguish three syllabic patterns, (cf. 62).

\[
\begin{align*}
\text{(62) a. } & \sigma (=A1) \\
\text{ON Cd} & \\
\text{CV C C} \\
\text{b. } & \sigma (=A2) \\
\text{ON Cd} & \\
\text{CVV C C} \\
\text{c. } & \sigma \sigma (=B) \\
\text{ON Cd} & \\
\text{CV} & \\
\text{CVV C C}
\end{align*}
\]

(The final C's have not been incorporated, because they cannot be not incorporated in the syllabic structure, cf. the conditions on syllable structure in (41)). However, as we have shown in the syllabification parameter settings (39), regular syllable structure is assigned only postlexically, while the morphological alternation of the verb stem must be a lexical process since it is determined by the affixes with which the verb stem is combined. Therefore, we should assume that the syllable structures as depicted in (62) are not yet present at the time of the working of the process determining the stem alternation. They are merely the (postlexical) result of it.

What, then, is the exact nature of this alternation process? If we take a close look at (62), we see that these forms differ in the quantity of the vowels. More correctly, we can say that they differ in the quantity of realisation of the single vowel value, as this the two V's in (62b) and the three V's in (62c) should be linked to the same vowel (see section 4.3.3). Hence it seems that we are faced here with a lexical process of specification of quantity.

Therefore, it is our conjecture that this morphological process does not involve templates on the CV-tier (as Archangeli (1984) does), but the specification of quantity in some prosodic form. This is in line with the proposals in Kaye & Lowenstamm (1986) and McCarthy & Prince (1986), where morphological processes involving bin-
yanim and reduplication (on reduplication, see section 1.4 of chapter 1) are viewed as the insertion of specific syllable types. It was shown in chapter 2 that quantity can be expressed in moras (although, as also demonstrated in that chapter, moras cannot directly be a building stone of syllable structure, but can be translated into it).

The three patterns CV(C), CVV(C) and CVCV(C) can clearly be characterised as mono-, bi- and trimoraic forms respectively, where only V's but not C's can count as moras. This represents one of the options for mora counting languages, the other being that both V's and C's can count as moras (see e.g., Hayes 1989). The root type A1, CV(C), is a verb root consisting of a light syllable (one mora), root type IA2, CVV(C), is a verb root consisting of a heavy syllable (two moras) and root type B, CVCV(C), is a verb root consisting of a light syllable followed by a heavy syllable (one mora plus two moras). Specifying full syllable types instead of moras would seem to introduce a redundancy, because if the quantity specification is known, the specific syllable type can be predicted, on the grounds of the regularities in syllable structures stated in the grammar. Hence, it can be concluded that only the number of moras must be specified.

However, recall from chapter 2 that the direct representation of moras into syllabic structure leads to fundamental problems with respect to the nature of representations. More specifically, it was shown in section 2.3.1, that the inclusion of moras into the syllable makes the model unrestrictive and unspecified in the number of dimensions. Therefore, we have to reject the idea that the moras specified in the morphology of the Yawelmani verb are themselves included in the syllable structure at some stage in the derivation. Instead, a mechanism should be operative, translating moras into syllable structure. This is the logical counterpart of the interpretative mechanism which should exist translating syllable structure into metrical quantitative structure, the necessity of which was demonstrated in chapter 2.

Our specific proposal is the following. The inserted templates in Yawelmani are assumed to be quantity specifications of one, two and the moras respectively. The A1, A2 and B templates can be assumed to look as follows ($\mu = \text{mora}$):

\begin{align*}
\text{(63) a.} & \quad \text{assign } \mu \quad (\text{A1}) \\
\text{b.} & \quad \text{assign } \mu \mu \quad (\text{A2}) \\
\text{c.} & \quad \text{assign } \mu \mu \mu \quad (\text{B})
\end{align*}

The morphological rules in (63) express that diacritics of the affixes (or, by default, the ones of the roots) either supply a light syllable, or a heavy syllable with a long vowel, or a combination of these two syllable types in light-heavy pattern.

Since only V's count for quantity, and V's in Yawelmani are always dominated by the nucleus, we can conceive of the quantity assignment in Yawelmani assignment of nucleus nodes. We assume the following two rules, which translate moras into nuclear structure:
a. Heavy Nucleus Assignment

\[
\mu \mu \rightarrow \begin{array}{c}
\wedge \\
\lor \lor
\end{array}
\]

b. Light Nucleus Assignment

\[
\mu \rightarrow \begin{array}{c}
\lor
\end{array}
\]

These rules are intrinsically ordered. The structural description of (64a) properly includes the one of (64b) and is therefore more specific. Therefore, the Elsewhere Condition, a principle first proposed by Kiparsky (1973) that gives priority in application to the more specific rule if we are faced with two rules competing to apply to a form, will decide which rule applies. Because the SD of Heavy Nucleus Assignment (64a) is more complex, this rule will apply if its SD is met (i.e., if there are two moras), and Light Nucleus Assignment (64b) will not be able to apply because structure has already been erected.

Like all prosodic structure assignment, this morphological (partial) syllable structure creation algorithm applies directionally. We posit that it applies from right to left. Hence in a specification of three moras, because two moras are found first a heavy nucleus is created by virtue of Heavy Nucleus Creation (64a). Then, only one mora has not yet been 'translated' into a nucleus structure and only Light Nucleus Assignment (64b) can apply. This produces the light-heavy pattern. In the case of the three possible configurations, the following partial syllable structures are formed for \( \mu \), \( \mu \mu \), and \( \mu \mu \mu \) stems respectively.

(65) a. \( A1 (= \mu) \)

<table>
<thead>
<tr>
<th>N</th>
<th>\lor</th>
<th>\lor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>\lor</td>
<td>\lor</td>
</tr>
</tbody>
</table>

b. \( A2 (= \mu \mu) \)

<table>
<thead>
<tr>
<th>N</th>
<th>N</th>
<th>\lor</th>
<th>\lor</th>
<th>\lor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>\lor</td>
<td>\lor</td>
<td>\lor</td>
</tr>
</tbody>
</table>

c. \( B (= \mu \mu \mu) \)

<table>
<thead>
<tr>
<th>N</th>
<th>N</th>
<th>\lor</th>
<th>\lor</th>
<th>\lor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>\lor</td>
<td>\lor</td>
<td>\lor</td>
</tr>
</tbody>
</table>

4.4.3.2 Unification with syllable structure

Let us now consider how these partial structures can be mapped into full structures, using the syllabification conditions of Yawelmani. Recall that the syllable structure conditions are expressed through the template in (41). We repeat them here as (66).

(66) Yawelmani syllable

\[
\sigma
\]

\[
\sigma
\]
Let us assume that if the morphological partial syllable structures as in (65) have been assigned, these syllable structure conditions are applicable. (We thus make the simplest assumption possible, i.e., that the syllable structure conditions applicable on the syllables formed by morphology are identical to the ones formed in the postlexical part of phonology.) Notice that the nucleus structures in (64) are partial syllable structures. They do not violate the syllable structure conditions, they are just incomplete. Minimal full structures corresponding to (65a,b,c), are respectively (abstracting away from the melody):

\[
(67) \quad \sigma_a \quad \sigma_b \quad \sigma_c
\]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>N</td>
<td>Cd</td>
</tr>
<tr>
<td>C</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>N</td>
<td>Cd</td>
</tr>
<tr>
<td>C</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>N</td>
<td>Cd</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>N</td>
<td>Cd</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Because of the conditions in (66), the structures in (65) should be supplemented by a higher structure including the syllable node, and material in the onset.

We will assume here that there is a unification mechanism in grammar which combines partial structures with independently stated requirements on syllable structure (the syllable structure conditions). We call this mechanism unification. The notion as we use it here has been inspired by a branch of computational syntax, i.e., unification grammar (Shieber 1986 and Carlson & Linden 1987).\(^1\) There are two logically necessary formal properties to unification which are important here. First, all information contained in the parts which are combined are retained (no information is deleted or lost; otherwise unification would not be a simple mechanism or process). This is called the monotonic character of unification. Second, the result of the unification should be the same no matter from which of the two items to be combined unification starts (otherwise unification would not be a simple combination but a specific structure creation). This property is called commutativity.\(^2\)

The syllable structures in (65) resulting from the Heavy and Light Nucleus Assignments (64) are unified with the independently motivated regularities. The result is the creation of the structures in (67). This unification is possible because, as mentioned, the structures in (65) do not contradict the syllable structure conditions in (67). They only display a partial syllable structure. Hence structure creation through unification can take place, because it is monotonic.

Once this has happened, unification takes place again: it combines the underlying verb root and the syllable structures in (67). We take two verb roots in (22), a biconsonantal one and a triconsonantal one, as examples. We assume that segments are linked to skeletal slots underlyingly. In this way, in contrast to Archangeli's analysis, we do not have to treat the vowel stems and the affixes in a fundamentally different way.

---

\(^1\) See Wiese (1990) for an application of unification grammar to phonology.

\(^2\) For a discussion of the requirement of commutativity, see Carlson & Linden (1987: 113).
In the case of (69a), another association convention applies than the spreading as shown in (70), and it applies between different tiers. Here, the C will map to the empty third position of the syllable, labelled coda, and the IA verb stem caw is the outcome:

(71) Mapping between the skeleton and coda in (69a):

In (70a), mapping of C to coda position cannot take place because the syllable structure condition expressed in (41b) (repeated in (66b)) would otherwise be violated.

If unification is from right to left, the outcome can be totally different. There are two possibilities here: the unification could start with the rightmost V's if one started from the skeleton in the syllable structures in (67) or with the rightmost C if one starts from the skeleton in the verb roots in (68):

(72) a. right to left unification of (67a) and (68a), starting with the skeletal elements in the syllable structure

b. right to left unification of (67a) and (68a), starting with the skeletal elements in the verb root.
The forms in (68) have to be unified with the structures in (67). In contrast to mapping as part of regular syllabification, here elements should be unified (fused), and not associated, because the skeleton is present in both the underlying forms (68) and the syllable structures in (67). This fusion can take place again through the principle of unification. Thus, a C in (68a,b) fuses with a C in (67a,b,c) if the structures which they are part of are unified with each other.

Again the question of directional application should be raised here. In principle the application of the fusion could go in either direction, from left to right or from right to left. We will demonstrate here that the actual direction of application is from left to right. We show what happens if unification takes place from left to right, and when it takes place from right to left. We start with the biconsonantal verb root in (68a).

4.4.3.3 Biconsonantal verb roots

(69) Left to right unification of (68a) and (67a,b,c)

Then, spreading from the melody to the skeleton takes place in (69b,c) linking a to the Vs unlinked to the melody. This produces the IB and II verb stems, viz. caaw and cawaa respectively.
In the case of (69a), another association convention applies than the spreading as shown in (70), and it applies between different tiers. Here, the C will map to the empty third position of the syllable, labelled coda, and the IA verb stem caw is the outcome:

(71) Mapping between the skeleton and coda in (69a):

In (70a), mapping of C to coda position cannot take place because the syllable structure condition expressed in (41b) (repeated in (66b)) would otherwise be violated.

If unification is from right to left, the outcome can be totally different. There are two possibilities here: the unification could start with the rightmost V's if one started from the skeleton in the syllable structures in (67) or with the rightmost C if one starts from the skeleton in the verb roots in (68):

(72) a. right to left unification of (67a) and (68a), starting with the skeletal elements in the syllable structure

b. right to left unification of (67a) and (68a), starting with the skeletal elements in the verb root.
We see here that RL unification starting from the verb roots (which have a C at their right edge) produces the wrong result, but not unification starting from the syllable structures in (67) (which have a V at their right edge). In that case, the outcome (after spreading and mapping between the skeleton and the coda, shown in (70) and (71)), would be the same as after unification from left to right. Note that, in this case, it was necessary to specify from which structure – the verb root or the syllable structure – unification starts. We will come back to this below.

Consider now right to left unification of the trimoraic syllable structure in (67c) and the biconsonantal verb root in (68a).

Here, right to left unification would not link the first leftmost C of the syllable structure (67c) to the first C of the verb root (68a). The outcome would be (after spreading of both $a$ and $c$ (recall that vowels and consonants are on different planes, so both can spread) and mapping to the coda node) $\ast$cacaaw. The real outcome is cawaa.
(74) b. *right to left unification of (67c) and (68a), starting with the skeletal elements in the verb root*

\[
\begin{align*}
\text{O N Cd} & \quad \text{O N Cd} \\
\text{CV} & \quad \text{CVV} \\
\text{Cv} & \quad \text{cv} \\
\text{a} & \quad \text{w}
\end{align*}
\]

This would produce, after spreading of the *a* in the melody the the two *V* positions on the skeleton, the correct form *cawaa*.

If we now look at right to left unification for the mono-, bi- and trimoraic syllable structures in (67a,b,c) respectively, we see that the correct form is produced if unification starts from the syllable structures in the case of mono- and bimoraic syllable structures (hence with the *V*s, because these syllable structures have a *V* at their right edge on the level of the skeleton), cf. (72), (73). In the case of trimoraic structures however, the correct form is produced if unification starts from the verb root (and hence starts with unifying the rightmost *C*s, because the rightmost skeletal element of the verb root is a *C*).

This shows that it is not possible, if one assumes right to left unification, to stipulate from which structure unification should start. Apart from this, such a stipulation would go against the requirement of commutativity, which was mentioned above in section 4.4.3.2. Right-to-left unification would not be *commutative*, i.e., the result would depend on the order of combination.\(^{18}\)

### 4.4.3.4. Triconsonantal verb roots

We will now briefly show that for the triconsonantal verb roots in (68b), left to right unification with the mono-, bi- and trimoraic syllable structures in (67) is also the only possible solution.

\[^{18}\text{The direction of unification is not the same as the order of combination of two structures. Rather, its specification is part of the specification of the nature of the combination (unification) itself. Hence specification of the direction does not constitute a violation of the requirement of commutativity.}\]
After spreading and mapping to the coda position this results in the forms \textit{bin}(t) and \textit{biin}(t) respectively. The \textit{t} has been put between parentheses to indicate that it is not incorporated in syllable structure. \textit{(biin}(t) will change into \textit{been}(t) as a result of Lowering, cf. section 4.3.3) Unification of the trimoraic syllable structure in (67c) and the triconsonantal verb root (68c) yields:

\begin{align*}
\text{(75) a. left to right unification} & \quad \text{of (67a) and (68b)} \\
\text{b. left to right unification} & \quad \text{of (67b) and (68b)} \\
\end{align*}

\begin{align*}
\sigma & \quad \sigma \\
\text{O N Cd} & \quad \text{O N Cd} \\
\text{C V} & \quad \text{C V} \\
\text{C V C C} & \quad \text{C V C C} \\
\text{b i n t} & \quad \text{b i n t} \\
\end{align*}

\begin{align*}
\sigma & \quad \sigma \\
\text{O N Cd} & \quad \text{O N Cd} \\
\text{C V} & \quad \text{C V V} \\
\text{C V C C} & \quad \text{C V V C C} \\
\text{b i n t} & \quad \text{b i n t} \\
\end{align*}

After spreading of \textit{i} to the two \textit{V}'s this produces the form \textit{binii}(t) (\textit{binee}(t) after Lowering). Note that the rightmost \textit{C} (the one that is linked to \textit{t}) cannot map to the coda position, as this is prohibited by the syllable structure conditions in (41) (repeated in (66)). Later, during regular syllabification, which as demonstrated in section 6.3.2, is only postlexical, this \textit{C} will have to be syllabified. If it cannot be incorporated into the onset of the syllable to the right, as is it can in \textit{binethin} (-\textit{hin}, aorist)), a new syllable will be imposed. Because this syllable cannot be minimally satisfied by mapping to unlinked \textit{C} in the normal way (the onset cannot be filled, although this is required by the syllable structures in (41) (or (66))), the existing syllable structure above \textit{nii} (\textit{nee} after Lowering) will be delinked and deleted. Thus a new syllable is created, according to the pattern in (41a) ((66a)). The material which belonged to the deleted syllable structure is newly syllabified, effectively shortening this vowel:
Note that the delinking of the original syllable is in line with the general assumptions of lexical phonology, as proposed by Kiparsky (1982a,b). Postlexically, rules and processes are not necessarily structure preserving.

If unification takes place from right to left, we should again distinguish between the case in which unification starts from the skeletal elements that are part of the monobi- and trimoraic syllable structures in (67a,b,c) or originates from the skeletal elements in the verb root. In the first case, the unification starts by uniting the rightmost V's, in the second case unification starts by uniting the rightmost C's:

(77) a. right to left unification of (67a) and (68b), starting with the skeletal elements in the syllable structure  

(77) b. left to right unification of (67a) and (68b), starting with the skeletal elements in the verb root
(78) a. right to left unification of (67b) and (68b), starting with the skeletal elements in the syllable structure

\[
\begin{align*}
\sigma & \quad \sigma \\
C V V C & \quad C V V C
\end{align*}
\]

\[
\begin{align*}
b & \quad n t \\
1 & \quad 1
\end{align*}
\]

As in the case of the biconsonantal verb roots in (72) and (73), the unification starting from the skeletal elements in the mono- and bimoraic syllable structure produces the correct results (after spreading and mapping to the coda position) viz. \textit{bin}(t) and \textit{bi}(nt) \textit{(bee}(nt) after Lowering). Right-to-left unification starting from the verb root produces incorrect, even bizarre results: \textit{*(bin)}(tii) in both cases (after spreading, \textit{*(bin)}(tee) after lowering).

The picture is again reversed in the case of a trimoraic syllable structure:

(79) a. right to left unification of (67c) and (68b) starting with the skeletal elements of the syllable structure

\[
\begin{align*}
\sigma & \quad \sigma \\
O N C d & \quad O N C d \\
C V & \quad C V \\
C V V C C & \quad C V V C C
\end{align*}
\]

\[
\begin{align*}
b & \quad i \\
1 & \quad 1
\end{align*}
\]

(79) b. right to left unification of (67c) and (68b) starting with the skeletal elements of the verb root

\[
\begin{align*}
\sigma & \quad \sigma \\
O N C d & \quad O N C d \\
C V & \quad C V \\
C V C C & \quad C V V C
\end{align*}
\]

\[
\begin{align*}
b & \quad i \\
1 & \quad 1
\end{align*}
\]

Here, unification starting from the skeletal elements in the syllable structure in (79a) produces the wrong results \textit{*bi}(nt), after spreading and lowering \textit{*bibe}(nt), whereas
it should be binee(t). We see again that right-to-left unification does not produce consistent results for the mono-, bi- and trimoraic syllable structures, and therefore would violate the requirement of commutativity, as explained above.

4.4.3.5 Theoretical implications

We have demonstrated the workings of the mechanism of morphological quantity specification in verb roots. Through a translation mechanism and unification with the syllable structure conditions it produces a syllable structure for the verb roots. Hence, this syllable structure erection is the result of the specification of quantity.

This does not constitute a refutation of our claim in sections 4.3.2 and 4.4.1, i.e., that general syllabification in Yawelmani is only postcyclic (and postlexical). One should bear in mind that only the verb stems receive a syllable structure through quantity specification (by the rules in (63), (64) and unification with the syllable structure conditions in (66)), even though additional affixes are available. Recall from section 4.3.3 that the morphological template insertion rules (26) (or (27)) proposed by Archangeli can only work if the stage in the lexical morphology has been reached at which the suffixes have already been added. This is so because it is in many cases the suffixes which bear the diacritic determining which template is inserted (if there is no suffix bearing such a diacritic, the diacritic of the verb root itself determines which template is inserted). Because our mora assignment rules (61) replace Archangeli’s template insertion rules (26) (or (27)), but are conditioned in the same way, this reasoning is equally true for our mora insertion rules.

This means that even though the suffixes are present during the syllable structure erection on the verb stems as a result of the application of the mora assignment rules in (63), the rules translating the quantity into nucleus structure (64) and of subsequent unification with the syllable structure conditions, these suffixes are not yet syllabified. This is also true for the third consonant of the triconsonantal roots. This consonant, as we have just seen (cf. (76)), is also syllabified only during regular, postlexical syllabification. The reason for this is that it is not required as part of minimal syllable structure (cf. (67)).

We conclude that the ‘template system’ as Archangeli terms it, is the result of a very simple rule system given in (63), assigning one, two or three moras. The statement that only V’s in Yawelmani count for weight, plus the right to left mora-to-nucleus translation result in the creation of that three weight structures, those given in (65), comprising of a light nucleus, heavy nucleus and a light nucleus followed by a heavy nucleus. Through unification with the syllable structure conditions given in (41) ((66)), these are transformed into full syllable structures. Finally, left to right unification with verb roots, the only direction of application which does not violate the requirement of commutativity, produces the observed verb stems.
The advantage of our account over Archangeli's templates is that general quantity categories are used, which mostly by general principles (unification, the Elsewhere Condition) and independently motivated statements (such as the syllable structure conditions) produce the verb stems. An added advantage of our approach is that Archangeli's rule of Slot Deletion (29) is no longer necessary. In Archangeli's approach where the skeletal templates CVCC, CVVCC, and CVCVVC are inserted, the final C has to be deleted in the case of a biconsonantal verb root.

4.4.4 Lowering

We assume the following lowering rule:

(80) Lowering

\[
\begin{array}{c}
[-\text{high}] \\
V V \rightarrow V V \\
[ ] \\
\hline
\end{array}
\]

tier

golden segmental tier

tier

This rule differs from the one given by Archangeli (cf. (24)), in that a feature value is assigned to a separate tier, which we have called the [high] tier. It is a feature adding rather than a feature changing rule. Because the feature specification assigned by the Lowering rule is on a specific tier, it is assumed that for phonetic interpretation, this specification overrides the more general specification on the vocalic segmental tier.\(^{19}\)

The advantage of this analysis is that it is not necessary to posit a copy rule, which Archangeli does for Yawelmani, in order to prevent the first vowel of a CVCVVC template to lower also. As pointed out in section 4.3.3, this first vowel does lower in Gashowu, which is why Archangeli assumes spreading for that closely related dialect. To us it seems strange that a copying rule applies to one dialect and a spreading rule to another. Spreading is a fairly general process (although for Yawelmani we have to limit it to stems), but copying although fairly common in reduplication analyses is much more specific. Also it must operate concomitant with the rules in (63b,c) (or Archan-

\(^{19}\) If one assumes Archangeli's theory that the default value is [+high]; there is no overriding of a feature, because the default feature has not yet been assigned (it is assigned only later in the derivation. (We do not go into Archangeli's underspecification theory here, because it falls outside the scope of this dissertation.) Also, if one assumes underspecification the Gashowu Lowering (cf. below) is genuinely feature adding. If one assumes, on the other hand, that the feature specification of the segment on the vocalic segmental tier contains a specification for [high], this feature specification is replaced by [-high]. In that case, the Gashowu Lowering rule is actually feature changing.

A slightly different solution would be that for both dialects, Yawelmani and Gashowu, the feature [-high] is assigned on separate tier, but that the domain for the application of this is the syllable for Yawelmani and the foot, (or, perhaps, the phonological word), for Gashowu (Norval Smith, personal communication).
geli's rules (27b,c)), which makes the whole operation very specific. To account for the difference between Yawelmani and Gashowu, we propose that the tier on which the lowering rule (80) operates is different for Yawelmani and Gashowu. In Gashowu the rule is:

(81) **Gashowu Lowering**

\[
\begin{array}{ccc}
V & V & V \\
\vee & \vee & \ \ \\
[] & \rightarrow & [-\text{high}]
\end{array}
\]

\[
\begin{array}{ccc}
\ \ & \ \ & \ \\
\cdot \cdot \cdot \cdot & \ \ & \ \\
\end{array}
\]

Here, the feature \([-\text{high}]\) is added to the vocalic segmental replacing the existing feature specification (but cf. note 15). Because the element on the vocalic segmental tier can also be linked to a single V on the skeletal tier in a preceding syllable (in the case of application of (63c), leading to a light-heavy syllable sequence (CVCV\text{W}), that vowel will also be lowered.

4.4.5 The segmental tier association rule

We now come to another feature of Yawelmani, alluded to shortly during our discussion of the forms in (25), which we repeat here as (82):

(82) desiderative-aorist \(-(h)\text{atn+hin}\)

- caw hatin hin
- hix hatin hin
- lag hatin hin
- lu\text{\textslash}l atin hin
- wu\text{\textslash}y atin hin
- bint atin hin

The h in \(-(h)\text{atn}\) is present when it is preceded by only one consonant and is absent when preceded by two consonants. Note that this process works so as to avoid CCC clusters. This alternation process also seems to be connected to syllable structure. It is by no means the only affix in which a segment may be absent, although this presence/absence relationship of segments depending on syllable structure applies only to certain segments in certain affixes with a given structure, not to all. The alternation can be found in the following affixes (with the alternating segment between parentheses, where the affix has not been attested for Yawelmani, but for another dialect of Yokuts, this is indicated):
(83) affixes with alternating segments

Newman (1944: page) (dialects)

a. -(h)atn- desiderative 114
b. -(h)ne:l- passive consequent gerundial 166
   -(ʔ)hana:- passive verbal noun 149 (Wikchamni)
   -(l)sa:- causative-repetitive 94
   -ʔ(h)iːy- consequent adjunctive 162 (Wikchamni, Gashowu, Choynimni)
c. -k(a) imperative 118
   -m(i) consequent gerundial 134
   -x(a) preceptive 119
d. -(a)l dubitative 20 120
   -(a)m aorist 123 (Chawchila)

The parenthesised segments in the affixes listed under (83b) are present if the affix is preceded by V, but absent if preceded by C. This means that the consonants in question are only absent if an illicit syllable structure would otherwise ensue, involving three intervocalic consonants (if this structure comes into being in other situations, an epenthetic vowel is eventually linked to the then empty nucleus, cf. our account of epenthesis in section 4.4.1). As with the alternation in -(h)atn-, the alternations in these affixes work so as to avoid CCC clusters. Note here the place of the alternating segment in the consequent adjunctive affix -ʔ(h)iːy-. It is not at the edge of the affix, as in the case of the other affixes, but is preceded by a non-alternating glottal stop.

The parenthesised vowels in the word final suffices under (83c) are present if the affix is preceded by a consonant, but are absent if the affix is preceded by a vowel. The alternating vowel is only present if otherwise an illicit syllable structure would ensue. Note the difference with the affix under (83a) where the alternating segments are only absent if a disallowed structure would ensue.

Finally, the alternating segments in the affixes under (83d) are present if preceded by a consonant, but absent if preceded by a vowel. Here the disappearance of the vowel of the affix takes precedence over the deletion of the vowel in the stem which would normally take place (cf. our account of vowel elision in section 4.4.1).

We will propose a rule that accounts for the -hatn/-atn- and -hneː:l/-neː:l- alternations (type a,b), where consonants constitute the alternating elements, as well as for the type c alternations (-kɑː/-k, etc.) and the type c alternation (-a(l)/-l), where the vowels alternate. We assume the form in (84) as the underlying form for -hatn-.

20 In the Wikchamni dialect, the form of the dubitative morpheme is -a(d). It displays exactly the same alternation as the -a(l) morpheme in Yawelmani.
As we will see, a rule, the Segmental Tier Association Rule (STAR), will link the unlinked \( h \) to \( C \) under certain conditions. The reason why we have not preferred an underlying representation with only three skeletal slots, together with a rule that projects a skeletal slot for an element on a melodic tier, will be given below when we treat the type b alternation \(-k\alpha/-k'\) etc.). We now come to STAR itself, which consists of two parts:

(85) **Segmental Tier Association Rule (STAR)**

a. associate an unlinked element on a melodic tier to an unlinked skeletal slot

b. condition: association may apply only if the resyllabified output contains fewer empty syllabic nodes than the input

By assuming STAR, we have replaced the automatic association by a conditioned rule. It is assumed that in language normally the melodic tiers are underlyingly linked and that the (exceptional) unlinked melodic elements are linked to the skeleton by rule. Note that condition (85b) is connected to our assumption, mentioned in chapter 2, that a one-to-one relationship between skeletal and segmental tiers constitutes the unmarked case, which is one of the principles of syllabification. In its turn, this principle of syllabification follows from the general association conventions. It is thus that the relationship of the alternation types \-(h)atn-, -(h)ne:l-, and -k(\(a\)) and \-(a)l\) will become clear.

We will now show some cases which illustrate the working of STAR. The first case concerns the \-(h)atn- type. Consider (86a,b) which are the underlying forms for *cawhatinhin* and *luk\(\)atinhin* (previously cited in (25)).

(86) a. \[
\begin{array}{cccccc}
C & V & C & + & C & V & C & C & + & C & C \\
\mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid \\
c & w & h & t & n & h & n \\
a & a
\end{array}
\]

b. \[
\begin{array}{cccccc}
C & V & C & C & + & C & V & C & C & + & C & C \\
\mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid & \mid \\
l & k & h & t & n & h & n \\
u & a
\end{array}
\]

The \-(h)atn- morpheme will now trigger morphological rule (63a), inserting one mora. After application of Light Nucleus Assignment (64b) and unification (cf. section 4.4.3.2) with the syllable structure conditions expressed in the templates in (41) (repeated in (66)), this amounts to the following structure:
The regular postlexical syllabification process (see section 4.4.1) will now produce the following syllabic structures:

(88) a. \[ \sigma \]
\[ \text{ON Cd} \]
\[ \text{CVC + CVC + CC} \]
\[ c \text{w} h \text{t n h n} \]
\[ a \]

b. \[ \sigma \]
\[ \text{ON Cd} \]
\[ \text{CVC C + CVC + CC} \]
\[ l \text{R} l \text{h} \text{t n h n} \]
\[ u \]
\[ a \]

Note that in (88a, b) the C which is situated above h but is not linked to it has not been incorporated into syllabic structure, because the syllable structure conditions in (41) ((66)) do not allow for skeletal slots that are not linked to a melodic tier to be syllabified (although the conditions do allow for empty sub syllabic nodes). Note also that (88a) contains three empty subsyllabic nodes and (88b) two. If we now link the C to the h below it, the results are (after the unsyllabified segments have triggered syllable structure imposition and the subsequent application of the association conventions):
We see that in (89a), the number of empty syllabic nodes has decreased by 1, but that in (89b), it has increased by 2. Therefore, STAR in conjunction with the condition on its application (83b) will link h to C in (89a), producing the correct result cawhatinhin, but will not link h to C in (89b), because the number of empty nodes would then increase instead of decrease. The correct form luklatinhin is thus produced, instead of *lukulhatinhin (the form which would eventually result from (89b) (after epenthesis and vowel harmony)).

We now come to the (83b) type of alternation, for which we first take the example involving the passive consequent gerundial -(h)ne:l-, which because of lowering, can be analysed as having the underlying form -(h)nül- (Archangeli (1984) also assumes this). What is interesting is that this suffix triggers morphological rule (63c), after Heavy and Light Nucleus Assignments (64) and unification with the syllable structure condition in (41) (repeated in (66)), producing a CVCW(C) stem (in Newman's terms: it takes a strong stem, in Archangelf's: it selects a CVCW(C) template). An example is given in (90) (from Newman 1944:166).

(90) a. tikehne[-]ni < *tiki 'tie, imprison', -ni, indirect objective
   b. ?amalnil < *?amal 'aid' + zero morpheme, subjective

Underlyingly, these forms are (the morphemes following -hniil- are omitted):

---

21 The expected form for (90b) is ?amalnel and not ?amalnil. This is so because the lowering rule in (80) normally applies independently of whether the V's linked to the vowel are linked to the syllabic structure or not. The linear accounts by Kuroda and Kisseberth have expressed this by assuming that (the segmental version of) Lowering stands in a counter-bleeding relationship to the shortening rule they postulate (cf. (3)). The non-lowering of the vowel in the underlying suffix -hniil- seems to be of an isolated character, and no other examples of this are found in Newman (1944).
The -(h)niil- morpheme will now trigger morphological rule (63c), inserting three moras. This produces, after Heavy and Light Nucleus Assignments (64) and unification with the syllable structure conditions (41)((66)):

Then spreading takes place from the stem vowel to the skeletal V-positions inserted as a result of Heavy Nucleus Assignment (64a):

Postlexically, regular syllabification will produce the forms in (94a,b). Note that in (94b), the second syllable has been resyllabified, due to the as yet unsyllabified i, belonging to the stem. (This was explained in section 4.3.3, see (76).) Because we are here in the postlexical part of the phonological derivation, we have omitted the indication of the morpheme boundary, as this information is not available anymore post-lexically.

Inspection of these syllabified forms reveals that (94a) (the form with the biconsonantal verb root) contains two empty subsyllabic positions, while the form with the triconsonantal verb root (94b) contains one such position. If we now link the C above the h
below it, the results are (after the unsyllabified segments have triggered syllable
structure imposition and the subsequent application of the association conventions):

\[(95) \begin{align*}
\text{a.} & & \sigma & \sigma & \sigma & \sigma \\
& & \text{ON Cd} & \text{ON Cd} & \text{ON Cd} & \text{ON Cd} \\
& & \text{CV} & \text{CVV} & + & \text{C} & \text{CVV} & \text{C} \\
& & & & & & & \\
\text{b.} & & \sigma & \sigma & \sigma & \sigma \\
& & \text{ON Cd} & \text{ON Cd} & \text{ON Cd} & \text{ON Cd} & \text{ON Cd} & \text{ON Cd} \\
& & \text{CV} & \text{CVV} & & \text{CVV} & \text{C} & \text{C} & \text{CVV} & \text{C} \\
& & & & & & & & & \\
\end{align*}\]

We see, as in (89), that in the form incorporating the biconsonantal root (94a), the
result of the linking is that the number of empty subsyllabic nodes decreases by 1,
while in the case of a triconsonantal root it increases by 2. Therefore, again, STAR in
conjunction with the condition on its application (85b) will link \( h \) to \( C \) in (93a), pro-
ducing the correct result \( \text{likemhnil} \) (for the height of the third vowel, cf. note 21), but
will not link \( h \) to \( C \) in (93b), because the number of empty nodes would then increase
instead of decrease. The correct form \( \text{?amaalhnel} \) is thus produced, instead of
*\( \text{amaalihnel} \) (the form which would eventually come out of (95b) (after epenthesis).

Another instance of the alternation type (83b) is represented by the consequent
adjunctive morpheme \( -\text{?} \text{(h)iy} \). What is interesting here is that it is not the first, but
the second segment of the morpheme that alternates with zero. The representation of
the morpheme must thus be assumed to be as in (96):

\[(96) \begin{align*}
\text{C} & \text{C} & \text{V} & \text{C} \\
\text{?} & \text{h} & \text{i} & \text{y} \\
\end{align*}\]

Examples of the alternations (from Gashowu) are given in (97) (Newman 1944: 163-
164).

\[(97) \begin{align*}
\text{a.} & \text{\( \text{ce} \text{s[\cdot]} \text{-?hiy-a} \text{ nim } \text{?otsu}\text{?}\) \text{ ‘(he) stole my knife’}, -a \text{ objective,} } \\
& < \text{\( \text{*ci} \text{i} \text{ ‘cut with the knife’} \text{ (the root}} \\
& \text{form postulated by Newman) } \\
\text{b.} & \text{\( \text{ho} \text{y\’cus na } \text{kana[\cdot]} \text{w-?iy-a}\) \text{ ‘I want a bed’}, -a \text{ objective,} } \\
& < \text{\( \text{*kanaw ‘fall asleep} \text{) } \\
\end{align*}\]

The alternation in (97) is similar to the one in (90). In both cases, we find a suffix
which triggers morphological rule (61c) inserting three moras, effectively creating,
through Heavy and Light Syllable Assignments (64) and unification with the syllable
structure conditions (41) (repeated in (66)), a CVCVV verb stem in the case of a bicon-
sonantal verb root and a CVCCVC stem in the case of a triconsonantal root. Hence,
there is a resulting sequence of two C's on the border of the stem and the suffix in the
first case, and one of three C's in the second case. It is not difficult to see now that
STAR will apply in the former case, but not in the latter. In the case of a biconsonantal verb stem, the C's starting with the suffix will fill the coda of the second syllable of the verb stem, creating a syllabic structure as in (98) (which also entails shortening (cf. (50), above)).

(98)  
\[ \sigma \sigma \sigma \]  
\[ \text{ON Cd ON Cd O ...} \]  
\[ \text{CV CVVC C} \]  
\[ c c c \]

In this case, linking the unlinked node to the melodic tier is beneficial in achieving the optimal filling of subsyllabic nodes. If the unlinked C is indeed linked, the syllabification as in (98) is produced, and onset and coda have been filled. On the other hand, if the same suffixes are combined with a triconsonantal verb root, rule (63c) will create, again through Heavy and Light Syllable Assignments (64) and unification with the syllable structure conditions (41) ((66)), a CVCVVC verb stem. Then, incorporating both C's starting the suffix will produce the syllabic structure in (99).

(99)  
\[ \sigma \sigma \sigma \]  
\[ \text{ON Cd ON Cd ON Cd O ...} \]  
\[ \text{CV CVVC C C C} \]  
\[ c c c \]

Here we see that two additional empty subsyllabic nodes are created, viz. an empty coda and an empty nucleus. Therefore, in this case, application of STAR is detrimental for the achievement of optimal syllable structure, and will therefore fail to apply.

We can go one step further in generalising and establish that the alternation type (83a) in fact is a parallel case. As we have seen, the -(h)atn- morpheme triggers rule (63a), which inserts one mora, through the now well-known mechanisms, effectively producing a CVC verb stem in the case of biconsonantal verb root, and a CVCC verb stem in the case of a triconsonantal verb root. The exact parallelism lies in the fact that if the unlinked C is realised, in the former case we have a sequence of two consonants, and in the latter case a sequence of three consonants.

We now come to the alternation displayed by the morphemes in (83c,d). These differ from the ones treated above in that in these suffixes, the alternating segments are vowels. The conditioning of the alternations displayed by the morphemes in (83c) and those in (83d) is essentially identical: if the verb stem preceding them ends in a vowel, the vowel of the alternating morphemes is not realised, if the verb stem ends in a con-
sonant the vowel is realised. Let us first consider the alternation type (83c), involving the morphemes \(-m(i), -(x)a, -k'\). An example is given in (100) (taken from Newman 1944: 29):

(100)  a. \(\text{kas-}k\) a 'pierce (it)'  b. taxa[\(\cdot\)]k 'bring (it)'

The \(-k' a\) morpheme, (like, incidentally, \(-m(i)\) and \(-x(a)\), the other two morphemes of this alternation type) does not not select one of the morphological mora insertion rules in (63). Therefore, the verb root itself triggers one of these rules, depending on what type of diacritic it carries (note that this is exactly parallel to Archangeli's analysis (cf. section 4.3.3), the only difference being that the diacritic carried by the verb root itself triggers one of the mora insertion rules in (61) instead of one of the skeletal template insertion rules in (26) or (27). It is for this reason that in (100a) we can find a CVC verb stem (in Newman's terms: a IA1 'primary base') and in (100b) a CVCW verb stem (a IB 'primary base'). If we compare the syllabic structures resulting from the potential application of STAR to those of its non-application, it becomes clear why the rule applies in the case of (100a), but not in the case of (100b):

\[\text{nonapplication}\]

(101)  a. \(\sigma\) \(\sigma\) \(\sigma\) \(\sigma\)  b. \(\sigma\) \(\sigma\) \(\sigma\) \(\sigma\)

\[\text{application}\]

(101)’  a. \(\sigma\) \(\sigma\) \(\sigma\) \(\sigma\)  b. \(\sigma\) \(\sigma\) \(\sigma\) \(\sigma\)

It is clear that in the case of (101a), application of STAR reduces the number of empty subsyllabic nodes, whereas in (101b) the working of STAR would increase the number of subsyllabic nodes. For this reason, STAR applies in (101a), but does not apply in (101b). Let us now look how STAR works in the case of the affixes in (83d). Consider the following example (Newman 1944: 120):

22 The unlinked \(\nu\) in (101b) will be deleted by the general convention deleting stray elements (proposed by McCarthy (1979b, 1981), Steriade (1982), J. Harris (1983), Ité (1986, 1989)) and as a result will not be spelled out as the default vowel \(i\). (See also note 13, above).
(102) a. tehe[·]l \(<\hat{\text{t}}\text{-}\) 'get skinny, get lean'\(^{23}\)
b. so'g-al \(<\hat{\text{s}}\text{ø}\text{-}\) 'pull out an unfastened object'

If we compare again the syllabified forms before and after the potential application of STAR, we see why that the vowel shows up in (102a), but not in (102b):

nonapplication

(102) a. \(\sigma\) \(\sigma\)
\(\text{ON Cd ON Cd}\)
\(\text{CV} \text{VVVC}\)
\(\text{t} \text{i} \text{a}\)

b. \(\sigma\) \(\sigma\)
\(\text{ON Cd ON Cd}\)
\(\text{CV} \text{VVVC}\)
\(\text{s} \text{u} \text{a}\)

application

(103)' a. \(\sigma\) \(\sigma\)
\(\text{ON Cd ON Cd}\)
\(\text{CV} \text{VVVC}\)
\(\text{t} \text{i} \text{a}\)

b. \(\sigma\) \(\sigma\)
\(\text{ON Cd ON Cd}\)
\(\text{CV} \text{VVVC}\)
\(\text{s} \text{u} \text{a}\)

In (103'a), the number of empty subsyllabic nodes has not changed. The condition on the application of STAR (85b) says that STAR only applies if the number of empty subsyllabic nodes actually decreases and therefore (103'a) is a structure which will not arise. In (103'b) however, we see that the number of empty subsyllabic nodes has indeed decreased, and therefore STAR will apply and the form shows up as soogal (after the application of Lowering) and not as soogul (as the form in (103b) would eventually surface without the application of STAR, but after Lowering, Epenthesis and Vowel Harmony).

4.5 Conclusion

This concludes our analysis of the segmental alternation in Yawelmani. The upshot of our analysis compared to those of Kuroda, Kisseberth and Archangeli is that it treats

\(^{23}\) The form tehe[·]l is listed by Newman as a Yawelmani form. As pointed out in section 4.4.4 however, normally in Yawelmani, in contrast to Gashowu, the first vowel of a CVCVVC verb stem does not lower. It seems that Newman's data are inconsistent on this point and that in this form Yawelmani has behaves like Gashowu with respect to Lowering.
seemingly syllable related alternations as being conditioned by syllable structure, and not as processes independent from syllable structure. In a letter (of 5 April 1984) written to us shortly before his death, Newman, commenting on a version of our 1985 article of Yawelmani, acknowledges that the processes in question must be syllabically conditioned. By positing our theory, we have been able to express this insight in a formal way.