

**PHONOLOGICAL PROCESSES
AFFECTING
SEGMENTS IN ANGAVE***

Richard F. Speece
Summer Institute of Linguistics

ABSTRACT

The Angave language is characterized by considerable phonetic and morphological variation. These two types of variation and their complex interaction are optimally accounted for by focusing on the phonological processes which map underlying representations onto the surface. Whereas phonological descriptions for other Angan languages have focused on units and distribution, this one, while not ignoring units and distribution, focuses primarily on process because focusing on process has been found to lead to a more integrated analysis.

Some of the more interesting cases of variation among consonantals include surface palatalization and labialization, the first of which is analyzed as a consonant vowel sequence and the second (in most instances) as subsequent rounding on a set of complex consonants. Another case involves the limited distributions of surface voiceless stops and voiced and voiceless fricatives in relation to word boundaries and medial glottal stop. An abstract solution which allows absolute neutralization is posited and substantiated in order to account for the variation.

Among vocalic segments, variants of the mid central vowel are particularly interesting for they clearly show how natural processes can be in tension and compete to move a vowel around the vowel chart. Vowel sequences in verbals are also interesting for

they may coalesce and surface as a single vocalic segment, or be separated by the insertion of semivowels.

Finally, glottal stop is treated as a suprasegmental and assigned to the syllable level of the phonological hierarchy because it is so unlike segmentals.

TABLE OF CONTENTS

- 1 INTRODUCTION
 - 1.1 People and Location
 - 1.2 Classification of the Language
 - 1.3 Field Work
 - 1.4 Aim and Organization
- 2 PHONOTACTICS
 - 2.1 Phonotactics Based on Univalent Patterns
 - 2.1.1 Univalent Patterns Found in Angave
 - 2.1.2 Limiting Possible Solutions in Accordance with Univalent Patterns
 - 2.2 Phonotactics Based on Phonological Processes
 - 2.2.1 /CIV(V)/ Underlies [CyV(V)]
 - 2.2.2 /C^wV(V)/ Underlies [C^wV(V)]
 - 2.2.3 /\$VV\$/ Underlies Some [VV]
 - 2.2.4 Complex Consonants Underlie Prenasalized Stops
 - 2.2.5 /CI/ Underlies Alveopalatals
 - 2.2.5.1 */CY/ as a Source of Alveopalatals
 - 2.2.5.2 /CI/ the Source of Alveopalatals
 - 2.2.6 Semivowels Indicate Syllable Structure
- 3 CONSONANTS
 - 3.1 Underlying Consonants
 - 3.2 Surface Manifestations of Consonants
 - 3.3 Phonological Processes that Account for Surface Representations of Consonants
 - 3.3.1 Non-Nasal Obstruents
 - 3.3.1.1 The Bilabial Non-Nasal Obstruent
 - 3.3.1.2 The Velar and Postvelar Non-Nasal Obstruents
 - 3.3.1.3 The Alveolar Non-Nasal Obstruent
 - 3.3.1.4 The Sequence /TI/
 - 3.3.2 Nasal Obstruents
 - 3.3.3 Nasals
 - 3.3.4 Semivowels
- 4 VOWELS
 - 4.1 Underlying Vowels
 - 4.2 Surface Manifestations of Vowels
 - 4.3 Phonological Processes that Account for Surface Representations of Vowels
 - 4.3.1 Front Vowels
 - 4.3.2 Central Vowels
 - 4.3.3 Back Vowels
 - 4.3.4 Sequences of Vowels
 - 4.3.5 The Mid Central Vowel and the Alveolar Non-Nasal Obstruent
- 5 GLOTTAL STOP AND SYLLABLE STRUCTURE
- 6 CONCLUSION
- APPENDIX A Work Chart of Phones
- APPENDIX B
 - Contrast between Underlying Consonants
 - Contrast between Underlying Vowels and Vowel Sequences
 - Contrast between /T, d, n/ and /TI, dI, nI/
- FOOTNOTES
- REFERENCES

1 INTRODUCTION

1.1 People and Location

The Angave language has an estimated 1,000 speakers living at the headwaters of the Swanson and Mbwei Rivers in Papua New Guinea. The language area lies at the northwest extremity of the Kaintiba Sub-District in the Gulf Province. See Figures 1-2. The northern half of the language area is administered by Morobe Province, though national and provincial policy have scant influence on the daily lives of the Angave.

Variation among speakers is prolific within Angave probably because traditional living patterns have minimized extensive social intercourse and maximized distance between hamlets (comprised of one to three nuclear families). Variation among speakers will occasionally be cited in the body of the paper, but because of constant intermarriage between hamlets and the people's mobility, it is impossible to assert clear lect boundaries. The linguistic situation could be described as a proliferation of idiolects.

The names, Angai, Winoyit, Wiokwa, Bu'u, Ikwundi, and Onapai on the map of Angave lands, correspond to ridges where prominent hamlets are established. These names are used in the paper to indicate variation associated with some speakers from those locales.

1.2 Classification of the Language

Angave ['angəbe] is one of twelve languages comprising the Angan ['aŋən] Language Family (formerly labeled Kukukuku). The family is a stock level isolate unrelated to the Austronesian and Eleman Languages along its borders. It does, however, show a "very distant relationship to the East New Guinea Highlands languages (5%), the Kunimaipan languages (4%), and the Pawaian language (3%)" (Lloyd, 1973:33).

FIGURE 1

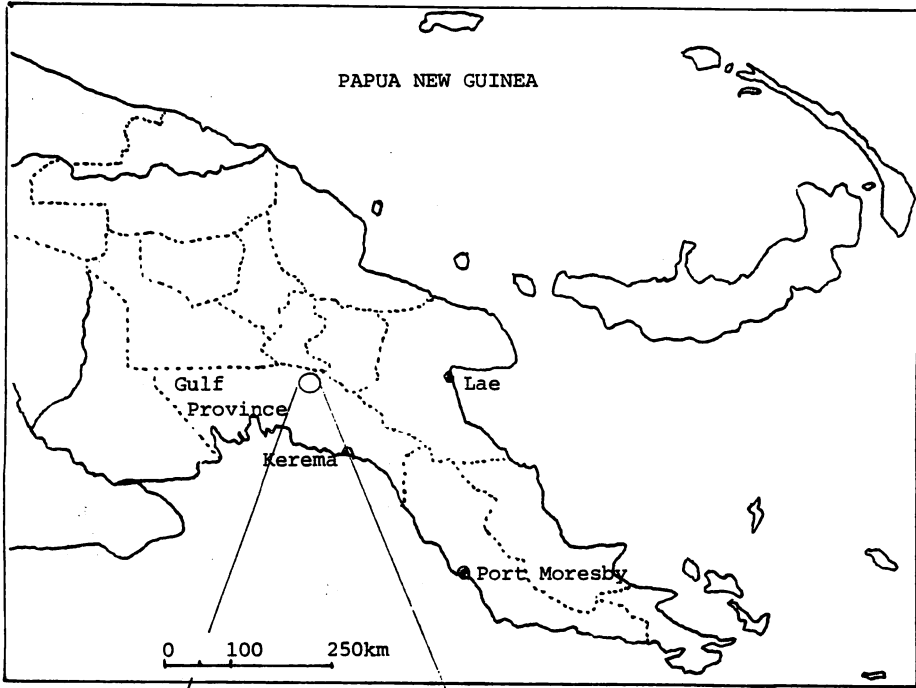
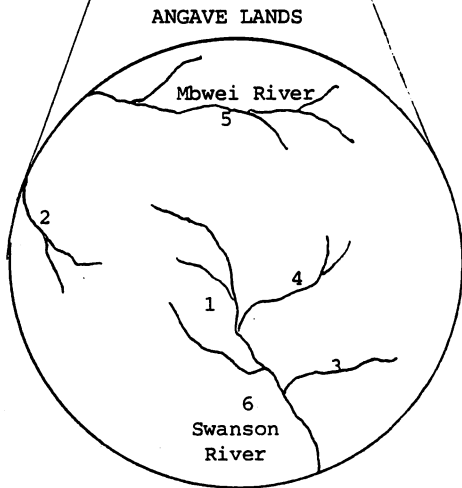


FIGURE 2



1. Angai
2. Winoyit
3. Wiokwa
4. Bu'u
5. Ikwundi
6. Onapai

Within the language family Angave is most closely related to Ivori and Lohiki. Lloyd (1973:36) lists the cognate percentages at 56% and 54% respectively. Unfortunately only minimal linguistic research has been done in either of these languages. The next closest language is Kapau whose phonology has briefly been described by Healey (1981:95-112).

Angave (also spelled Ankave) is the local name for the Swanson River. The Angave themselves call their language [aŋ'gabaʔnɛʔ] 'the real language' as opposed to other languages.

1.3 Field Work

Data for the following phonological study was collected on site from October 1978 - March 1981 under the auspices of the Papua New Guinea branch of the Summer Institute of Linguistics, which is under contract with the Papua New Guinea Department of Education. The analysis is based on about 2,000 words elicited bilingually and monolingually plus two hundred fifty pages of partially analyzed text material. Grammatical and semantic analysis have been done in parallel with work on the phonology and have provided insights useful for phonological decisions.

The primary consultants who supplied data are Na Omaro (30yr.), Akwio (30yr.), Raxayo (17yr.) and Oniokwo (50yr.), all of whom are native male speakers of Angave and reside at or near Angai. I rely on Oniokwo in cases of discrepancies in the data because he is a monolingual, who speaks neither Pidgin English nor Police Motu, and is the eldest among the consultants.

1.4 Aim and Organization

The aim of this article is to give a coherent synchronic description of the underlying segments in the Angave sound system by focusing on the phonological processes which account for surface manifestations. By a coherent description I mean one that is

motivated by the data and explains it in view of natural phonological processes.

The article is divided into four main chapters. Chapter two deals with phonotactics. It shows that focusing on phonological processes is well-motivated for this language with substantial variation in surface forms. Chapters three and four describe phonological processes that account for the surface manifestations of underlying consonantal and vocalic segments. My approach in these two chapters is to: one, catalogue the underlying segments and their surface manifestations; two, examine variation in selected data and formulate rules which describe it; three, test the rules against a broader range of data, making revisions where necessary; and four, integrate the rules with statements about other processes. Chapter five deals with glottal stop which has been treated as a suprasegmental and placed on the syllable level in the phonological hierarchy.

2 PHONOTACTICS

Phonemic analysis begins with segmentation. Segmentation has traditionally been constrained by the univalent sequences of segments and univalent syllable patterns in each language. Univalent sequences are those sequences of surface segments that unambiguously must be a sequence of segments in the underlying representation. Ambiguous sequences and syllables are then segmented in accordance with the patterns observed in unambiguous sequences and syllables. Frequently, univalent patterns narrowly limit the range of solutions available in segmentation. For Angave, however, it will be seen that univalent patterns in themselves only broadly and inadequately limit the range of permissible solutions. In what follows I propose that (for Angave) phonological variation in verb paradigms is the best place to begin when looking for solutions in segmentation. In fact, it is only by focusing on phonological processes in Angave that I have been able to decide

which analysis is optimal within the broad range of solutions allowed by its univalent patterns. I will demonstrate that this is the case by first focusing on units and their distribution in Angave. We will see that, while some possible analyses are eliminated by univalent patterns, the number of solutions allowed by this method of segmentation is very great. Furthermore, there is then no way to decide which one of the many remaining solutions is optimal. Next I will show that, in contrast to the inadequate univalence metric, the range of solutions is adequately narrowed by focusing on phonological processes. I conclude as a result that a phonological process is a better criterion for making phonotactic decisions than units and distribution (at least for languages like Angave which manifest substantial phonological variation).

2.1 Phonotactics Based on Univalent Patterns

I will first state the univalent patterns found in Angave and then evaluate some possible analyses of a restricted amount of data in accordance with these patterns.

2.1.1 Univalent Patterns Found in Angave

In Angave no unambiguous consonant or vowel sequences occur in surface manifestations, i.e. no heterorganic V_1V_2 or C_1C_2 sequences occur. Reverse vowel sequences, however, do occur:

	(a)	(b)	(c)
(1)	[<u>y</u> aŋəʔ] ³ 'gift'	[<u>py</u> aʔwəʔ] 'testicle'	[<u>au</u> bŋəʔ] 'a betel nut' ⁴
(2)	[<u>a</u> lwaʔ] 'food'	[<u>ma</u> lʔmaŋəʔ] 'front teeth'	[<u>pwa</u> ŋnə] 'he is passing'

The evidence for the reverse sequence [a] ([ya] in 1a,b) is prolific, but not for [au] [ua] ([wa] in 2c). The only examples of [ua] in the data is in compound verb formatives like 2c [pwaŋnə] /P†+u+a†n†/. Therefore, there is no evidence from surface forms

for having /CC/ sequences in Angave and little for /VV/. In addition, unambiguous syllable patterns are limited to CV and V (see sec. 5).

2.1.2 Limiting Possible Solutions in Accordance with Univalent Patterns

Having stated Angave's univalent patterns, let us now consider some data and possible analyses of its surface representations. On the basis of Angave's univalent (unambiguous) patterns we will see that there are many permissible analyses of this data⁵ even though some possible analyses are eliminated:

- (3) ['myæɾnə] 'he is digging'
 (4) [l'kwyæɾnə] 'he is untying'
 (5) [kwyal'kwyæɾnə] 'he is splitting'

The syllables under focus in 3-5 are underlined. By looking at the vocalic and consonantal sequences in various ways several possible analyses of these syllables are:

2.1.2.1 Simple Consonants with Sequences of Vowels

- CVV /miarɪnɪ/
 CVVV /ikularɪnɪ/
 CVVVV /kulaikularɪnɪ/

2.1.2.2 Complex Consonants with Sequences of up to Two Vowels

- CɣV /myarɪnɪ/ or CVV /miarɪnɪ/
 CɣɣV /ikwyarɪnɪ/ CɣVV /ikwiarɪnɪ/
 CɣɣVV /kwyalkwyarɪnɪ/

2.1.2.3 Complex Consonants with Sequences of up to Three Vowels

- CɣV /myarɪnɪ/ or CVV /miarɪnɪ/
 CɣVV /ikwiarɪnɪ/ CVVV /ikularɪnɪ/
 CɣVVV /kwialkwiarɪnɪ/

2.1.2.4 Complex Consonants with Closed Syllables

C^yV /m^yar+n+/

C^wyV /ik^wyar+n+/ or C^wVV /ik^wlar+n+/

C^wyVC /k^wyayk^wyar+n+/ C^wVVC /k^wlayk^wlar+n+/

2.1.2.5 Consonant Clusters with Sequences of up to Two Vowels

CCV /myar+n+/

CCCv /ikwyar+n+/ or CCvV /ikwlar+n+/

CCCvV /kwyalkwyar+n+/

2.1.2.6 Consonant Clusters with Sequences of up to Three Vowels

CCV /myar+n+/

CCvV /ikwlar+n+/ or CCCvV /ikwyar+n+/

CCvVv /kwlaikwlar+n+/ CCCvV /kwyalkwyar+n+/

2.1.2.7 Consonant Clusters with Closed Syllables

CCV /myar+n+/

CCCvV /ikwyar+n+/ or CCvV /ikwlar+n+/

CCCvC /kwyaykwyar+n+/ CCvVC /kwlaykwlar+n+/

2.1.2.8 Complex Consonants in Consonant Clusters with Sequences of up to Two Vowels

C^yV /m^yar+n+/

C^wCV /ik^wyar+n+/

C^wCVV /k^wyaik^wyar+n+/

2.1.2.9 Complex Consonants in Consonant Clusters with Closed Syllables

C^yV /m^yar+n+/

C^wCV /ik^wyar+n+/

C^wCVC /k^wyayk^wyar+n+/

The analyses proposed in 4., 7., and 9. can be eliminated because there are no unambiguous examples of closed syllables in Angave surface forms. Furthermore, analyses 5.-9. can be eliminated because surface forms manifest no univalent consonant sequences. In several other Angan languages, however, both closed syllables⁶ and

consonant clusters⁷ have been set up in underlying forms. This had been done in phonemic analyses by those who assume the univalence metric despite the fact that each language's univalent patterns are essentially the same as Angave's. Returning to the list of possible analyses, 1. and 3. must also be eliminated, for there is no evidence of sequences of three vowels. So only the analysis stated in 2. is viable. And since even it is not based on univalent patterns, but a single reverse vowel sequence, it also must be considered tentative. The univalence metric has eliminated all but one analysis. There are, however, several other possible analyses that must be considered.

If it is granted that underlying syllable boundaries may not correspond to surface syllable boundaries, then several more analyses are possible:

2.1.2.10 Two or More Underlying syllables in One Surface

Syllable with Simple Consonants

CVV	or	CV\$V	/mlar+t+/
CV\$CV			/kuyar+t+/
CV\$CVV		CV\$CV\$V	/kuyalkuyar+t+/

(\$ indicates underlying syllable breaks within a single surface syllable.)

2.1.2.11 Two or More Underlying Syllables in One Surface

Syllable with Complex Consonants

CV\$V	or	CVV	/mlar+t+/
C ^w V\$V		C ^w VV	/k ^w lar+t+/
C ^w V\$VV		C ^w VV\$V	/k ^w ialk ^w lar+t+/

In analysis 10. it is suggested that [kwyV], a single surface syllable, could possibly be analyzed as a sequence of two underlying syllables, i.e. /ku\$yV/. Analysis 10. does not appear to be a viable option because of a couple of words like [l'kuzi?]⁸ /l'kuyf/ 'gas' and [kuža'fəɾnə] /kuyaT'taT+t+/ 'he is honking', for they show that the sequence of segments [kuyV] can belong to a

sequence of two syllables where the underlying and surface level syllabification match (more examples would strengthen the argument). If these couple of words are derived from an underlying form not matching the surface segments [kuyV], then 10. is a permissible solution. Analysis 11. is a viable option, if it can be shown that it is possible for each vowel in a sequence of vowels to belong to a separate underlying syllable.

If we add the sequence restriction rule that $[-\text{anterior}]_{\text{uwV}}$ doesn't occur, then two more analyses of the data are possible, assuming that $[-\text{anterior}]_{\text{uwV}}$ underlies $[-\text{anterior}]_{\text{wV}}$:

2.1.2.12 Complex Consonants and Two or More Underlying Syllables in One Surface Syllable with the Insertion of /u/

Cu\$CvV /ikuwyar+t+/
 Cu\$CvVV /kuwyalkuwyar+t+/

2.1.2.13 Simple Consonants and Two or More Underlying Syllables in One Surface Syllable with the Insertion of /u/

Cu\$CvV /ikuwlⁱar+t+/
 Cu\$CvV\$V /kuwlⁱalkuwⁱar+t+/

If another segment sequence restriction is postulated, that [ClyV] does not occur, then there are two more possible analyses, assuming that /ClyV/ underlies [CyV]:

2.1.2.14 Three Underlying Syllables in One Surface Syllable with the Insertion of /l/ and /u/

Ci\$CV /mlⁱyar+t+/
 Cu\$Ci\$CV /ikuwlⁱyar+t+/
 Cu\$Ci\$CVV /kuwlⁱalkuwⁱyar+t+/

2.1.2.15 Complex Consonants and Two Underlying Syllables in One Surface Syllable with the Insertion of /l/

Ci\$CV /mlⁱyar+t+/
 C^wi\$CV /k^wlⁱyar+t+/
 C^wi\$CVV /k^wlⁱak^wlⁱyar+t+/

The upshot of analyses 12. through 15. is to spread a single surface syllable over two or three underlying syllables. The underlying structure presented in 14. conforms nicely to the syllable patterns attested in univalent syllables, but the VV sequence remaining may no longer find support in reverse vowel sequences because they have been analyzed away by setting up VSV (S = semivowel). In addition, words like ['mlyʔ] /'mlyʔ/ 'a tree' show that the sequence CiyV, though infrequent, does occur in surface structure. So 14. and 15. appear to be unlikely options. If, however, the [y] in ['mlyʔ] could be predicted by a semivowel insertion rule following a high front vowel, then 14. and 15. are viable analyses.

It may also be suggested that /C+yV/ is the underlying form of [CyV], but contrasting pairs such as [opə'ʒaʔ] /óPɫ'yá/ 'a vine' and [o'pyaʔ] /ó'PIá/ 'a bird' invalidate this possibility. If /C+yV/ was set up as the underlying representation for [o'pyaʔ], then the rule which deleted the central vowel preceding /y/ would also apply to the underlying representation for [opə'ʒaʔ] and generate the wrong surface form *[op'yaʔ] ([ž] is a variant of /y/).

We have seen that a single surface syllable of [kwyalkwyærna] has the following legitimate analyses as limited by univalent segment sequences and univalent syllable patterns in Angave.

- | | |
|----------|-----------------|
| 2.1.2.2 | \$CʷVVS\$ |
| 2.1.2.10 | \$CV\$CVV\$ |
| 2.1.2.11 | \$CʷV\$VV\$ |
| 2.1.2.12 | \$Cu\$CʷVVS\$ |
| 2.1.2.13 | \$Cu\$CVVVS\$ |
| 2.1.2.14 | \$Cu\$Ci\$CVV\$ |
| 2.1.2.15 | \$Cʷi\$CVV\$ |

The valid options appear to be at least seven, and several more could be added by making even finer distinctions within some of these as stated. Which one is the best for Angave? It is obvious

that our search must extend beyond univalent segment sequences and syllables for guidelines.

2.2 Phonotactics Based On Phonological Processes

I once believed that it was best to establish phonological patterns from the treatment of nominals first and then examine verbals for parallels. Verbals are so much more complex in their surface manifestations that I finally realized the reverse approach is preferable for Angave. Therefore, I intend to examine variation in verb formatives for additional insights to help narrow the range of permissible solutions presented above. Furthermore, I will assume that the solution that leads to less alternation in verbals is preferable to other equally adequate solutions precisely because it leads to less variation in verb formatives. Moreover, when such a solution leads to added complexity in nominals, the cost is nevertheless tolerable; for it has purchased simplicity in the very complex structure of verb formatives.

2.2.1 /CIV(V)/ Underlies [CyV(V)]

Formation of the continuous present tense suggests that [CyV(V)] sequences are best analyzed as /CIV(V)/. Consider the following verb formatives:

	(a)	(b)	(c)	(d)	
(6)	[nə'mɪfə]	/nɪ+mɪ+Tɪ/	['myɛɾnə]	/mɪ+aTɪnɪ/	'dig'
(7)	[nə'mɛfə]	/nɪ+mɛ+Tɪ/	['mɛɾnə]	/mɛ+aTɪnɪ/	'raise'
(8)	[nə'mɛfə]	/nɪ+mɛa+Tɪ/	['mɛɾnə]	/mɛa+aTɪnɪ/	'get'
(9)	['nəfəfə]	/nɪ+Tɪ+Tɪ/	['fɛɾnə]	/Tɪ+aTɪnɪ/	'say'
(10)	['nuɾə]	/nɪ+u+Tɪ/	['wɛɾnə]	/u+aTɪnɪ/	'go'
(11)	[nə'fɔfə]	/nɪ+Tɔ+Tɪ/	['fɔɾnə]	/Tɔ+aTɪnɪ/	'cut'
(12)	[nə'fɔfə]	/nɪ+Tɔa+Tɪ/	['fɔɾnə]	/Tɔa+aTɪnɪ/	'remove'
	(infin)		(pres cont 3s)		

Infinitives with seven different stem vowels (or vowel sequences) are listed in column a. The verb stems may be identified by stripping away the prefixed /n+/- and suffixed /-T+/- as is indicated by the underlying forms in column b. In the formation of the present continuous tense (column d) the suffix /-aT+n+/- is suffixed to the verb stem. Notice that, of the corresponding surface forms in column c, only the high vowels /i/ and /u/ (from the verb stems /mi-/ and /u-/) do not coalesce with the initial vowel of /-aT+n+/- and surface in a single segment (/CIV/ [CyV] not *[CV] (6c)).

A further inspection of all /i/-stem verbs and their formatives reveals that in most occurrences [i] can only be analyzed as /i/ and not as the semivowel */y/ nor as part of a complex consonant /CY/. Consider the /i/-stem verb /mi-/ 'dig' and how the /i/ surfaces in 13-21:

(13) ['m _i ?y _i l _n ə]	/m _i {+n+}/	'I dug (just now)'
(14) [m _i ? 'ya _i ʔnə]	/m _i {áT+n+}/	'I have dug'
(15) ['m _i ?ya _i ñ _i ʔgə _n ə]	/m _i {an _i +g+n+}/	'I have dug'
(16) ['m _i ʔa _i ñ _i ʔgə _n ə]	/m _i {ʔan _i +g+n+}/	'I dug'
(17) [m _i ? 'p _i ly _i]	/m _i {p _i +}/	'dig!'
(18) [m _i ?y _i l _i l _ʔ ʔ _ʌ nə]	/m _i {fT+ʔ+n+}/	'dig! (tomorrow)'
(19) [m _i ? 'ma _i ?anə]	/m _i {m _i +an+}/	'I will dig (now)'
(20) [m _i ? 'ma _i ?a _i ʔnə]	/m _i {m _i +áT+n+}/	'I will dig (tomorrow)'
(21) [m _i ? 'ʔa _i ʔnə]	/m _i {ʔáT+n+}/	'I used to dig'

Every occurrence of the verb stem /mi-/ in 13-21 has [i] as its surface manifestation. The /i/ in /i/-stem verbs will invariably surface as [i] when followed by glottal stop or a consonant. 22-25 show that this is not true when followed by vowels:

(22) ['my _a ʔ _i +ʔə _n ə]	/m _i {aT+ʔ+n+}/	'I'm digging'
(23) ['my _a ʔ _i +ʔa _i ʔgə _n ə]	/m _i {aT+ʔag+n+}/	'I was digging'
(24) ['my _a ʔ _i +ʔa _i ʔnə]	/m _i {aT+ʔáT+n+}/	'I dig (customarily)'
(25) ['my _a ʔ _i +ʔa _i ʔnə]	/m _i {ayaT+ʔáT+n+}/	'I dig (periodically)'

22-25 show that when followed by a vowel the /l/ in /ml-/ always surfaces as [y]. All /l/-stem verbs uniformly follow this pattern.⁹ If the form /Cl-/ is set up as basic, then [Cy] can be derived by a rule which produces the semivowel [y] when the suffix immediately attached to it begins with a vowel:

(26) CLASS CHANGE $\begin{matrix} V \\ [+high] \end{matrix} \text{ -----} \rightarrow [-vocalic] / C _ _ V$

CLASS CHANGE has been stated general enough (no formative boundary is specified in the structural description) so that it will produce [CyV] and [CwV] in nominals as well as verb formatives. It states that /l/ and /u/ surface as the semivowels [y] and [w] when preceded by a consonant and followed by a vowel. The following derivations illustrate its operation on strings containing /ClV/ and /CuV/:¹⁰

(27)	(a)	(b)	(c)	(d)
U.F.	/mlaTɪnɪ/	/'plɪɪf/	/PɪuaTɪnɪ/	/'bue/
/ɪ/ DELETION ¹¹	-----	-----	PuaTɪnɪ	-----
CLASS CHANGE	myaTɪnɪ	'pyɪf	PwaTɪnɪ	'bwe
S.F.	['myɛɾnə]	['pya?wə?]	['pwaɾnə]	[m'bwe]
	'he is digging'	'testicle'	'he is passing'	'river name'

To sum up, the phonological process described by CLASS CHANGE as motivated by alternation in verb stems indicates that setting up an underlying /ClV(V)/ is the best analysis of [CyV(V)]. Next we turn our attention to the ambiguous sequence [CwV(V)].

2.2.2 /CwV(V)/ Underlies [CwV(V)]

With respect to verbs like [ɪ'kwɪɾnə] 'untie' and [ɪ'gwɪɾnə] 'harvest (sugar cane)', are the ambiguous sequences (underlined) to be analyzed as */CuV(V)/ following the pattern of /l/-stem verbs, or are they to be analyzed as something else? An inspection of the many verb stems and verbals which contain the ambiguous sequence in question reveals that the [w] never varies. It never fills the

nuclear syllable slot in verb stems. In fact, simple verb stems of the form [Cu] do not exist as may be determined by examining 28-31a below. All the verb stems are [VCwV] (the part of the verb stem preceding [CwV] is immaterial to this discussion, as 30-31a show).

(a)	(b)	(c)	(d)	
(28) [nu'kwɪřə]	[u'kwɪʔyɪnə]	[u'kwɪŋaɪnə]	[u'kwɪʔtɪnə]	'open'
(29) [nuɟ'wɪřə]	[ɟ'wɪʔyɪnə]	[ɟ'wɪŋaɪnə]	[ɟ'wɪʔtɪnə]	'stay'
(30) [ni'gwořə]	[i'gwoʔwuna]	[i'gwoŋaɪnə]	[i'gwoʔtɪnə]	'separate'
(31) [ni'gwořə]	[i'gwoʔwuna]	[i'gwoŋaɪnə]	[i'gwoʔtɪnə]	'harvest'
(infin)	(immed past 1s)	(cust past 1s)	(cont pres 1s)	

Unlike /l/-stem verbs, where /l/--->[y]/___V and [l]/___ $\left\{ \begin{array}{l} C \\ ? \end{array} \right\}$, the [w] in question always fills a non-nuclear slot in the syllable, even when the verb stem is followed by a glottal stop (28-31b) or consonant (28-31c). Since [w] in simple verb stems is always followed by a vowel that fills the nucleus of the syllable, there is no motivation for analyzing [CwV(V)] as */CuV(V)/. Furthermore, note that in 28-31 [w] always follows a segment that is [-anterior]. Chen states that if "a phonological system has only one series of labialized consonants, it will be the labiovelar" (1974:49). The distribution of labialization on segments is limited to the velar and postvelar points of articulation in Angave. Since the labialization does not enter into variation in verb stems and since its distribution is limited to [-anterior] segments in both nominals and verbals, I analyze it as a feature inherent to a set of complex segments /C^w/. Moreover, by analyzing this sequence as /C^w/, sequences of four vowels in simple verb stems have been eliminated as a possibility.

To sum up, since the [w] in [CwV(V)] does not undergo any phonological processes, and since its distribution is restricted to following segments which are [-anterior], it is analyzed as labialization on a series of labialized consonants. Having settled

upon analyses for surface palatalization and labialization we must now deal with vowel sequences.

2.2.3 /\$VV\$/ Underlies Some [VV]

The interpretive decisions made thus far exclude */CuV(V)(V)/. Labialization in such sequences has been analyzed as belonging to a set of complex consonants /C^w/. This leaves [VV(V)] sequences which must be analyzed in conformity with univalent Angave syllable patterns, CV and V. The phonetic reverse vowel sequence [aɪ] and [ɪa], though not especially frequent, suggests that sequences of two vowels /VV/ may fill the nucleus of a single syllable. More important, however, the phonological process of vowel coalescence in Angave where $\left\{ \begin{array}{l} /oa/ \\ /ao/ \end{array} \right\} \text{ ---} \rightarrow [ɔ]$ and $\left\{ \begin{array}{l} /ea/ \\ /ae/ \end{array} \right\} \text{ ---} \rightarrow [æ]$ substantiates the evidence of the reverse vowel sequence and motivates analyzing /VV/ as filling the nucleus of a single syllable (cf. sec. 4.3.4 for the formulation of MONOPHTHONGIZATION(') (295, 306) which describe this process).

There is no evidence for analyzing /VVV/ as filling the nucleus of one syllable. Even the motivation for analyzing /VV/ as tautosyllabic may be questioned. Recall that /l/-stem verbs have surface forms like ['myæɾnə] /ml+aTɪnt/ 'he is digging' where it may be argued that the single surface syllable [myæ] is the synthesis of two underlying syllables /ml+a/; then the conclusion may be drawn that /VV/ may not be tautosyllabic if the first vowel is /l/. Likewise, the process of vowel coalescence cannot motivate underlying tautosyllabic /VV/ because it also produces the manifestations in a single surface syllable from formatives which are heterosyllabic. For example, consider /ámá+o/ [áʔmɔ] 'man' whose final surface syllable results from two heterosyllabic formatives. This line of argumentation could lead one to conclude that every occurrence of /VV(V)/ is a sequence of V syllables.

I am inclined not to accept this argument that can lead to analyzing /VV(V)/ as /\$V\$V\$(V)\$/, because I would expect then that

all morphemes are heterosyllabic. This is not the case because simple formatives like /-ʔ-/ 'existential' and /-ŋ-/ 'continuous action' are not in themselves a whole syllable; simple formatives like /'Tɪfwɪ/ 'dog' are more than one syllable. To me, /VV/ as the filler of a syllable nucleus is a reasonable solution in view of the process of vowel coalescence operating in the language. It also seems reasonable to me that where the first vowel is /ɪ/ in verb stems with the shape /CV(V)(V)/, the /ɪ/ is underlyingly heterosyllabic from the following vowel(s). That appears to eliminate the possibility of /VVV/ sequences being analyzed as tautosyllabic. The widespread phonological processes of semivowel epenthesis (cf. sec. 4.3.4 for the formulation of SEMIVOWEL EPENTHESIS' (329) and [w̄] EPENTHESIS' (342)), however, operate on verbals inserting the semivowels [w], [y] and [w̄] between sequences of vowels which are not perceived as tautosyllabic. It could be argued that [y] would be inserted following /ɪ/ in /CɪV(V)/, if the /ɪ/ was heterosyllabic from the following underlying vowels. But then again, we have already seen that CLASS CHANGE (26) operates in this context producing [y] from /ɪ/ and thus SEMIVOWEL EPENTHESIS' (329) is blocked from applying.

Clearly, the factors relating to analyzing vowel sequences are many and involved. At present, however, I find no compelling evidence for saying that every underlying vowel fills the nucleus of a separate syllable, though in some syllables they may; nor for saying that /VVV/ sequences must be the complex filler of a single syllable nucleus, though some may be. Based on the process of vowel coalescence I think that it is reasonable to assert that /VV/ may fill the nucleus of a single syllable or fill two V syllables, but sometimes it is hard to know whether [VVV] is to be analyzed as /\$VVV\$/, /\$V\$VV\$/, /\$VV\$V\$/ or /\$V\$V\$V\$/ (cf. 413, which indicates that syllabification of some vowel sequences does vary from one lect to another).

So far we have come to three solutions based on phonological processes operating in Angave. First, [CyV(V)] sequences come from /CIV(V)/. Second, [CwV(V)] sequences are the surface manifestation of /CwV(V)/. And third, [V₁V₂(V₃)] sequences (where V₁≠[u]) may have a sequence of vowels filling the nucleus of an underlying syllable: /\$V₁V₂V₃\$/, /\$V₁V₂\$V₃\$/, /\$V₁\$V₂V₃\$/ or /\$V₁\$V₂\$V₃\$/. This is not to say that these are the only analyses valid for Angave, but to say that they are well-motivated and coherent within the phonological framework of the language.

2.2.4 Complex Segments Underlie Prenasalized Stops

Voiced stops in Angave are always prenasalized, i.e. [mb], [nd], [ŋg], and [ɲj]. (A prenasalized affricate will be analyzed as the sequence /d/ in sec. 2.2.5.2). They occur word initial and medial, but always in the prenuclear slot of a CV syllable. When occurring medially the nasal of the prenasalized stop closes the preceding surface syllable and the stop fills the onset slot of the following surface syllable. For example, ['ʔambəʔ] 'juice harp'. The assumption that two CV syllables (actually CV and CV&') underlie ['ʔambəʔ] can be supported by the articulation of native speakers asked to say such words carefully. The voiced stops are always pronounced as a unit subsequent to a slight pause after the vowel. So based on syllable structure conditions these prenasalized stops must be analyzed as complex segments filling a single onset syllable slot, for closed syllables are not allowed in Angave and sequences of unambiguous consonantals do not occur.

Loan words in Angave also corroborate the analysis of prenasalized stops as complex segments. The Pidgin English words buk, balus, and gan, are Angavized [m'bugwʔ], [m'baʔutʂʔ], and [ɲ'ganaʔaʔ] respectively. Note that voiced stops have been prenasalized and that closed syllables are made to conform to Angave syllable structure constraints, i.e. \$CVC\$ → \$CV\$CVʔ\$ (Vʔ\$). Furthermore, the Angave who have learned Pidgin English and Motu as

adults cannot suppress prenasalization of voiced stops, so that for example Motu dala 'road' is pronounced ['ndaʃa]; and my two sons Benjamin and Brad are called [mbeŋʃi.'mano] and [m'bwæʃo].

2.2.5 /CI/ Underlies Alveopalatals

There are two possible sources of alveopalatals in Angave. They may be the surface manifestation of a set of palatalized consonants */CY/ or the sequence /CI/. We will consider the alternatives in view of segment pattern congruity and observable phonological processes. First let us consider the evidence for deriving alveopalatals from */CY/.

2.2.5.1 */CY/ as a Source of Alveopalatals

If the phonetic sequences [CyV] were assumed to come from */CYV/ rather than from /CIV/, as suggested in sec. 2.2.1, then [š, lš], and [ɲ], and [ɲʃ] should arise from */TY/,¹² */dY/, and */nY/. This claim nicely fills out the pattern of possible palatalized segments so that nearly all points and manners of articulation have palatalized variants. 32 shows the potential distribution of */CY/, if one analyzed segments and sequences so as to maximize the distribution of palatalized consonants.

(32) The Potential Distribution of */CY/

P	T	K	K ^w	ʃ	ʃ ^w
*PY	*TY	*KY	*K ^w Y		
b	d	g	g ^w		
*bY	*dY				
				[š]	
				[ɲ,ʃ]	
m	n	ŋ	ŋ ^w		
*mY	*nY ← [ɲ]	*ŋY			
w					
*wY	y				

Not only do */Tʲ/, */dʲ/, and */nʲ/ potentially complete an array of underlying palatalized consonants, they also represent assumptions substantiated by phonological processes in verbals and personal pronouns. Consider the following verb formatives and the changes accompanying the insertion of the formative /-y-/ that indicates 'benefaction'.

- | (a) | (b) | (c) | |
|------------------------------|------------------|--------------|---------------------|
| (33) /lKea+aT+n+/ | /n+lKea+y+aT+n+/ | [ŋlɤæ'yæɾnə] | 'lighting for me' |
| (34) /oT+aT+n+/ | /n+oT+y+aT+n+/ | [no'tʃæɾnə] | 'sharpening for me' |
| (35) /d+aT+n+/ | /n+d+y+aT+n+/ | [ɒŋ'jæɾnə] | 'picking for me' |
| (pres cont 3s) (benefaction) | | | |

34 and 35 show that when /-y-/ 'benefaction' is suffixed to some /t/-stem verbs, the central vowel is lost, /T/ and /d/ are then contiguous to /-y-, and the alveopalatals [tʃ] and [ŋj] result.

Object pronouns prefixed to transitive verbs point as well to setting up */CY/. Consider the alternation in the surface manifestations of the pronoun prefixes /n-/ 'me' and /T-/ 'you' in 36-38:

- | (a) | (b) | (c) | (d) | | |
|---------------|----------------------|----------|-------------------|---------------------|-------------|
| (36) ['æɾnə] | / <u>ea</u> aT+n+/ | ['yæɾnə] | /y <u>a</u> T+n+/ | | |
| (37) ['næɾnə] | /n+ <u>ea</u> aT+n+/ | '...me' | ['ŋæɾnə] | /n+y <u>a</u> T+n+/ | '...to me' |
| (38) ['fæɾnə] | /T+ <u>ea</u> aT+n+/ | '...you' | ['ʃæɾnə] | /T+y <u>a</u> T+n+/ | '...to you' |
| | 'he is hitting' | | 'he is listening' | | |

When the object pronouns /n-/ and /T-/ are prefixed to verbs like /eaaT+n+/ that begin with a vowel (36a,b), they are realized as [n] and [f] (37-38a,b). But, when they are prefixed to verbs beginning with /y/ (36c,d), they coalesce and are realized as [ŋ] and [ʃ] (37-38c,d).

The formation of personal pronouns in 39-40 also points to an underlying */CY/:

	(a)	(b)	(c)	(d)	
(39)	/'n+yo+n+/'	['ŋonə]	'I'	/'n+gɬ/ ['n+ŋgəʔ]	'mine'
(40)	/'d+yo+ŋ+/'	[ŋ'Joŋʌ]	'you'	/'d+ŋɬ/ [n'dʌŋʌʔ]	'yours'
	(personal pronouns)		(possessive pronouns)		

Again, /n/ and /d/ coalesce with /y/ in 39-40a,b and surface as the alveopalatals [ŋ] and [ŋj]. In possessive pronouns there is no /-yo-/ following /n/ and /d/, and so they are realized as [n] and [nd].

These several cases of alternation (33-40), along with the potential distribution of palatalized segments (32), demonstrate that */CY/ could quite plausibly be the source of alveopalatals.

2.2.5.2 /Cj/ the Source of Alveopalatals

Substantial evidence has been presented from alternation in verbals and pronominals as well as the potential distribution of palatalized consonants to support analyzing alveopalatals as */CY/ underlyingly. Does this evidence controvert the earlier decision to analyze [CyV] as the surface manifestation of /CIV/? Not necessarily, though the sequence */CYV/ certainly is a valid analysis of the data presented thus far. And, as I will demonstrate, /CIV/ is just as valid and even preferable. There are several reasons why /CIV/ is a preferable solution. First, in 33-40 [Cy] results from a coalescence of /C+y/ and not from */C+y/. Second, the forms with underlying /C+y/ could also be analyzed as /C+I/ in each example. Third, CLASS CHANGE (26) would have to be reformulated, if */CY/ was to be maintained. Fourth, and most important, there is neutralization of contrast between alveopalatals and alveolars preceding /I/, which can be used along with the /CIV/ analysis posited earlier to shrink the inventory of underlying segments rather than increase it by setting up a series of palatalized segments */CY/. Alveolar segments do not occur preceding /I/ (except in the two words [nə'tɬyɬʔ] 'Kapau People' and [nɪgəʔ'n+ŋgəʔ] 'shield'). All alveopalatals frequently precede

/l/. The neutralization is evidence by alternation in verbals where the object prefixes /n-/ 'me' and /T-/ 'you' surface as [ŋ] and [š] when prefixed to multisyllabic verb stems whose initial segment is /l/. Consider 41-42:

- | (a) | (b) | |
|-------------------------------------|--------------------------|-----------------|
| (41) / <u>n</u> +l m ó n a T + n +/ | ['ŋ l m ə ʔ n a r n ə] | 'I like (it)' |
| (42) / <u>T</u> +l m ó n a T + n +/ | ['š l m ə ʔ n a r n ə] | 'you like (it)' |

Because alveolar segments do not occur preceding /l/ (cf. 37-38), i.e. there is a 'hole' in the pattern, I conclude that each alveopalatal can be analyzed and represented sequentially as an underlying alveolar segment followed by /l/, i.e. /Tl/, /dl/, /nl/ surface as [š, tš], [ŋJ], and [ŋ]. This conclusion is substantiated by alternation in verb stems. Consider the following verbals:

- | (a) | | (b) | |
|------------------------|-------------------|-------------------|-------------|
| (43) ['m y ə r n ə] | 'he is digging' | [n ə 'm l f ə] | 'to dig' |
| (44) [ŋ ' J ə r n ə] | 'he is fastening' | [ŋ ŋ ' J l f ə] | 'to fasten' |

Notice that both 43 and 44 are /l/-stem verbs as is indicated by their infinitival forms (43-44b). If the underlying representation /mlaT+n+/ is assumed for 43a, then one would expect the underlying representation of 44a to include the sequence /la/ since they are both /l/-stem verbs. Because of the evidence already given showing the feasibility of analyzing [ŋJ] as */dʎ/ or a sequence of /d/ and /y/, and because of what has just been argued, it is also true that [ŋJ] could be the result of /d/ and /l/. The underlying representation of 44a is thus /dl a T + n +/. A rule, describing /dl/, /Tl/, and /nl/ coalescing to [ŋJ], [š, tš], and [ŋ] as a process of palatalization, would then produce the appropriate surface representation of /dl a T + n +/. Since CLASS CHANGE (26) will operate on /CIV/ and change the high front vowel to the high front semivowel, we will state the rule so that it operates on the output of CLASS CHANGE and is thus intrinsically ordered after it:

(45)	PALATALI-	[+coronal]	-consonantal	V --->	+coronal	∅	V
			+high		+high		
			-back				
	1		2	3	1	2	3

PALATALIZATION states that an underlying alveolar segment followed by the sequence /yV/ that is produced by CLASS CHANGE surfaces as an alveopalatal with the semivowel deleted. This is an assimilatory process, for the tongue position of the high front semivowel is superimposed on the preceding consonant. Derivations 46a-d illustrate PALATALIZATION producing alveopalatals.

(46)	(a)	(b)	(c)	(d)
U.F.	/'Tɪaŋf/	/'Tɪɪŋf/	/i'niá/	/'dɪoŋt/
CLASS CHANGE	'Tyaŋf	'Tyɪŋf	i'nyá	'dyoŋt
PALATALIZATION	'šaŋf	'šɪŋf	i'ñá	'.Joŋt
S.F.	['šagaʔ]	['šɪŋaʔ]	[i'ñáʔ]	[ñ'Joŋʌ] ¹³
	'heavy'	'star'	'rain'	'you'

The attractiveness of this analysis of alveopalatals is seen in the way CLASS CHANGE (26) and PALATALIZATION (45) complement each other, for they are intrinsically ordered, the former feeding the latter. Furthermore, by accounting for alveopalatals with PALATALIZATION, CLASS CHANGE, which was independently motivated by variation in verbals, is kept intact. If alveopalatals were analyzed as palatalized alveolars, a subset of palatalized consonants, then CLASS CHANGE would have to be reformulated and the variation in /l/-stem verbals (cf. 13-25) would have to be accounted for in another way.

Now, the next question to be addressed is: must /y/ be analyzed as a sequence of /y/ and /l/ since it is an alveopalatal? In principle and for absolute consistency it could,¹⁴ but would it have been analyzed as */yV/, had we decided upon the analysis deriving alveopalatals from palatalized consonants? Also, /y/ is

not the same as obstruents such as [š, tš], [ñj], and [ñ] since it is [-consonantal]. Therefore, it should not be expected to act everywhere like the set of alveopalatal consonants.

To sum up, though alveopalatals could be analyzed as */CY/, /CI/ is a better solution because of the phonological processes described by CLASS CHANGE (26) and PALATALIZATION (45), and the way they complement each other. If */CY/ were to be maintained in underlying forms, then CLASS CHANGE would have to be reformulated and the inventory of underlying segments would be increased by ten, which would unnecessarily multiply theoretical machinery.

2.2.6 Semivowels Indicate Syllable Structure

The high vowels [i] and [u] occur in syllable nuclei. The semivowels [y] and [w] only occur outside syllable nuclei as (47) informally describes:

$$(47) \left\{ \begin{array}{l} /i/ \\ /u/ \end{array} \right\} \dashrightarrow \left\{ \begin{array}{l} [y] \\ [w] \end{array} \right\} / \left\{ \begin{array}{l} \text{C} \\ [-\text{consonantal}] \\ [+ \text{sonorant}] \\ \# \\ \text{V} \end{array} \right\} \text{--- V.}$$

Even without including a reference to syllable structure in its structural description, rule 47 is an adequate statement because it always produces appropriate surface representations. It states that a high vowel becomes a semivowel when a vowel follows, and if the preceding environment is one of three elements: a semivowel, a vowel, or a word boundary. The rule is capable of multiple applications. For example:

(48)	(a)	(b)
U.F.	/#maulá#/	/#laulauaTɪnɪ#/#
47	'mawjá	yaywɪawaTɪnɪ
S.F.	['ma ^u wyaʔ]	[yɪlɪwɪa ^u waɾnɛ]
	'chin'	'he is going to think'

The [u] glide following [a] in 48a,b is accounted for by BACK GLIDE INSERTION (266). [yaɪ], the first syllable in the surface form of 48b, does not differ phonetically from the resulting yay. Consider how 48b is operated on by rule 47. The first high vowel is word initial, i.e. is preceded by a #, and followed by a V, so it becomes [y]. The next high vowel is intervocalic so it results in [y]. The third is preceded by the semivowel just produced and another vowel follows, so it results in [w]. The fourth follows the pattern of the third, and the fifth is also intervocalic and results in [w]. Thus 48b shows the application of rule 47 in all its possible environments. I will, however, continue to write underlying forms with /w/ and /y/ in the onset slot of syllables, though they could be written /u/ and /i/ on the basis of rule 47. My reason for doing this is based on orthographic conventions, i.e. the underlying form /ɪɪlɪlɪwɪwɪtɪnɪ/ is much more difficult for us to read than /yɪlɪlɪwɪwɪtɪnɪ/ because we must first determine which of the high vowels surface as semivowels. By writing /w/ and /y/ we thereby include some redundant information in the underlying form, which is helpful, in syllabifying what potentially could be written as long sequences of underlying vowels.

3 CONSONANTS

I will break up the discussion of Angave consonants into three parts. First, I state what the underlying consonants are for Angave and briefly describe them. Next, I catalogue the surface manifestations of underlying consonants with their attendant features. Following these two brief sections, I describe the phonological processes that operate on consonants and produce their surface representations. I motivate phonological and morphological rules inductively and illustrate their operation with derivations.

3.1 Underlying Consonants

(49)

Point of Articulation			
(-high)		high	(-high)
(-coronal)	coronal	(-coronal)	
anterior		back (-anterior)	

Manner of Articulation (-conson) consonantal sonorant (-sonorant) (-nasal) nasal (-nasal)	p	t	k	k ^w	ʔ	ʔ ^w
	b	d	g	g ^w		
	m	n	ŋ	ŋ ^w		
	w	y				

The preceding matrix of consonants (49) requires explanation in two points, first the parameters of the matrix with their attendant features, and second, the underlying consonants themselves. The parameters of the matrix displaying the underlying consonant segments are point of articulation and manner of articulation. The two parameters are divided further by other features. Point of articulation is segmented by the features 'anterior' (-back), 'coronal' and 'high'. These features and their divisions in the matrix have been chosen for simplicity in designating each of the four points of articulation. For example, [-anterior] is sufficient to distinguish the underlying segments in the velar column.

The vertical parameter, manner of articulation, is subdivided by three features, 'consonantal', 'sonorant', and 'nasal'. Again,

The underlying consonants have already been minimally specified. 'Continuant' and 'voice' must be included to adequately specify the voiceless stops and voiced and voiceless fricatives arrayed in 50. Some features specified in 49 are used in combination with others to maintain oppositions not obvious from the underlying consonants, i.e. the opposition between [w] and [w̄] is maintained by the feature 'high'. 'Grave' is included in order to group the bilabials and back consonants together. Its inclusion will be motivated in the discussion of phonological processes (see sec. 4.3.2). Other features which are redundant but indicate the precise articulatory nature of each of the phones are listed in the full feature specification chart (51). All pluses and minuses have been marked including redundancies. All phonetic manifestations are produced with pulmonic airstream. The very limited distribution of the features 'delayed release', 'strident', 'flap' and 'aspiration' indicate their redundant nature for Angave.

The postvelars and [w̄] are the phones that require a further explanation of their precise articulatory nature. The postvelars are articulated in the postvelar region approximating the uvula. When non-continuant and non-labialized, i.e. [kʰ], the postvelar is aspirated lightly. The phone [w̄] is completely predictable on the basis of vowel sequences and glottal stop. It differs from [w] in that it does not cause rounding in preceding or following vowels. The lips round but the tongue is lower like when articulating [o].

3.3 Phonological Processes that Account for Surface

Representations of Consonants

The phonetic manifestations of underlying consonants can be accounted for by rules dealing with the horizontal parameter of the matrix, which is point of articulation, and the vertical parameter, manner of articulation. The chart displaying the phonetic manifestations of the underlying segments is not sufficiently explicit at pointing out this fact. A work chart of phonetic manifestations (Appendix A) is more lucid in making clear the distinction between rules dealing with manner of articulation and rules dealing with point of articulation.

With regard to producing the appropriate point of articulation in surface manifestations of consonantals, just one rule is needed. This rule accounts for the variation manifested at the velar point of articulation. Because of its scope of application, it will be motivated and stated first. 52-66 show predictable variation at the velar point of articulation:

(a)		(b)		
(52)	['kɪʔmɪŋəʔ]	'egg'	['kəbɪŋəʔ]	'storm clouds'
(53)	['ɪkəʔ]	'feces'	[pə'kəʔ]	'honeybee'
(54)	['kwɪʔmɪŋəʔ]	'pus'	[kwe'baŋəʔ]	'a tree'
(55)	['ɪkwuʔ]	'leaf'		
(56)	['ʃɪŋɡwɪʔ]	'mushroom'	[ɪʃə'ʔegweʔ]	'a bat'
(57)	['ʃuŋɡwɪʔ]	'foot'		
(58)	[yŋu'baŋəʔ]	'a shell'	[ŋ'ge]	'where?'
(59)	['yŋɪʔnaʔ]	'when'	['nɪyŋəʔ]	'mine'
(60)	[ɪŋ'gwaʔ]	'slivers'	[ŋ'gwɪʔnəʔ]	'Adam's apple'
(61)	['ʃuŋɡwɪʔ]	'lime'	['ʃoŋɡwɪʔ]	'sun'
(62)	['ɪŋəʔ]	'bird'	['maŋəʔ]	'mouth'
(63)	['uŋo]	'who went'		
(64)	[mɪ'ŋɪʔ]	'arrow shaft'		
(65)	['ʃuŋɡwɪʔ]	'eye'	[ŋ'waʔ]	'sharpen'
(66)	[ŋ'mɪyŋwɪʔ]	'a cholias'	['ʔæŋwɪʔ]	'saliva'

In column a each of the manifestations at the velar point of articulation has been fronted, whereas in column b none have been fronted. The environmental factor that accounts for this variation is the vowels to which each manifestation is contiguous. When abutting on the high vowels, [i] and [u], the surface manifestation of velar consonantals is fronted. This claim holds for the non-nasal obstruent, nasal obstruent, velar nasal, and also the labialized counterpart of each. The rule VELAR FRONTING has been formulated to account for this pattern:

$$(67) \text{ VELAR FRONTING } \left[\begin{array}{c} \text{C} \\ \text{-anterior} \\ \text{+high} \end{array} \right] \text{ ----> } [+coronal] \# \text{ ______ } \left[\begin{array}{c} \text{V} \\ \text{+high} \end{array} \right]$$

VELAR FRONTING states that velar consonantals are pulled forward and articulated at the coronal point of articulation when contiguous to high vowels, as is signaled by the mirror image notation. Derivations 68a-c illustrate VELAR FRONTING:

(68)	(a)	(b)	(c)
U.F.	/'g'íná/	/'Tít'ɣwɪ/	/'fKɪ/
/ɬ/ REGRESSIVE ROUNDING (251)	-----	'Tít'ɣwɪ ¹⁶	-----
PALATALIZATION (45)	-----	'šɣɣwɪ	-----
VELAR FRONTING	'g'íná	'šɣɣwɪ	'fKɪ
D.F.	[ɣ'g'ɪ'naʔ]	['šɣɣwɪʔ]	['fKɪʔ]
	'when?'	'eye'	'feces'

Derivation 68b shows that /ɬ/ REGRESSIVE ROUNDING (251), which raises and rounds the mid central vowel, feeds VELAR FRONTING.

Having formulated VELAR FRONTING that accounts for variation in point of articulation, let us turn to formulating rules which account for variation in the manner of articulation. Since phonological processes apply to natural classes of consonants, we will order our discussion by sets of consonants beginning with non-nasal obstruents.

3.3.1 Non-Nasal Obstruents

The surface manifestations of voiceless stops as well as voiceless and voiced fricatives result from underlying obstruents that contrast with prenasalized voiced obstruents (Appendix B) and therefore, have a minus value for the features 'nasal' and 'sonorant'. I will attempt to motivate this analysis for fricatives and voiceless stops by approaching the data inductively and showing that among the possible analyses an abstract set of non-nasal obstruents best accounts for the variation. The limited distribution of voiceless stops and voiced and voiceless fricatives in Angave surface forms is illustrated by 69-74.

	(a)	(b)	(c)	(d)
(69)	[še' <u>b</u> yaʔ] 'long'	[št' <u>p</u> yaʔ] 'a bird'	[/p'tɪŋəʔ]~[p] 'cliff'	[/b'tɪŋəʔ]
(70)	[wa' <u>f</u> aʔ] 'skin'	[wa' <u>t</u> aʔ] 'board'	[/t'tɪŋəʔ]	[/f'tɪŋəʔ] 'a bird of paradise'
(71)	[/' <u>g</u> əʔ] 'a tree'	[/' <u>k</u> əʔ] 'feces'	[/kəb'tɪŋəʔ]	[/'gəb'tɪŋəʔ]~[x]~[k] 'storm clouds'
(72)	[/'p <u>l</u> gwuʔ] 'fin'	[/' <u>k</u> wuʔ] 'leaf'	[/kwe'baqʌʔ]	[gwe'baqʌʔ]~[xw]~[kw] 'a tree'
(73)	[yo' <u>g</u> aʔwəʔ] 'bridge'	[a' <u>k</u> haʔwəʔ] 'a wild yam'	[/'khaʔəʔ]	[/'gaʔəʔ]~[x]~[kh] 'battle axe'
(74)	[fə' <u>g</u> waʔm'tɪŋəʔ] 'a fern'	[fə' <u>k</u> wam'tɪŋəʔ] 'coals'	[/'kwoʔ]	[/'gwoʔ]~[xw]~[kw] 'tongs'
	(medial)	(medial)	(initial: ##___)	(initial: #___)

The entries in columns a and b (the segments in focus are underlined) show that voiceless stops contrast with voiced fricatives in word medial position. Contrast is not maintained in word initial position, however, as the entries in columns c and d demonstrate, for both columns contain the same forms in two different environments. Column c shows that voiceless stops, not voiced fricatives (though a voiceless bilabial fricative varies

with its corresponding stop) occur when word initial coincides with an external word boundary. But in the same forms, when word initial coincides with no boundary greater than an internal word boundary (column d), voiced fricatives occur at each point of articulation ([f] patterns with voiced fricatives in Angave). Column d also shows that velar and postvelar voiced fricatives have other variants following an internal word boundary, voiceless fricatives and voiceless stops.

Let's ignore temporarily the variation between [p] and [p̥] in 69c and work with the overall pattern in column c; voiceless stops occur following an external word boundary, but not voiced fricatives. Let's also set aside for now the variation in 71-74d at the velar and postvelar points of articulation, and work with the overall pattern; voiced fricatives occur after an internal word boundary, but voiceless stops do not. We will return to the exceptions later and offer explanations for them. Since the data itself suggests no conditioning factor that could account for the contrast between voiceless stops and voiced fricatives in columns a and b, it appears that the contrast must be maintained in underlying representations. There are essentially two possible solutions. One solution, following the tight methodological constraints of natural generative phonology, would postulate three sets of underlying consonants: a set of voiceless stops for column b, a set of voiced fricatives for column a, and a set of archisegmentals which are specified for neither 'voice' nor 'continuant' from which the variants in column c and d would be derived based upon the presence of an external word boundary.

A second solution, following the more liberal constraints of transformational generative phonology, would postulate a set of voiceless stops for column b and a set of fricatives for column a. Then the variants manifested in columns c and d would be derived from the set of underlying voiceless stops (or from the set of underlying fricatives). A rule would be written to capture the

generalization that voiceless stops do not vary in word medial position, but do word initial, depending on whether or not they follow an external word boundary. The disjunctive rule with a fully stated structural description would look something like this:

$$(75) \text{ SPIRANTIZATION} \quad \begin{array}{c} \text{C} \\ \left[\begin{array}{l} -\text{continuant} \\ -\text{voice} \end{array} \right] \end{array} \rightarrow \left\{ \begin{array}{l} \left[\begin{array}{l} +\text{continuant} \\ +\text{voice} \end{array} \right] / \# \text{ ___} \\ \left[\begin{array}{l} -\text{continuant} \\ -\text{voice} \end{array} \right] / \left\{ \begin{array}{l} \#\# \text{ ___} \\ \text{elsewhere} \end{array} \right. \end{array} \right.$$

SPIRANTIZATION states that voiceless stops are realized (1) as voiced fricatives when word initial and preceded by no boundary greater than an internal word boundary,¹⁷ and (2) as voiceless stops when preceded by an external word boundary or otherwise unspecified environments. If we continue to ignore the exceptions to this generalization and account for them subsequently (cf. sec. 3.3.1.1 and 3.3.1.2), then the major rule can be reformulated as follows:

$$(76) \text{ SPIRANTIZATION}' \quad \begin{array}{c} \text{C} \\ \left[\begin{array}{l} -\text{continuant} \\ -\text{voice} \end{array} \right] \end{array} \text{ ---->} \left[\begin{array}{l} +\text{continuant} \\ +\text{voice} \end{array} \right] / \# \text{ _____}$$

SPIRANTIZATION' states that voiceless stops are realized as voiced fricatives when preceded by an internal word boundary (or less), and as voiceless stops elsewhere.

Given only the data in 69-74, either solution is valid as formulated within their respective theoretical frameworks. There is, however, another factor relevant to reaching a solution. Consider the distribution of glottal stop (word final position is irrelevant here) in 77-84. 77-84 is arranged schematically like the array of underlying consonantal segments (49). The segments in focus are all medial and they are underlined. The last six rows (79-84) are arranged in pairs showing that nasal obstruents, nasals, and semivowels occur medially following a vowel (79, 81, 83) or following glottal stop (80, 82, 84). Each of the first two

rows in the array (77 and 78) does not have a corresponding pair. Neither voiceless stops (77) nor voiced fricatives (78) are ever preceded by glottal stop in surface manifestations. This inspection of 77-84 has revealed that glottal stop is conspicuously absent in two medial environments at each point of articulation. Specifically, glottal stop never precedes voiceless stops or voiced fricatives, yet it does precede nearly all other consonantals.

	(a)	(b)	(c)	(d)	(e)	(f)
(77)	[ʃt'pyaʔ]	[wa'laʔ]	[l'kaʔ]	[l'kwuʔ]	[a'khaʔwəʔ]	[fo'kwamɪŋəʔ]
	'a bird'	'board'	'feces'	'leaf'	'a wild yam'	'coals'
(78)	[ʃe'byaʔ]	[wa'faʔ]	[l'gaʔ]	[p'ligwuʔ]	[yo'gaʔwəʔ]	[fo'gwaʔmɪŋəʔ]
	'long'	'skin'	'a tree'	'fin'	'a bridge'	'fern'

	(a)	(b)	(c)	(d)
(79)	[om'baʒaʌʔ]	[oŋ'doʒaʌʔ]	[l'mengəʔ]	[aʉŋ'gwoʒaʌʔ]
	'many'	'a palm'	'slope'	'a pitpit'
(80)	[eʔ'mbaʔ]	[oʔn'dugwuʔ]	[yl'teʔŋgəʔ]	[aʔŋ'gweʔŋlʔ]
	'above'	'a tree'	'a pitpit'	'a tree'
(81)	[a'maʔ]	[pənaʔ]	[ʃt'ŋaʔnə]	[ʃ'ŋwuʔ]
	'a banana'	'a tree'	'visible'	'neck'
(82)	[aʔmaʔ]	[pəʔnəʔ]	[ʃt'ŋaʔ]	
	'person'	'hidden'	'stone'	
(83)	[l'wuʔ]	[ya'ylʔ]		
	'woodpile'	'happy'		
(84)	[l'ʔwuʔ]	[l'na'ʔylʔ]		
	'child'	'an arrow'		

This limitation in the distribution of glottal stop, coupled with the previous observation that voiceless stops and voiced fricatives only contrast word medially, permits a third solution for fricatives and voiceless stops. Medial voiceless stops could be represented sequentially as a combination of underlying glottal closure on a preceding vowel, followed by $\left[\begin{array}{l} \text{-sonorant} \\ \text{-nasal} \end{array} \right]$. Then medial