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LANGUAGE UNIVERSALS, MARKEDNESS THEORY, 
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THE INTERACTIONS OF NASAL AND ORAL CONSONANTS 

DISSERTATION 

Presented in Partial Fulfillment of the Requirements for 
the Degree Doctor of Philosophy in the Graduate 
School of The Ohio State University 

By 
Robert Kevin Herbert, B.A., M.A. 

The Ohio State University 
1977 

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Before the discovery of the duckbilled platypus in Tasmania and Southern Australia, zoologists in their general definitions of mammals did not foresee the egg-laying ones; nevertheless these obsolete definitions retain their validity for the overwhelming majority of the world's mammals and remain important statistical laws.

- Roman Jakobson (1958:20-1)

As a matter of general scientific principle, one does not disprove the egg-laying nature of the duckbilled platypus by producing a photograph of one or even a dozen not laying eggs.

- Roger Lass (personal communication, via Lachlan Mackenzie)
ACKNOWLEDGEMENTS

This thesis owes a great deal to many people. It is difficult for me to adequately express my appreciation to all those who have counseled and encouraged me during the course of its writing.

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A special thanks goes to Gillian Brown who gave freely of her time and knowledge and thus helped to make my stay in Edinburgh a pleasant and profitable one. I am grateful to the Department of Linguistics and Phonetics of the University of Edinburgh for extending its hospitality to me and also to Roger Lass who gave critical comments of some earlier versions of ideas presented in this thesis.
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thesis; I have been able to incorporate some of these data into the present version of this work.

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## Chapter

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NOTES ON SYMBOLS

In most cases, it has been found preferable to retain the transcriptions used by various authors, except when they are idiosyncratic or ambiguous. In certain cases, this has been necessitated by the author's not giving precise phonetic descriptions and the fact that the symbols used are ambiguous. It has not been possible to verify these forms with native language consultants.

The distinction between nasal-oral surface clusters (NC) and unit prenasalized consonants (NC, NC, NC) is indicated only when it crucially affects the argument at hand or is not clear from the text. Similarly, we follow our sources in the transcription of prenasalized consonants as NC or NC; it seems unlikely that such a distinction could ever be contrastive. ñ indicates a nasalized vowel except in Kikuyu and some related languages where I and u are the standard orthographic symbols for [i] and [u]. Y indicates a "super-close" vowel, usually cited in the context of Bantu (cf. Guthrie 1967-70).

Note also the following equivalences and conventions:

\[ ñ = ʃ \]
\[ ñ = ʒ \]
\[ ʃ = ʒ \]
\[ ʒ = dʒ \]
\[ mgb = mgb = nmgb \]
\[ nkp = mkp = nmkp \]
N represents a homorganic nasal preconsonantally or a nasal unspecified for point of articulation. Similarly, C represents any consonant. The other symbols employed are those of the International Phonetic Alphabet. The diacritic symbols £, £, £ will be used to indicate voiced, voiceless, retroflex, and syllabic consonants respectively. Other symbols and diacritics will be noted in the text. Finally, slashes (/.../ ) will be used to distinguish phonological or underlying forms from surface phonetic forms, which will be cited within square brackets ([... ]). Underscore (_) will be used for items cited in their orthographic forms and foreign words cited within the text.
CHAPTER I
INTRODUCTION AND ORIENTATION

1.0 Introduction

This thesis considers in detail the complex interactions which obtain between nasal and oral consonants which abut upon one another, especially those which are realized as surface units, i.e. prenasalized and postnasalized consonants. In this regard, a comparison is made with other types of half-nasal consonants which have different sources of origin. The approach employed will be largely processual. In addition to its substantive interest, this study will further illustrate the methodology of dynamic comparison of Greenberg (1969b).

1.1 Background and Theoretical Orientation

The basic goals of the present research are three. First, an exhaustive categorization of the various types of half-nasal consonants which occur among the world's languages will be presented. Second, various claims about the underlying nature of prenasalized consonants and their representation in any synchronic system will be set forth. Finally, this project also attempts to make a contribution to the relatively scarce literature explicating the relationship between diachronic and synchronic universals in phonology as discussed by Greenberg (1966a).

We will examine in detail the various types of diachronic processes in which prenasalized consonants participate. It will be
demonstrated that these processes are mirrored in synchrony, although there can be no absolute boundary between the two since it is not always possible to separate synchrony and diachrony within a language system. However, that synchronic systems and diachronic generalizations regarding change are mutually supportive will be cited as an important consideration bearing on the validity of the analyses proposed.

Among the crucial questions which will be addressed during the course of this thesis is whether prenasalized and postnasalized consonants, i.e. the so-called "half-nasal" consonants, can ever be considered as single underlying units, and, if so, under what conditions. There are a wide variety of criteria which could be cited as relevant in such a determination. For example, among the criteria mentioned by Trubetzkoy is:

A sound group can only be considered as a realization of a single phoneme if it is produced by a single, unitary act of articulation or in the course of the general breakdown of an articulatory configuration (1968:14).

The issue of determining underlying status for complex surface units will be examined in detail in Chapter 3.

Another important issue which arises during the course of the following investigation is the close mirroring in behavior between prenasalized consonants and nasal plus oral consonant clusters. There are close parallels not only in their patterning within synchronic language systems, but also in diachronic developments to which they are subject. This parallelism follows naturally from the phonetic parallelism which exists between the two types of sequences. However, we shall argue that it is possible to further reduce these two sets of generalizations to a
single one based on closer underlying identity. The demonstration of
the non-unitary underlying status of prenasalized consonants forms the
basis of one of the central claims of the present work.

The scope of this study is asserted to be universal. That is, the
generalizations proposed are claimed to be valid relations among various
properties of language systems for all languages at all times. In the
early chapters of this work, the topic of universals is treated through
the consideration of hierarchical relations, especially those pertaining
to marked and unmarked features. Greenberg (1966a, 1969b, 1970a, and
elsewhere) has demonstrated that this is a viable method since it offers
the opportunity to illustrate a number of general methodological problems
such as the relationship between typology and universals, the relation-
ship between synchronic regularities and diachronic processes, and the
problem of levels of generalization.

The justification for a project such as this comes from the need to
generalize on the basis of existing knowledge of languages of the world.
This stems from a basic belief that not only do language universals
exist, but that explanations for their existence also necessarily exist.
It is still possible to argue that our knowledge of linguistic facts is
not sophisticated enough to allow for the statement of universals. Thus,
many proposed universals have later been "downgraded" to the status of
"near-universal" or abandoned altogether (Kuipers 1968). The present
study attempts to discover the underlying universals and regularities
of behavior involving one particular type of linguistic phenomenon: the
interactions of nasal and oral consonants. The actuation, i.e. temporal,
factor is not accommodated within the present study. As Greenberg
(1969b:195) has pointed out: this problem deserves continued investigation, but it is preferable "as a matter of scientific tactics to investigate first those areas in which success seems more likely and is indeed a possible prerequisite for the wider problem."

1.2 Sources of Data

The data on which the analyses proposed in this work are based come from a variety of sources. I have attempted to cite data from a wide variety of language families in order to demonstrate the general validity of generalizations. However, the main source languages come from families with which I am most well acquainted, Bantu and Austronesian. This bias does not reflect limitations on the processes discussed; these language groups are particularly well suited to the needs of the present study because of their rich morphological systems. The bibliography lists sources of similar data for other language groups.

The various types of data which are examined in this thesis include: internal interactions resulting from inflectional and derivational processes, external sandhi, historical developments involving both word-internal changes and those occurring across morpheme boundaries, and casual speech.

This thesis is primarily a work of library research. I have taken the liberty on certain occasions to modify the transcriptions used by various authors in order to provide some regularity. However, a complete regularization did not seem either possible or advisable in the absence of precise phonetic descriptions. A table of symbol equivalences is presented in the preliminaries. Frequently, the authors'
transcriptions are left unmodified when they do not crucially affect the matter at hand.

1.3 Arrangement of the Chapters

In the early chapters of this work, we examine in detail the evidence relating to the underlying status of prenasalized consonants. In Chapter 6, a derivational model is presented which accounts adequately for the observations reported. Finally, in later chapters, various universals of process and their implications for linguistic reconstruction and other general methodological problems are discussed.

In Chapter 2, the question of definition for prenasalized consonants is examined in detail from both phonetic and phonological perspectives. The phonological definition of prenasalization is linked to various prerequisites within a sound pattern for the recognition of prenasalized consonants and to a general discussion of markedness theory as articulated by Chomsky and Halle (1968), Postal (1968), and Lass (1972). The phonological markedness of prenasalized consonants is examined in detail based on the criteria provided by Greenberg (1970a).

The general question of unit vs. cluster analysis will be examined in the following chapters. In Chapter 3, we link an underlying unit analysis with various problems inherent in a distinctive feature analysis which employs a cover feature [prenasal]. There are several problems with the postulation of such a feature, e.g. the severe distributional limitations which would need to be placed upon its occurrence in many languages. Further, it is demonstrated that such a feature cannot adequately represent common diachronic developments such as the
simplification of prenasalized consonants. These problems are crucially linked to the question of subclass which is examined in Chapter 4. In this latter chapter, we also examine in some detail the various formal proposals which have been put forward in the literature to account for prenasalized consonants. The question of a surface phonetic feature is then examined since separate sets of features are necessary to specify the phonological and phonetic components of language (Vennemann and Ladefoged 1971). A single feature analysis is again shown to be inadequate; a vector specification is tentatively proposed to account for the surface facts.

The interactions of prenasalized consonants with the general phonetic systems of languages in which they occur are examined in Chapter 5. These interactions are shown to affect preceding vowels in three ways: vowel quality, vowel nasality, and vowel quantity. We also examine alternations between ambisyllabic sequences of nasal plus oral consonants and tautosyllabic prenasalized consonants, which provide further evidence for a non-unit analysis of prenasalization.

The derivational model which is required to account for prenasalized consonants is presented in Chapter 6, after an initial examination of other models which have been proposed by Oates (1967) and Myers (1974 Ms). The model which is proposed in this work draws a crucial distinction between segmental and syllabic levels of organization; the implications of this distinction are also examined. Finally, the explanatory value of this model is discussed in detail, and a possible extension of the model is presented. Thus, Chapters 2 through 6 attempt to demonstrate
the non-unitary underlying status of prenasalized consonants and to
reconcile underlying nasal-oral clusters with the facts of their surface
unity.

Chapter 7 is a detailed survey of all the various processes which
give rise to prenasalized consonants. In addition to processes which
juxtapose nasal and oral consonants and thus give rise to the type of
prenasalized consonant discussed above, we examine in detail the
"environmentally produced" half-nasal consonants and the formal treatments
which they have been afforded by Anderson (1974, 1975, 1976a), Rivas
(1974), and Goldsmith (1976a, 1976b). The "series generating component"
of prenasality was previously discussed in Chapter 2, and thus all of
the processes which result in surface prenasalization are accounted for.
In Chapter 8, we survey the natural processes which affect either the oral
or nasal component of nasal-oral sequences. It is demonstrated that the
general direction of evolution is toward the least marked sequence of
nasal plus voiced stop. These processes give support to Greenberg's
(1970a) observation that diachronic processes explain frequency in
phonology. Finally, the relationship between gemination and prenasal-
ization is examined briefly in an appendix to Chapter 8.

In the concluding chapter of this thesis, we reconcile our analysis
of prenasalization with various theoretical considerations presented in
earlier chapters. We demonstrate in detail how the markedness of pre-
nasalized consonants is naturally explained as a consequence of the
underlying complexity which we propose. We also discuss how the
universals of origin and process proposed in Chapters 7 and 8 are
valuable tools in reconstruction, "the touchstone of validity for all reconstructed systems" (Jakobson 1958). We distinguish in this regard the reconstruction of state and the reconstruction of process. The relationships between synchronic universals and diachronic processes and between typology and universals is again discussed in this light. Finally, we attempt to set this analysis within the framework of a larger theory of phonology and to point the way for future research, especially research involving other complex sound units, in which the methodology here employed may be particularly fruitful.
CHAPTER II
DEFINITION AND PHONOLOGICAL STATUS OF PRENASALIZATION

2.0 Introduction

Prenasalized consonants are generally regarded as areal phenomena involving the languages of Oceania, Amerindia, and especially sub-Saharan Africa. They thus figure among the "exotic speech sounds" which typically receive scanty, if any, attention in general phonetic treatises. Even in Pike's (1943) Phonetics, a masterful attack of the traditional phonetic classification and its neglect of many sound types which occur in speech, prenasalized consonants are left largely unanalyzed although great attention is paid to clicks, implosives, etc. This neglect within Pike's treatment is somewhat surprising given his anthropophonolic orientation, an orientation which attempts to delimit all possible parameters which can be manipulated in sound production and all the possible combinations of parameters. It is important to note here that Pike's concern is not only with actually occurring speech sounds, but with the "sound producing capabilities of man". The approach is thus purely phonetic and has no immediately apparent applications for a general theory of language. For example, the questions why the same speech sounds occur again and again among the world's languages and why articulatorily "simple" sounds such as voiceless nasals occur relatively rarely are left unasked. We will
attempt to shed some light on these questions in Chapter 6.

A possible explanation for the cursory treatment afforded pre-nasalized consonants in most phonetic works may be a general confusion as to whether prenasalization is a phonetic or phonological phenomenon. Phonetically, apart from very subtle timing considerations, prenasalized consonants would appear to be more "straightforward" than clicks, labio-velars, etc. Phonologically, they are typically assigned the "simplest" interpretation available within any given model; this issue is examined in Chapter 3. As will be demonstrated later in this thesis, there is a wide degree of phonetic variation in the realizations of the class of sounds which are traditionally termed prenasalized consonants. Clearly, to speak of the articulations themselves as being prenasalized is to make the term wholly phonetic, and this seems unadvisable. In this way, the problem of definition for prenasalized consonants is similar to that for geminated consonants. In fact, there is a close relationship between prenasalization and gemination which is examined briefly in Section 8.4.

2.1 The Problem of Definition

2.1.1. Phonetic Definition

In a review of the relevant literature, we find few attempts at a solution to the problem of definition for prenasalized consonants. Chomsky and Halle (1968:317) state:
Phonetically, prenasalized consonants differ from the more familiar type of nasal consonant in that the velum, which is lowered during the period of oral occlusion, is raised prior to the release of oral occlusion, whereas in the more common type of nasal consonant the velum is raised simultaneous with or after the release of oral occlusion.

It is important to note here that the point of departure for definition is "the more familiar type of nasal consonant", i.e., prenasalized consonants are defined by reference to another series of sounds, nasals. This contrasts with the description provided by Armstrong (1940:31) of the prenasalized stops of Kikuyu, a Bantu language of Eastern Africa. She writes:

> It is phonetically sound to consider mb, nd, ng and nj as single consonant sounds with a nasal "kick-off".

Similarly, Ladefoged (1971a:33) states that:

> Another use of the oro-nasal process common in African languages is in the formation of a series of voiced stops which contrast with other fully voiced stops by having a short nasal section during the first part of the articulation.

Here prenasalized consonants seem to be defined by reference to the non-nasal consonants. Whether prenasalized consonants should be defined as oral consonants with a nasal "kick-off" or as nasal consonants with an oral release is not an arbitrary decision. This question has important implications which are examined in detail in Chapter 4.

Certainly the essential concept in any phonetic definition of prenasalization will be an initial nasal articulation followed by an oral articulation. Note that Chomsky and Halle's reference to simple raising of the velum and Ladefoged's description are insufficient since not only voiced stops may be prenasalized. The question which needs to
be asked here is whether simple reference to the order of nasal and oral articulations will suffice as a definition for prenasalized consonants. Obviously, it will not, or we would then have no way of distinguishing prenasalized consonants from the common nasal plus oral consonant sequences which occur in many languages. In general, the attempted solution to this problem is reference to homorganicity. Thus, Dahl offers the following definition:

Par prénasalisée, je comprends des occlusives ou affriqués précédés d'une nasale homorgane. Le seul mouvement des organes articulatoires qui se produit, en passant de la nasale à la buccale, est le soulèvement du voile du palais qui ferme la cavité nasale. (1951:48)

This is the most sophisticated definition found in the numerous descriptive grammars which have been consulted in the preparation of this present work. One reason for the insufficiency of definition is, of course, that many descriptions of languages exhibiting prenasalized consonants were composed not by trained linguists, but by missionaries, government officials, explorers, etc. The lack of linguistic training of many authors is by no means the same as a lack of linguistic awareness, however. Still, some ingenuity is often required in order to decipher impressionistic descriptions which appear in the literature. For example, it is not immediately apparent that "a prolonged nasal, pronounced with an upward movement of the lower nose" (Fox 1947:72) is really a description of what seems to be a syllabic nasal. Similarly, it is unclear what Young (1932:66) means to distinguish when he contrasts a "nasalized n" and a "pure n", both of which may precede consonants.
It should also be remembered that these descriptions were often intended to be of service to Europeans learning the languages of the oversea colonies. Thus, the formulae "pronounced as in German" or "...as in Italian", etc. were, however indefensible linguistically, of utilitarian intent. Young (1932:25) provides the following description of prenasalized consonants, which is evidently intended as an aid to language learners:

Where "m" or "n" occurs as partner in a dual consonantal sound, e.g. "mbunda" : "ntowa", the effect is to produce the temporary nasalisation of the second consonant until, lips or teeth having been opened, its pure value is free to find expression. It is not correct to pronounce these "mb-", "mp-", "nt-", "nd-" forms by the introduction of a preliminary vowel such as "i" or "u". There should be no sound heard except that of imprisoned "m" or imprisoned "n" until the barrier of the lips or teeth is removed.

Meinhof (1915:65-66) describes the problems of articulating prenasalized consonants for language learners as:

If any one [sic] is about to utter two different sounds in combination, he finds himself in presence of an untried task, which so far embarrasses him that while pronouncing the first sound he is already thinking of the second, or when producing the second is still thinking of the first.

This "embarassment" and its effects are presumably responsible for the position assimilation of preconsonantal nasals as well as various other assimilations which occur between two components of a complex unit. These processes will be discussed in detail in Chapter 8.

Maddox (1902:8-9) makes the follow observations about the nasals of Runyoro, an Ugandan Bantu language:
m and n are pronounced as in English. These two letters [sic] before all stop consonants cease to be labial and palatal [sic] consonants respectively, and become a vowel sound voiced through the nose, which partakes of the character of the following consonant.

Here again, we have reference to a syllabic nasal followed by a homorganic consonant. The notion of "vowel sound voiced through the nose" shows a great deal of phonetic awareness although there is the understandable confusion between the notion of vowel sound and syllabic. Compare the above description with that provided by Kirwin and Gore (1951:9) for Luganda, a closely related language:

When n (or sometimes m) stands before another consonant at the beginning of a word, it is pronounced much more in the mouth than in the nose (i.e. it is "voiced") and it forms a separate syllable.

Although the authors directly refer to the syllabic status of these nasals in Luganda, it is unclear what "pronounced much more in the mouth than in the nose (i.e. it is "voiced")" is intended to convey here.

The relationship between sequences of syllabic nasal plus oral consonant and prenasalized consonants is a very close one; it is examined in some detail in Section 5.4.

For prenasalized consonants, where the nasal is not syllabic, we find no impressing definitions, but only passing reference to a "single sound". Bates (1926:10) distinguishes syllabic nasal plus consonant sequences from prenasalized consonants by describing the nasal component of the latter as "not vocalized," but merely a consonant sound "closely joined with the following sound." Thus, the nasal component of nga! 'wife' is different from that in ngal 'gun' in Bulu, the former being syllabic. White (1949:3) writes of the prenasalized consonants of
Lwena: "...the latter combination is called an homorganic nasal and pronounced as a single sound." Usually, however, even this scanty information is not explicitly stated and needs to be inferred from the sketchy description of syllable structure where it is typically stated that every syllable ends in a vowel.¹ Thus, the syllabification of words such as lumonde is lu-mo-nde, not lu-mon-de. The language learner had to content himself with this type of information or seek some clarification from a native speaker.

It is often held that the term prenasalized consonant is synonymous with nasal compound. In fact, the two are used interchangeably in the literature. We find the following definition of nasal compound in Doke's (1935:73) Bantu Linguistic Terminology:

A nasal compound in Bantu is a composite sound in which a nasal consonant is conjoined to another consonant homorganic to it, e.g. mb, nt, nz, nk, etc.

It is to be noted here that prenasalized consonant is not cross-referenced in the dictionary nor does it have its own entry. Also, with regards the definition of nasal compound which Doke provides, the notions "composite sound" and "conjoined to another consonant" seem especially vague. Under Doke's entry for compound sound, we find:

A compound sound is one which contains more than one elemental phone, e.g. an affricate.

Thus, it would appear that the only criterion available for distinguishing prenasalized consonants (i.e. nasal compounds) from other sequences of nasal plus oral consonant is this vague notion of conjunction which obtains in the former.

In none of the preceding discussion has there been any mention of that criterion which we think essential for distinguishing between
prenasalized consonants and other nasal-oral sequences. It should be obvious that homorganicity will be insufficient in this regard.

Reference needs to be made to timing considerations. It should be clear that the introduction of timing considerations into our definition of in no way introduces non-purely phonetic data into a phonetic definition. On the contrary, considerations of timing and relative durations form an integral part of phonetic description at every level of analysis. Therefore, we propose the following phonetic definition of prenasalized consonant:

A prenasalized consonant is formally defined as a necessarily homorganic sequence of nasal and non-nasal consonantal segments which together exhibit the approximate surface duration of "simple" consonants in those language systems within which they function.

That is, it is well-known that within any given language, apart from considerations of intrinsic duration, there is some degree of consistency in the duration of consonants at any given speech tempo (Lehiste 1970). Our reference to "approximate duration" above is therefore necessarily imprecise; it is intended to exclude cases where the nasal and oral elements have clearly independent phonetic existence.

Further, it should be noted that no reference was made in the above definition to the notion of function or to the underlying unity of the components involved in a prenasalized consonant. This is precisely because both of these notions are phonological in nature and therefore have no place in a phonetic definition. Obviously, however, phonological considerations will be of great import in a discussion of prenasalization. They are treated below in some detail; the relationship...
between the phonetic and phonological correlates of prenasalization will
comprise one of the major themes of this thesis.

2.1.2 Phonological Definition

The question of phonological definition for prenasalized consonants
is intimately tied to the question of their underlying unitary status.
This is a much larger issue than that which we are examining at the
moment, which issue is treated in great detail in Chapters 3 and 4.
From the discussion therein, several conclusions concerning the
universal underlying nature of prenasalization are forthcoming, which
are incorporated into a derivational model proposed in Chapter 6. We
propose to examine now the place of prenasalization in several types of
consonant systems. From the role of prenasalized consonants within the
consonant inventory of a language, it is suggested that some conclusions
regarding the nature and status of prenasalization in that language can
be advanced. It should be pointed out at the outset of this discussion,
however, that prenasalization used phonologically is a cover term for
several distinct phenomena/processes which show some similarity in
phonetic realization. This is another topic to which we turn our
attention later in this work. The point which we attempt to make in the
present section is that even when the phonetic phenomenon of prenasal-
ization is in evidence, we need not recognize underlying prenasalization
of any sort. We examine below the prerequisites for the recognition of
phonological prenasalization.

2.1.2.1 Strategy of Definition

One of the basic tenets of structural linguistics, especially
Praguean structuralism, is that the phoneme can be satisfactorily
defined not by reference to its psychological nature or phonetic reality, but by reference to its function within a language system (Trubetzkoy 1949). Thus, the role of "distinctive oppositions" is crucial for the discovery and delimitation of the phonemes of a given language. As an example of this procedure of discovery, we will consider the case of nasal vowels as a prelude to our consideration of prenasalized consonants.

It is often asserted that in order to determine the phonemic existence of nasal vowels in any given language, it is necessary for three of the following four pairs to be distinctively opposed: CV - CV - NV - NV (Pike 1947; Ladefoged 1968). It is assumed here that every language contrasts nasal and non-nasal consonants; this is the content of Ferguson's (1966:56) first universal concerning nasals:

I. Every language has at least one PNC in its inventory. A PNC [primary nasal consonant] is defined by Ferguson as "a phoneme of which the most characteristic allophone is a voiced nasal stop."

Additionally, no language presents only nasal consonants in its inventory. Therefore, every language will necessarily present at least one item from each of the following sets of items:

1. a) CV b) CV
2. a) NV b) NV

That is, the logically possible inventories:

A. CV CV B. NV NV

are excluded from consideration. Many languages make use of 1a) and 2a) exclusively, i.e., in these languages vowel nasality is non-contrastive. It is also non-contrastive in those languages which exhibit only CV and
NV since these languages presumably have a simple process nasalizing all vowels in conjunction with nasal consonants. Another logically possibly inventory, CV and NV, where only nasal vowels occur is universally excluded since no language makes use of nasal vowels exclusively. This is stated in another of Ferguson's proposed universals:

XI. In a given language the number of NV's [nasal vowels] is never greater than the number of nonnasal vowel phonemes.

Finally, the last of the two-place inventories analyzeable as non-distinctive nasality, CV and NV, is also excluded since the language in question would have a process nasalizing vowels in conjunction with oral consonants only. This is counter-intuitive and universally does not obtain.

Languages will all four sequences are common, e.g. Modern French. In these languages the independence of vowel nasality is everywhere directly reflected in the surface phonetics.

There are four logically possible inventories which make use of three of the four sequences. Of these, only two commonly occur, however. Many languages exhibit CV - CV - NV inventories; in these cases we assume underlying independence of vowel nasality and a superficial process neutralizing vowel nasality in conjunction with nasal consonants. This is the content of Ferguson's Universal XIII. Alternatively, such an inventory could result from the much less common process denasalizing consonants before oral vowels. Similarly, inventories composed of CV - NV - NV would be ruled out by Universal XIII since these languages would have a process neutralizing vowel nasality in
conjunction with oral consonants. However, such inventories could obtain by the uncommon process that nasalizes consonants before nasal vowels. Very few cases involving a neutralization of consonantal nasality in favor of the oral consonant before oral vowels or the nasal consonant before nasal vowels occur. Trubetzkoy (1949:190) claims that the correlation of nasality in consonants in very rarely neutralized. He cites a case wherein there is final neutralization of nasals and voiceless stops in favor the nasal consonants in Ostiak-Samoyede (Sölkoup). In Gbeya (Samarin 1966:32), there is neutralization before another nasal in favor of the oral consonant:

\[ b\tilde{m} \text{ zou n} \text{ ne mle} \text{ s} \text{ dyn} \]

\[ \text{ when I looked, Monsieur was coming' } \]

Haudricourt (1970) reports that Kan-on, an ancient Chinese dialect of Japan, neutralized nasal and oral consonants in initial position in favor of the oral consonant. The cases involving prevocalic neutralization are examined in Chapter 7 in some detail.

The two possible three-place inventories which are unlikely to occur are: CV - CV - NV and CV - NV - NV. The former of these is extremely unlikely since it would depend on a process denasalizing vowels after nasal consonants or a process denasalizing consonants before nasal vowels. The counterparts to these processes, i.e. the nasalization of vowels in conjunction with oral consonants and the nasalization of consonants before oral vowels, also do not occur. If such inventories were to be attested, they would require substantial explanation in order to salvage our present notion of natural process.
We may schematicize these three-place inventories and the processes which give rise to them as follows:

<table>
<thead>
<tr>
<th>Inventory</th>
<th>Processes</th>
</tr>
</thead>
</table>
| A. CV .CV N\(\nu\) | i) NV \(\rightarrow\) NV (common)  
ii) NV \(\rightarrow\) CV (unlikely) |
| B. CV NV N\(\nu\) | i) C\(\tilde{\nu}\) \(\rightarrow\) CV (disallowed)  
ii) C\(\tilde{\nu}\) \(\rightarrow\) NV (uncommon) |
| C. CV .CV NV | i) NV \(\rightarrow\) NV (unlikely)  
ii) NV \(\rightarrow\) CV (unlikely) |
| D. C\(\tilde{\nu}\) NV N\(\tilde{\nu}\) | i) CV \(\rightarrow\) C\(\tilde{\nu}\) (unlikely)  
ii) CV \(\rightarrow\) NV (unlikely) |

The issue of nasal vowels and their relationship to consonantal nasality is returned to in Section 7.2, dealing with the interrelationship of vowel nasality and prenasalization.

The above discussion is intended to exemplify the type of relationships found between items in a sound inventory, distinctive oppositions, and natural processes. On the one hand, certain inventories are universally unexpected based upon our current notions of what constitutes a natural process. Additionally, certain inventories which present the superficial phonetic occurrence of vowel nasality are reanalyzeable in terms of underlying non-distinctive nasality. This same approach will be applied presently to the case of prenasalized consonants where similar results should obtain.
2.1.2.2 Phonological Prenasalization

In his cursory discussion of prenasalized consonants, Trubetzkoy (1949:195) states:

...elles ne peuvent exister en tant que phonèmes particuliers que si dans la langue donnée elles se distinguent phonologiquement d'une part des occlusives habituelles (non-nasalisées) et d'autre part des groupes «nasale + occlusive».

Although not stated above, it is clear from the example which Trubetzkoy cites that he intends simple nasals to be included as well, i.e., prenasalization would be recognized as distinctive only when all four of the following elements occur: C - N - N+C - NC. This situation obtains extremely rarely, if ever, and the example which Trubetzkoy gives of Peul (Foulfoulde, Fula) when properly analyzed does not fit the paradigm. He himself points out that in most African languages there is no question of consonantal nasality of this sort since there is no phonological opposition between prenasalized consonants and groups of nasal plus consonant. We are aware of only one other language, apart from Fula, where such a distinction has been claimed, Sinhalese, an Indo-European language of Sri Lanka (Gair 1970). However, here too the data are uncompelling and alternative analyses are available, e.g. Coates and de Silva (1960) and Feinstein (1977). There are, we believe, principled reasons why all four terms do not simultaneously occur. This is the subject of later chapters of this thesis and is accounted for in the derivational model proposed in Chapter 6.

If we reduce the inventory to a three-place one involving C - N - NC, we find that C and N are necessary prerequisites for
phonological prenasalization. We see no reason, however, why the occurrence of N+C should be a necessary prerequisite for the occurrence of prenasalization. In fact, in the absence of any evidence pointing to the correctness of such a claim, it appears to have no foundation whatsoever and to be motivated solely by the desire to keep the number of distinctive correlations operative in any language to a minimum. By the same token, we could require that in order for vowel nasality to have an independent existence, CV must contrast with CNV. Thus, in a language with a surface inventory of CV - CV - NV, we need not recognize the independence of nasality, but only reanalyze CV sequences as CNV. We counter such an analysis by pointing out that there is no evidence to support the contention that surface CV is anything but that. It is necessary to employ the same criterion in our analysis of prenasalized consonants. If there is no evidence to suggest that they are really N+C, then they are regarded as prenasalized consonants.

Hockett (1955:119-20) provides an analysis of Senadi, a Voltaic language of Ivory Coast, which closely resembles the above rejected analysis of vowel nasality. Senadi has the phonetic nasals [m n ñ ñ]. It also has nasal and oral vowels; contiguous vowels always agree in terms of nasality, i.e. they are all nasal or all oral. After a nasal consonant, only nasal vowels occur whereas after a non-nasal consonant both oral and nasal vowels may occur. There are also syllabic nasals which occur preconsonantally; these nasals are always homorganic with the following consonant and bear a surface tone. Thus, we have the following inventory (where a represents any vowel):
Senadi

\[
\begin{array}{cccc}
\text{ba} & \text{da} & \text{d} & \text{ga} \\
\text{be} & \text{de} & \text{d} & \text{ge} \\
\text{me} & \text{ne} & \text{ne} & \text{ne} \\
\text{fiba} & \text{fda} & \text{d} & \text{ga} \\
\text{fiba} & \text{fda} & \text{d} & \text{ge} \\
\end{array}
\]

where the immediately apparent analysis recognizes four oral consonants, four nasals, independent vowel nasality, and possibly an independent syllabic nasal which is unspecified for point of articulation. However, Hockett proposes to account for this data with four oral consonants, one nasal, tone, but without vowel nasality. According to Hockett, /n/ occurs with or without a tone before a consonant. Thus,

/\text{fiba fda fda} \text{f} \text{a} \text{f} \text{a} \text{a} / \text{are realized} [\text{fiba fda fda} \text{f} \text{a} \text{f} \text{a} \text{a}]

/nba nda nda a nga/ are realized [\text{m} \text{a} \text{a} \text{a} \text{a} \text{a} \text{a} \text{a}]

That is, when /n/ does not bear a tone, it is realized as nasalization of the following stop and vowel. /n/ also occurs prevocally when preceded by an oral consonant: /\text{bn} \text{a} \text{d} \text{n} \text{a} \text{d} \text{a} \text{g} \text{a} / \text{are realized as phonetic} [\text{b} \text{a} \text{d} \text{a} \text{d} \text{a} \text{g} \text{a} \text{g} \text{a}], in which case the nasal is realized solely as vowel nasality. The underlying representation for [fiba] is therefore the unlikely /\text{fb} \text{n} \text{a} / . There can be no question of the reality of such an analysis nor even of its mere usefulness as a description. Yet, Hockett writes:

This reanalysis is not a trick: it is an attempt to extract in the most economic way those factors which are maximally independent of each other in their occurrence, non-occurrence, and co-occurrence.

(1955:120)
This justification remains unconvincing and the analysis needs to be rejected as arbitrary.

In terms of surface inventories involving prenasalized consonants, we find that oral and nasal consonants occur independently whenever prenasalized consonants do. Thus, if we examine prenasalized voiced stops, which are by far the most common type of prenasalized consonants, they almost invariably co-occur with nasals and voiced stops. However, there are surface inventories where this condition does not obtain. An interesting example of this phenomenon is observed in the languages of the Reef Islands-Santa Cruz Family which is basically Papuan, but bears heavy Austronesian influence (Wurm 1972b). In Nambakaeng5, one of the languages of Santa Cruz, we find the following consonantal system:

<table>
<thead>
<tr>
<th>Nambakaeng⁵</th>
</tr>
</thead>
<tbody>
<tr>
<td>p  pʰ  t  tʰ  k  kʰ</td>
</tr>
<tr>
<td>mb  mbʰ  nd  ndʰ  ng  ngʰ</td>
</tr>
<tr>
<td>m  mʰ  n  nʰ  ʰ  ṣ  ṣʰ  y</td>
</tr>
</tbody>
</table>

i.e. complete series of voiceless unaspirated stops, prenasalized voiced stops, and nasals, as well as a partial series of voiceless aspirated stops corresponding to the non-labialized stops of the other series. Phonetically, the prenasalized series consists of real prenasalized stops, following the definition proposed in Section 2.1.1. However, the question which needs to be asked at the moment is whether it is necessary to recognize the existence of prenasalized consonants on the
phonological plane. We claimed above that phonological prenasalization will not occur in the absence of voiced and voiceless stops and nasals. The real question then is whether we want to reanalyze the prenasalized stops as something other than that, reanalyze the other series so as to introduce a voiced:voiceless stop distinction, or revise the proposed prerequisites for the recognition of phonological prenasalization.

There seems to be no reason to believe that the voiceless aspirated: unaspirated distinction is anything but that. The same distinction occurs in other members of the Reef Islands-Santa Cruz Family. Additionally, we know that such a distinction can exist without the presence of corresponding voiced stops as it does, for example, in many dialects of Scottish Gaelic. However, we see no reason not to analyze the series of prenasalized voiced stops as simply oral stops on the phonological level and to claim that the presence of a nasal "kick-off" is a fortuitous fact of surface realization. Taken on its own merit, this may seem like little more than a clever trick of reanalysis and an unjustified abstraction of surface reality. There are, we believe, sufficient grounds to motivate such a reanalysis here and in similar cases as we shall attempt to demonstrate below.

The consonantal inventories of other members of the Reef Islands-Santa Cruz Family lend credence to the proposed reanalysis. In other Santa Cruz languages, we find that the prenasalized stops of Nambakaengö correspond to optionally prenasalized stops, e.g.: 
where, apart from the presence of an extra consonant \((\text{m})\text{d}^\prime\), the two inventories are identical. Thus, there is some reason, at least in Nea and the other languages exhibiting free variation between voiced and prenasalized voiced stops, to regard the prenasalization as an optional surface realization of underlying voiced stops. This optional low level phonetic rule has become obligatory in Nambakaeng§.

Similarly, in Lobaha, a language described by Ivens (1940-2), there appears to be some justification for analyzing the surface prenasalized stops as underlying voiced oral segments:

\text{Lobaha} \\
\begin{align*}
\text{t} & \quad \text{k} \\
\text{mb} & \quad \text{nd} \\
\text{v} & \quad \text{r, l} \\
\end{align*}

There is also a sound represented by the letter \(\text{g}\) which Ivens reports as representing a sound \([\text{kmbw}]\); this is a unit sound, possibly the prenasalized equivalent of \(/\text{m}^\text{w}/\), which is itself a labio-velar of some kind.
We note that, in the above inventory, the prenasalized series contains no velar member and that the series of voiced oral fricatives contains only a velar member. We postulate, therefore, that these two comprise a single underlying series in which the bilabial and dental elements are always realized as surface prenasalized voiced stops and the velar is always realized as a voiced oral fricative. Whether these sounds are underlying stops or fricatives is not an issue here; phonetically, natural processes accounting for the surface realizations exist for either analysis. The idiosyncratic behavior of the velar is not too problematic since velars, especially nasals or oral consonants in conjunction with nasals, often exhibit aberrant behavior. This is a much larger theme, which is dealt with briefly in a later chapter.

The surface presence of prenasalization on voiced stops is actually very widespread in the Pacific area. In many languages where it occurs, we find that the prenasalization is at least occasionally absent. For example, the consonantal system of Fijian (Milner 1954) is:

Fijian

\[
\begin{array}{c}
m \\
n \\
q \\
mb \\
nd \\
ndr \\
ng \\
t \\
k \\
\beta \\
\theta \\
s \\
r \\
w \\
l \\
y
\end{array}
\]

Scott (1947-8:739) writes that "the nasal element is not always easily distinguished from voicing in initial position but is fairly long in medial position." In fact, only one of Scott's informants would not accept a fully voiced [b] without a preceding [m]. The denasalization
of prenasalized consonants in initial position is a fairly widespread phenomenon. This has been reported for very diverse languages, including Javanese (Horne 1961), Delaware (Voegelin 1946), Reyesano (Key 1968), and several Bantu languages, e.g. Holoholo (Coupez 1955:13):

A l'initiale d'un mot, une nasale précédant une autre consonne est peu perceptible; les Holoholo tendent à l'omettre quand ils écrivent.

We assume therefore that the instability of prenasalization in this position is due to some inherent physiological or perceptual difficulty. This would seem to be supported by the development in some languages of an epenthetic vowel which "supports" the prenasalization. This point is returned to in a later chapter dealing with processes affecting prenasalized consonants.

Further support in favor of analyzing prenasalized consonants as underlying voiced stops or fricatives in those languages where the latter do not occur or are non-contrastive comes from the widespread occurrence of this phenomenon in the Pacific area. Thus, we might consider it as an areal characteristic although it is not limited to the Pacific exclusively; it occurs, for example, in Modern Greek (Householder et al. 1964). Of course, this feature does not affect all of the languages of the Pacific families either.

There is apparently free variation between prenasalized and voiced oral stops in some dialects of Malay (Hendon 1966) in all positions, in many Melanesian languages (Ray 1926), in many non-Austronesian languages of New Guinea (Capell 1969) and in some Austronesian languages cited by Dyen (1971). In describing this situation within the Austronesian languages of New Guinea, Capell (1969:29) writes:
Prenasalization occurs in some areas as a normal process or as a local peculiarity. In Tuna, some speakers have /b, d, g/, others /mb, nd, ng/, according to a geographical distribution of villages. While the prenasalization is normal in some areas of insular MN (Melanesia) - Fijian has only /mb, nd, ng/, it is either optional in or missing from others, e.g. Central Malaita (optional), Nguna-Efate (New Hebrides - present in the north, absent in the south).

Wurm (1964) described the phenomenon as:

...a widespread series generating component of prenasalization combinable with stops and yielding a series of stops additional to one (voiceless) or, rarely, to two (voiceless and voiced) stop series...

In the prenasalized series, voicing of the stops is phonemically irrelevant. (1964:81)

A more interesting case of this same phenomenon involves South Gomen, a language of New Caledonia, which exhibits a complex surface inventory. Haudricourt (1971:364) gives the consonant system as:

South Gomen

\[
\begin{array}{cccc}
\text{w} & \emptyset & h & \hat{h} \\
p & p^w & \hat{t} & c & k \\
p^h & p^w & \hat{t}^h & \hat{c} & k^h \\
mb & mb^w & nd & nd^h & ng \\
m & m^w & n & \eta & \eta \\
h & h^w & h_n & h_y & \eta & \eta
\end{array}
\]

all of which consonants appear initially. Intervocically, however, neither of the aspirated series may occur and the voiceless stops are pronounced voiced (in N. Gomen as voiced spirants). Is it legitimate here to analyze the prenasalized stops as underlying voiced stops since voiced stops are the positional realization of another series of stops? It seems clear that the voicing of consonants is largely irrelevant; we
would argue nonetheless that the underlying representation of the stop series here makes use of only three features: [voice], [nasal], and [aspirate]. The feature [voice] may seem as arbitrary as a feature [X 135] in this case. All New Caledonian languages distinguish oral, prenasalized, and nasal series, so that it might seem more appropriate to introduce some feature [prenasalized]. An argument making reference to the universal non-occurrence of such a system on the underlying level is invalid at this point since it includes the use of a generalization involving data in an analysis of the data; this is clearly methodologically unsound. Haudricourt reconstructs the prenasalized series as such for Proto-New Caledonian. Some evidence that there is a relationship between the feature [voice] and the prenasalized series of stops comes from the fact that the closely related languages of the Loyalty Islands show a series of voiced stops which corresponds to the New Caledonian prenasalized stops. Additionally, in some New Caledonian languages the prenasalized series has re-developed into voiced oral stops, e.g. Noumea.

This discussion of a feature [prenasalized] is returned to in later sections of this thesis; one of the major hypotheses which we shall put forward is that there is no need to recognize such a feature on a universal scale. The major point of the present discussion has been that, in languages exhibiting prenasalized voiced stops but not voiced oral stops, the correct feature specification for the former may be [+voice]. There is the evidence of historical and comparative data, which support such an analysis as well as the facts of synchronic alternations. Finally, the independence of a feature [prenasalized] would seem to be
questioned by the fact that prenasalized voiceless stops or fricatives universally do not occur in these languages although they are clearly attested elsewhere. It is at least interesting to note that the two indigenous American languages which Longacre (1968) reconstructs with prenasalized consonants are both curiously lacking a series of voiced stops and that only prenasalized voiced stops are reconstructed:

**Proto-Mixtec**

\[
\begin{array}{c}
\text{Proto-Mixtec} \\
\dot{t} \quad k \quad k^w \\
\emptyset \quad x \quad x^w \\
\text{n}_d \quad \text{n}_g \quad \text{n}_g^w \\
\text{n} \quad (\text{M}) \quad \text{m} \\
\text{l} \quad \text{y} \quad \text{w}
\end{array}
\]

**Proto-Chipanec-Mangue**

\[
\begin{array}{c}
\text{Proto-Chipanec-Mangue} \\
p \quad \dot{t} \quad k \\
\text{s} \quad \text{h} \quad \text{h}^w \\
\text{m}_b \quad \text{n}_d \quad \text{n}_g \\
\text{m} \quad \text{n} \quad (\text{M}? \text{M} \text{[hm]} \\
\text{w} \quad \text{y} \\
\text{l/r}
\end{array}
\]

Thus, we have claimed that a prerequisite for the recognition of phonological prenasalization is the existence of voiced oral stops (or fricatives) and nasal stops within any given language system.

Although it is logically possible that languages with surface prenasalization might exist in which a series other than the voiced oral stops were absent, we have no examples of such a system. There exist
no cases of languages with surface prenasalization which lack a series
of voiceless stops; the primacy of voiceless stops has long been
established and figures in Jakobson's (1968) "panchronic laws". There
are a few cases in the literature of nasal-less languages. Apart from
the Northwest Coast cases discussed by Hockett (1955), Ferguson (1966),
and Thompson and Thompson (1972), another interesting example is treated
by Firchow and Firchow (1969). In Rotokas, a mixed Papuan-Melanesian
language of New Guinea, there is a consonantal system of six elements:

**Rotokas**

<table>
<thead>
<tr>
<th>p</th>
<th>t</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td>r</td>
<td>g</td>
</tr>
</tbody>
</table>

This situation is contrary to Ferguson's (1966:56) claim that every
language contains at least one primary nasal consonant. However,
Rotokas is interesting for the realization of the series of voiced
consonants. In the surface phonetics, there is apparently free
variation between voiced stops, voiced continuants, and nasals:

\[
/\text{b}/ \rightarrow [\text{b}] \sim [\text{b}] \sim [\text{m}] \\
/\text{r}/ \rightarrow [\text{d}] \sim [\text{r}] \sim [\text{i}] \sim [\text{n}] \\
/\text{g}/ \rightarrow [\text{g}] \sim [\text{g}] \sim [\eta]
\]

so that nasal consonants are at least phonetically present. Firchow and
Firchow report that in the Aita dialect the nasal realizations pre-
dominate so that the underlying system should be represented:

**Rotokas, Aita dialect**

<table>
<thead>
<tr>
<th>p</th>
<th>t</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>n</td>
<td>q</td>
</tr>
</tbody>
</table>

Whether we want to analyze the other dialects as having a system of
underlying consonants similar to Aita seems to us an unimportant question at this point. The point here is that in none of these systems do we find surface prenasalization; this supports the hypothesis that oral and nasal stops are prerequisites for phonological prenasalization.

A possible counter-example to this claim comes from the Flamingo Bay dialect of Asmat, a Papuan language described by Voorhoeve (1965). Voorhoeve analyzes the underlying consonant system as:

<table>
<thead>
<tr>
<th>Asmat, Flamingo Bay dialect</th>
</tr>
</thead>
<tbody>
<tr>
<td>p  t  c  k</td>
</tr>
<tr>
<td>f  s</td>
</tr>
<tr>
<td>m  n</td>
</tr>
<tr>
<td>w  r  j</td>
</tr>
</tbody>
</table>

The two nasals, /m/ and /n/, are realized as [m], [b], [mb] and [n], [d], [nd] respectively. The distribution of the different realizations of /m/, extrapolated from Voorhoeve's discussion, is informally schematized:


There are clearly several processes governing the distribution of phones here. On the one hand, we find that /m/ is always realized as [m] when the following syllable begins with a nasal consonant. The only
exception to this generalization is in initial position where [m] → [b].
There is an explanation for this fact; the process giving [m] before
following nasal syllables is the same process known as Meinhof's Law
in Bantu and is also active in some Amerindian languages and non-Bantu
African languages. Briefly, it is a natural phonetic assimilatory
process, which is treated at length in Herbert (1976c). [b] occurs
only after a nasal and in initial position. The former might be
explained as a natural dissimilation and the latter is related to the
already mentioned instability of initial prenasalization. That is,
some speakers have initial [mb] and others [b]. For those with initial
[b] before non-nasal syllables, [b] also occurs before nasal consonants
since the assimilation to [m] affects prenasalized consonants. The
speakers with initial [mb] elsewhere thus have [m] before a nasal
syllable. This relationship is schematized:

\[
\begin{array}{c}
/m/ \rightarrow [b] \text{ or } [mb] / \# \\
\downarrow & \downarrow \\
[b] & [m] / \_V(N)
\end{array}
\]

This leaves only the distribution of the prenasalized realizations to
be explained. Briefly, [mb] occurs initially and intervocalically when
the next syllable does not begin with a nasal consonant. We might
explain this occurrence by reference to the "series generating component"
described by Wurm, but that generally affects oral stops. There is
clearly no processual explanation which is readily available.
Since we do have natural phonetic explanations which account for the
oral and simple nasal realizations, it is tempting to regard the pre-
nasalized form as basic and to predict the other realizations from this
base. However, there is a methodological problem here as well: it is clearly incorrect to evaluate solutions in terms of "ease of formulation". One solution is not to be preferred to another simply because it is easier to formalize.

If the Asmat data do indeed warrant reanalysis, it is not in terms of positing an underlying series of prenasalized stops, but rather a series of voiced oral stops. Again, here we would make reference to the "series generating component" of prenasalization. Prenasalized alternants would be realized as nasal stops before nasal syllables and in final position where, presumably, the oral release would not be particularly distinctive. The prenasalized element would be unstable in initial position and immediately following a nasal consonant. However, the difficulty here is the non-occurrence of the oral stop after non-nasal consonants and intervocally. There seems to be no non-arbitrary way of explaining these gaps, and we therefore accept Voorhoeve's original analysis with underlying /m/ and /n/ as the correct one.

Thus, we have found no cases of prenasalization phonologically when voiced stops/fricatives or nasals have been absent in the consonantal inventories. Phonetic systems with prenasalization of voiced stops are fairly widespread. We have claimed that these prenasalized voiced stops are correctly analyzed as simple voiced stops in those cases where voiced stops do not occur phonetically. There is no need to recognize an independent feature [prenasalized] to account for these cases. If prenasalization were an independent entity, there is no reason for it not to appear in the absence of nasals, for example. That it appears
in incomplete inventories only in the absence of voiced oral stops supports our analysis that in these cases surface prenasalization is a fortuitous realization of the underlying feature specification [+voice]. Thus, we hope to have successfully established that the recognition of phonological prenasalization necessarily presupposes the existence of voiced oral, voiceless oral, and nasal stops in any given language system. This exactly parallels the preceding discussion of nasal vowels in which we claimed that there existed both phonetic and phonological prerequisites for their recognition.

2.2 Phonological Markedness

2.2.1 Theoretical Background

The preceding discussion of phonological prerequisites for the recognition of a phonological class has certain obvious links with the theory of markedness articulated by Chomsky and Halle (1968), Postal (1968), and others, building on the foundation of Praguean markedness. Just as we are hesitant to recognize an independent class of nasal vowels in languages wherein surface nasality can be explained by reference to well-motivated natural processes, there is a similar hesitation with regards prenasalized consonants. Of course, both of the above examples were motivated by certain underlying prejudices, e.g., we assume that nasal vowels are in some sense "less basic" and "more costly" than oral vowels. This is by no means an unfounded prejudice; it is based on a number of observable cross-language regularities in the behavior of nasal vowels in diachronic developments, in child phonology, in loan phonology, in distributional frequency, etc. The evidence for this particular primacy is well-known and does not need to be reviewed.
The theory of markedness is an attempt to establish a universal evaluation measure for phonology which is based on an assumption of "intrinsic content" assigned to every phonological feature. In addition to specific marked and unmarked values for features, there is a "linking" principle which relates these proposals to conditions on the output of phonological rules. This theory claims that a universal phonological structure of rules converts abstract M and U values into a less abstract matrix consisting of + and - feature specifications. The theory claims that for every feature in every context one such feature "value is 'natural' and costless, the other 'unnatural' and with a cost." (Postal 1968:167). As Postal points out:

Accepting such a theory commits one to determining for each feature value in each context grounds for a non-arbitrary choice of M or U representation. That is, accepting such a theory involves the responsibility for discovering the right class of universal rules interpreting M and U representations as + and -.

(1968:168)

The various types of considerations which are methodologically involved in the assignent of M and U values have already been mentioned above. We do not attempt to justify the use of these considerations here. However, we do point out that as a group they represent only a class of observations. In this sense, there is nothing "intrinsic" about the theory of markedness as a theory of content as it has been articulated to date. We believe nonetheless that the notion of "intrinsic content" is well-founded. Statistical frequencies, diachronic mergers, synchronic neutralizations, etc. point to the fundamental correctness of this concept. The theory remains one of observation, one of probabilities. To quote Postal once again:
...such a theory does not claim that in every case the Unmarked phonetic element will actually appear in the position of neutralization. It claims only that this will be the case in the majority of instances since, if it is, no special language particular rule is required. (1968:168)

The critical value of such a theory is significantly weakened, we believe, not by the infrequent instances in which its predictions do not obtain, but rather by the total lack of explanation which is incorporated into the theory. For example, we know that the Unmarked value for non-back vowels is [-round]. This is captured in the formulation proposed by Chomsky and Halle (1968:405):

\[
\begin{align*}
\{ [\alpha \text{ round}] & \rightarrow [\alpha \text{ back}] \\
[u \text{ round}] & \rightarrow \{ [-\text{ round}] & \rightarrow [+\text{ low}] \}
\end{align*}
\]

That is, vowels which are [-back] are in some sense less costly than those vowels which are specified as [+round]. Why this is so is not explained within the theory. As Postal (1968:170-71) points out: we may hope that physiological and perceptual investigations will ultimately provide evidence for the assignment of M and U values. Lass (1972) has examined this particular proposal concerning the roundness of vowels in detail and attempted to show that for some language families, e.g. Germanic, marking conventions for vowel roundness reduce to a statement of very weak probabilities. Lass claims on this basis that marking conventions have no predictive value in such cases since the "more
costly" grammars of Germanic languages with round front vowels function as well as those Germanic languages without front rounded vowels and as well as the grammars of families where the convention is almost absolute, e.g. Bantu. There is no explanation for the failure of marking conventions. Therefore, Lass is led to reject markedness theory in its universal form and to substitute family-specific conventions. The only other alternative is to inject content and explanation into the original theory; this does not seem realizable at the moment.

We agree with Lass that, as a theory of intrinsic content, markedness theory fails rather severely. However, we believe that it does represent a successful prelude to such a theory of content. We attempt to exemplify in later sections how content is to be injected into the foundation of the theory in a non-arbitrary fashion and the true explanatory value which results therefrom. We shall do this using the example of prenasalized consonants as a marked class and the various marked subtypes within the class of prenasalized consonants. (Cf. Chapter 8.) The background for this later discussion is presented below.

Before proceeding to a discussion of the marked value of prenasalized consonants, it is perhaps advisable to address some words to Lass' main criticism of markedness theory. Lass claims that as currently proposed the theory fails to reconcile meta-theoretical considerations of simplicity with language-internal economy of individual phonological systems. Markedness theory makes the claim that front rounded vowels and clicks will be rare in the languages of the world. On a statistical level, these claims are justified. How then, Lass asks, are we to reconcile these universal considerations with the sound inventories of
Swedish and Zulu? According to the theory, not only should unmarked segments be favored in synchronic neutralizations, but they should predominate in diachronic developments as well. Lass interprets this as meaning that unmarked sounds will always gain ground at the expense of the marked sounds and that new marked sounds will not develop. Of course, such was not the serious intent of the theory; this is equivalent to claiming that all phonological evolution is directed toward the development of an optimal sound inventory consisting of a single consonant and single vowel. In this case, all linguistic utterances would have the phonetic shape \([p\alpha\beta\alpha\ldots]\). Nevertheless, Lass goes on at great length in his discussion of front rounded vowels to demonstrate that they do indeed persist and develop anew in diverse languages. This is as Postal originally maintained: the theory is one of predictions which we expect to be borne out "in the majority of instances."

Lass' dismissal of the theory on these grounds as being devoid of any interesting theoretical considerations seems a bit hasty. We will attempt to demonstrate here that even for language inventories which are highly marked, the theory is not devoid of content. The case which we will discuss is not that of front rounded vowels in Germanic, but another which Lass mentions several times, i.e. the click sounds of Southern Bantu, a case with which we are more familiar.

### 2.2.2 Clicks

The basic assumption of this discussion is that the click sounds are indeed marked segments. They occur only in certain restricted Southern Bantu languages and in the Khoisan languages, from which they were originally borrowed into Bantu. On the one hand, the fact that
Zulu and other Nguni languages should have incorporated clicks into their phonological systems is a point which weighs against markedness theory. Historically, we know that Bantu had no click sounds and that they were introduced during a period of particular sociological contact in which Khoisan women were taken as wives by the invading Bantus (Faye 1923-5:776 ff.). Lanham (1964:383) describes the system of polygamy practiced by the Bantus and notes that the father was only an "occasional visitor" to his families. Therefore, the greater influence during a child's early years was that of the mother, and it was only later that the influence of the father and the extended family began to be felt. This type of bilingual situation differs considerably from the canonical varieties, which explains the extraordinary linguistic results. For example, fully seventeen of the present 47 consonant phonemes in Zulu were introduced from Khoisan. Lanham places the original contact between the Bantus and Khoisan peoples between five and seven centuries ago. Thus, we have an extraordinary sociolinguistic situation which accounts for the introduction of the click sounds into Bantu. We take this as the point of departure for the following discussion.

Were we to assume an unmarked status for the click sounds in Nguni, for example, we would have no way of accounting for the reduction of click oppositions since other consonantal oppositions make use of the same places of articulation. We do not find any Bantu language which makes use of the full range of click sounds; in each case the number of oppositions has been reduced. Thus, there are five click types in the Khoisan languages:
All the Bushman languages exhibit four types, but the labial click occurs rather infrequently (Bleek 1939).

Zulu and Xhosa show the most extensive incorporation of clicks into sound inventories. Both languages distinguish three main click types: the dental click, the palato-alveolar click, and the lateral click. Lanham (1964:382) reports that fully one-seventh of Zulu words and one-sixth of Xhosa words contain clicks. These are, of course, mainly words which are themselves borrowed from Khoisan. The Bantu words which exhibit clicks come mainly from the hlonipha vocabulary. Hlonipha is a process whereby taboo words undergo various phonetic alterations. These alterations include the substitution of:

i) a non-click for a non-click
ii) a click for a non-click
iii) a click for a click
iv) a non-click for a click

Faye (1923-5) provides a detailed discussion and numerous examples of this process.

Pedi (Stopa 1960:23) is reported to distinguish two clicks: the pre-palatal and a retroflex fricative. The situation in Swazi is unclear. Ziervogel (1952:8) reports a contrast between the dental and the palato-alveolar types. Thus, Zulu amaxolo 'bark' may be found in
Swazi as \textit{emacolo}, \textit{emagolo}, \textit{emagcolo}, \textit{emagqolo}. However, Stopa and Lanham both claim that Swazi has a single click, which is substituted for all the other varieties. Similarly, in Sutho (Tucker 1929:63), there is only one click type, the palato-alveolar, and in the other Sutho-Tswana languages the clicks have disappeared entirely.

Knowing, as we do, extremely little about the routes and chronology involving click incorporation into Bantu, we might explain the number of types as an inverse function of the directness of borrowing. That is, those languages which borrowed directly from Khoisan should exhibit the greatest number of distinctions and those which borrowed from other Bantu languages should show reduced inventories. This would constitute an argument supporting the marked status of the clicks, albeit a rather weak argument. Such an argument would, of necessity, make socio-historical claims about contact which cannot be substantiated since we are dealing here with pre-history. Additionally, a much stronger argument in favor of the marked status of clicks in Bantu would be forthcoming if we suppose that languages may have previously had a wider range of clicks than they evidence at present. This would be especially powerful since we know of no cases of languages independently increasing the number of clicks in their inventories. Of course, just as there is no evidence that the clicks were transmitted indirectly into some languages, there is no evidence that all the Bantu click languages previously had the full series of clicks or even the number of oppositions presently displayed in Zulu. However, there is evidence that at least some languages have reduced their click inventories and that in some languages the clicks have been eliminated.
entirely. Stopa (1960:23) attributes to Elmslie the observation that among the older Ngoni [sic] people, all the clicks are attested as in Zulu. Apparently, the dental click replaced the other types in normal speech and a "new dialect" appeared which has various combinations of consonants as substitutes for clicks. In N. Transvaal Ndebele, there are no clicks, but older language consultants "remember times" when clicks were used in speaking (Ziervogel 1959:33). A very few plant names still show the clicks:

- **muggqoqolo** (Scholopia eckloni)
- **ngaxi** (Lycium sp.)
- **mughanu** (Rhus amera Meikle)

For the most part, however, this dialect of Ndebele has non-click sounds corresponding to clicks in other languages. For example [kx'] is the normal development of Bantu *nk, but there are cases pointing to [kx'] as the development of the palato-alveolar click, symbolized as q in the Zulu orthography:

<table>
<thead>
<tr>
<th>Ndebele</th>
<th>Zulu</th>
</tr>
</thead>
<tbody>
<tr>
<td>-kx'wala</td>
<td>-qala</td>
</tr>
<tr>
<td>-ɛŋkx'ɛla</td>
<td>-ɛqa</td>
</tr>
<tr>
<td>-kx'adʒa</td>
<td>-qeqa</td>
</tr>
<tr>
<td>-11kx'anga</td>
<td>-iqanda</td>
</tr>
</tbody>
</table>

Similarly, a nasal click is most often represented as [ŋ] in Ndebele:

- **ŋanɛ**   - **ncanɛ**  'small'  
- **ɛŋɛŋɛ**  - **ɛŋxɛñɛ**  'elsewhere'  
- **not'ula**  - **nqodula**  'pull out'  

There are no known cases of the reverse substitutions, i.e. of clicks
for non-clicks in normal linguistic evolution.\textsuperscript{13}

Notice that this type of evolution is exactly what markedness theory would predict. Lass claims that there is nothing "unnatural" about clicks in Zulu, voiceless lateral affricates in Nahuatl, front rounded vowels in Swedish, etc. Yet, we have seen that Lass' notion of family universal cannot be sustained. Clicks may be "natural" in some Southern Bantu languages in that they exist in these languages; in this regard, markedness theory is not a theory of "naturalness evaluation". The grammars of Zulu and Xhosa work as well as the grammars of non-click Bantu languages. However, the evidence points to the clicks being more "complex", more "costly", or simply secondary in those languages where Lass claims they are natural.\textsuperscript{14}

The marked value of clicks is evident not only in diachronic developments. Louw (1964:147) has noted that in certain idiolectal and dialectal varieties of Zulu, the clicks are replaced by other consonants and that the lateral click is disappearing in general. Also, clicks are the last sounds acquired by Zulu children and are usually replaced by the corresponding non-clicks (Louw 1964; A. Nkabinde, pers. comm.). In fairy tales, the speech of animals, usually represented as baby talk, is devoid of clicks (Jakobson 1958:35).

Thus, on the whole, Lass' notion of family universals and language-specific markedness seems to contribute little to the general theory. Lass claims that for non-click languages like English and Chinese, the clicks are neither marked nor unmarked; they are simply not part of the inventory. Similarly, there is nothing unnatural about clicks in click languages; these languages are simply "that kind of beast".\textsuperscript{15}
However, we have demonstrated that the clicks are indeed marked in the click languages. It would be difficult to explain the data of diachronic developments, synchronic replacement, child phonology, etc. otherwise. This points to an inherent difficulty in Lass' revision of markedness and would seem to be a vindication, on a rather small scale, of the more orthodox theory of markedness.

Another set of purported counter-examples to markedness theory not available in the click data is discussed by Katamba (1974) and has to do with the geminated or "strong" consonants of Ganda. Katamba adopts Lass' version of markedness because, contrary to universal predictions, strong consonants appear not only to be stable, but are actually increasing in Ganda. He notes that "markedness theory would predict that they shall be lost in the course of language change" (1974:159). Historically, these geminated consonants developed from the loss of a vowel /i/ and then assimilation of a preceding consonant in all features to the following consonant. Upon closer examination of Katamba's claim that the geminates are actually spreading, it becomes clear that such is not really the case. The "extended domain" of these consonants arises from another type of vowel loss, involving the /u/ of the infinitive prefix /ku-/, so that we have the following alternations:

<table>
<thead>
<tr>
<th>Standard dialect</th>
<th>Innovating dialect</th>
</tr>
</thead>
<tbody>
<tr>
<td>kukola</td>
<td>kkola 'to work'</td>
</tr>
<tr>
<td>kuclma</td>
<td>ccclma 'to fetch'</td>
</tr>
<tr>
<td>kugoboa</td>
<td>ggoboa 'to drive away'</td>
</tr>
<tr>
<td>kupima</td>
<td>ppima (kupima)16 'to weigh'</td>
</tr>
<tr>
<td>kuteema</td>
<td>ttima (kuteema)16 'to chop'</td>
</tr>
<tr>
<td>kusala</td>
<td>ssala (kusala)16 'to divide'</td>
</tr>
</tbody>
</table>
Markedness theory does not claim that geminated consonants will not develop in the course of a language's history or that they will quickly die out in the course of linguistic evolution. Rather, it claims that such sounds are "less favored". It predicts that a context-free change from geminated to simple consonant should be common whereas the reverse process:

\[ C \rightarrow C_1C'_1 \]

should be uncommon. The Ganda case does not fit the above schema; the "spread" of the strong consonants poses no problems for markedness theory since it does not result from a spontaneous strengthening of normal consonants.

The rather extended examples which we have discussed above are not intended to, and indeed do not, resolve the most crucial problem with markedness theory, i.e., there is no attempt to explain why the clicks are marked sounds. Simple reference to complexity of articulation seems too simplistic an explanation since, presumably, all the clicks are equally complex in this respect, yet some are favored over others. Also, there is nothing physiologically difficult about front rounded vowels, for example. What we hope to have demonstrated is that despite this serious gap in the theory, its predictions are borne out by synchronic and diachronic language data. Markedness theory is fundamentally correct as a theory of observations and predictions. In the following section we will demonstrate the marked value of prenasalized consonants as a class of sounds by reference to the same sort of considerations as utilized above. There are some problems in this regard, however. In a later chapter, we will deal with the relative
markedness of the various subtypes of prenasalized consonants and we provide an explanation for both types of markedness. In this sense, we address ourselves to the critical problem with the theory and attempt to demonstrate how it can develop into a theory of "intrinsic content" by injecting explanation into its foundation.

2.2.3 The Markedness of Prenasalized Consonants

2.2.3.1 Phonological Implications

We have already demonstrated one important piece of data which points to the status of prenasalized consonants as a marked series of sounds. Specifically, we have seen that the presence of prenasalized consonants in the surface inventory implies the presence of nasal consonants and, on the phonological level, prenasalized consonants imply the presence of voiced oral stops/fricatives. This type of implicational data figures prominently in Praguean discussions of markedness. Jakobson's celebrated "panchronic laws" take the form of such implications. The presence of a marked category implies or presupposes the existence of the corresponding unmarked category. There is little need to justify this observation; in addition to Jakobson (1968), it is cited by Greenberg (1966a, 1968, 1969a, 1970a, 1970b) in his classic discussions of language universals. The evidence relating to prenasalized consonants in this regard was presented in Section 2.1.2.

2.2.3.2 Frequency of Distribution

A second major type of evidence which is used to demonstrate the marked status of elements comes from the frequency of their distribution. Here it is necessary to distinguish two types of frequencies: cross-language frequency of occurrence and language-internal frequency of
occurrence. On a cross-language basic, there is no doubt that pre-
nasalized consonants occur relatively rarely; they are all but unknown
in Indo-European, Finno-Ugric, Sino-Tibetian, etc. In these same
language families, voiced stops and nasals occur almost universally --
as they do in languages which exhibit prenasalized consonants.

Language specific frequency is generally determined by textual
frequency counts. The frequency of the marked element should be less
than the frequency of occurrence of the corresponding unmarked element.
Since the marked item carries an extra "mark", it is more complex or
costly. Thus, the generalization of frequency of occurrence is
captured by Zipf's well-known "principle of least effort". The
circularity of the reasoning behind this principle is also well-known:
it asserts that there exists a general preference for "easier" (unmarked)
sounds and therefore these sounds occur frequently in human language.
However, at the same time, the status of "easier" sounds can be
determined only by reference to those sounds which occur most frequently.
Nevertheless, it is true that for any language, certain characteristics
have a greater probability of occurrence than others. Ferguson (1966:58)
notes that the frequency of occurrence of nasal vowels is always less
than that of non-nasal vowels (Universal XII). The data for language
internal occurrence of prenasalized consonants are less clear, however.
There is a principled reason for this fact, which will be presented
shortly.

When we consider languages which exhibit only a single series of
prenasalized consonants, no problems are presented since prenasalized
consonants in these languages always occur less frequently than the
corresponding nasals and voiced consonants. Typically, if only one
series of prenasalized consonants is present, it is the prenasalized
voiced stop series. For example, in a 1000 phone count of Kikuyu and
Kwanyama, distantly related Bantu languages, which exhibit only
\[mb, nd, \tilde{n}j, \tilde{ng}\], we obtained the following statistics:

**Kikuyu**

- Oral consonants: 246
  - Sonorants: 84
  - Obstruents: 162
    - Voiceless: 114
    - Voiced: 48
- Nasal consonants: 104
- Prenasalized consonants: 56

**Total consonants**: 404

**Kwanyama**

- Oral consonants: 240
  - Sonorants: 57
  - Obstruents: 183
    - Voiceless: 158
    - Voiced: 25
- Nasal consonants: 101
- Prenasalized consonants: 60

**Total consonants**: 401

We note that prenasalized voiced stops are by far the most common
series. Ferguson (1966) lists only these among his "secondary nasal
consonants". Similarly, most definitions of prenasalized consonants
refer only to this series. Chomsky and Halle's (1968:317) definition,
which distinguishes prenasalized consonants from simple nasals by
reference to the raising of the velum prior to the release of oral
occlusion, is clearly descriptively insufficient for prenasalized
voiceless stops or prenasalized fricatives. In these latter cases,
raising of the velum must be coordinated with a cessation of vocal fold
vibration or a reduction in the degree of stricture. Although they are
less common, these sounds certainly occur. For example, Rundi and Ganda,
two other Bantu languages, have the following consonantal inventories:

**Rundi**

\[
\begin{array}{llllllllll}
\text{m} & \text{n} & \text{ŋ} & \text{p} & \text{t} & \text{k} & \text{mp} & \text{nt} & \text{ŋk} \\
\text{b} & \text{d} & \text{g} & \text{mb} & \text{nd} & \text{ŋg} \\
\text{v} & \text{z} & \text{ʒ} & \text{ʒ̃} & \text{ŋ} & \text{ŋz} & \text{nʒ̃} & \text{nʒ} \\
\text{f} & \text{s} & \text{ʃ} & \text{ʃ̃} & \text{n} & \text{ŋʃ} & \text{nʃ} \\
\text{pf} & \text{ts} & \text{cy} & \text{c} & \\
\text{r} &
\end{array}
\]
Thus, Rundi exhibits a total of fourteen prenasalized consonants. A 1000 phone count obtained the following results:

**Rundi**

Oral consonants: 317  
Sonorants: 84  
Obstruents: 233  
\[ \text{Voiceless: 132} \]  
\[ \text{Voiced: 101} \]

Nasal consonants: 77  
Prenasalized consonants: 30

---

Total consonants 424

It is interesting to note that the occurrence of the fourteen prenasalized consonants is less than half of the frequency of the three simple nasals /m, n, ñ/. In Ganda, however, the following figures obtain:
Ganda

Oral consonants: 274
Sonorants: 56
Obstruents: 218
Voiceless: 106
Voiced: 112

Nasal consonants: 55

Prenasalized consonants: 65

Total consonants 394

where the frequency of occurrence of prenasalized consonants surpasses that of the simple nasals /m, n, ŋ, η/. This fact requires explanation since it does not represent an isolated phenomenon. In some cases, the disproportion is even larger. For example, Zande, an Adamawa-Eastern language described by Tucker and Hackett (1959), has the following consonantal inventory:

Zande

<table>
<thead>
<tr>
<th>m</th>
<th>n</th>
<th>ŋ</th>
</tr>
</thead>
<tbody>
<tr>
<td>p</td>
<td>t</td>
<td>k</td>
</tr>
<tr>
<td>b</td>
<td>d</td>
<td>g</td>
</tr>
<tr>
<td>mb</td>
<td>nd</td>
<td>ng</td>
</tr>
<tr>
<td>f</td>
<td>s</td>
<td>h</td>
</tr>
<tr>
<td>v</td>
<td>z</td>
<td>mv</td>
</tr>
<tr>
<td>r</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>f</td>
</tr>
</tbody>
</table>

That is, Zande exhibits only prenasalized voiced sounds, both stops and continuants. There are seven prenasalized consonants and three nasals; the following frequencies were obtained in a 1000 phone count:
Zande

<table>
<thead>
<tr>
<th>Oral consonants: 271</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonorants: 93</td>
</tr>
<tr>
<td>Obstruents: 178</td>
</tr>
<tr>
<td>Voiceless: 142</td>
</tr>
<tr>
<td>Voiced: 36</td>
</tr>
</tbody>
</table>

Nasal consonants: 36

Prenasalized consonants: 80

Total consonants 387

Prenasalized consonants occur more than twice as frequently as the simple nasals.17

We believe that these problematic statistical observations are crucially linked to a traditional misanalysis of prenasalized consonants. It has been very generally assumed that prenasalized consonants are essentially nasal consonants, i.e. a subclass of nasal consonants. This is reflected in Ferguson's assignment of them to the class of "secondary nasal consonants" along with other types such as voiceless nasals, nasal clicks, emphatic nasals, etc. The question of subclass and prenasalized consonants is a complex one; it is examined in detail in Chapter 4. We merely remark at this point that this assignment of prenasalized consonants is problematic for other reasons.

Another characteristic of a marked-unmarked relationship is that the number of distinctions in the marked category should not exceed that in the unmarked (Greenberg 1970a:92-3). However, Rundi has fourteen prenasalized consonants and three nasals, Ganda twelve prenasalized consonants and four nasals, Zande seven prenasalized consonants and three nasals, Malagasy nine prenasalized consonants and four nasals, Yaka five
prenasalized consonants and two nasals, etc. Ferguson (1966:57-8) states explicitly that the number of secondary nasal consonants for any given language will never exceed that of the primary nasal consonants. That this situation obtains not infrequently requires explanation.

First, we note that these problems are not general to the class of Ferguson's secondary nasal consonants. For example, the number of voiceless nasals never exceeds that of the voiced nasals. Similarly, voiceless nasals occur internally much less frequently than voiced nasals. In 1000 phone counts of two Bantu languages exhibiting voiceless nasals, we obtained the following frequencies:

**Shona**

Nasals: 83
Voiceless: 2
Voiced: 81

**Kvanyama**

Nasals: 101
Voiceless: 5
Voiced: 96

We shall argue in later chapters that the problematic statistical observations involving prenasalized consonants, both in terms of textual frequency and number of distinctions, is due precisely to this incorrect assignment of prenasalized consonants to the class of secondary nasal consonants. It is noted that the correct analysis does not treat prenasalized consonants as a subclass of oral consonants; this is counter-intuitive. We believe that the question of subclass can ultimately be demonstrated as irrelevant for prenasalized consonants since it revolves around the issue of underlying unitary status. It
has already been mentioned that the major thesis of later chapters will be that prenasalized consonants do not occur as underlying unit segments. This reanalysis will enable us to explain why, for example, the number of distinctions in place of articulation for prenasalized consonants is often greater than the number of distinctions for simple nasals. For example, Zande has \([m, n, \text{\i}]\) as primary nasals, but at least \([m, n, \eta, \eta m]\) preconsonantly and probably \([\text{\i}]\) as well. One reason is of course, that the nasal component of prenasalized consonants is necessarily homorganic with the following consonant and the number of distinctions in place of articulation for oral consonants often exceeds that for nasals. These issues are returned to in Section 8.2.1.

2.2.3.3 Allophonic Variation

Another of the characteristics of a marked-unmarked relationship in phonology mentioned by Greenberg (1970a:92) is that the unmarked member(s) should show greater allophonic variation. For example, voiceless stops are unmarked with respect to voiced stops. In English, the voiceless stop \(/p/\) may have several different phonetic realizations: it may be aspirated or unaspirated, released or unreleased, etc. The voiced counterpart \(/b/\) is never aspirated, for example. Therefore, for prenasalized consonants, we expect to find that the greater allophonic variation occurs not with the prenasalized consonants but with the unmarked counterparts. On the one hand, this prediction would appear to be verified. For example, in Bolia, a Bantu language of Congo Kinshasa, \(/p/\) and \(/b/\) often lose their explosive character so that there are variations such as the following:
However, /mp/ and /mb/, the corresponding prenasalized stops, never lose their explosive character (Manet 1960:14). Similarly, in Ganda the prenasalized voiced stops /mb, nd, ng/ have single phonetic realizations as such. The corresponding voiced sounds show limited variation. Thus, /b/ may be [b] or [β], /g/ may be [g] or [γ], and one of the non-prenasalized counterparts of [nd] is /l/, which shows a wide range of realizations. It would be surprising to find such variation in the oral component of the prenasalized consonant if it did not occur with the simple oral consonant as well since one of the better-known contexts for consonant strengthening is in connection with nasal consonants.

Thus, [nd] has two non-prenasalized counterparts in Ganda, /l/ and /d/, as the following forms demonstrate:

- kudaliza ndaliza 'to embroider: I embroider'
- kulallira ndalilira 'to leap: I leap'

There is a natural phonetic explanation for the preference of prenasalized stops over prenasalized continuants which is dealt with in the chapter concerning primacies and processes. For the other series of non-prenasalized counterparts, i.e. simple nasals, we do not ordinarily find allophonic variation.

In those languages where prenasalized consonants are one realization of underlying voiced stops or nasals, i.e. where prenasalization is not phonologically distinctive, it is not appropriate to speak in terms of
allophonic variation of prenasalized consonants. We have demonstrated that there is no question of phonological prenasalization in these cases.

There are, however, a few problematic pieces of data concerning allophonic variation and prenasalization. First, it has already been mentioned that the nasal component is always homorganic with the following consonant. In some cases, it appears that there is a single underlying nasal, which is responsible for prenasalization. Thus, if /n/ occurs both before vowels and consonants, we expect that it is unmarked in prevocalic position. Yet, it typically has a single phonetic realization here and several before consonants. Thus, greater variation is found in the marked form.

Prenasalized fricatives exhibit a type of behavior not ordinarily found with prenasalized stops wherein the nasal component is realized only as nasalization of a preceding vowel. Thus, while /s/ and /z/ may be phonetically only [s] and [z], /ns/ and /nz/ may be [ns] and [nz] or ["s] and ["z]. Here, greater allophony occurs with the marked series. There is an explanation for this fact. Although prenasalized consonants have a relatively stable duration in any language, the relative durations of the nasal and oral components vary systematically with the feature specifications of the oral component. This is discussed in Sections 5.3 and 8.2. It will suffice to say here that the nasal component is shorter before fricatives than before stops. There is, we believe, a perceptual motivation for this fact, which we present later. The shortening of the nasal often results in its disappearing entirely under certain conditions.
Similarly, prenasalized fricatives pose another sort of problem. They may alternate with prenasalized affricates so that /ns/ may be [ns] or [nts] whereas /s/ has a single phonetic realization. There is again a phonetic explanation for this fact. Simply, a slight non-coordination of the raising of the velum with the movement of the other articulators may result in an oral stop being inserted between the nasal and the following fricative. This tendency, in fact, affects not only prenasalized fricatives but any sequence of nasal plus fricative. As Schuhmacher (1972:268) writes:

Given the homorganic (or quasi-homoorganic) combination nasal plus fricative, a stop will occur almost automatically in-between as it is easier to articulate nasal plus affricate (cf., for example, German Gans [gants] 'goose').

This process is also evident in English and explains why prince is very often homophonous with prints. The point here is that, again, allophony is greater within the marked series than the unmarked series. Although there exist natural phonetic explanations for these facts, they are problematic for our general characterizations of marked-unmarked relationships.

2.2.3.4 Neutralization and Diachronic Developments

It has already been mentioned that one of the most important and often cited characteristics of Praguean markedness is neutralization in favor of the unmarked element. For example, the unmarked status of voiceless consonants is demonstrated by the fact that in many languages the distinction between voiced and voiceless consonants is neutralized in final position in favor of the voiceless elements, e.g. German. The justification and numerous examples of this characteristic are well-known
and will not be detailed here.

We should expect to find that prenasalized consonants do not appear in contexts of neutralization. There are a few examples which evidence the marked status of prenasalized consonants in this regard, but they are not particularly common, and a few counter-examples appear to exist. Trubetzkoy (1949:190) noted that the correlation of simple nasality is ordinarily not neutralized in consonants. We could make a similar claim for the correlation of prenasality; however, this seems to us an ad hoc solution to the general problem. We will discuss the evidence relating to prenasalized consonants in this regard below. The principled explanation for their slightly problematic behavior is forthcoming in later sections of this thesis.

One of the clearest examples of contextually determined neutralization of prenasalized consonants is found in the phenomenon known as Meinhof's Law or the Ganda Law, operative in many Eastern Bantu languages. In fact, the same process has been documented in several unrelated Pacific and Amerindian languages. We will not be concerned here with the exact nature of the processes involved, but only with the output of the "law". The processes will be returned to briefly in a later section of this thesis; they are discussed in detail in Herbert (1976a). The facts of Meinhof's Law are that prenasalized voiced stops are realized as simple nasals when the next syllable begins with another nasal segment, e.g. Kikuyu:
The opposition between prenasalized and simple nasal consonants is neutralized before a following nasal syllable.

A seemingly similar phenomenon is found in a very few scattered Bantu languages where we find neutralization of prenasalized consonants in favor of the oral consonant. This neutralization occurs in the environment of a preceding prenasalized consonant:

<table>
<thead>
<tr>
<th>Kwanyama</th>
<th>Herero</th>
</tr>
</thead>
<tbody>
<tr>
<td>ongadu</td>
<td>ongandu 'crocodile'</td>
</tr>
<tr>
<td>ongobe</td>
<td>ongombe 'beast'</td>
</tr>
<tr>
<td>ombabl</td>
<td>ombambli 'steenbuck'</td>
</tr>
</tbody>
</table>

Both of the above processes are traditionally described as dissimilations. It has been demonstrated elsewhere (Herbert 1976a) that this is an incorrect characterization.

Another possible case of neutralization in favor of simple oral consonants is the already mentioned phenomenon of loss of nasalization in initial prenasalized consonants. This has been noted in a wide range of languages, and its effect is surface identity between prenasalized and oral stops in this position. Similarly, prenasalized /mb/ and /nd/ are reported by Dahl (1951:112) to lose their oral component in...
Maanjan, an Austronesian language of Borneo, when they occur before the main accent in a word. This is another case of neutralization in favor of a nasal consonant.

When we begin to consider diachronic mergers, overall tendencies are much easier to discern. However, here too the factors governing the development of prenasalized consonants into oral or nasal consonants are not clear. If we consider first the case of the Bantu languages, we find that very often the reconstructed prenasalized consonants have developed into oral consonants:22

**S. Sotho**

${\text{mp > ph}}$ \hspace{1cm} ${\text{mb > p'}}$

${\text{nt > th}}$ \hspace{1cm} ${\text{nd > t'}}$

${\text{nk > kxh}}$ \hspace{1cm} ${\text{ng > k'}}$

**Lori**

${\text{mp > p}}$ \hspace{1cm} ${\text{mb > p}}$ \hspace{1cm} \(\text{*p > t}\)

${\text{nt > t}}$ \hspace{1cm} ${\text{nd > t}}$ \hspace{1cm} \(\text{*t > l}\)

${\text{ng > k}}$ \hspace{1cm} \(\text{*k > h}\)

Similarly, Dempwolff (1928-30:30) gives the following course of development for his Indonesian-Melanesian-Polynesian proto-language to Urmelanesian to Sa'a, a language of the Solomon Islands:
<table>
<thead>
<tr>
<th>#I-M-P</th>
<th>#UM</th>
<th>Sa'a</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>m</td>
<td>m</td>
</tr>
<tr>
<td>n</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>η</td>
<td>η</td>
<td>η</td>
</tr>
<tr>
<td>b</td>
<td>p</td>
<td>h</td>
</tr>
<tr>
<td>d</td>
<td>d</td>
<td>r</td>
</tr>
<tr>
<td>t</td>
<td>t</td>
<td>Ø</td>
</tr>
<tr>
<td>d'</td>
<td>d'</td>
<td>t</td>
</tr>
<tr>
<td>g'</td>
<td>g</td>
<td></td>
</tr>
<tr>
<td>l</td>
<td>l</td>
<td>l</td>
</tr>
<tr>
<td>!</td>
<td>r</td>
<td>r</td>
</tr>
<tr>
<td>y</td>
<td>r</td>
<td>l</td>
</tr>
<tr>
<td>mb</td>
<td>mb</td>
<td>p</td>
</tr>
<tr>
<td>mp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>nd</td>
<td>nd</td>
<td></td>
</tr>
<tr>
<td>nt</td>
<td>nt</td>
<td></td>
</tr>
<tr>
<td>n'd'</td>
<td>n'd'</td>
<td></td>
</tr>
<tr>
<td>n'g'</td>
<td>n'g'</td>
<td></td>
</tr>
<tr>
<td>k</td>
<td>ng</td>
<td>k</td>
</tr>
<tr>
<td>ηg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
where again although the prenasalized consonants have become simple oral consonants, they have not merged with the original oral consonants.

In a reconstruction of Proto-Takanan, which represents a group of Amerindian languages of Bolivia and Peru, Girard (1971) found it necessary to reconstruct the following nasals: *m, *n, *M, *N, *昊. The reflexes of these are clearly different, so a distinction in the proto-inventory is warranted. However, Girard takes only the first step in reconstruction, i.e., he notes reflexes and assigns cover symbols to ancestor forms. One goal of reconstruction should be, however, to make statements about the phonetic and phonological systems of the reconstructed systems. An examination of Girard's data suggests that his abstract symbols are actually cover terms for prenasalized consonants. This data is examined briefly below.

The consonantal system reconstructed by Girard is:

Proto-Panoan-Takanan

\begin{tabular}{ll}
\text{Proto-Panoan-Takanan} & \\
\text{p} & t \\
\text{b} & d \\
\text{m} & n \\
\text{M} & N \\
\text{P} & r \\
\end{tabular}

This system develops into the consonantal systems of Proto-Panoan and Proto-Takanan in a way which we conveniently schematize as:
The justification for the original reconstruction is not at issue here. We note merely that the reflexes of *M, *N, *N exhibit two reflexes in Proto-Takanan, one oral and one nasal. We are not interested here in the place of articulation of the reconstructed segments, but the development of *M, *N, *N suggests that the actual phonetic character of these elements involved both an oral and a nasal articulation. It is possible, therefore, to hypothesize that these segments may have been prenasalized consonants or even nasal-oral clusters.23

There are numerous examples attesting to the development of prenasalized consonants into oral consonants. Their development into nasals is also a common phenomenon. Looking again first to Bantu, we find this
line of development attested in various languages:

**Holoholo**

*mb > *m
*nd > *n
*νg > *ŋ

Cases involving the development of prenasalized voiceless stops into simple nasals are rarer:

**Luyana**

*mp > m
*n [+ > n
*ŋk > n

Occasionally, it appears that prenasalized voiceless stops of Bantu have become voiceless or aspirated nasals:

**Tswa**

*mp > mŋ
*n [+ > nh
*ŋk > h

There is apparently no hierarchy for the development of prenasalized voiced and voiceless stops into nasals. There exist languages in which the voiceless sounds have become nasals while the voiced sounds have developed into oral consonants; there are also languages in which the reverse situation obtains:
Similarly, prenasalized consonants are lacking in most Nilotic languages, but they do occur in a few, e.g. Luo. The prenasalized consonants of Luo correspond to simple nasals in the other languages (Tucker and Bryan 1966:406):

<table>
<thead>
<tr>
<th>Luo</th>
<th>Shilluk</th>
<th>Acoli</th>
</tr>
</thead>
<tbody>
<tr>
<td>r3-m3</td>
<td>r3-mbm</td>
<td>r3-mbm</td>
</tr>
<tr>
<td>r3-mb3</td>
<td>r5-m3co</td>
<td>r5-m3</td>
</tr>
<tr>
<td>-ny5</td>
<td>-ny5co</td>
<td>-ny5</td>
</tr>
<tr>
<td>-ny6</td>
<td>-ny6co</td>
<td>-ny6</td>
</tr>
<tr>
<td>-ng6</td>
<td>-ng6co</td>
<td>-ng6</td>
</tr>
<tr>
<td>c-ng3</td>
<td>c-ng3co</td>
<td>c-ng3</td>
</tr>
</tbody>
</table>

\[ NC \rightarrow N \rightarrow N \]

Cases involving an across the board prenasalization of oral or nasal consonants are unknown to us. This is not to claim that prenasalized consonants never develop from these latter types. However, when they do,
it is a contextually-conditioned development, e.g., nasals may become
prenasalized stops preceding an oral vowel or oral stops may be pre-
rasalized following a nasal vowel. These phenomena are dealt with in
Section 7.2, which surveys various synchronic processes which give rise
to prenasalized consonants.

The facts of diachronic development explain why prenasalized con-
sonants are not common as a universal type and why, even in language
families for which they are reconstructed, they are often absent from
the synchronic inventories. Greenberg (1970a:97). points out that
frequency in phonology is the resultant of overall diachronic tendencies.

2.2.3.5 Child Language and Distributional Limitations

There are two additional considerations which need to be taken into
account in a discussion of marked phonological segments. These are data
from child language acquisition and distributional limitation on the
segments. Unfortunately, the former type of evidence is lacking insofar
as prenasalized consonants are concerned. I know of no detailed
acquisitional study dealing with a language which exhibits prenasalized
consonants or even passing remarks on their acquisition. We should
expect, however, that they will be mastered after oral and nasal
consonants.

There is a great deal of data dealing with distributional limiting-
atons on the occurrence of prenasalized consonants within synchronic
language patterns. For example, in Kikuyu no verb or adjective root
and extremely few noun roots begin with a prenasalized consonant. Taken
by itself, this represents an interesting distributional observation.
Similarly, in N'zébi (Guthrie 1968), prenasalized consonants occur only
as \(C_2\) in radicals and nominal stems. They occur in \(C_1\) position in a very restricted number of nominal stems where they are historically analyzable as incorporated nasal prefixes or as \(-NVCV\) bases with vowel loss. The canonical root shape in Bantu is \(-CVC-\), so roots such as \(-ntu\) 'entity', which figures in the family name Bantu, are deviant. In Ewondo, one of the few Bantu languages which admit final consonants, the prenasalized consonants are barred from final position (Abega 1969).

Obviously, we would like to think that there is/was some principled reason motivating these limitations. That is, the distributional limitations point to the marked status of these segments, but we want to be able to explain why a particular segment or segment type is marked. This relates to the previously discussed desire to inject content into the foundation of our theory of markedness. We believe that it is possible to provide principled reasons for the markedness of prenasalized consonants from which follow not only the distributional limitations above but fully all of the observations related in this chapter. This explanation will rest upon a reanalysis of our basic assumptions concerning prenasalization. We will attempt to establish that at the level of underlying representation, prenasalized consonants do not exist universally. This contradicts the traditional assumption that surface prenasalized consonants may be underlying unitary or non-unitary segments. We deny the existence of the former. This claim will be examined in detail in the following chapters.

2.2.3.6 Phonological and Grammatical Markedness

A particularly interesting connection between marked categories in phonology and grammar can be demonstrated by the behavior of
prenasalized consonants in some languages. Greenberg (1970a:99) notes that glottalization of consonants is used to indicate diminutives, a marked grammatical category, in some Amerindian languages. Similarly, unlauted vowels are used in German to indicate plurality, another marked category, for some nouns. Thus, we expect to find prenasalization, when it is so used, as an indicator of a marked grammatical category.

A particularly nice example of this connection between phonological and grammatical markedness is observed in a few Nilotic languages. The data to be cited are from Tucker and Bryan (1966:407-8) and Gregersen (1972). The examples are from Luo, but similar situations occur in Adhola, Alur, and Bor. In Luo, we find that certain grammatical categories are indicated by a change in the stem-final consonant and an optional change in the final vowel. The type of alternation which concerns us here is that affecting nouns with stem-final nasals in their nominative singular form. The nasals become the corresponding prenasalized stop in the appertentive singular (the so-called "Status constructus") and in the nominative and appertentive plural:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>buom</td>
<td>buomb</td>
<td>buombe</td>
</tr>
<tr>
<td>ājuno</td>
<td>ājund</td>
<td>ājunde</td>
</tr>
<tr>
<td>boŋ</td>
<td>boŋj</td>
<td>boŋje</td>
</tr>
<tr>
<td>tʊŋ</td>
<td>tʊŋg</td>
<td>tʊŋge</td>
</tr>
<tr>
<td>sigana</td>
<td>sigand</td>
<td>sigande</td>
</tr>
</tbody>
</table>

In fact, these alternations are part of a much larger process to which
Gregersen (1972, 1974) gives the name consonant polarity. The polarity is not complete, however, since words with prenasalized consonants in the nominative singular do not show simple nasals in the marked categories: rombo 'sheep' (nom. sg.) and rombe (nom. pl.). Thus, prenasalization is characteristic of the marked grammatical category even when we might expect the polar form *rome. Polarity is complete for other series of consonants, e.g. the voiced-voiceless polarity of oral consonants:

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>kede</td>
<td>kete</td>
</tr>
<tr>
<td>okot</td>
<td>okode</td>
</tr>
<tr>
<td>codo</td>
<td>coke</td>
</tr>
<tr>
<td>sanduku</td>
<td>sanduge</td>
</tr>
</tbody>
</table>

There is a principled explanation for the lack of complete polarity in the nasal-prenasalized opposition, which is not directly related to the notion of marked category. The main point of the present discussion is simply that prenasalization, a marked phonological category, is characteristic of the marked grammatical categories appertentive and plural in Luo.

Another example pointing to this same connection between marked grammatical categories and prenasalization is found in Lungu, a Bantu language of Angola described by Atkins (1954). Here again the alternation is part of a larger series of complex alternations used to indicate the first person singular of verbs and the plural of certain nouns. Atkins distinguishes three main types of alternations:
1. Friction: ʰ, k > th, kh; h > p
2. Plosion: ʃ, s, ʃ > pf, ts, ʧ
3. Nasalization: v, z, ʃ > mv, nz, ň, ň v, nz, ň, ň b, d, l > mb, nd, nd

Historically, these alternations are due to a prefix /N-/. There is no reason to posit the existence of such a prefix synchronically, however. We prefer to analyze these data as morphologically conditioned alternations. Some examples of these alternations follow:

-king- 'wait' khingidi 'I waited'
-hond- 'kill' phondele 'I killed'
-ful- 'forge' pfudidi 'I forged'
-jimbil- 'hold' tšimbidi 'I held'
-vutuk- 'return' mvutukidi 'I returned'
-bi·nd- 'shut' mbî·ndidi 'I shut'
-la·mb- 'cook' nda·mbidi 'I cooked'

What is of further interest to our present discussion is that stems which do not fit the above schema also mark these forms by initial prenasalization. That is, nasal-initial and vowel-initial stems exhibit prenasalized voiced stops:

-mon- 'see' mbuense 'I saw'
-u- 'hear' nguide 'I heard'

Unfortunately, Atkins gives only these two examples; it is therefore difficult to determine how widespread this phenomenon is. Both examples are somewhat problematic historically.

Our final examples of the connection between prenasalization and marked grammatical categories are taken from the Fe³Fe²-Bamileke data
discussed by Hyman (1972a). In Bamileke, verbs have two forms: a zero form which is morphologically unmarked and a prenasalized form which is marked by the presence of a homorganic nasal prefix /N-/. Hyman notes the morphological markedness of the latter form, but he fails to remark on the connection between this and grammatical marking as well. Basically, the zero form of the verb is associated with the imperative and the completive aspect whereas the prenasalized form indicates non-completed and consecutive aspects:

<table>
<thead>
<tr>
<th>Zero</th>
<th>Prenasalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>fat</td>
<td>nfat</td>
</tr>
<tr>
<td>cen</td>
<td>ncen</td>
</tr>
<tr>
<td>pen</td>
<td>mben</td>
</tr>
<tr>
<td>yen</td>
<td>ngen</td>
</tr>
<tr>
<td>len</td>
<td>nden</td>
</tr>
</tbody>
</table>

The same relationship is found in the singular-plural distinction in some Bamileke nouns, where the marked category, plural, is characterized by initial prenasalization:

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
</tr>
</thead>
<tbody>
<tr>
<td>sak</td>
<td>nsak</td>
</tr>
<tr>
<td>khù</td>
<td>ñkhù</td>
</tr>
<tr>
<td>lâk</td>
<td>nlâk</td>
</tr>
<tr>
<td>γ̂aʔ</td>
<td>ñγ̂aʔ</td>
</tr>
</tbody>
</table>

There are some nouns which exhibit prenasalized consonants in both singular and plural forms:
The main point of Hyman's discussion concerns the "hardening" of consonants in some post-nasal environments. (Cf. Section 8.1.2.) There are apparently no nouns in Bamileke where the singular is marked by prenasalization and the plural is not.

Interestingly, in the fully Bantu languages, we typically find that prenasalization of initial consonants occurs in two noun classes: Class 9/10, where it is a mark of both singular and plural, and Class 11/10, where it occurs only in the plural. The reconstructed form for the prenasalizing prefixes is */ni-/. In some languages, the prefix */mu-/, which marks the singular of Classes 1/2 and 3/4, has also undergone vowel absorption and the nasal has come to stand directly before the stem-initial consonant. In some languages, the nasal assimilates in position to the following consonant; in some languages, it is always syllabic. For example, in most dialects of Swahili, these class prefixes are always syllabic [m], regardless of the following consonant. In other dialects, however, the prefix is no longer /m-/, but a syllabic nasal homorganic with the following consonant, i.e. /N-/. Thus, in Chi-jomvu and Ki-ngowe, two dialects described by Lambert (1958b), we find the following Class 3 forms:
where the initial nasal is syllabic in every case. We assume that the */ni-*/ prefixes went through similar stages of development during the course of their evolution to simple prenasalizing prefixes. For example, in Standard Swahili these prefixes are still realized as:

- syllabic before monosyllabic stems: mv'i 'grey hair', nch'i 'country'. It would therefore seem not improbable that some language should show simple prenasalization of stem-initial consonants as the synchronic realization of the */mu-*/ prefixes.

This is precisely the situation which occurs in Gitonga as described by Lanham (1955). Gitonga has no syllabic consonants; the realization of the Class 1 and 3 singular prefixes is:

1. mu- before monosyllabic stems
2. mw- before vowel-initial stems
3. ø before voiceless consonants and r
4. prenasalization of voiced consonants: b > mb, ð > mb or m,
   l > n(d), γ > ng.

Some examples are:
Singular | Plural | Meaning
---|---|---
muthu | bathu | 'person'
mugo | bago | 'stepfather'
mwamana | bamana | 'lad'
simbo | misimbo | 'tree'
cungu | bacungu | 'European'
tholo | mitholo | 'boring tool'
roto | miroto | 'beak'
rembwa | barembwa | 'illegitimate child'
mbanyisi | babanyisi | 'savior'
noyi | baloyi | 'witch'
ndoyo | baliphi | 'liar'
nayo | milayo | 'law'
ngome | miyome | 'Eur. type of building'
nguyu | miluyu | 'fig tree'

On the one hand, the Gitonga data would seem to counter the general claim that prenasalization tends to be characteristic of the marked grammatical category. Note first, however, that the opposition here is not between a zero and a prenasalized form; the corresponding plurals involve canonical CV- prefixes. Also, the range of prenasalization is extremely limited, affecting only underlying voiced consonants, but not /r/. Additionally, there is a tendency, at least for the non-velar series, to replace the prenasalized consonant with the corresponding simple nasal. Finally, nouns which enter the language through borrowing and deverbative nouns are immune to the rules of "M-nasalization" given
above. These nouns always exhibit a full mu- prefix:

- muThwa baThwa 'Tahwa'
- muPutukes! baPutukes! 'Portuguese'
- muonI baoni 'sinner' (< Tava)
- musayIsi basayIsi 'protector' (< -sayIsa)
- mubati babati 'carpenter' (< -bata)
- mulayell balayell 'adviser' (< -laya)
- muyIrI bayIrI 'maker' (< -Ira)

There are a few deverbatives which coexist with "normal" nasalized forms:

- mbanyIs! 'savior' (< -banyIsa)
- mbanyIs! 'savior' (< -banyIsa)
- niph! 'liar' (< -Iphä)
- mulliph! 'liar' (< -Iphä)

All of these facts seem to point to the instability of prenasalization as a Class 1 and 3 marker in Gitonga. The fact that deverbatives, i.e. nouns associated with "living roots", resist initial prenasalization is especially significant. That is, these forms resist deformation of the base stems in the singular. It would seem then that prenasalization in Gitonga as a marker of Class 1 and 3 forms is not destined to survive long.

We do not consider the Gitonga data a significant indictment of the general connection between marked grammatical categories and prenasalization. As had already been pointed out, markedness theory in its present form is a theory of predictions; it is not absolute. At best, it claims that when a marked situation develops it should not be particularly stable.
It is noted that many of the examples in which prenasalization is associated with a marked grammatical category show a zero mark in the unmarked category. This is to be expected since, historically, prenasalization often results from affixation, i.e. the addition of some mark to a base form. The corresponding unmarked categories are often simply without any mark whatsoever. Synchronically, however, some cases do not warrant the postulation of an affixed morpheme to account for prenasalization; in these cases, the fact that prenasalized consonants occur in the marked category is simply a morphophonemic fact of the language concerned.

2.3 Summary

By way of summary, we have provided in this chapter a phonetic definition of prenasalized consonants, which, as a purely phonetic definition, makes no reference to their underlying nature or function within a language system. Phonetic prenasalization is defined in terms of three criteria:

1. sequence of nasal and non-nasal consonantal segments
2. homorganicity of the elements
3. combined duration of "simple" consonants

Phonetic events meeting the first two, but not the third, criteria are common among the world's languages. In a later chapter of this work, we examine the relationship between such events and prenasalized consonants in detail.

We have claimed in this chapter that the occurrence of surface prenasalized consonants does not imply their occurrence at a deeper level of linguistic organization. Specifically, we proposed that there
exist certain prerequisites for the recognition of phonological pre-
nasalization, which include the existence of a series of nasals and
voiced oral stops/fricatives. We attempted to establish that prenasal-
ization may be the surface realization of an underlying feature
specification [+voice]. Using this phonological criterion, we can then
dispense with one type of prenasalization at the underlying level. In
the next chapters, we attempt to dispense with the remaining
varieties of prenasalization at this level of analysis.

Some of the general characteristics of marked segments in phonology
were also examined in the preceding chapter, and these characteristics
were applied to prenasalized consonants. We saw that certain charac-
teristics, e.g. frequency counts, neutralizations, etc., were somewhat
problematic for prenasalized consonants. Other characteristics, e.g.
occurring primarily with marked grammatical categories, posed no such
problems. In later chapters, we motivate an explanation for these
observations. The explanation rests upon the non-unitary underlying
status of prenasalized consonants. Indeed, this claim represents the
basic thesis of this present work.
NOTES

1 There is a principled reason for the high distributional co-occurrence of prenasalized consonants and open syllables, which is dealt with in Chapter 6, along with a review of the more general problems which reference to syllables involves.

2 There is, of course, some historical support for the inclusion of durational considerations in phonological strategies. For example, Trubetzkoy (1968:16) notes that: "A sound group can only be classed as the realization of a single phoneme if its duration does not exceed the duration of other phonemes in the relevant language." The parallels with our definition of prenasalized consonants are evident.

3 Ferguson (1966) notes that Hockett (1955:119) has reported nasal-less inventories for some Salishan languages where the PNC's of an earlier period have become voiced stops. These data are discussed in more detail and clarified in Thompson and Thompson (1972).

4 Actually, a more exact statement would mention voiced stops or fricatives since some languages have β, l, γ, but lack b, d, g.

5 We adopt the following conventions for the discussion of Asmat only: (N) represents any nasal, (-N) any non-nasal consonant, and (C) any consonant. The use of parentheses does not imply optionality.

6 The case of vowel roundness is not too complex. There is nothing inherently difficult about front rounded vowels (although cf. Lindblom 1972). They are, however, marked within a total vowel system because they are acoustically similar to both front and back vowels in their formant structure. The perceptually most distinctive system is one composed of front unrounded and back rounded vowels.

7 Although the fact that there are any exceptions should invalidate the family-specific generalizations proposed by Lass too. Kiyanzi, a Bantu language mentioned by Welmers (1973:21) contrasts front rounded and unrounded vowels:

\[
\begin{array}{ccc}
& i & u \\
\text{e} & \emptyset & o \\
\text{a} & \\
\end{array}
\]

8 Lass' choice of front rounded vowels in Germanic to exemplify his claims is less than felicitous. It appears that in addition to the color of these vowels, other considerations such as length and tenseness play an important role in their history. Thus, the interaction of various factors is more complex than Lass presents.

9 It appears that the unmarked airstream mechanism is the pulmonic egressive one. (Cf. Catford 1974:24 ff.) That is, glottalic egressive (ejectives), glottalic ingressive (implosives), and the velaric (clicks) are all marked mechanisms. It is unclear what, if
any, is the relative markedness of the latter three types. This should, in theory, be discoverable in languages where all four mechanisms are employed, e.g. Zulu, Xhosa, etc.

10 It is unclear in most cases whether the clicks were introduced directly from Khoisan or via some other intermediary Bantu language.

11 This effect is similar to that produced in the children's game known as "telephone", in which the final degree of simplification of a message whispered from one participant to another is a factor of the number of participants.

12 We assume a fundamental difference between languages with no clicks incorporating them into their sound systems and languages with click sounds increasing their click inventory.

13 As we have already mentioned, the only candidate for such a substitution is hlonipa.

14 This argument could be further strengthened by accepting Stora (1937) or Van Ginneken's (1939) hypothesis that clicks represent the most primitive speech sound and from these have evolved all other consonant types. In this case, the non-survival of clicks again points to their marked nature, and we regard the evolution as basically simplificatory in nature. However, we also expect the most primitive consonants to be the unmarked ones. In fact, this hypothesis is very suspect, based on extremely little empirical data.

15 Even in those languages where clicks are original elements, Bushman and Hottentot languages, there are distributional restrictions on the occurrence of clicks (Greenberg 1970b:67). Also, Bleek (1939:61) reports that many Bushman words with clicks coexist with clickless variants and that certain words with clicks in the speech of older speakers have lost their clicks with the younger speakers. Finally, she observes that "most words that are very often in use such as pronouns, demonstratives and verbal particles, have no clicks in all the languages" indicating a "tendency to drop the clicks."

16 Apparently, in Katamba's own speech these derivations are limited to verb roots beginning with [-anterior] non-nasals as in the first three examples cited. However, his younger brother finds all the cited forms acceptable. This restriction is absent for Katamba when the prefix does not directly precede the verb root:

/ku + ba + laba/  bbalaba  'to see them'
/ku + mu + laba/  mmulaba  'to see him/her'

17 The justification for treating /ɬ/ as a prenasalized consonant is presented in Section 8.2.4. The statistical skew does not depend crucially on this analysis; /ɬ/ occurred only 13 times in the text.
18 This mirrors the fact that a language may have more clusters involving some class of segments than there are members in that class.

19 A treatment of the [β] - [b] alternation in terms of a variable rule as well as an implicational hierarchy appears in Herbert (1974). In my own research in Ganda, I have not observed any significant similar tendencies for /g/, but they are mentioned by Katamba (1974) for his own speech.

20 Zwicky (1972:291) has pointed out that in fast speech the [ns] of prince and the [nts] or prints vary freely with one another. Also, some speakers do not have a systematic distinction between the two even in slow speech.

21 There is at least one case of a counter-tendency, i.e. the epenthesis of initial nasality to a voiced consonant. In Miao-tseu, a Sino-Tibetan language, we find "récemment les initiales sonores ont développé une nasale" (Meillet and Cohen 1952:565):

mbwa 'hog' (Burm. wak; Tib. p'ag)
mplei 'rice' (Tib. obras)
nje 'ear' (Burm. na; Tib. rna)

22 In the following examples from Bantu, we consider for the most part the development of prenasalized consonants in C₁ position, which is not necessarily identical with their development in C₂. The data are from Guthrie (1967-70).

23 The other type of articulation involving oral and nasal components, postnasalized consonants, is another logical possibility. Other Takanan languages show prenasalization as a synchronic phenomenon, however (Key 1968).

24 We do not provide evidence for the markedness of the grammatical categories which we discuss here. For the most part, their status are well documented in the literature and involve such generally agreed categories as plural, non-completive aspect, etc.

25. It is interesting that younger speakers tend to use no prefix at all for the above plural forms so that singular and plural are distinguished only by their respective modifiers:

γεα' 25 'my cheek'
γεα 30 'my cheeks'

Again, the loss of prenasalization here points to its marked status.
CHAPTER III
PRENASALIZED CONSONANTS: UNITS OR CLUSTERS?

3.0 Introduction

In the preceding chapter we examined the distinction between phonetic and phonological definitions of prenasalization. We also demonstrated certain phonetic and phonological prerequisites for the recognition of underlying prenasalized consonants and the markedness of these sounds as a class. In this and the following chapter, we will examine the various treatments which have been afforded prenasalized consonants in the literature from a phonological point of view. This will involve an examination of the various feature proposals which have been put forward in an attempt to accommodate prenasalized consonants within the current phonological model. However, before proceeding to this issue, it will be profitable to review in some detail the evidence presented to date upon which the need for any phonological feature must rest, i.e. the recognition of an underlying unitary phenomenon. Thus, we believe that the crucial question which must be answered is whether prenasalized consonants are to be analyzed as unit phonemes or not. Of course, this question is not unique to prenasalized consonants, but involves many types of "complex" sounds. We propose first to examine briefly a few analyses which have been provided for other complex sounds in order to establish what methodological considerations are in use. Following this review, we will then
proceed to a more detailed examination of prenasalized consonants.

3.1 Strategy of Determination

An interesting example involving the issue of unit vs. non-unit phonemes is found in Borgström's (1940) analysis of aspiration in Scottish Gaelic. Borgström's methodology is reviewed by Ternes (1973) and then applied in his own study of the Gaelic of Applecross, Ross-shire. Scottish Gaelic exhibits both preaspiration of consonants as well as the more common postaspiration. It is noted that preaspiration occurs in many unrelated or only remotely related languages of Northern Europe including Icelandic, Faroese, some Norwegian dialects, Finnish, Lappish, etc. The question which is necessarily raised anew for each language is whether surface preaspirated consonants represent underlying unitary phonemes or a cluster of phonemes. In some languages, e.g. Finnish, there is apparently good cause to analyse them as clusters of /h + C/ so that the phoneme which is responsible for aspiration is on a par with other consonant phonemes of the language. Contrary to this analysis, in some languages, preaspirated consonants are best analyzed as the phonetic realization of underlying single phonemes, e.g. many treatments of Icelandic.

The data involving preaspirated consonants of the Gaelic spoken in the Hebrides are less clear. This leads Borgström to propose that in some dialects preaspirated consonants are clusters of phonemes whereas in others they are phonetically complex realizations of underlying unitary phonemes.

Borgström proposes that in the dialects of the Northern Hebrides, especially that of Lewis, for example, preaspirated consonants are
complex units. There is a simple rule which predicts the occurrence of preaspiration as a variant of the underlying voiceless stops. For example:

\[ /kh/ \rightarrow [kh] / \]

\[ [^hk] \text{ elsewhere} \]

i.e. postaspiration of initial aspirates and preaspiration medially and finally. Thus, \([kh^h][\text{cat}]\) is said to be the realization of three underlying phonemes in these dialects: \(/kh/\), \(/a/\), and \(/th/\).

Borgström rejects this same analysis for the dialects of the Southern Hebrides, e.g. the dialect of Barra, and opts for a cluster analysis for preaspirated consonants. Thus, in these dialects, the phonetically identical string \([kh^h][\text{cat}]\) is composed of four underlying phonemes: \(/kh/\), \(/a/\), \(/h/\), and \(/t/\).

There are four basic reasons which motivate Borgström to posit such a distinction in Hebridean underlying forms. First, preaspiration is the Southern dialects shows a great deal more phonetic variation than in the North. Thus, in the North, preaspiration is always \([h]\) as in \([hp, h^t, h^s, h_k, h_k]\) whereas in the South one finds \([hp, c\text{\&}', h^t, h^s, c't, x't, c'k, h_k, x_k]\) etc. with preaspiration realized as \([h], [c'], \text{or}[x]\). Second, the phonetic realization of preaspiration in the North is shorter than the realization of the phoneme \(/h/\) in these same dialects. It is also shorter than the preaspiration in the Southern dialects. Third, there exists no palatalized equivalent of preaspiration in any Scottish Gaelic dialect. In the Northern \([ht, h_k]\), preaspiration is palatalized, but not as narrowly as \([c']\) in the South. Last, when speaking English, Lewismen (Northern dialect) tend to
render non-initial /p, t, k/ of English as \[^h\text{p}, ^h\text{t}, ^h\text{k}\] so that back is pronounced \[^h\text{pa}\]k\]. This tendency is not observed with speakers of the Southern dialects, pointing to the independence of aspiration in these dialects. These four criteria invoked by Borgström seem well motivated; they are by no means the unique criteria used in analyses of the unit vs. cluster question.

A singly important piece of evidence traditionally cited as pointing to the unitary status of prenasalized consonants is, as we shall see, the fact that the order of components is contrary to the sonority hierarchy. According to this hierarchy, also known as the "Law of Sonority", the sonorance of segments should increase as the syllable nucleus is approached, i.e., maximally sonorant segments are to be found in the nucleus itself. Prenasalized consonants are by no means the only phenomenon which runs counter to this hierarchy. For example, Cygan (1970) discusses the English clusters /sp, st, sk/ in initial position. He notes that these are the only underlying clusters in English which violate the hierarchy and that some linguists have attempted to treat them as complex units for this reason. These clusters are unique in another respect, namely that they are the only English clusters which occur both initially and finally. A non-cluster analysis is supported by the fact that we do not find the corresponding combinations /sb/, /sd/, /sg/. For this reason, some linguists have made reference to the Praguean notion of archiphoneme to account for the neutralization of an underlying distinction in certain positions, e.g., the neutralization of voiced and voiceless consonants. Since voiced and voiceless stops do not contrast after /s/, it is claimed that
these post-\(/s/ stops differ from those which participate in the voiced-
voiceless opposition. The representation \(/sp, sT, sK/ is often
suggested to differentiate the two kinds of stops. Other linguists
prefer to speak simply of a third type of stop here, a "stigmatized"
stop (Hill 1966), e.g. \(/sp, st, sk/, which contrasts with the other
two types, \(/p, t, k/ and \(/b, d, g/. A final type of evidence used in
analyses of initial \(/sp, st, sk/ is their non-reversibility in Germanic,
i.e. *\(/ps-, ts-, ks-/ Again, these same arguments are traditionally
cited in analyses of prenasalized consonants as we shall see below.

A rather different sort of evidence is employed extensively by
Ferreira (1965) in a phonetic study of various complex sounds found in
South African languages. Ferreira's methodology consists basically in
instrumental analysis, not particularly sophisticated, of sounds in
"contracted" and "detached" positions. For example, the Afrikaans
consonants [\(\pm s, \j, \t, \tn\] are contrasted as follows:

<table>
<thead>
<tr>
<th>Contracted</th>
<th>Detached</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\pm s/\pm s)</td>
<td>die Katse 'the cats'</td>
</tr>
<tr>
<td>(\j/\j)</td>
<td>by Sjina 'in China'</td>
</tr>
<tr>
<td>(\t/\t)</td>
<td>skatlik 'dear'</td>
</tr>
<tr>
<td>(\tn/\tn)</td>
<td>na knoop 'after knot'</td>
</tr>
</tbody>
</table>

Ferreira notes a general phonetic similarity between the two series
although the contracted series tends to show an increase in intensity
which is a function of their degree of contraction. Ferreira notes:
Spectrographic analysis reveals in all comparable cases a similarity in the peak curve patterns of compound or contracted sounds and their free or detached symmetries. This similarity suggests sufficient phonetic correspondence between members of a compound sound and their free symmetries as to regard them as belonging to one and the same phoneme...

Phonemic analysis of a language should therefore not be complicated and obscured by the linking of phonemes into compound or contracted speech sounds or phones. In establishing the phonemes of a language, the phonetically free and unsuspected forms should first be isolated. In broad principle all compound or contracted sounds which can be reduced to two or more of the free forms realising phonemes in the language, should be regarded as a group of phonemes consisting of the same phonemes as the free forms (1965:44).

However, such methodology is linguistically unjustified. The term phoneme is itself not a phonetic one and does not rely on phonetic data for its definition. Those phonetic data which might be of use in a unit vs. cluster analysis include considerations of timing and relative durations, etc., which Ferreira neglects altogether. Surely, if a sound complex is suspected of being a cluster of two phonemes, we expect that the grounds for this suspicion will include surface phonetic similarity with the realizations of the two phonemes elsewhere. That is, we might originally hypothesize that a complex [ts] is really a cluster of /t/ plus /s/ precisely because the complex sounds like [t] followed by [s]. Spectrographic similarity is not too surprising a phenomenon when there is acoustical similarity. No one has suggested that we regard the click sounds, although they involve two separate articulations, as a cluster; clicks do not sound like a velar articulation and some anterior articulation although this is their essential nature. Even if clicks did sound like a sequence of articulations,
they remain unitary phonemes because of other facts of the language
systems in which they function. Phonemic status is obviously a
phonological and not a phonetic fact. It is discoverable by an
analysis of the function of sounds within a total linguistic system,
not by instrumental analysis. Although Bloomfield may have fantasized
about the day when advanced technology would allow us to perform
phonological analysis by machine and to evaluate competing phonologi-
cal analyses instrumentally, such technology is not forthcoming.
Indeed, our present instruments cannot perform relatively "simple"
tasks such as counting syllables -- assuming analysts could agree on
what a syllable is and if they really do exist.

Obviously, Ferreira's methodology breaks down in the situation
where one or both of the components of a contracted sound do not occur
as free phonemes. For example, if the compound [ts] is exhibited by
a language where only /s/ exists as an independent phoneme, but not
/t/, Ferreira's method dictates a single phoneme /ts/. This discovery
procedure might seem intuitively correct; if neither /t/ nor /s/ exists
in that language, there can be no question of a cluster analysis for
[ts]. However, I will argue later that such methodology is equally
unjustified although it does figure prominently in the literature.

There is no reason to suppose that the phonetic realization of
two phonemens in sequence will necessarily coincide with their
realizations elsewhere. The preeminence which Ferreira attaches to
phonetic data in phonological analysis falls out of his general con-
fusion of phonetic and phonemic identity. The underlying philosophy
seems to be: if two elements sound alike, they are the same element,
but if they sound different, then they are different phonemes. Of course, the role of phonetic similarity is important in phoneme identification; the classic example of a counter-intuitive analysis which can result in the absence of phonetic considerations is the assignment of [h] and [η] in English to a single phoneme since they are in complementary distribution. However, this is not an absolute rule. For example, in a language with [nd] but no [d] which is not post-nasal, Ferreira's criteria dictate a unit analysis for [nd]. It is possible, and indeed common, for [nd] to represent the surface realization of /n/ + /l/. In some languages, [nd] represents both /n/ + /l/ and /n/ + /d/. According to the criterion of phonetic similarity, all occurrences of [nd] would be represented as /n/ + /d/ e.g. Ganda:

(ndaliza) tadaliza 'I embroider:we embroider'
(ndalira) tulalira 'I leap:we leap'

It should be noted that the necessity of treating as a single phoneme any sound complex of which one of the components has not independent existence is stated by Trubetzkoy (1968). This seems like a valid principle; the problem arises with the interpretation of "independent existence". In a language where glottalized consonants occur but glottal stop does not, the glottalized consonants are best regarded as unit phonemes. The occurrence of an independent glottal phoneme does not, of course, demonstrate a priori the non-unitary status of the glottalized consonants. Lanham (1955) treats the nasal compounds of Gitonga as units because both /nd/ [ndr] and /ŋg/ occur, but [d] and [ɡ] do not. However, it is perfectly clear that [ndr] and [ŋg] obtain from the juxtaposition of /n/ + /l/ and /n/ + /ŋ/ respectively:
ndo:yi (< -loya 'bewitch') 'a witch'
nguyu (miyuyu 'fig trees') 'a fig tree'
The "hardening" of consonants in a post-nasal environment is a natural phonetic process and is dealt with in Chapter 8. The point of the present discussion is simply that the crucial considerations in phonemic analysis are forthcoming from a total analysis of a sound pattern. Raw phonetic data is a small part of the input to phonological analysis in the respect discussed by Ferreira.

Our final example of the different sorts of considerations motivating a unit or cluster analysis of complex sounds is taken from Darlene Bee's (1965) discussion of Usarufa, a New Guinea Highlands language. The data here concern sequences of glottal plus consonant. Bee offers two solutions to the problem of underlying analysis: a cluster solution and a unit solution.

The cluster solution merely interprets sequences of glottal plus consonant as a cluster of two distinct phonemes. Contrarily, Bee's unit solution interprets such sequences as single unit phonemes. The difference in phonemic inventory in the two solutions is schematized:

<table>
<thead>
<tr>
<th>Cluster Solution</th>
<th>Unit Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>p t k</td>
<td>p t k</td>
</tr>
<tr>
<td>m n</td>
<td>?p ?t ?k</td>
</tr>
<tr>
<td>w y</td>
<td>m n</td>
</tr>
<tr>
<td></td>
<td>?m ?n</td>
</tr>
<tr>
<td></td>
<td>w y</td>
</tr>
<tr>
<td></td>
<td>?w ?y</td>
</tr>
</tbody>
</table>

Each solution has certain merits to recommend it. On the one hand, the
cluster solution gives a simple distribution statement for seven consonant phonemes and a single glide /ʔ/. The unit solution does increase the number of phonemes substantially, but, on the other hand, this increase is balanced by an exceedingly simply statement of syllable structure with no problems as to borders. Also, some aspects of morphophonemic change are more easily stated in this interpretation.

Bee's data and solutions are reviewed by Oates (1967), who seeks to resolve the conflict between the two phonemic procedures of phoneme discovery and interpretation. Oates desires to incorporate the relative benefits of each solution by adopting them both at different levels of analysis. The cluster solution is adopted for the segmental level and the unit solution for the syllable level. A Usarufa word such as [keʔoʔkeʔ] 'every kind' poses a problem with the sequence [ʔk] as to whether it is to be analyzed as C or as CC. The conflict arises because[ʔ] has an independent existence elsewhere. Oates proposes that such sequences be analyzed as filling "undefined slots" in analysis. His interpretation (1967:31) is schematized as:
Thus, Oates' solution to the problem is that undefined slots be analyzed as one syllable unit on the syllable level but as two phoneme units at the segmental level. This principle is attributed by Oates to Pike's *Phonemics*, wherein it is stated that:

"a syllable may have a close-knit sequence of two phonemes on the segmental level which acts in distribution in the syllable like a single simple nuclear phoneme."

Oates' schematization of the Usarufa phonemic system is thus:

<table>
<thead>
<tr>
<th>Segmental Phonemes</th>
<th>Syllable Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>p t k ?</td>
<td>?p ?t ?k</td>
</tr>
<tr>
<td>m n</td>
<td>?m ?n</td>
</tr>
<tr>
<td>w y</td>
<td>?w ?y</td>
</tr>
</tbody>
</table>

We find Oates' suggestion that two levels of analysis need to be recognized intuitively appealing. However, the evidence which Oates cites is not particularly compelling and his analysis seems ad hoc at times. Additionally, no definition of *syllable* is provided by Oates, so it is unclear what the level of syllable analysis is and what linguistic reality it is supposed to represent. This is a problem.
which we attempt to resolve in a later section. The justification for
the introduction of the concept syllable unit is also ad hoc. In
spite of a well motivated attempt to separate distinct levels of
analysis, it seems to us that the distinction Oates provides is unclear
and itself poorly motivated. We have examined Oates' model in some
detail here because he addresses himself to the question of homorganic
nasal plus consonant sequences, which is of direct interest to this
dissertation. His interpretation of these data will be presented in
Chapter 6. Additionally, it is a distinction in levels of analysis
which we shall attempt to motivate and explicate below. It is ultimate­
ly upon such a distinction in levels that our analysis of prenasalized
consonants will rest.

In the examples which we have examined, virtually all the major
types of considerations which are traditionally cited in analyses of
complex sounds as units or clusters appear. In fact, most of these
considerations find their way into diverse treatments of prenasalized
consonants although no single treatment cites all or even most of
these factors. For convenience's sake, we list these types of
evidence in outline form here:

1. independent variation in one or both parts of
   the complex
2. timing considerations
3. phonetic interplay between the two components
4. considerations of foreign accents and loan phonology
5. sonority hierarchy
6. ability of each component to combine with other segments
7. reversibility of the components
8. phonetic similarity between free and bound forms
9. occurrence of each component as an independent phone
10. size of phoneme inventory
11. syllable structure considerations
12. ease of stating morphophonemic changes

The various analytical alternatives available for any given complex include:

i) analysis as a cluster of phonemes
ii) analysis as a phonemically independent unit
iii) bi-level approach incorporating both solutions

We now turn our attention to a critical examination of analyses of prenasalized consonants which make reference to the above criteria.

3.2 General Considerations

The three most often cited considerations concerning prenasalized consonants include: timing considerations (2), sonority considerations (5), and syllable structure considerations (11). In terms of timing, the duration of prenasalized consonants is approximately the same as the duration of non-suspect unit consonants in many languages where they occur. This is not a particularly subtle point of observation and is easily verified by instrumental analysis. Unfortunately, not a great many instrumental studies of prenasalized consonants are available. Nonetheless, the observation is explicitly stated in several studies, e.g. by Dahl (1951) for Malagasy and Herbert (1975) for Ganda. Elsewhere it is reported, but without instrumental verification. For example, Welmers (1973:68) reports of a Swahili
speaker recounting how he learned to read and pronounce Swahili in school by reciting sets of syllables in rapid succession. The timing of the third set was precisely the same as that of the first two:

\[
\begin{array}{c}
\text{ta, te, } t\text{, } t\text{o, } t\text{u} \\
\text{la, le, } l\text{, } l\text{o, } l\text{u} \\
\text{mba, mbe, mbl, mbo, mbu}
\end{array}
\]

These facts are not open for interpretation. Such durational considerations formed part of our phonetic definition of prenasalized consonants presented in Section 2.1.1. However, it is clear that timing organization within an utterance occurs at a level which involves more than individual segments. We return to an analysis of such higher level organization in Chapter 6.

The sonority considerations are also very straightforward. It has already been stated that the basic claim of the sonority hierarchy is that the sonority of segments should increase as the syllable nucleus is approached. Otherwise stated, it is purported that the externalness of a segment within a syllable is an inverse function of its degree of sonorance. Here the concept of syllable is obviously treated as a surface phenomenon. Thus, whenever this condition does not obtain, a complex unit is defined in place of a cluster. In the case of nasal and oral sequences, we expect to find that the nasal is more syllable-internal than the oral consonant because the nasal is more sonorant. This is, we expect that following "natural" order of elements:

\[(C)(N)V(N)(C)\]

We note that this situation obtains in a great many languages. For
example, English allows a large number of the sequences syllable-
finally, and the oral consonant always follows the nasal: lamp, land,
lance, lunch, lank, etc. When such sequences occur medially, the
syllable boundary usually occurs between the two components: amber,
injure, lancer, lanky, etc. It is interesting to note that English
allows nasal and oral combinations as syllable offsets, but the
corresponding oral plus nasal sequences do not occur as syllable onsets.
The only exception is /sm-/ and /sn-/ clusters, e.g. smack, snail.
Phonetically, various fast or casual speech processes seem to give rise
to other CN onsets, e.g. phonetics [fneɪtɪks], Chanel [ʃnɛl]. These
same processes give rise to other impermissible sequences, e.g. [sr] as
in serendipity [srɛnˈdɪpəti], serape [sræpə]. However, it does not seem
that stop plus nasal sequences result from these processes although some
speakers might have forms such as [bnaɛn] banana.

We might suppose that the relative infrequency of oral plus nasal
clusters and postnasalized consonants as syllable codas is explained by
reference to the sonority hierarchy. However, this would predict then
that these same elements should be relatively common as syllable onsets,
a situation which does not obtain. In fact, postnasalized consonants
are by far less common than prenasalized consonants, regardless of
their position within a phonological item. This is a situation which
traditional analyses cannot pretend to explain. Nevertheless, we believe
that a complete theory of phonetics should explain not only the more
traditional concerns of phoneticians such as phonetic classification and
change, but must also ultimately answer the question of why the same
speech sounds occur again and again among the world's languages and others, which are physiologically possible, rarely or never occur. Certainly, part of the answer to this complex problem lies in acoustic and perceptual considerations. K.N. Stevens (1972) has demonstrated, for example, that within the vocal tract certain regions are favored because variation within the region has relatively little acoustic effect. Other regions show major acoustic consequences of relatively small articulatory differences; these areas are avoided as "target" regions. However, these types of considerations are not the only relevant factors. We shall demonstrate that the much greater frequency of prenasalized consonants over postnasalized consonants has a more purely phonological basis and that perceptual or physiological concerns are not particularly relevant. We reserve this discussion until Section 6.3.2.

The consequences of accepting the sonority hierarchy as any more than a general tendency in language is that prenasalized consonants are then necessarily defined as unit sounds. As has already been mentioned, one problem with the sonority hierarchy is that it refers to surface syllables only. There is considerable evidence that linguistic organization occurs at several levels of analysis. This is true, we believe, of syllable units. Syllables are not only surface phenomena, as we shall demonstrate later. Indeed, the evidence for syllables as linguistically real units is weakest for surface syllables. Finally, it is unclear how the notion of unitary sound defined by the sonority hierarchy really resolves the problem raised for prenasalized consonants since the more sonorous component, i.e. the nasal, is still more
external than the oral component. Reference to the unit status of these sounds seems like an ad hoc defense since it is by reference to the sonority hierarchy than they were originally defined as units. Thus, on the evidence of the sonority hierarchy alone, analyses of prenasalized consonants as unit consonants seems unmotivated and ad hoc.

Ladefoged (1968:24) seems to take as primary criterion for regarding nasal compounds as units or clusters whether the nasal is tone-bearing. If the nasal is tone-bearing, it is syllabic, and there is then no question of a single underlying phoneme. The basis for regarding a sound as syllabic or not is often problematic, however. Among Africanists, a common practice is to define syllabicity by reference to tone. Thus, Carter (1970:144) points out:

> Judgement as to whether any particular element is syllabic depends upon the definition chosen for 'syllable'. In Zoombo, the only workable definition is 'tone-bearing element'.

The same definition is employed by Richardson (1959:115), where a syllable is defined as "a fragment bearing a unit of the tone pattern."

We find this definition incompatible with certain facts to be presented in a later section of this thesis. Additionally, this definition is obviously useless in the analysis of non-tone languages. In those instances where the nasal component of nasal-oral sequences does not exhibit any surface tone, Ladefoged would presumably consider these as unit phonemes. However, such a criterion seem to us too superficially based. The question of phonemic independence is not necessarily one which can be answered by reference to surface phonetics. This is
especially true in the case of "tone-bearing elements". Our knowledge of tonology in general is not particularly advanced; however, it is clear that elements which bear underlying tones (and are hence syllabic) may be realized without a tone (and hence be non-syllabic) and that elements unspecified for tone at the underlying level may be realized as tone-bearing elements. Accepting such a definition entails several counter-intuitive analyses, e.g. the initial voiceless stop in a word such as ṭpēēsā 'button, coin' in Ganda would be defined as syllabic since it bears a tone which causes tonal perturbations of a preceding vowel. Clearly, to speak of a voiceless stop as syllabic is incompatible with the normal notion of syllable.

Ladefoged (1968:1) points out that:

The decision as to whether to regard the members of a particular sequence of consonants as single phonemic units, or as clusters, is, of course, often arbitrary.

Some grammars attempt to skirt the problem of decision in such cases by merely pointing out that a problem exists in determination. For example, in his description of Rundi, Meeussen (1959) merely notes that all the consonants of Rundi except /r/ and /h/ -- and obviously the nasals -- may be prenasalized. The question of unitary or cluster status for the prenasalized consonants is not raised. Similarly, Meeussen (1964), in a description of Lega, merely notes that [mb, mp, mv, nd, nt, nz, ns, ng, nk] occur and that:

ces données permettent plusieurs interprétations phonologiques sans que ces différences aient une répercussion sur d'autres parties du système (1964:2).
The problem of the long consonants of Lega is likewise avoided by stating:

...il peut s'agir, soit de séquences de deux phonèmes identiques, soit d'un phonème accompagné
d'un épiphonème de longueur (1964:2).

Bouquiaux (1973) takes Meeussen to task for exactly this failure to deal conclusively with the Rundi data. He states:

Là où Meeussen parle de 'groupes de consonnes', de 'séquences' ou de 'complexes à nasale', on
se demande si ces groupes, séquences ou complexes ont une valeur mono- ou polyphonématique (1973:117).

The illustrations which Meeussen chooses to cite largely exhibit only nasal-oral sequences which are morphologically complex:

Indian /i + N + da/ 'belly'
Inzu /i + N + zu/ 'house'
Njirë /N + jir + e/ 'that I smoke' (subj.)
Mpfukë /N + pfuk + e/ 'that I wrap up' (subj.)

However, non-morphologically derived sequences also exist:

Kumënza /ku + men3 + a/ 'revolt against'
Kwëŋka /ku + onk + a/ 'suck'
Mbë /mbë/ interrog. particle

On this basis, Bouquiaux concludes that the fourteen prenasalized con-
sonants of Rundi are actually unitary phonemes. However, the assumption
that morphological and phonological complexity are parallel is unjustifi-
fied. It seems again that this confusion falls out of a general failure
to keep different levels of analysis distinct. This is also evident
in the French School of Africanists' tendency to rely only on commutation
to discover the phonemes of a language. Thus, if a language contrasts
[cabal, [ama], [amba], three phonemes /b, m, mb/ are defined. This is methodologically unjustified. It is the technique which appears time and again in the work of the French School, e.g. Thomas (1963).

It is difficult to see how, using this methodology, clusters could exist in any monomorphemic forms. For example, all the initial clusters of English are necessarily defined as unit phonemes because they contrast with other unit phonemes in that position: spill, pill, trill, till, twill, etc.

Hagège (1967) argues for a unit analysis of nasal-oral sequences in Wori, a language of Southwest Cameroon. Hagège claims that if prenasalized consonants were really clusters, other consonant combinations should be in evidence. For example, a commutation of the nasal element in [mb] with other consonants should give sequences such as [nb, sb, vb], and a commutation of the oral component should produce [mp, mt, ms], which do not occur. The only sequences which occur in Wori are nasal plus homorganic voiced consonant. This criterion of component commutation does not seem especially valid here since it is well-known that many languages impose distributional restrictions on which consonants may combine to form surface units and in which order they may combine. This topic is returned to in a later chapter. That the nasal component of prenasalized consonants is always homorganic with the following consonant points to the existence of natural assimilatory processes. Given the surface timing considerations involved in the articulation of prenasalized consonants, it is not surprising that the two components are always homorganic. Simply, the articulation of the
nasal and the oral component takes place in so short a period that it would be difficult to articulate non-homorganic sequences, and it is questionable whether the difference between [mb, md, mg] would be readily perceivable. In fact, even in non-suspect clusters of nasal plus consonant we find that place of articulation assimilation often occurs. For example, in English, such sequences are nearly always homorganic both within and across morpheme boundaries: lamp, land, lank [ŋk], impossible, information [ŋf], insincere, incorrect [ŋk].

It would seem as if the "strength" of morpheme independence or boundary is sometimes a factor too. Thus, inglorious has [ŋg] more often than ingrown in my own speech. This varying awareness of morphemic integrity is well-known; another example was cited in our discussion of Gitonga and the failure of "M-nasalization" to apply to deverbative nouns because its application would result in the deformation of a "living" stem.

Just as the homorganicity of nasal-oral sequences cannot be taken as evidence of their underlying unity, so too the failure of every consonant in a language to appear in prenasalized form cannot be cited as evidence for a unit analysis. The theory here seems to be that if prenasalization were an independent underlying entity which owed its existence to real clusters of nasal plus oral consonants, then nasals should freely combine with every consonant. Quite apart from any distributional restrictions, the regularity apparent in which series of consonants will appear prenasalized when the entire consonant inventory is not present in prenasalized form strongly suggests that some
processes govern the surface occurrence of nasal-oral sequences in these languages. Hagege (1967) uses the non-occurrence of [mp] next to [mb] to argue for the non-independence of the two components of the latter. However, we find that prenasalized voiceless sounds generally imply the presence of prenasalized voiced sounds. The implication is not bilateral and many languages exhibit only the latter series. The question which needs to be asked is whether such regularity is a fortuitous fact of occurrence. Obviously, it is not, and in many languages sequences of nasal plus voiceless consonant are realized as prenasalized voiced stops. For example, in Kikuyu, voiceless consonants are voiced after a nasal so that:

\[ N + t \rightarrow nd \]
\[ N + c \rightarrow nj \]
\[ N + k \rightarrow ng \]

and we find singular/plural alternations such as ruku/ngu 'firewood'.

There is another rule which deletes a nasal before certain continuants in Kikuyu; thus, the only nasal-oral sequences which appear on the surface are prenasalized voiced stops. In Swahili, nasals are deleted before all voiceless sounds so that there are only prenasalized voiced stops and fricatives. This tendency is by no means limited to Bantu. In Malagasy, certain prefixes cause voiced consonants to become prenasalized, but the same prefixes merely result in nasalization of voiceless consonants, i.e. a substitution of a nasal for the corresponding voiceless consonant. There is a great deal of other evidence which points to the markedness of prenasalized voiceless sounds vis-à-vis prenasalized voiced sounds. This evidence is presented in detail in
Chapters 8 and 9. It suffices to say here that the absence of a complete inventory of prenasalized consonants within a language cannot be taken as evidence pointing to the unitary status of those which do occur. Gaps in the prenasalized inventory may be motivated either by synchronic or diachronic processes affecting the nasal or oral component of nasal-oral sequences.

3.3 Syllable Structure Considerations

The traditionally most damning arguments against a cluster analysis for prenasalized consonants have to do with syllable structure. However, there are several difficulties with these arguments relating chiefly to the deficiency of a definition for syllable, a confusion of underlying and superficial levels of organization, and the methodology of determining or counting syllables. Of course, some linguists have come to doubt the reality of the syllable as a linguistic unit altogether. It is not the province of this thesis to take issue with these views. It will suffice to say here that the evidence usually cited seems to be not so much evidence against the syllable as it is evidence that alternative analyses of data are available. That is, these arguments do not disprove the reality of the syllable, but rather they attempt to demonstrate that the notion of syllable is simply superfluous and unnecessary. It will become clear in later sections that we take issue with this claim, but it will not detain us presently.

The arguments which relate syllables and unit phonemes are chiefly of two kinds. The first type makes reference to such facts as syllabification of larger linguistic units elicited from native speakers,
the behavior of the syllable in word games involving a reordering of syllables, etc. The second type of argument is more purely phonological and refers not to phonetic facts of syllable realization, but is rather an attempt to extract in a maximally efficient way the factors governing syllable shape or structure in individual languages. We shall examine each of these arguments in some detail and attempt to demonstrate that the evidence they present in favor of a unit analysis of complex sounds is at best inconclusive with regards prenasalized consonants.

3.3.1 Elicited Syllabification

It is a well-known fact that speakers of languages exhibiting prenasalized consonants will typically assign the nasal and oral components to the same unit whenever they are asked to artificially divide words into smaller units. These units are supposedly equivalent to syllables. The fact that the nasal and oral components are inseparable point to their underlying unitary status. Thus, Price (1962:7) reports that "the Nyanja speaker speaks in syllables all of which end in vowels: ma-ba-ngö, mye-tse-ťa-ńi, la-mbu-li-la." Similarly, Stevick writes that:

When a Ganda speaker pronounces a word a bit at a time, my data indicate that the breaks come after the vowels: bā̃mba 'they cook' is ba fu mba, and not *ba furn ba. Similarly, skūja 'to come' is o ku jia; skūliča 'to spy' is o ku lii ma and not *o ku li i ma. What we have represented by open space in these examples may appropriately be called 'natural syllaboid breaks' (1969:3).

The traditional arguments proceed from this observation to claim that because they native speaker treats nasal-oral sequences as inseparable
phonetic units, it follows that such sequences are inseparable precisely because they represent unitary phenomena. However, such a conclusion, based on this data alone, is completely unjustified. This is not to say such considerations are irrelevant for unit vs. cluster analysis. For example, if native speakers of a language systematically produced units in which the nasal and oral components of prenasalized consonants occurred in distinct syllables, this might provide good evidence for a cluster analysis. For example, the usual syllabification of nasal-oral sequences in English is as: in-for-ma-tion, an-tip-a-thy, in-con-gru-ous, am-ber, etc. This points to the non-unit status of such sequences. However, the fact that no syllable boundary occurs between the nasal and oral consonants in words like lank, lint, limp, etc. does not point to the underlying unitary status of these sequences. As a general rule of thumb, we might do well to suppose initially that surface facts mirror underlying facts unless there is evidence to the contrary, but there is no a priori reason why the two are necessarily the same. We know that surface facts often obscure the real nature of underlying elements and relations; evidence attempting to establish the nature of underlying relations based solely on the facts of surface relations is sometimes inconclusive.

In some languages, prenasalized consonants behave as tautosyllabic units in some environments and ambisyllabically elsewhere. Thus, Hoijer (1946:59) reports that the prenasalized consonants of Chiricahua Apache are ambisyllabic between a short vowel or syllabic nasal and a following vowel:
However, since the prenasalized consonants /mb/ and /nd/ occur tautosyllabically in other environments, the facts of surface syllabification on their own merit would seem to contribute little to the unit vs. cluster question. The criteria chosen for regarding such sequences as units must come from other sources. We have already mentioned that similar facts about surface phonetic syllabification are forthcoming from the analysis of non-unit sequences such as in English:

- lance - lancer
- bank - banker
- lank - lanky

It would seem that the only situation in which the facts of surface syllabification are to be regarded as conclusive evidence in a unit vs. cluster discussion is when there is superficial contrast between the two. That is, if a language were to contrast VN-CV and V-NCV (or the unexpected VNC-V) syllables and no other underlying distinction could account for this surface phenomenon, then the facts of surface syllabification provide evidence for the underlying relation between elements. In the absence of such a distinction, we need to look elsewhere in order to discover if underlying relations are mirrored in surface syllables. Additionally, it seems to us that
VN-CV syllabification is stronger evidence for a cluster analysis than V-NCV is evidence for a unit analysis. As we shall demonstrate in later chapters, there exists a series of natural processes which give rise to surface units from underlying clusters; we are unaware of any counter-processes which give surface clusters from underlying units.

In the preceding discussion, we have assumed that arguments relating to the unit vs. non-unit status of superficial sequences refer to some level of representation deeper than the surface. On the one hand, we do not deny that surface prenasalized consonants are phonetic units; this is demonstrated by the hormorganicity of their components, the total length of these sequences, and various other subtle phonetic adjustments which occur between the two components. However, we claim that such surface unity can be reconciled with underlying independence of the components. The processes responsible for this "unification" are detailed in Chapter 6, dealing with our proposed derivational model. Also, the notion of unit vs. non-unit seems not totally appropriate in terms of surface phonetics. The problem of segmentation of sounds is a large problem in phonetic methodology; in spite of what our naive linguistic intuitions might lead us to believe, we do not speak in a series of discrete phonetic units, but rather in a fluid continuum of articulatory movements. Viewed in this light, the question of surface unit vs. surface cluster seems a more trivial one.

Before proceeding to a review of the arguments cited in favor of regarding prenasalized consonants as unitary phenomena, which relate to syllable patterns and composition, we will briefly discuss two related
types of evidence which are themselves related to the facts of elicited syllabification presented above. These two kinds of data come from language games which make reference the syllable as a unit and musical and rhythmic considerations.

3.3.2 Secondary Evidence for Syllabification

3.3.2.1 Language Games

The syllabification obtained in language games parallels that which is artificially elicited from native speakers. This is not surprising, and this more natural type of syllabification, occurring as it does as part of unsolicited language behavior, provides evidence for the reality of syllables. One argument against the validity of elicited syllabification is that it is often a learned skill and therefore of questionable linguistic value. An example pointing to this is Welmer's (1973:68) already cited example of a Swahili speaker learning to pronounce /mba, mbe, mbi, mbo, mbu/ in the same time as /ba, be, bi, bo, bu/. Bell (1975) discusses the problems relating to elicited syllabification. Obviously, one way to avoid such criticism is to observe syllable behavior in normal language behavior.

Two interesting examples of language games involving syllables are provided by Gowlett (1968). In Zulu, a common children's "secret language" is produced by inserting di before every syllable of ordinary language, except for sentence-initial syllables. Thus, the normal Zulu utterance Uzo hamba nami 'You will go with me' is transformed as follows:
U.zo hamba na.mi →

U.dizo diha.dimba dina.dimi

i.e.: U消毒 didadimba'dinadimi. The essential point here is that the nasal-oral sequence is assigned to a single unit so that no di is inserted between the two components. Another Zulu language game gives similar results. This "language" is more complicated than the former and involves reversing the order of syllables within any given word. The only additional rule is that in a case where two vowels are juxtaposed, a semi-vowel is inserted between them. Thus, the normal language Izinja sizongiluma uma ngingéna engadini 'The boys will bite me if I enter the garden'. transforms:

I.zi.nja zi.zo.ngi.lu.ma u.ma ngi.nge.na e.nga.di.ni →

Nja.zi.yi ma.lu.ngi.zo.zi ma.wu na.nge.ngi ni.di.nga.ye

i.e.: Njaziyi malungizodzi mawu nangengi'ndingaye. Here again pre-nasalized consonants are treated as tautosyllabic elements.

Paralleling the data from Zulu, Katamba (1974: 208 ff.) cites examples from Ludikya, a cover term for several varieties of children's languages in Ganda. In the various dialects on which Katamba reports, all the transformations except one have to do with the insertion of nonsense syllable(s) or rearranging the order of syllables. For example, Ntambaazi ya kinyomo erinnya'omutì nga yetisse 'The Kinyomo (a large black ant) is an audacious chap, he climbs a tree with a load on his back' becomes:

a) Ntatifu mabaatifu zitifuyatifu kitifu nyotifu.motifu etifu ritifu nyatifu otifu mutifu ngatifu yeetifu ssetifu.
b) Zambaanta monyikiya nyarie timuo nga ssetiye.

In the first example, -tifu is inserted after every surface syllable, and in the second example, the order of syllables within each word is reversed. As with the Zulu examples, the treatment of prenasalized consonants points to surface units. Ganda also exhibits geminated consonants which are clearly to be regarded as underlying sequences. In terms of surface duration, the duration of a geminated consonant is twice that of a single consonant. These geminates also act as superficial units. The relationship between prenasalization and gemination is examined in Section 8.4. Note that the initial nasal in ntambaazi is syllabic; it is heard as a separate syllable and bears a tone. Yet, it acts as a unit with the following syllable so that when the order of syllables is reversed we do not find #zambaatan. The explanation for this is simply that syllabic nasals are found only in initial position preceding another consonant. The constraint which governs their distribution in normal language also governs their distribution in secret languages. The syllabic nature of the initial nasal is reviewed in Sections 5.4 and 6.4.

Our analysis of the data forthcoming from a study of language games and secret languages is precisely that which we offered for elicited syllabification. Specifically, we agree that the behavior of prenasalized consonants clearly points to their surface unitary status. No surface syllable in Ganda ends in a nasal unless the nasal itself is a syllabic nasal. However, we do not believe that such considerations necessarily cast any light on the question of their underlying status.
3.3.2.2 Rhythmic Considerations

A more interesting and, we believe, more fruitful type of data comes from rhythmic analyses of languages exhibiting prenasalized consonants. There is, unfortunately, little published work dealing with such considerations. Katamba (1974:216) cites a xylophone technique used by the Baganda where there is a beat on every second mora of an utterance. In a moric analysis, a distinction is made between nuclear and onset morae. In Ganda, syllable nuclei may be composed of one or two morae, depending on whether the vowel is short or long. A single consonant onset does not count as a mora, but a consonant plus glide onset counts for one, e.g. muti 'tree' is composed of two morae whereas msato 'boats' and mwaka 'year' both have three morae. Similarly, a prenasalized consonant or a geminate adds another mora which is best regarded as belonging to the preceding syllable. No syllable may present more than two surface morae.

The problem posed by such considerations for unit analyses in general is that prenasalized consonants add an extra mora to a word. If prenasalized consonants were underlying unitary consonants similar to the other consonants of the language, this behavior cannot be explained. There is no apparent reason why sounds which are merely characterized by some feature, e.g. [+prenasalized], should exhibit such extraordinary behavior. That the prenasalized and geminated consonants of Ganda do indeed impose an extra mora is supported by their behavior in the xylophone techniques mentioned above. The nasal of prenasalized consonants and the initial consonant of a geminate
receive an extra beat. Katamba merely provides this as evidence for a moric analysis. However, he does not consider the problems which such facts pose for his interpretation of prenasalized and geminated consonants as underlying units.

Similarly, bakašimba dance songs of the Baganda are characterized by isochronous clapping accompanying the song; when drums are used, the deepest drum (the mpuunyi) underlies this clap. The clap falls on every sixth mora. In spite of his positing underlying unitary status for prenasalized consonants, Katamba reports:

Note that it is sometimes impossible to state unequivocally where the clappulse (and mora) falls. This is especially true where a vowel is followed by NC sequences...In such cases it may be more rewarding to regard the mora as belonging partially to the vowel and partially to the nasal of the NC sequence (1974:215).

The question which is to be asked is why it is not possible to determine where the clap pulse falls on syllables preceding prenasalized consonants. If there were a clear boundary between vowel and prenasalized consonant as the syllabification arguments maintain, this cannot be explained. There is, however, a great deal of evidence pointing to a close underlying relationship between the nasal component of prenasalized consonants and preceding vowels. This evidence relates to rules of vowel lengthening, vowel nasalization, vowel lowering, etc. and is reviewed in detail in Chapter 5. We merely introduce the notion here that all the evidence of language behavior does not point unequivocally to a nasal-oral sequence independent of preceding syllables.
3.3.3 Syllable Structure Arguments

We turn our attention presently to the issue of syllable structure which figures so prominently in analyses of prenasalized consonants as units. It is important to note that these arguments have a completely different basis than those presented above since phonetic considerations as such have a very minor place in these arguments. They are almost exclusively phonological or phonemic in nature. We examine this type of argument in its several forms below and deal critically with their methodological justifications.

It is a distributional fact that a seemingly inordinately high percentage of languages exhibiting prenasalized consonants are characterized by open syllables exclusively. Jakobson and Halle (1956) note that this is the only universal syllable type. We believe that there is a principled reason motivating this distributional fact of co-occurrence which will be discussed in Chapter 6. At this point, it will suffice to merely note the observation. For example, Doke (1935:207) quotes Daniel Jones' definition of syllable as a sequence of sounds containing one peak of prominence. Jones noted that in practice it is often not possible to determine the limits of a syllable with any precision since there are no means of fixing exact points of minimum prominence. Doke goes on to point out, however, that:

In Bantu, syllable limits are more easily determined, for every syllable is open (i.e. it ends in or consists of a vowel) or composed of a syllabic consonant.

Similarly, Ferreira writes of Bantu:
The normal sequence of speech sounds in the Bantu languages analyzed is consonant-vowel. Where consonants follow one another (usually nasals, \( l \) or \( r \)) the first consonant is syllabic and usually has its own characteristic tone, suggesting a diachronic elision of a vowel between two consonants (1965:24).

The claim that Bantu syllables are open is clearly a generalization, albeit a generalization founded on data. It has already been mentioned that some languages, particularly those of the Western Region, admit some closed syllables as well. Nevertheless, the generalization is well-founded. The methodological problem arises when generalization is introduced as evidence in analysis.

In many analyses of individual languages, these considerations of syllable structure are cited as evidence for an analysis of prenasalized consonants as underlying units. For example, in his description of Gitonga of Inhambane, Lanham writes:

The technique applied in the identification of phonetically complex single phonemes is based on syllable structure or 'structural pressure,' which K.L. Pike has established as an important criterion in phonemic analysis. The CV syllable is typical of Gitonga as it is of the Bantu language family generally, and on this basis single consonant phonemes comprising two or three phonetic segments have been identified (1955:34).

Lanham (p. 49) notes that although prenasalized consonants are phonemically single units, this does not mean that they are indivisible morphemically. For example, in the following forms the prenasalized consonants arise from the juxtaposition of a consonant-initial stem and a nasal noun class prefix:
It is unclear how such examples could be reconciled with the notion of phonemic unity. However, even in forms which are not morphologically complex, this approach is problematic as we shall see below.

It is not difficult to see how such a "structural pressure" argument develops. If the non-suspect syllable structure of a language were entirely CV, it is natural to attempt fitting suspect elements into this pattern. Viewed in this light, a cluster analysis of pre-nasalized consonants might appear counter-inductive, but this is precisely because phonetic considerations are not incorporated into the argument. Such arguments are by no means infrequent. Samarin (1966:19-20) writes of Gbeya, an Adamawa language of West Africa:

A word concerning the phonemicization of the pre-nasalized stops (as well as the preglottalized nasals) is appropriate here. The principled reason for considering them unit phonemes is one of 'pattern-pressure': since the language is generally characterized by unit phonemes in initial position, it is justifiable to consider these as such.

Similarly, Hagège (1967:26) cites as his primary reason for analyzing prenasalized consonants as units in Wori the fact that if they were to be analyzed as clusters, one could not generalize the syllable structure as CV CV ... Vail (1974:24) finds it best to interpret pre-nasalized consonants as unit phonemes "from the point of view of economy of description."
A parallel treatment of postnasalized consonants is found in Capell (1967). Postnasalized stops occur not infrequently in areas of Papua word-finally. In Aranda, a language of Australia, however, they occur initially, e.g. /pmaːa/ 'camp', /tnama/ 'digging stick', /knara/ 'large'. Capell (p. 90) notes that "the initial plosive is not exploded and the two form practically a single unit." It is somewhat unclear how "practically a single unit" is to be interpreted. However, Capell notes (p. 101) that these postnasalized stops need to be single consonants because no initial clusters are allowed in Aranda. The use of generalization in analysis is again apparent.

We maintain that such arguments are methodologically unjustified and invalid. The use of generalization in analysis is a classic problem in the philosophy of science. That is, it is from facts that we construct an original theory, but we need to insure that later facts are not ignored or merely interpreted in terms of the original theory. Thus, the argument that a given language is characterized by unit phonemes in initial position in general and therefore all elements in initial position are unit phonemes is invalid. Certainly, there can be no question of justification for such analyses. At best, we might attempt to motivate such analyses solely for the sake of convenience of description. However, when a counter-inductive theory is presented, i.e. a theory which cannot be "read" off the facts because it necessitates a reinterpretation of the facts, we need to look elsewhere for an evaluation criterion. Ultimately, we want to determine non-prejudicially which theory does most justice to the facts and has
greater explanatory power. We shall claim that a theory positing an underlying cluster analysis for prenasalized consonants represents such a theory. In Chapter 6, we will deal with the necessary reinterpretation of certain facts which our theory involves and the explanatory value which results therefrom.

Thus, the open syllable structure of Bantu, for example, is no longer a "well-established fact" once a counter-inductive theory is possible. In fact, well-established facts are often based on unspecified assumptions upon which the articulated theory is based. In other words, statements of fact often incorporate theory. The uniquely open syllable structure of Bantu is based on a conscious effort to interpret certain facts of Bantu in that light. When a rival theory such as our own is presented which postulates other types of syllables for Bantu, the "fact" that Bantu admits only open syllables is no longer a fact; it becomes a theoretical prejudice and as such has no value in evaluating the two theories. If it were admitted as an evaluation criterion, science could not advance; it would be hopelessly stagnated. Obviously, the only criterion for evaluating theories is non-prejudicial evidence. At this point, however, the crucial problem is to separate evidence from interpretation. We return to this problem in later chapters wherein we discuss the role of rival theories in science and attempt to justify our own rival theory. The essential point of the present discussion is that the criterion of "pattern pressure" is methodologically indefensible in an analysis of complex sounds. It falls out of a general tendency which is even
more evident below to reduce to the absolute minimum the complexity
of underlying language patterns.

There is a counter argument to the above which is an argument in
favor of analyzing complex sounds as underlying clusters. However,
it is as methodologically unsound as the above. The concern of this
type of argument is simplicity or economy of another sort. The
motivation behind this analysis of prenasalized consonants as clusters
is the desire to reduce to the minimum the phonemic inventory of the
language in question. Thus, in a language with the following
consonantal inventory:

\[
\begin{array}{cccccccc}
p & t & c & k & mp & nt & ŋ & ŋk \\
b & d & j & g & mb & nd & ŋj & ŋg \\
m & n & ŋ & ŋ & \\
f & s & h & mf & ns \\
v & z & ŋ & mv & nz \\
\end{array}
\]

this argument would claim that the prenasalized counterparts of the
oral consonants should be treated as clusters because in this way the
number of independent consonant phonemes in the language is reduced
from 31 to 19. We believe that considerations of simplicity do have
a place in linguistic analysis and description. However, the over-
riding considerations in an attempt to "discover" the phonemes of a
particular language should not be simplicity or symmetry of inventory,
but rather an attempt to discover what is, in some sense, psycho-
logically "real" for the native speaker. Even "pattern pressure"
analyses seek to discover underlying regularity despite their unjustified methodology. Considerations of inventory on their own merit do not even achieve that level, and they are therefore not considered further here.

Dyen (1965), in an article dealing with the Formosan reflexes of Proto-Austronesian, introduces a methodology which attempts to inject phonetic reality into historical reconstructions. All too often reconstructions achieve only the first step of their goal, i.e., they note various reflexes of proto-phonemes and assign convenient cover terms to these latter. There is, unfortunately, no attempt to discover the real phonetics of the reconstructed system in many cases. Indeed, it has been asserted that such inferences are beyond the scope of historical linguistic methodology and the best we can hope to accomplish is to discover the relations which held between sounds in the proto-language and not the identity of the sounds themselves. The classic example here is the case of voiced aspirates of Indo-European. There have been numerous attempts to discover what the phonetic nature of the segments traditionally reconstructed as *bh, *dh, etc. must have been. Hopper (1973) attempts to reinterpret these segments in the context of a total system. He proposes that *bh, *dh were simple voiced stops and that *p, *d, *g were actually voiceless ejectives. This would account, for example, for the low frequency of *p [p̥], which mirrors universal tendencies. The use of universals in reconstruction is discussed in detail in Chapter 9.
The traditionally reconstructed pairs of Proto-Austronesian *t₁, *t₂ and *n₁, *n₂, which have merged in all languages outside Formosa, show different reflexes in some languages and therefore are generally assigned to different proto-phonemes. The Formosan reflexes noted by Dyen (1965:289) are:

<table>
<thead>
<tr>
<th></th>
<th>med</th>
<th>fin</th>
<th>med</th>
<th>fin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atayal</td>
<td>†</td>
<td>s</td>
<td>†</td>
<td>n</td>
</tr>
<tr>
<td>Saisiyat</td>
<td>†</td>
<td>s</td>
<td>n</td>
<td>l</td>
</tr>
<tr>
<td>Kavalen</td>
<td>†</td>
<td>†</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>Pazeh</td>
<td>†</td>
<td>s</td>
<td>n</td>
<td>l</td>
</tr>
<tr>
<td>Thao</td>
<td>†</td>
<td>θ</td>
<td>n</td>
<td>d</td>
</tr>
<tr>
<td>Bunun</td>
<td>†</td>
<td>†</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>Ami (Baram, Kibi)</td>
<td>†</td>
<td>†</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>Ami (Taparon)</td>
<td>†</td>
<td>†</td>
<td>n</td>
<td>d</td>
</tr>
<tr>
<td>Puyuma</td>
<td>†</td>
<td>†s</td>
<td>n</td>
<td>l</td>
</tr>
<tr>
<td>Paiway, etc.</td>
<td>†</td>
<td>†s</td>
<td>n</td>
<td>l</td>
</tr>
<tr>
<td>Raiwan, etc.</td>
<td>c</td>
<td>†s</td>
<td>n</td>
<td>l</td>
</tr>
<tr>
<td>Rukai, etc.</td>
<td>†</td>
<td>†s</td>
<td>n</td>
<td>l</td>
</tr>
<tr>
<td>Tsou</td>
<td>†</td>
<td>†s</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>Kanabu</td>
<td>†</td>
<td>†s</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>Saaroa</td>
<td>†</td>
<td>†s</td>
<td>n</td>
<td>l</td>
</tr>
</tbody>
</table>

Dyen finds it reasonable to believe that *t₂ was an affricate due to 1) the frequent appearance of a sibilant as its reflex, 2) the frequent appearance of an apical stop reflex, and 3) the occurrence of an
affricate reflex in at least one group of languages. He therefore adopts the new cover symbol *C. However, his treatment of the nasals is less satisfying. He notes (pp. 292-3) that the reflexes of *n₁ and *n₂ are found only in medial and final position and that it is "reasonable to believe that *n₂ was an alveolar nasal" (p. 289). He adopts the new cover symbol *N for this proto-phoneme. On the one hand, it is difficult to see what the advantage of this new cover symbol is over the equally abstract *n₂. Additionally, it is not immediately apparent why it is reasonable to regard *n₂ as an alveolar nasal. We return to this question in a later chapter dealing with various phonetic processes, but the stability of nasality as an inherited feature strongly suggests that *n₂ was not a simple nasal whereas the constantly recurring nasality of the reflexes of *n₁ clearly points to a proto-nasal. The high percentage of oral reflexes of *n₂ warrants explanation.

The present interest with Dyen's article though rests with some methodological remarks on the justification for reconstructing distinctions in proto-phonemes. Dyen argues that wherever a distinction in proto-phonemes seems to be warranted, it is necessary to consider if one of the distinctions could be attributed to a cluster of phonemes. In this case, a new proto-phoneme need not be reconstructed. For example, if either *t or *C could be reconstructed as a cluster, the Proto-Austronesian inventory could be reduced. The methodological problem here is to distinguish a complex unit from a cluster in a reconstructed inventory since this is frequently not
possible even in synchronic systems. Dyen argues that the basis for such a determination is provided by syllable structure.

The present theory of Proto-Austronesian syllable structure is that it was (C)V(C), i.e. words had the shape of a multiple of this unit. It follows from this that only single consonants could occur as initials and finals whereas both units and clusters could occur medially. Any reflex noted in initial position must therefore represent a proto-phoneme. Dyen claims that it is more costly to revise a syllable theory than to add a new proto-phoneme, so the latter is always preferable.

Milner (1965) takes issue with the methodology and general assumptions which Dyen uses to determine whether a reflex represents an original complex unit or cluster. Milner points out that it may ultimately be necessary to revise, or at least clarify substantially, the syllable structure of Proto-Austronesian. With regard to nasal-oral sequences, he proposes that optional prenasalization of stops occurred not only in medial position, but also initially in the proto-language. That is, just as it is necessary to recognize doublets of the shapes CVCVC and CVNCVC (cf. Section 7.1.1), it may be necessary to recognize optional initial prenasalization: CVCVC and NCVCVC. This optional prenasalization is purely phonetic; it does not have a morphological function as initial prenasalization does in many Western Austronesian languages synchronically.

In support of such a proposal, Milner cites the fact that optional prenasalization by a "series generating component" (Section 2.1.2) is
found synchronically in many Eastern (Oceanic) languages. The decline of initial prenasalization in Western languages is attributed to the rise of morphophonological prenasalization in these languages. This analysis would explain why a very small number of Western languages, e.g. Nova (Merina) dialect of Malagasy, exhibit a tendency to prenasalize initial consonants in contexts which cannot be accounted for by the general processes active in other Western languages. That is, Milner hypothesizes that this non-distinctive prenasalization represents a conservative, not an innovative, feature of these languages. This analysis may also explain various problematic initial reflexes which could be attributed to C and NC doublets.

There is a serious problem with Milner's proposal. In most, but not all, Western Austronesian languages, the reconstructed medial NC clusters are phonetically clusters, i.e., they exhibit the surface length of two surface consonants. Prenasalized consonants produced by a series generating component have the length of a single consonant, i.e., they are complex surface units. The general analysis of those languages which exhibit complex units synchronically, e.g. Malagasy, Javanese, etc., is that the reconstructed clusters became complex units: NC → NC. The development of prenasalized consonants produced by a series generating component into clusters is virtually unknown universally; it would entail the context-free development of clusters from optionally complex units: C → NC → NC, a development which is especially unlikely given the otherwise CVCVC structure of these languages. It needs to be noted, however, that other attempts to
account for medial NC clusters of reconstructed Austronesian roots are also problematic. (Cf. Section 7.1.1.)

3.4 Motivation for a Feature Analysis

The most compelling evidence which we have found in favor of a unit analysis of prenasalized consonants is not usually advanced as such. It concerns cases in which prenasalization appears to function as an underlying feature similar to other features such as [voice]. The data here concern various sorts of morphophonemic and phonological interactions and are forthcoming from both diachronic and synchronic studies.

It is important to distinguish two types of interaction here. On the one hand, we have cases in which the reconstructed or underlying element is characterized as [+prenasalized] and the modern reflex or surface realization is specified as [-prenasalized]. Such cases would seem to present no evidence for a unit vs. cluster analysis on their own merit since the loss of a segment or cluster simplification is a non-suspect linguistic phenomenon attested in many independent forms. For example, if we have a hypothetical reconstructed consonant inventory which includes the following sounds as well as certain others:

```
m n η
p t k np n̂ ηk
b d g mb nd ng
```

and this is represented at a later stage of development as:
we have no basis for inference about the nature of the reconstructed
nasal-oral sequences *mp, *mb, *nt, etc. The loss of a feature
[prenasalized] would appear to be as tenable an analysis as simplifi-
cation of the sequences in favor of an oral consonant in the case of
nasal plus voiced stop sequences and in favor of a nasal for nasal
plus voiceless stop sequences. Such a change in inventory is attested
in Mbole, a Bantu language, via the following changes:

*p > φ
*t > t
*k > φ
*b > φ
*d > l
*g > k
*m > m
*n > n
*ŋ > ŋ

*mp > f
*nt > t
*ŋk > k
*mb > m
*nd > n
*ŋg > ŋ

In fact, some evidence against a feature analysis is presented by
such data. That is, if we posit underlying feature representations
to account for unit elements such as:
we should then expect that a rule such as:

\[ C \rightarrow [-\text{prenasalized}] \]

should have similar results in terms of the nasality or non-nasality of the output. Of course, in many languages this situation obtains. The question is whether prenasalized consonants are properly regarded as a subclass of oral or nasal consonants in the languages where it does not obtain. Since the reflex of */nt/* is an oral consonant and the reflex of */nd/* a nasal, we have the alternative of specifying */nt/* as \([-\text{nasal}]\) and */nd/* as \([+\text{nasal}]\), which is counter-intuitive. Or, we could introduce the use of angle brackets to express these relationships in which case the rule looks much less natural:

\[ C \leftarrow [-\text{voice}] \rightarrow [-\text{prenasalized}] \leftarrow [-\text{nasal}] \]

This does not constitute a particularly strong piece of evidence in this form since we can easily explain the changes by the development of aspiration with the voiceless series, devoicing of the nasal, loss of nasal, and then frication or loss of aspiration:

\[
\begin{align*}
*m_p \rightarrow m_p h \rightarrow m_p h \rightarrow p_h \rightarrow f \\
*n_t \rightarrow n_t h \rightarrow n_t h \rightarrow t_h \rightarrow t \\
*n_k \rightarrow n_k h \rightarrow n_k h \rightarrow k_h \rightarrow k
\end{align*}
\]
which stages are attested elsewhere in the Bantu family. (Cf. Section 8.1.6.) Simultaneous with these changes, a different series of changes affected the prenasalized voiced series:

\[
\begin{align*}
&*mb > m \\
&*nd > n \\
&*ng > η
\end{align*}
\]

These changes are dealt with in detail in Chapter 8 wherein we discuss the full range of processes affecting prenasalized consonants. However, strong proponents of a feature analysis still have to come to grips at some point with the difference in nasality of the reflexes at whatever stage the loss of the feature occurred and to reconcile the above stages with such an analysis. Notice that these data pose no problem for a cluster analysis; it is simply necessary to posit two rules, one of which will delete nasals before voiceless consonants and another which deletes voiced consonants after nasals. Both of these processes are attested in synchronic grammars.

We have already mentioned in the preceding chapter (Section 2.2.3.4) one case which might be cited as a clear example of the loss of a feature [+prenasalized]. This concerns the phenomenon known as Meinhof's Law. Its effect is to convert a prenasalized voiced stop into the corresponding simple nasal when the following syllable begins with a prenasalized consonant or, in a few languages, a simple nasal. Some examples from Lamba:
Assuming a feature analysis of prenasalization, we have intermediate forms such as *imbango, *imbansa, *indembo which are converted into the surface realizations by a rule:

\[ \text{C} \rightarrow [-\text{prenasalized}] \big/ \text{V} \rightarrow [+\text{prenasalized}] \]

i.e. a simple dissimilation rule. However, in Herbert (1976a), it was demonstrated that although it is easy to formulate as such, Meinhof's Law does not involve dissimilation. That the loss of a feature [prenasalized] is untenable as an analysis is shown by the operation of the rule in languages such as Ganda, where the output is a long, i.e. geminate, nasal:

<table>
<thead>
<tr>
<th>Phonology</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>emmango</td>
<td>/e + N + bengo/</td>
</tr>
<tr>
<td>ennimi</td>
<td>/e + N + limi/</td>
</tr>
<tr>
<td>enqqendo</td>
<td>/e + N + gendo/</td>
</tr>
</tbody>
</table>

From these examples, it becomes clear that the reality of Meinhof's Law is to condition assimilation of a non-nasal consonant in a nasal environment. The details of this process are treated in Herbert (1976a, 1976c). The feature [prenasalized] is thus completely unnecessary to account for this process:

\[ \text{C} \rightarrow [+\text{nasal}] \big/ \text{N} \rightarrow \text{V}\left\{ \frac{\text{NC}}{\text{N}} \right\} \]

We explain the simple, non-geminated, output in languages like Lamba by reference to a general rule operative in many languages whereby a
sequence of nasals is simplified, e.g. Lamba:

mine       /N + min + e/    'let me swallow'
nonke      /N + noŋk + e/    'let me get rich'
qate       /N + qat + e/    'let me snarl'

which contrast with the Ganda forms:

mnałe      /N + mal + e/    'let me finish'
nnoonye    /N + noony + e/    'let me seek'
ŋnoole     /N + ŋool + e/    'let me disapprove'

Thus, the operation of Meinhof's Law even in those languages which exhibit single nasals as its output provides no evidence for an operative feature [prenasalized], but, on the contrary, would seem to point to the correctness of a cluster analysis for prenasalized consonants.9

The real problem for a cluster analysis of prenasalized consonants comes from data where the interchange between prenasalized and simple consonants works in the other direction, i.e. where a historically or underlying simple oral consonant or nasal develops into a prenasalized consonant. There are cases of prenasalized consonants developing from both oral and nasal consonants which again would appear to demonstrate the independence of the supposed feature [prenasalized] from the feature [nasal]. In the following discussion, we shall be referring only to cases of the development of prenasalization which are not directly attributable to a cluster analysis. Very nearly all the cases which we have considered admit a cluster interpretation. However, in a few cases, prenasalization seems to function exactly as other
features within the language pattern. These cases provide the strongest evidence for a unit analysis of segments which are merely specified as [+prenasalized] by some morphophonemic or phonological rule. However, the evidence here too is not unequivocal as we shall see below.

An example of this type of data has already been presented in Section 2.2.3.6; it concerns the consonant polarity found in some Nilotic languages. To review briefly, there is in certain forms an alternation in the feature specification [voice] for stem-final oral consonants; stem-final nasals become prenasalized. The polarity is incomplete because stem-final prenasalized consonants do not become simple nasals:

<table>
<thead>
<tr>
<th>Luo</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Singular</strong></td>
</tr>
<tr>
<td>kede</td>
</tr>
<tr>
<td>okot</td>
</tr>
<tr>
<td>cogo</td>
</tr>
<tr>
<td>buom</td>
</tr>
<tr>
<td>Ḗuno</td>
</tr>
<tr>
<td>rombo</td>
</tr>
</tbody>
</table>

Since the process affects feature specifications for oral consonants, it is reasonable to suppose that a change in feature specification is also involved for the nasals. The process involving the oral consonants is easy to characterize; Gregersen (1972:79) gives the following formulation:
Gregersen notes that it is difficult to incorporate the nasal alternation into the same rule because of problems inherent with the features of generative phonology. He therefore proposes the ad hoc feature [heavy]; this feature is positively specified for voiceless stops and clusters and negatively specified for voiced stops and nasals. This now gives:

$$[-\text{voc} \ + \ *\text{con}] \rightarrow [-\alpha \text{ voice}] \quad / \quad \{\text{Plural -E} \quad \text{Appertentive}\}$$

except that prenasalized consonants do not become nasals, so another ad hoc feature [-cluster] is needed:

$$[\alpha \text{ heavy}] \rightarrow [-\alpha \text{ heavy}] \quad / \quad \{\text{Plural -E} \quad \text{Appertentive}\}$$

The introduction of the [-cluster] specification is unnecessary and problematic. On the one hand, it has been demonstrated elsewhere (Herbert 1977 Ms) that the reason prenasalized consonants do not appear to participate in the polarity is due to certain surface phonetic constraints of the languages concerned. Briefly, the polar equivalent of underlying /mb/ would be /mp/ by virtue of the $\alpha$-switching rule. However, these languages exhibit only surface prenasalized voiced stops, so the rule cannot apply, or, if it does apply, its output is reconverted into phonetic [mb]. On the other hand, Gregersen's introduction of the feature [heavy] was designed to accommodate prenasalized consonants within his statement of the rule; the introduction of the feature [cluster] to exclude them from its operation is thus a problem in terms of the elegance which the new features were designed
to provide.

Gregersen (1972:81) suggests that the plural morpheme is really /KE/ and that two rules account for the polarity observed. First, there is a rule making /K/ homorganic with preceding consonants, e.g.:

1. /K/ → [b] / m

and second, a rule switching the feature [voice] with stops, e.g.:

2. a) k + K → [g]
   b) g + K → [k]

Unfortunately, the phonetics involved in these rules are so suspect as to warrant their rejection. This is not to claim that such rules are impossible. However, 2a) strikes us as odd in the very least, and in all the cases of nasal-oral sequences which we have observed, a process similar to 1) is also suspect. We believe that the polarity is best regarded as a morphophonemic process affecting features in most cases. Although not mentioned in Gregersen's data, Stafford (1967:21) notes that not only stem-final /n/, but also /l/ has plurals in -nde:

| tleló  | plende | 'foot, root' |
| toł    | tonde  | 'rope'       |
| bul    | bunde  | 'drum'       |
| thoul  | thounde| 'snake'      |
| plen   | plende | 'skin, hide' |

These data point to a further problem with an attempt to handle the polarity in terms of feature switching alone.

Ladefoged (1968:24) notes that the initial nasal component of prenasalized consonants patterns in some languages "like an additive
component such as voicing." This is true of a number of languages. Thus, for example, in Mende the following alternations occur:

<table>
<thead>
<tr>
<th>Strong form</th>
<th>Weak form</th>
</tr>
</thead>
<tbody>
<tr>
<td>p-w</td>
<td>wele</td>
</tr>
<tr>
<td>kp-gb</td>
<td>gbato</td>
</tr>
<tr>
<td>f-v</td>
<td>fande</td>
</tr>
<tr>
<td>s-j</td>
<td>sanl</td>
</tr>
<tr>
<td>mb-b</td>
<td>mba</td>
</tr>
<tr>
<td>nd-l</td>
<td>ndoma</td>
</tr>
<tr>
<td>ng-y</td>
<td>yenge</td>
</tr>
<tr>
<td>-w</td>
<td>wulu</td>
</tr>
<tr>
<td>ńj-y</td>
<td>ńjil</td>
</tr>
</tbody>
</table>

The strong forms occur in the isolation form and the weak form in a number of syntactic constructions, e.g. nya wele 'my house'. It seems clear that we want to regard the strong form as basic. Thus, this case involves the loss of a feature [prenasalized] or alternatively a simplification of an underlying sequence. Other consonants do not participate in the alternation: /b, g, j, l, y, gb, w/, i.e. those which already occur in "weak" form and also /d, h, m, f, η/. (Crosby 1944).

Sapir (1949:188) mentions in passing a case where a feature [prenasalized] apparently functions as an additive component. The example involves song diction in Karesau-Papua, a language of New Guinea. In songs, voiceless stops become corresponding prenasalized
voiced stops, *apil > ambil*. Unfortunately, this is the only example cited by Sapir; it would be necessary to see what other types of changes occur in song diction in order to provide a complete analysis.

A case of non-phonetically conditioned alternations involving prenasalized consonants in Bedik, a language of E. Senegal, is discussed by Ferry (1968). In Bedik, the following series of alternations occur:

\[
\begin{align*}
&f \rightarrow p & w \rightarrow b \rightarrow mb & s \rightarrow w \\
s & t & r \rightarrow d \rightarrow nd & l \rightarrow d \rightarrow n \\
&j \rightarrow c & y \rightarrow j \rightarrow \mathfrak{h} & y \rightarrow n \\
h \rightarrow k & y \rightarrow g \rightarrow ng & (y) \rightarrow \eta
\end{align*}
\]

Ferry schematizes these in the following fashion:

\[
\begin{align*}
\text{degree I:} & \quad f \quad s \quad j \quad h \quad w \quad r \quad l \quad y \quad y (y) \\
\text{II:} & \quad p \quad t \quad c \quad k \quad b \quad s \quad d \quad \mathfrak{j} \quad y \quad g \\
\text{III:} & \quad - \quad - \quad - \quad mb \quad m \quad nd \quad n \quad \mathfrak{j} \quad \mathfrak{n} \quad ng \quad \eta
\end{align*}
\]

Where degree I is unspecified, it is equivalent to degree II; where degree III is unspecified, it is also the same as degree II. All of the forms can appear in the same phonetic environment. Again, due to a lack of data, it is unclear how these data are to be properly analyzed.

Another example which perhaps requires the use of a feature (prenasalized) is taken from Tucker and Bryan (1966:301) and concerns the Kodugli-Krongo languages. In these languages, plosives are voiced after certain prefixes, e.g.:
Katcha

kusu plural: nu-ŋusu 'owl'

tembi plural: ki-tembi 'cock'

Krongo

ta plural: na-ŋa 'potsherd'

fa-fala fem.: ma-da-fala 'guest'

After other prefixes, plosives are realized as prenasalized voiced stops:

Katcha

foda 'meat'

ba-ngoda 'piece of meat'

Both these processes also occur across word boundaries within sentences. Thus, /kafi obu kuku a kufi/ 'Kafi hits Kuku with a stick' is pronounced [kafi obu ŋguku a gufi]. Historically, the development of prenasalization is probably to be explained by a prefix-final nasal which has been lost synchronically. Obviously, if the nasal never appears on the surface synchronically as such, we need to recognize the existence of a morphophonemic process which specifies consonants as [+prenasalized] in certain syntactic constructions. The alternative is to argue that there is indeed a prefix-final nasal synchronically which does appear on the surface as such; it appears as the nasal component of prenasalized consonants. In this case, however, we need to explain how the nasal plus plosive separated by a morpheme boundary comes to give rise to a single prenasalized consonant. Of course, this is the same process exhibited in many Bantu languages
involving nasal noun class prefixes. The nature of the phonetic processes involved in the fusion of nasal and oral consonants will be described in detail in Chapter 6. We believe this analysis represents a viable alternative to the recognition of a phonological feature [prenasalized].

In another group of languages discussed by Tucker and Bryan (1966:232 ff.), the Daju Group, representing Shatt, Liguri, Daju, Mjalgulgle, etc., we find another type of interaction between simple and prenasalized consonants. As with the above examples, prenasalization here might be viewed as deriving from simple oral consonants, but in these languages prenasalized consonants pattern with geminates as well. The relevant alternations are exhibited in the initial consonants of the singular and plural imperative. Corresponding forms from the first person singular indefinite aspect are also cited. The following examples are from Shatt:

<table>
<thead>
<tr>
<th></th>
<th>Sg.Imp.</th>
<th>Pl.Imp.</th>
<th>l sg. indef.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>p - b</td>
<td>pax-a</td>
<td>a-pax-e</td>
</tr>
<tr>
<td></td>
<td>b - bb</td>
<td>bok-sI</td>
<td>bbok-sI</td>
</tr>
<tr>
<td></td>
<td>b - mb</td>
<td>bald-a</td>
<td>mbald-a</td>
</tr>
<tr>
<td></td>
<td>t - d</td>
<td>tuny-l</td>
<td>duny-l</td>
</tr>
<tr>
<td></td>
<td>d - nd</td>
<td>dim-l</td>
<td>ndim-l</td>
</tr>
<tr>
<td></td>
<td>c - j</td>
<td>cox-a</td>
<td>jox-a</td>
</tr>
<tr>
<td></td>
<td>k - g</td>
<td>kas-a</td>
<td>gas-a</td>
</tr>
<tr>
<td></td>
<td>g - ng</td>
<td>gan-a</td>
<td>ngan-a</td>
</tr>
<tr>
<td></td>
<td>$0$ - n(n)</td>
<td>ox-a</td>
<td>nox-a</td>
</tr>
</tbody>
</table>
One approach to the above alternations might be to take the singular imperative form as basic and predict the other alternations from that base. This is apparently the approach taken by Tucker and Bryan although this can only be inferred from their description. This approach necessitates the postulation of three processes:

1. voicing of voiceless consonants
2. prenasalization of voiced consonants
3. gemination of voiced consonants

Such an approach is problematic, however, since it cannot predict, for example, when b-initial stems will have a plural in bb- or mb-.
that the phonetic realization of the stem in other forms does not provide any evidence as to which form should be taken as basic; in verbs of Class I, i.e. those with initial explosives or $\emptyset$, the indefinite stem is the same as the plural imperative base. For verbs of Class II, those with all other stem-initial consonants, the indefinite stem is the same as the singular imperative. However, if we take the plural form as basic, then we can derive the singular forms by two simple processes:

1. devoicing of initial single consonants

2. cluster simplification

By Cluster Simplification, we understand here the loss of any initial consonantal segment immediately followed by another consonant. It is only by such an analysis that we can predict the non-basic forms with any high degree of accuracy. The $\emptyset - n$ alternation will require a special rule in any treatment.

A somewhat different type of case which might be formalized so as to incorporate the addition of a feature [prenasalized] involves cases of consonantal nasalization in the environment of another nasal. Occasionally, we find that historically oral consonants develop into prenasalized consonants when a preceding syllable contains a nasal consonant. Such a process is easy to formalize:

$$C \rightarrow [+\text{prenasalized}] / \begin{bmatrix} +\text{cons} \\ -\text{voc} \\ +\text{nasal} \end{bmatrix} V_1$$

and is exhibited in the following Sinhalese prenasalized consonants which are not attributable to Sanskrit nasal plus voiced stop
sequences (Wijeratne 1957):

\[
\begin{align*}
ni\tilde{\mathring{a}} & < nigraha \\
m\tilde{a} & < mada \\
sama\tilde{\mathring{a}} & < samagra
\end{align*}
\]

A rule such as that given above adequately describes the change in that it delimits the environment in which the change occurs. However, no explanation of the processes involved is forthcoming from such a formulation. This problem is discussed in some detail in Herbert (1976c) and in Chapter 5. It will suffice to say here that there is a great deal of cross-language evidence suggesting the prenasalization in Sinhalese and other parallel cases is to be accounted for by a nasalization of the post-nasal vowel. This mirrors the development of prenasalized consonants after phonemically nasal vowels in some languages and relates to the notion of nasal prosody which is to be discussed in Section 5.2. We do not consider, however, that such cases provide any evidence for the existence of an underlying feature [prenasalized].

Our final example of data which might be used to support the existence of a phonological feature to account for surface prenasalized consonants comes from Gbeya, an Adamawa language of the Niger-Congo family. Samarln (1966:32-3) notes that there is a common alternation between plain nasals and prenasalized stops. In some words, the two series vary freely, but in other cases the alternation appears to be morphologically or syntactically determined. Some examples of the freely varying forms are:
The determined alternation occurs when words with final nasals occur with certain vowel suffixes, e.g. in verbs preceding the third person singular pronominal affix, the perfective suffix, and the emphatic suffix, and in nouns before the determinant suffix:

- Tom 'to send' təmbəa 'send him'
- Bom 'to be blind' bombə 'become blind'
- Kam 'food' kambəa 'the food'
- Kpəm 'one' kpəmbəa 'the first'
- 'Dong 'back' ḋəngəa 'the back'

Samarin notes that the prenasalized consonant occasionally occurs as a variant of the plain nasal before open juncture when followed by a vowel:

- ɪn (-ɪnd) ə ɯ-ɾə 'with people'
- ḥa ɲməa ham ('hemb) əɓ 'give some to me please'

It was mentioned in Section 2.1 that Samarin treats prenasalized consonants as unit phonemes in Gbeya. He apparently wants to treat the plain nasal as basic in these alternations which presumably would be accounted for by a morphophonemic rule such as:

\[
\begin{align*}
[+\text{cons}] & \rightarrow [+\text{prenasalized}] / \ldots
\end{align*}
\]
Note that in these schemata prenasalized consonants would appear to be a subclass of simple nasals. However, it seems to us preferable to treat the so-called prenasalized consonants as underlying and to predict the simple nasals from the former. Thus, there will be a rule simplifying nasal-oral sequences in final position which accounts for surface forms such as [tôm] (/tomb/). The form which appears before the vowel suffixes exemplified is the underlying form. The same simplification rule applies optionally in the prevocalic open juncture forms. This alternative analysis which posits the nasal-oral sequences as basic thus provides no evidence for the existence of a phonological feature [prenasalized] since a simplification rule in final position is a plausible analysis.

3.5 Summary

We have examined in this chapter several cases where surface alternations might lead us to postulate the existence of a phonologically distinctive feature to account for prenasalized consonants. However, in each case we have seen that viable alternative analyses are available which are not ad hoc and which do not warrant the postulation of such a feature. If an underlying feature [prenasalized] does exist, we expect it to function independently in language change; the evidence in this regard is unconvincing. Additionally, it was demonstrated that the postulation of a feature is problematic in that it cannot adequately describe certain common linguistic changes. We expect the feature [prenasalized] to figure in both of the following developments:
1. C → [-prenasalized]
2. C → [+prenasalized]
both synchronically and diachronically. The changes described by Rule 1 are common. However, the simple use of this feature to describe them is not without problems since it does not account for the frequent differences in nasality of the output consonant. These cases are easily handled by a cluster simplification analysis. We examined several purported cases involving applications of Rule 2 above; these were shown as perhaps being preferably reanalyzed as cases of Rule 1 or, therefore, of cluster simplification. Those few cases for which we could not provide a reanalysis such as Sapir's Karesau-Papua song diction and Ferry's discussion of Bedik must await further data which elucidates the behavior of prenasalized consonants within these total language systems. Thus, the evidence which currently exists for an independent feature [+prenasalized] would seem to be negligible.

Another problem inherent with a feature or unit analysis of prenasalization comes from the distributional facts mentioned earlier. Briefly, in many languages prenasalized consonants are barred from initial position. No verb or adjective roots and extremely few noun stems begin with a prenasalized consonant in Kikuyu. De Silva (1969: 204) notes that all consonants other than prenasalized voiceless consonants occur initially in Maldivian. Similarly, Dahl (1952) reports that any consonant may begin a word in Malagasy except the prenasalized voiceless consonants. Dahl proposes a unit analysis for the prenasalized
consonants of Malagasy because they present the same surface length as other consonants of the language and because no consonant combinations occur. We have already commented upon the validity of these criteria in analysis and will return to the evidence of timing in Chapter 5. In some dialects of Malagasy, the prenasalized voiceless series is merging with the simple voiceless consonant series. Thus, these would apparently be treated as a subclass of oral consonants in order to predict correctly the non-nasality of the output consonants after the loss of the feature [prenasalized]:

\[
\begin{array}{c}
\text{[+cons]} \\
\text{[-voc]} \\
\text{[+prenas]} \\
\text{[-nasal]}
\end{array} \rightarrow \text{[-prenasalized]}
\]

However, a feature analysis cannot really adequately account for the distributional limitations on prenasalized consonants. That is, if we assume that these consonants have the same status as other underlying consonants except that they are specified as [+prenasalized] and that this feature has the same status as other phonological features, we expect to find that these consonants behave as others do. "Normal" consonants typically occur in $C_1$ position of roots if nowhere else. Obviously, we could argue that the feature [prenasalized] is in some sense extraordinary and does not function initially. This is obviously unsatisfactory as an explanation. If we assume, on the other hand, that these consonants do not have the same status as other underlying consonants and can present independent evidence for such an underlying distinction, we have a natural explanation for
differences in behavior. Such a distinction will be motivated in the later chapters of this dissertation.
NOTES

1 Sonority hierarchies are not novel. For example, Jespersen (1913:191) gives the following hierarchy:

1. voiceless consonants (minimum sonority)
2. voiced occlusives
3. voiced fricatives
4. nasals and laterals
5. ֵ
6. high vowels (i, ü, u)
7. mid vowels (e, ø, o)
8. low vowels (a, m, etc.) (maximum sonority)

Håsa (1961) notes that a similar hierarchy based on articulation, i.e. degree of stricture, was proposed by de Saussure:

0. occlusives
1. spirants (fricatives)
2. nasals
3. liquids
4. semi-vowels (i, ü, u) and high vowels (i, ü, u)
5. mid vowels (e, ø, o)
6. low vowels (a, m, etc.)

Grammont (1950) divides 4 into two distinct ranks:

4. semi-vowels
5. high vowels
6. mid vowels
7. low vowels

The similarity between the acoustic and articulatory hierarchies is not too surprising. Jespersen's more complete schema is more explanatory for the present concerns since it is based on sonorance.

2 Stampe (1973a:50) rejects Chomsky and Halle's (1968:419) claim that all preconsonantal nasals are identified as the unmarked nasal /m/ in English; he claims assimilation does not apply to /m/. There is at least anecdotal evidence to the contrary: Ayo Bamgbosé's name was pronounced [bɒŋgeboz] by an airport announcer in Columbus. Since the name was read from a list, not repeated from a model, we assume that m became [ŋ] before the velar stop and an epenthetic vowel was inserted to break up the non-English cluster gb which represents, of course, a labio-velar consonant. This is not to claim that nasal assimilation cannot be limited to a single nasal in some language. Evidence to the contrary is presented in Chapter 6.

3 Ambisyllability for prenasalized consonants is defined as the situation wherein the nasal component is interpreted as belonging to a preceding syllable and the oral component to a following syllable. This term is also used in the literature (e.g. Welmers 1973) to refer to the phenomenon whereby a single phoneme is supposed to belong to two syllables simultaneously. These two uses of the term are thus quite distinct and should not be confused. We return to the notion of ambisyllability and prenasalized consonants in a later chapter.
4. It might be thought that techniques such as the latter should provide evidence for deciding what constitutes a phonological word in some languages. This is a question with a long history in Bantu studies as a quick examination of the various orthographies which have been adopted for official use will indicate. However, apparently, different speakers have different Ludikya rules or different phonological words. For example, *n̩ga yetise becomes *n̩ga asetive for some speakers and asetiyeng for others; this might suggest that it is a phonological unit for the latter speakers, but not for the former.

5 In Herbert (1975), evidence is presented to the effect that more precision can be achieved in a description of Ganda by referring to different syllable weights than by reference to morae. This evidence will be reviewed briefly in Chapter 5.

6 Dahl (1973:60) agrees with Dyen that *tɔ may have been an affricate, but he raises a practical objection to Dyen's algebraic symbol *τ. Since the reflexes of t₁ and t₂ differ only in Formosa, it is impossible in many cases to decide if *t represents *t₁ or *t₂. Dahl notes that, in these cases, the symbol *t which is ambiguous between the two assignments is convenient. Our objection to this proposal is that it again obscures the phonetic interpretation of the reconstructed system. It is proposed instead that *t to be represented as *t₃ and that in cases where the assignment needs to be ambiguous, *t(s) be used as mnemonic device. This exactly parallels Dempwolff's use of a nasal in parenthesis, i.e. (N)C, to handle "identical" wordbases of the type CVVCV in one language and CVNVC in another, which occasionally both occur in the same language.

7 Dahl (1973:74) notes that Dyen's characterization of *n̩ as an alveolar nasal is especially unconvincing since it has merged with Proto-Austronesian *l in all languages outside Formosa, and in Formosa it often has reflexes which are laterals, occasionally voiceless. Dahl proposes *l instead. However *n̩ also shows lateral reflexes in initial position.

8 The feature [+prenasalized] is here used as a cover feature for any unit feature proposal.

9 The operation of Meinhof's Law synchronically is not, however, especially strong evidence for a cluster analysis of prenasalized consonants precisely because it can be observed only in morphologically complex forms. Its application in monomorphic forms would be obscured by relexicalization. There are some historical cases in which relexicalization is attested.

10 Note that the geminate nasals could in fact be the result of either (2) or (3) since in some languages where gemination is unknown, the prenasalized counterpart of a nasal is a geminate nasal.
4.0 Introduction

In the preceding chapter, we reviewed the various types of arguments which are traditionally cited as evidence for a unit analysis of prenasalized consonants. We examined each type in some detail and demonstrated that the evidence is far from convincing when it is viewed objectively. Apart from those arguments which were shown to be methodologically unsound and invalid, the remaining evidence allowed for viable reinterpretation. The evaluation of the rival interpretations must be external to both of the theories which they represent. However, before proceeding to an examination of such external criteria, we propose to examine in this brief chapter a problem already mentioned in the preceding chapter, viz. that of the interaction of a proposed feature [prenasalized] with other phonological features. Our use of the feature [prenasalized] represents no particular theoretical bias; it is intended as a general cover term for any single feature which is proposed to account for prenasalization. The various feature proposals which have been put forward to date are reviewed below. We assume that a distinctive feature analysis is inseparable from a unit analysis and therefore treat them as such. After a review of the feature proposals, we proceed to an examination of the problems inherent with such analyses since the postulation
of a feature necessarily makes certain predictions about its use in phonological change. It will be shown that these problems are themselves linked to the larger problem of whether prenasalized consonants are properly analyzed as a subclass of oral or nasal consonants.

4.1 Formal Representation

4.1.1 Distinctive Feature Proposals

Chomsky and Halle (1968:317) present three possibilities for the incorporation of prenasalized consonants into their feature framework. They note that prenasalized consonants differ from the more familiar type of nasal in that the velum is raised prior to the release of oral occlusion for prenasalized consonants and not simultaneously as it is for simple nasals. It is therefore suggested that it will be necessary to recognize "a feature that governs the timing of different movements within the limits of a single segment."\(^1\)

Myers (1974, 1974 Ma) notes that this is a larger problem within the distinctive feature system and involves not only prenasalized consonants, but many other complex units. Several attempts have been made to classify "natural" or "unmarked" segmental sequences, e.g. Chomsky and Halle (1968: Chapter 9), Stanley (1967), Cairns (1969), but as Myers points out: "These treatments do nothing to explain which of these sequences may be reanalyzed as unit segments, or may function as unit segments, in the phonology of some language." Vector features are proposed by Myers to account for complex unit segments which partake of qualities of both components of the complex unit. They represent a "changing, vectoring, value over the duration of the segment." For example, the feature [delayed release] is essentially
a vector feature designed to describe segments that are initially
[-continuant] and then during the articulation of the segment become
[+continuant]. Note that affricates are thus treated as a subclass
of stop consonants since all segments which are [+delayed release] are
necessarily specified as [-continuant]. Vector features are not only
characteristic of segmental features, however. Leben (1971), for
example, has demonstrated that a sequence of tones may be compressed
onto a single segment. Thus, a sequence of high tone and low tone, if
realized as a unit, would be a single falling tone.

Myers notes that tone vector features tend to be symmetrical
whereas segmental vectoring does not. Thus, the segments /ts/, /dz/
,/pf/, /tš/, /kx/, etc. are exhibited in a wide variety of languages,
but the reverse sequences, /st/, /zd/, /fp/, /št/, /xk/, etc.,
"would not be much expected and what combinations of [-continuant]
and [+non-continuant] do occur are invariably treated by linguist and
language alike as irreducible clusters." This is, in fact, not quite
true; in Section 3.1, for example, we reviewed the evidence, not all
of it unconvincing, in favor of treating clusters such as /st/ in
English as unit segments. However, it is true that a parallel feature
to [-delayed release] which would be [+delayed closure] is unwarranted.

Similarly, sequences of nasal plus oral consonant are often
possible in many languages whereas the reverse sequences are not.
Myers claims that these latter are always separate morphemically and
cites the English example *kiddnapper*. This is again not quite true.³

The data dealing with postnasalized consonants and oral-nasal sequences
are cited in a later chapter. Consider, however, such forms as German *Knabe*, Russian *kniga*, *Dnieper*, French *pneu*, etc.

In addition to their movement feature, Chomsky and Halle suggest that the already motivated feature [delayed release] might be used to account for prenasalized consonants. They note that this treatment appeals to them, but they are "at present unable to provide serious arguments in its favor." However, the use of [delayed release] seems unjustified here. Prenasalized consonants involve not a delayed release of stricture, but rather a delayed raising of the velum.

There is another problem in the use of [delayed release] to characterize prenasalized consonants, i.e. the possibility of prenasalized affricates such as *[ntʃ,ŋkʃ, mpʃ]*. It would be necessary to use the same feature to describe the transition from nasal to oral articulation and for stop to fricative articulation. Current theory does not allow for such double specifications within a single segment.

The last of Chomsky and Halle's suggestions is to regard prenasalized consonants as [-sonorant] as opposed to the more common type of nasals which are [+sonorant]. There are several problems with this suggestion which are reviewed in Herbert (1975). It will suffice to point out here that the nasal component of prenasalized consonants is often tone-bearing and thus necessarily [+sonorant] since only sonorants can bear a surface tone. In many languages, the nasal is realized as a separate syllable under certain conditions; this makes such an analysis even less tenable. For example, in Ganda, the nasal comprises an independent syllable in initial position:
n. di. ga 'sheep' (cf. e. ndi. ga 'sheep')
n. da. ba 'I see' (cf. ku. nda. ba 'to see me')
m. ba. la 'I count' (cf. ku. mba. la 'to count me')

Thus, we need to reject the use of the feature [sonorant] to account for prenasalized consonants as untenable; the feature [delayed release] was shown to be, at best, problematic. Of the three proposals put forward, we are thus left only with the movement feature as a tenable analysis.

This is, in fact, the solution which Myers (1971 Ms) opts for in her generative treatment of Kikuyu phonology. Myers' treatment is unique in that she points out:

It is clear that before any feature specification can be chosen we must discover whether these sounds are nasal stops with an early velar closure, or oral stops with a late velic closure and whether they seem to behave like sonorants or obstruents.

Myers finally concludes that they are essentially nasal stops with a secondary articulation. She bases this conclusion on the fact that the prenasalized stops of Kikuyu appear to pattern with simple nasals in the conditioning of Meinhof's Rule in Kikuyu. Unfortunately, this analysis of Meinhof's Rule is itself incorrect as we have demonstrated elsewhere (Herbert 1976a) and shall argue below. Even if we consider only cross-language data from the various Bantu languages exhibiting Meinhof's Rule synchronically, the criteria provided by Myers leads to an analysis wherein prenasalized consonants would be specified as [+nasal] in some languages and [-nasal] in others. Obviously, this is less than a felicitous situation. In any event, Myers proposes the
feature [early velar closure] ([e.v.c.]) to characterize prenasalized stops. In spite of the fact that we shall attempt to demonstrate below the incorrectness of her analysis, it seems that Myers' is the most methodologically sound of all the treatments which have appeared to date.

Ladefoged (1971:35) posits a feature [PRENASALITY] which "must be defined in terms of the duration of an event." He notes (p. 105) that this corresponds to Chomsky and Halle's first proposal for a feature which governs the timing of the movement of the velum within a single segment.

Bailey (1973:149) treats prenasalized stops as [-continuant] and [+turbulent] as opposed to fricative nasals which are [+cont, +trb]; both are [+nasal]. It is unclear how prenasalized fricatives would be incorporated into such a framework. Bailey remarks that the feature [release] might be helpful in designating phonological units from which are generated more than one phone, e.g. /n̩d/, /ʃ/, /p/, provided onsets are distinguished from offsets. An aspiration feature is used in conjunction with [release] for preaspirated and postaspirated stops, /hps/ and /ps/, and, presumably, for stop-fricative and fricative-stop sequences, /ts/ and /st/, and for prenasalized and postnasalized stops /n̩d/ and /n̩/.

Bird (1971:166-7) considers the problem of the proper feature specification for the set of prenasalized consonants of Mende: /mb, nd, nj, ng/. He notes, first, that the set of voiced stops in Mende is of marginal phonemic status and that the primary contrast is between voiceless and prenasalized stops. Second, the prenasalized
stops of Mende correspond to the voiced stops in Loma and sonorants in Kpelle. Third, no rule in Mende makes reference to a natural class including the nasals and the prenasalized stops. Therefore, the feature [nasal] is inefficient as a characterization of the two sets. Bird concludes that the proper way to characterize the Mende prenasalized stops is exactly that of the Loma and Kpelle voiced stops, i.e. [+lowered, -nasal]. An attempt is made to justify this analysis in physiological terms. Bird notes that there are a limited number of ways in which lowered supraglottal pressure can be maintained during stop closure: the pharyngeal wall may be loosened, the glottis may be lowered, or another means of preventing a pressure build-up would be the brief opening of the nasal passage. We are not overly concerned with Bird's use of the feature [lowered] here. What is of interest, however, is that he treats prenasalized consonants as a subclass of oral consonants. This is exactly the opposite approach to that taken by Myers, who claims they are a subclass of nasal consonants. In addition, both of these analyses are based on language systems which exhibit only prenasalized voiced stops. It is unclear how either of these analyses could be modified to account for prenasalized voiceless stops and prenasalized fricatives, which sounds certainly occur in the world's languages.

4.1.2 Complex Symbols

Campbell (1974a) and Sasse (1976), as an alternative to positing ad hoc features such as [early velar closure], have proposed that complex segments be described by means of multi-columned matrices of distinctive features. Thus, there would be a feature column for
each of the components which contribute to the complex unit. When we consider, for example, the case of affricates, in lieu of a feature [delayed release], we have a specification such as:

\[
\begin{array}{c}
+\text{cons} \\
-\text{voc} \\
-\text{voice} \\
-\text{nasal} \\
-\text{ant} \\
+\text{cor} \\
-\text{cont} \\
+\text{cont}
\end{array}
\]

for /ts/.

For the class of prenasalized voiced stops, such a proposal seems attractive. The feature specification for /mb/, for example, would be:

\[
\begin{array}{c}
+\text{cons} \\
-\text{voc} \\
+\text{voice} \\
+\text{nasal} \\
-\text{ant} \\
-\text{cor} \\
-\text{cont}
\end{array}
\]

The two components which contribute to the complex unit /mb/ agree in all their feature specifications except that the first component is [+nasal] whereas the second is [-nasal]. It is proposed that phonological rules can apply to all or to one of the columns of a complex matrix. Surely, however, for rules to affect only part of a complex segment should lead one to begin to question whether the segment is really an underlying unit or not. Campbell and Sasse do not include any means of limiting the types of matrices which may succeed each other to form complex units. Ostensibly, any combination is possible within this proposal; this seems like a serious gap in the theoretical framework. We expect that such a theory should incorporate the fact
that specifications such as the above are in some sense natural while the reverse unit /bm/ is less common, less expected, and, in that sense, less natural. Of course, this problem is not unique to the multi-columned matrix proposal, but represents a larger theoretical issue. Myers (1974 Ms) attempts to come to terms with this problem so that her feature [early velar closure] will be valued as more natural than its counterpart [late velar opening]. However, as we shall demonstrate in a later section, Myers' explanation is ad hoc and has no real empirical foundation. It seems to us that one of the ultimate goals of a theory of markedness should be to explain why certain segments and segment types are marked relative to others. We shall return to this issue below.

Another problem with Campbell and Sasse's proposal is exactly that which unit feature proposals could not deal with. Specifically, although the feature matrix for /mb/ seems straightforward, we still have to provide specifications for prenasalized voiceless stops and fricatives. Some languages exhibit the full range of prenasalized consonants, e.g. Rundi (Meeussen 1959):

<table>
<thead>
<tr>
<th>Rundi</th>
</tr>
</thead>
<tbody>
<tr>
<td>mb nd ng</td>
</tr>
<tr>
<td>mp nt n̩ ṉ nk</td>
</tr>
<tr>
<td>n̓v nz n̓v n̓ y n̓</td>
</tr>
<tr>
<td>n̓f ns n̓f y n̓ f</td>
</tr>
<tr>
<td>n̓pf n̓ts n̓c̓v n̓c</td>
</tr>
</tbody>
</table>

Thus, the feature specification for /ns/ is:
\(/n_s/\)

\[
\begin{array}{c}
+\text{cons} \\
-\text{voc} \\
+\text{voice} -\text{voice} \\
+\text{nasal} -\text{nasal} \\
+\text{ant} \\
+\text{cor} \\
-\text{cont} +\text{cont}
\end{array}
\]

and for a complex such as \(/n_t_s/\), we have:

\[
\begin{array}{c}
+\text{cons} \\
-\text{voc} \\
+\text{voice} -\text{voice} \\
+\text{nasal} -\text{nasal} \\
+\text{ant} \\
+\text{cor} \\
-\text{cont} +\text{cont}
\end{array}
\]

The non-changing feature specifications merely express that the unit is composed of homorganic consonants which agree in no other features. Thus, although the multicolumned matrix proposal provides the formalism to represent such complex units, the representations which it provides seem intuitively ad hoc and, it will be argued, have no real role in phonological rules.\(^5\)

4.2 Feature Analyses: Theoretical Considerations

Quite apart from the issue of how to represent prenasalized consonants within a theory of phonology, the issue which we wish to examine in somewhat more detail here is how any proposed single feature would interact with the other features of any given linguistic system. Before proceeding to that discussion, however, we will review several basic assumptions about any feature theory, which are necessary to our discussion.
4.2.1 Orthogonality

Within the current phonological framework, it is generally assumed that the set of universal features from which a language selects those features which it will employ distinctively is composed of orthogonal features. Seemingly, however, the term orthogonal is applied here in two different ways. On the one hand, it is used to describe the individual independence of each of the phonological features. That is, under this interpretation, it is asserted that every given feature specification is free to vary independently of every other feature specification. Obviously, this is a universal theoretical claim, not a language particular one. Since no language avails itself of all the possible phonological segments and contrasts which feature theory allows us to define, certain features will be redundant and invariable. This view has obvious correlates in the system of marking conventions proposed within markedness theory. For example, in a language such as English which has phonologically explosive consonants only, the feature [implosive] cannot vary, but is consistently specified either as [-implosive] or [0 implosive]. This generalization is captured by a marking rule such as:

\[ [U \text{ implosive}] \rightarrow [-\text{implosive}] \]

which, with other such rules, specifies that the unmarked, "normal", or expected airstream mechanism is pulmonic egressive and therefore explosive consonants are unmarked on a universal level. In contrast to English, in other languages such as Shona, for example, /b, d/ coexist with /b, d/ and the above rule merely predicts that the
[-implosive] consonants should be more highly valued than their implosive counterparts. That is, /b, d/ should be more common, should occur in positions of neutralization, should be first acquired by Shona children, etc. (Cf. Section 8.1.3.) In Shona, the specification for the feature [implosive] is free to vary precisely because the language chooses to avail itself of this feature.

It needs to be noted, however, that certain combinations of specifications are ruled out on physiological grounds. For example, due to the physical movements involved in the production of implosive consonants, i.e. supraglottal closure, downward movement of the glottis with the vocal folds set in vibration this creating a negative pressure in the vocal tract, voiceless implosives and implosive continuants cannot occur. Thus, the features [voice], [continuant], and [implosive] are not orthogonal in this sense since if a unit is specified as either [-voice] or [+continuant], then it is necessarily [-implosive]. Similarly, [+implosive] necessarily implies both [+voice] and [-continuant]. This is a universal restriction with clear physiological bases, and not a language particular one such as the non-occurrence of implosives in English. The segments /p, t, k/ never occur. It seems to us a serious problem with marking conventions that they do not distinguish between such facts as the general markedness of voiced implosive stops and affricates and the non-occurrence of implosive continuants and voiceless implosives. Thus, not all feature specifications are actually free to vary independently of each other on a universal level. Nevertheless, this sense of orthogonal captures
an important theoretical generalization and is tenable although in need of a more precise definition.

The other interpretation which is occasionally assigned to the term *orthogonal* is that the phonological features are independent units in that no hierarchy of features exists. Under this interpretation, each feature (not feature specification), should be equally valued. There seems to be, however, an overwhelming amount of evidence pointing to the fundamental incorrectness of such a claim. Leaving aside the major class features which are necessarily universally employed since every language opposes consonants and vowels, we find that certain features are more "normal" or expected than others. For example, while not absolutely universal, most languages exhibit the features [voice] and [nasal] in association with consonantal segments. In addition to the major class features and place of articulation features, Rotokas (Firchow and Firchow 1969), a Papuan-Melanesian mixed language of New Guinea, makes use of only one distinctive feature, [voice], although in the Aita dialect the distinction is profitably viewed as utilizing only the feature [nasal]. On the other hand, relatively few languages employ features such as [implosive], [velaric], [breathy], etc. distinctively. That these facts are not merely accidental patterns of occurrence is demonstrated, for example, by their mirroring in child acquisition. The feature [velaric] is the last acquired by Zulu children. The question which needs to be asked is whether these are fortuitous regularities. We believe they are not. Garnica and Herbert (1976) have demonstrated via data from second
language learning and language loss that there is a hierarchy even among the "core" phonological features. Very few learning errors concern the features [nasal], [voice], [continuant], which are themselves ordered as above within the tentatively proposed hierarchy. However, the feature distinguishing /s/ from /z/ is often lost or "forgotten". These facts are mirrored not only in child acquisition, but in normal, i.e. through neglect, and pathological language loss, and in phonological patterning within linguistic systems. For a more complete discussion, see Garnica and Herbert (1976). The essential point here is that it is possible to establish a non-ad hoc feature hierarchy and, thus, this interpretation of orthogonal cannot be maintained.

4.2.2 Question of Subclass

Another commonly held belief in current phonological theory concerns not the theoretical universal independence of features but certain language specific constants. For example, it has already been mentioned that the use of the feature [delayed release] to account for affricates necessarily treats affricates as a subclass of oral stops. This falls out of our definition of affricates: they are essentially [-continuant] segments which become [+continuant] during articulation. If we want to treat affricates as a subclass of continuants, the feature [delayed release] is inappropriate; what we would need in such a case is not a feature characterizing the early release of primary stricture, but rather one referring to the late attainment of second degree stricture. Although affricates are a
subclass of stop consonants, they do indeed function with continuants occasionally. For example, there is the well-known case of the rule specifying the pronunciation of the English plural morpheme after nouns, which rule makes reference to the class of [+strident] consonants and therefore separate stops from affricates. Additionally, in some languages we find /mp, mb, nt, nd, nk, ng/ and /p, b, f, v, t, d, s, z, c, j, k, g, x/, i.e., continuants and affricates have no prenasalized counterparts. However we formalize the process responsible for this gap, it does not follow that affricates are [+continuant] segments, merely that this language singles out [-continuant] segments which are [-delayed release]. This is to be expected or we should have no need of a feature [delayed release]. It is conceivable, however, that some surface affricates, e.g. those derived from underlying continuants in contact with a nasal consonant, might warrant being specified as [+continuant]; in this case, it is best to regard the initial stop component as a non-pertinent fact of surface realization.

The corresponding problem for the class of prenasalized consonants concerns their relationship with other nasal segments within a linguistic system. Specifically, we are interested in whether prenasalized consonants are properly specified as a subclass or oral or nasal consonants. The question may seem at first an irrelevant or trivial one; it is, however, of crucial import for a theory of language change. We have already seen that some analysts propose to analyze prenasalized consonants as oral consonants with a nasal onset
whereas others, the majority, claim they are nasals with an oral release. The distinction is not an arbitrary one if prenasalized consonants function with one of the other class in phonological rules.

The reason for asserting that prenasalized consonants are necessarily a subclass of either nasal or oral consonants is a corollary of the phonological prerequisites for prenasalization presented in Chapter 2. Since only languages with at least one simple nasal exhibit prenasalized consonants, all such languages presumably have incorporated in the feature inventories the feature [nasal]. Thus, prenasalized consonants will necessarily be specified as either [+nasal] or [-nasal] segments. Again, this should not be an arbitrary fact of analysis, but is to be determined by the behavior of prenasalized consonants within the total language pattern. Hockett (1955:124) discusses the prenasalized voiced stops /md, nd, ng/ which figure in the consonant inventories of Fijian and Chatino. In the former case, no set of voiced stops occurs whereas /b, d, g/ do occur in Chatino. Hockett refers to the prenasalized consonants as mixed obstruent-sonorants and notes:

In neither case does there seem to be any justification for forcing the prenasalized voiceless [sic] stops into the classification of 'pure obstruents' or 'pure sonorants'.

Hockett is willing to consider a cluster analysis for Chatino, but not for Fijian. It is difficult to see how, using current feature theory, one can avoid "forcing/ prenasalized consonants into one or the other category."
It has already been mentioned that Bird (1971) considers the pre-
nasalized voiced stops of Mende as essentially oral stops because
the primary contrast in the language is between voiceless and pre-
nasalized stops and because no rule refers to the natural class of
nasals and prenasalized consonants. There are also various compa-
rative considerations. The evidence for regarding prenasalized
consonants as [-nasal] is not particularly compelling in general as
we shall demonstrate below. In fact, all of the cases which might be
used to support such an analysis which we have examined reduce to a
single type and exhibit a single natural phonetic process.

Several of the cases which might be used to posit an underlying
[-nasal] specification for prenasalized consonants involve nasal
prosodies. These are discussed in more detail in Chapter 5. It
suffices to point out here that most often in a situation of true nasal
prosody, i.e. where nasality once initiated in a word proceeds until
"checked", prenasalized consonants appear to behave as oral con-
sonants. In these cases, nasality is characteristic not of individual
segments but of larger phonological units.

In Sundanese (Robins 1962), vowels are nasalized after a nasal
consonant. This is an extremely common phonological process. However,
in Sundanese the nasality proceeds over segments until it is checked
or stopped by a supraglottal non-nasal consonant or a word boundary.
The specification supraglottal is necessary since [h, ʔ] do not check,
but rather transmit, nasality. Some example of this process are:
maneh [mânh] 'you'
maro [mâro] 'to halve'
fiar [fîr] 'to seek'
iis [nîs] 'to take a holiday'
kumaha [kumâhã] 'how?'
nahokôn [nãhkôñ] 'to inform'
bofhar [bõfhãr] 'to be rich'

However, prenasalized consonants do not transmit nasality:

mandi [mãndi] 'to bath'

Thus, we might argue that prenasalized consonants are essentially non-nasal consonants in Sunda, i.e. oral consonants with a nasal onset.

A parallel situation exists in Dayak (Scott 1964). In Land Dayak, nasality is not transmitted nor initiated by the prenasalized voiceless consonants:

sampêi 'extending to'
inceh 'is'
suntok 'in need of'
sungkoi 'cooked rice'
mpahit 'send'
ntakadn 'taste'

Malay and Sea Dayak also exhibit sequences of homorganic nasal and voiced plosive. These too serve to check nasality:

Malay: ŋmbun S.D.: embun 'dew'
gambar 'picture'
In Sea Dayak, the plosive element is often weak or even absent, but the checking of nasality indicates that the surface nasal does not correspond to an underlying simple nasal:

\[
\begin{align*}
nangga & /\text{nangga}/ [\ddot{\text{n}a}\ddot{\text{g}}a] \quad \text{'set up a ladder'} \\
nanga & /\text{nanga}/ [\ddot{\text{n}a}a] \quad \text{'straighten'}
\end{align*}
\]

In Land Dayak, nasal plus voiced plosive combinations do not occur, but it is necessary to distinguish a simple nasal from other consonants involving a nasal consonant.

In Malay, Sea Dayak, and Land Dayak, /m, n, η/ may occur in final position. However, in Land Dayak, the final nasal is sometimes preceded by a weak homorganic stop element:

\[
\begin{align*}
[p\ddot{o}\ddot{l}\ddot{a}\ddot{b}m] & \quad \text{'mango'} \quad (\text{cf. S.D. empelam}) \\
[k\ddot{a}\ddot{i}\ddot{d}n] & \quad \text{'cloth'} \quad (\text{cf. Mal., S.D. kain}) \\
[p\ddot{a}\ddot{d}a\ddot{g}n] & \quad \text{'field'} \quad (\text{cf. Mal, S.D. padang /padaŋ/})
\end{align*}
\]

The presence of the homorganic stop is conditioned by the nasality of the preceding syllable. If the final syllable is nasalized, then a nasal in final position is realized as a simple nasal. However, where the final syllable is not nasalized, a final nasal is realized with the homorganic stop preceding:

\[
\begin{align*}
\ddot{\text{tan}}\ddot{\text{in}} & \quad \text{'story'} \\
\ddot{\text{n}}\ddot{\text{an}} & \\
\ddot{\text{m}}\ddot{\text{i}}\ddot{\text{s}}\ddot{\text{i}}\ddot{\text{d}}\ddot{\text{n}} & \quad \text{'invite'} \\
\ddot{\text{pa}}\ddot{\text{dn}} & \\
\ddot{\text{pa}}\ddot{\text{t}}\ddot{\text{ud}}\ddot{\text{n}} & \quad \text{'song'}
\end{align*}
\]

In some cases, a surface simple nasal checks nasality. These correspond
to Malay and Sea Dayak nasal plus voiced plosive sequences:

[omudn] 'dew' Mal. ṭembun, S.D. embun
[monabm] 'sickness' mandam 'dizzy, intoxicated'
[una:gn] 'prawn' S.D. undang undan

These contrast with forms such as:

[†ona:n] 'arm' Mal. tangan tanan
[ponin] 'dizzy' pening pening
[†i:am] 'feeling'

The alternative analysis to classifying the prenasalized stops of Sundanese and Dayak as [-nasal, +prenasal] is, of course, to specify them as [+nasal] and note that nasality is not transmitted or initiated by [+nasal] segments which are [+prenasal]. This makes the process slightly more complex to formulate. If we ignore for the moment the fact that [h, ?] transmit nasality, we are left with the following alternatives:

i) prenasalized consonants as oral subclass:

\[ V \to [+nasal] / [+nasal] (V) \]

ii) prenasalized consonants as nasal subclass:

\[ V \to [+nasal] / [+nasal] \]

Thus, the former interpretation allows us to formalize this rule more simply in that one less feature is required. However, the basis of phonological analysis and description is not concerned with the ease of rule writing, i.e., one analysis is not preferable to another simply because it is easier to formalize. The goal, however unattainable, of
our analyses should be to capture what is psychologically real for the native speaker. The obvious analysis in the case of nasal prosody checked by prenasalized consonants is simply that the oral component of the prenasalized consonant serves to check nasality for the same reason that simple oral consonants do not transmit nasality, viz. the velum is completely raised during the articulation of an oral consonant. This is a natural phonetic explanation; once the velum is raised, or programmed to be raised, for no matter how short a period, it is not lowered again until nasality is reinitiated by another nasal. That prenasalized consonants are [+nasal] segments would seem to be indicated by those cases in Land Dayak which correspond to Sea Dayak nasal plus voiced plosive. If we were to analyze prenasalized consonants as a subclass of oral consonants because they check nasality, we are left with an analysis which treats the medial nasals in forms such as [umudn], [monabm], etc. as [-nasal] which is clearly counter-intuitive. However abstractly we wish to characterize these segments, they remain nonetheless surface nasals which do not transmit nasality. The process governing the insertion of a homorganic stop element before a final nasal in non-nasal syllables is basically a protective environmental shielding process. It is treated in detail in Chapter 8, which deals with the processes of origin of prenasalized consonants. It suffices to say here that since the final nasal is in the same syllable as a non-nasal vowel, there is a risk of vowel nasalization due to the final nasal; typically, vowels nasalize in the same syllable as a nasal consonant, especially a final nasal. If the vowel in [umudn]
were to nasalize, Land Dayak speakers could not distinguish [m] which corresponds to Sea Dayak [m] from that which corresponds to [mb]. Since the underlying consonant distinction is neutralized in surface realization, its distinctive role is transferred to the vowel. A slight non-coordination of the velum with the other articulators will result in vowel nasalization; a short (weak) homorganic stop is inserted as a protective buffer.

Similarly, in Kongo certain assimilations conditioned by a preceding nasal are not conditioned by prenasalized stops (Meinhof 1932: 180-1). For example, the /l/ of certain suffixes is pronounced [n] when the preceding syllable contains a nasal consonant:

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
<th>Realization</th>
</tr>
</thead>
<tbody>
<tr>
<td>tana</td>
<td>'rob'</td>
<td>/tan + ila/</td>
</tr>
<tr>
<td>soma</td>
<td>'thread a needle'</td>
<td>/som + ula/</td>
</tr>
<tr>
<td>koma</td>
<td>'chain up'</td>
<td>/kom + ele/</td>
</tr>
<tr>
<td>tina</td>
<td>'run'</td>
<td>/tin + ili/</td>
</tr>
</tbody>
</table>

However, these assimilations do not obtain when the preceding consonant is a prenasalized consonant:

<table>
<thead>
<tr>
<th>Word</th>
<th>Meaning</th>
<th>Realization</th>
</tr>
</thead>
<tbody>
<tr>
<td>komba</td>
<td>'sweep'</td>
<td>/komb + ele/</td>
</tr>
<tr>
<td>ßanga</td>
<td>'do'</td>
<td>/ßang + ila/</td>
</tr>
</tbody>
</table>

One way to analyze these facts is to claim that prenasalized consonants are specified as [-nasal], which we have already claimed is counter-intuitive. Alternatively, the rule could be formulated so as to apply to [+nasal] segments which are [-prenasalized]. Or, we could again make reference to the ordering of phonetic sequences as we did in our analysis of nasal prosody above; this distinction seems
arbitrary, however. That this latter analysis is incorrect is demonstrated by the fact that the assimilation takes place when the nasal is not in the syllable immediately preceding the suffixal element:

\[
\text{soneka 'write'} \quad \text{sonekana /sonok + ela/}
\]

Thus, the only acceptable analysis for the present seems to be that the rule is conditioned by segments which are \([+\text{nasal}]\) and \([-\text{preanalized}].\) We return to these data again in Section 4.3.

An interesting comparison with the Sundanese and Dayak data is provided by Berry's (1955) analysis of Nzema. Nzema exhibits a particular type of consonant mutation which is unique in Akan. The primary consonant systems which Berry posits is:

\[
\begin{align*}
\text{Nzema} \\
p & t & k \\
b & d & g \\
m & n & \eta \\
f & s & \gamma \\
w & y
\end{align*}
\]

which consonants may have a number of different phonetic realizations. These realizations are themselves morphologically conditioned. Some examples of the mutations are:
<table>
<thead>
<tr>
<th>Underlying</th>
<th>Unprefixed</th>
<th>M-prefix</th>
<th>H-prefix</th>
</tr>
</thead>
<tbody>
<tr>
<td>/b/</td>
<td>b-</td>
<td>mm-</td>
<td>aw-</td>
</tr>
<tr>
<td>/t/</td>
<td>t-</td>
<td>nd-</td>
<td>ad-</td>
</tr>
<tr>
<td>/d/</td>
<td>d-</td>
<td>nn-</td>
<td>al-</td>
</tr>
<tr>
<td>/k/</td>
<td>k-</td>
<td>ng-</td>
<td>ah-</td>
</tr>
<tr>
<td>/ky/</td>
<td>tŋ-</td>
<td>ndʒ̄-</td>
<td>ac̄-</td>
</tr>
<tr>
<td>/n/</td>
<td>n-</td>
<td>nn-</td>
<td>anl-</td>
</tr>
<tr>
<td>/l/</td>
<td>f-</td>
<td>mv-</td>
<td>av-</td>
</tr>
<tr>
<td>/v/</td>
<td>y-</td>
<td>mm-</td>
<td>ay-</td>
</tr>
</tbody>
</table>

Additionally, Berry notes that in a root all vowels are either nasal or oral; he therefore wants to abstract nasality as a prosodic feature which is characteristic of larger-than-segment units. This analysis is given some justification by the behavior of nasality in reduplicated forms:

\[ [k\text{a}] 'say' \rightarrow [k\text{YhN}] \]

"where both vowels and the h are nasal." In addition to implying that all vowels of a root will be nasal, the nasal prosody also means that the medial root consonants will be realized as nasalized consonants or prenasalized consonants. Thus, the underlying representations:

\[ /'kaka/ \quad \text{[kYhN]} \]
\[ /'fufu/ \quad \text{[fʊŋvʊ]} \]

In these cases, prenasalized consonants apparently transmit nasality in a way that the prenasalized consonants of Sundanese and Dayak do not. Of course, the two types of cases are not really comparable.

In Nzema, nasality must be abstracted as an independent variable
whereas in Dayak it is initiated by underlying nasal segments. Also, it is perhaps not too profitable to regard the prenasalized consonants of Nzema as transmitting nasality. Rather, the prenasalized consonants, which are underlying oral consonants, function as if they were "nasalized" equivalents of the oral consonants in a way that nasalized vowels are the equivalent of oral vowels in a nasal context.

Of course, it is theoretically possible that prenasalized consonants are treated as a subclass of oral consonants in some languages and as a subclass of nasal consonants in others. This is not a felicitous situation, however, since we prefer to believe that there are some universal considerations which govern such factors. The cases which we examined above that might be used to argue for a [−nasal] specification for prenasalized consonants are not particularly convincing. Even if it were demonstrably true that prenasalized consonants were [+nasal] in some cases and [−nasal] in others, we might be able to salvage our belief in underlying systematicity if we could discover some regularity governing their classification as such.

Myers (1974:30) notes that there is a wide degree of phonetic variation within the class of segments termed prenasalized consonants. She cites the example of Kikuyu where the nasal element is of very short duration so that prenasalized stops sound very much like oral stops. This contrasts with the prenasalized consonants of Kisi, a Mel language of West Africa, where the duration of the nasal is much longer and the prenasalized consonant is almost indistinguishable from a simple nasal. We treat this variation as part of language-specific
realization rules. That such variation is not the result of underlying relations which differ from one language to another may be demonstrated, for example, by dialect variation in Scottish Gaelic (Borgström 1940). In the groups nasal plus voiced occlusive, the occlusive is generally reduced in most dialects, e.g. that of certain areas of Lewis, to the point of often disappearing entirely:

am bata 'the boat' [(o)m^a:h+{e}] [(o)ma:h+{e}], an gille 'the lad' [(o)n^a:IL'ø] [(ø)n'IL'ø]. However, in the southern Hebridean dialects, it is the occlusive which dominates and the nasal is severely reduced. In allegro speech, the nasalized form is hardly different from the non-nasalized form: [(ø)^m ba:htø] [(ø)^n g'IL'ø].

It will be shown in Chapter 7 that there are a number of distinct processes which give rise to prenasalized consonants. If it could be demonstrated that prenasalized consonants that arise by a series generating component function as [-nasal] segments and those which arise from a juxtaposition of nasal and oral consonants were [+nasal], no problems are posed for our theory. As Greenberg (1966a:514) notes:

We may expect that languages which belong to the same typological classes on very general criteria may by more specific criteria show similarity or difference, depending on whether the more general phenomenon arises by the same diachronic process or not.

Although this appears to be possible to a limited extent, e.g. prenasalized consonants which arise by a series generating component of prenasalinity generally function as oral consonants, there are various problems. If we attempt to force prenasalized consonants into a classification of [+nasal] and [-nasal] segments, very closely
related members of the same language family would appear to categorize
them differently.

For example, there is a phonological process operative in a rather
restricted group of Eastern Bantu languages known as Dahl's Law. The
effect of this process is basically that a sequence of syllables
beginning with voiceless plosives are dissimilated and the first
plosive is realized as [+voice], e.g. Nyamwezi:

- gathl (*-katl) 'in the middle'
- dathu (*-tatu) 'three'
- bitha (*-pita) 'pass'

Bennett (1967) has shown that there is fairly extensive variation from
language to language in terms of which voiceless stops are dissimilated
and which sounds condition the change. There are also variations which
are irrelevant for the present discussion concerning the operation of
the process across prefix and suffix boundaries.

Among the Thaglic languages, only /k/ is affected by the voicing
process in S. Kikuyu and its application is conditioned by /ɓ (/*ɓ), t, c, k/.
In Embu, the operation of Dahl's Law is that same except that
/ɓ/ does not condition the dissimilation. The point of interest here
comes from languages like Mvimbi and Tharaka, where the process affects
and is conditioned by prenasalized voiceless stops as well as by
simple voiceless stops. In Tharaka, /k, mp, nt, ɓk/ are voiced when
the next syllable begins with /t, c, k, nt, ɓk/ and probably /mp, nc/
as well. The operation of the process is much the same in Mvimbi
except that /nt/ is not affected, so we have comparative forms such as:
Gusii, a non-Thagicul language, shows only /k/ and /ŋk/ affected and
the change is conditioned by /t, s, c, k, nt, ns, nc, ŋk/.

The problem posed by these latter cases involving prenasalized
consonants is that if we posit a unit analysis for such sounds, we are
forced into characterizing them as [-nasal] segments, i.e. as a sub-
class of voiceless oral consonants. Thus, the process known as Dahl's
Law is basically to be formulated as:

\[
\text{Dahl's Law} \\
\begin{align*}
C &\rightarrow [+\text{voice}] / \quad V [-\text{voice}] \\
\end{align*}
\]

and the feature specification for the prenasalized voiceless consonants
would be [-nasal, -voice, +prenasal]. This is clearly counter-
intuitive. In those languages where prenasalized consonants are not
involved, the rule is the same, but the prenasalized consonants are
specified as [+nasal]. Note that in these cases we cannot offer the
alternative analysis which we did for the Dayak and Sundanese data
making reference to the order of components. That is, in the Sundanese
case we were able to claim that the nasality was transmitted until the
oral component of the prenasalized stop. Vowels following pre-
nasalized consonants were not nasalized because the component nearest
to them was not nasal. Adopting Campbell's (1974) complex symbol
proposal, the process merely affects that part of the matrix nearest
to the conditioning segment. However, such a reanalysis is not
possible in the Dahl's Law case since when a prenasalized consonant
conditions the dissimilation, the matrix further from the affected sound is that which conditions. The supposedly syllable-initial nasal component is irrelevant for the operation of the rule, i.e., the rule "skips over" that part of the matrix. This is problematic since, if we allow such "matrix skipping", it becomes unclear what the real status of complex symbols as opposed to a sequence of independent symbols might be. In this regard, complex symbols seem largely ad hoc and unmotivated.

The analysis which we shall ultimately propose for prenasalized consonants can distinguish between languages where prenasalized consonants are involved in the operation of Dahl's Law and those where they are not. Briefly, prenasalized consonants are treated not as underlying units but as underlying sequences. Therefore, the question of an underlying feature specification for prenasalized consonants does not arise. Evidence will be presented demonstrating that the distinction in the operation of Dahl's Law is motivated by the order of the rule's application relative to processes whereby underlying nasal plus oral consonantal sequences are "unified" into single phonetic elements. In Tharaka, Dahl's Law applies before this unification while the nasal component of the future prenasalized consonant is not syllable-initial, but rather syllable-final within the preceding syllable. After unification, the nasal and oral components function as a single syllable-initial segment. In those languages where Dahl's Law does not involve prenasalized consonants, it is ordered after the processes uniting the components and thus applies when there is no
longer a syllable-initial voiceless plosive to condition the change. This distinction is not a trick of analysis. The motivation and justification for our notion of component unification of underlying clusters is presented in Chapters 5 and 6.

We made mention in Section 3.4 to another phonological process operative in Eastern Bantu known as Meinhof's Rule. This process is traditionally treated as a nasal compound dissimilation rule. It is on the basis of the operation of this rule in Kikuyu that Myers (1974 Ms) classifies the prenasalized stops of Kikuyu as [+nasal] segments. We have already pointed out that this process is properly analyzed not as a dissimilation process, but as an assimilation in nasality of the oral component of the first of the sequence of prenasalized consonants. In fact, Meinhof's Rule provides evidence for a cluster analysis of prenasalized consonants (Herbert 1975, 1976c).

In its most general form, Meinhof's Rule causes a prenasalized voiced stop to be realized as a simple nasal or geminate nasal when the following syllable begins with a prenasalized consonant. In some languages, e.g. Kikuyu, the process is conditioned not only by prenasalized consonants, but by simple nasals as well. Because these two sound types function together, they are both classified by Myers as [+nasal] with the former as [+early velar closure]. In fact, however, this process actually provides no conclusive evidence since, as a natural assimilatory process, the rule could simply make reference to the component nearest the assimilated segment. Thus, the rule refers to the first column of a complex matrix as proposed by Campbell (1974)
or to the leftmost element of a nasal–oral cluster. No conclusive evidence in favor of classifying prenasalized consonants as a subclass of nasal consonants is thus presented by these data.

4.2.3 Conclusion

In the preceding sections of this chapter we have examined various pieces of evidence in support of treating prenasalized consonants as a subclass of oral or nasal consonants. We argued that analyzing them as a subclass of oral consonant was counter-intuitive and that the arguments in favor of such an analysis were un-compelling. The data in each case allowed reinterpretation so that we had only to make reference to the relative order of the nasal and oral components or, in the case of Dahl's Law, to an otherwise motivated syllable boundary between the two components of prenasalized consonants. The evidence in favor of this latter analysis is forthcoming in Chapter 5. The traditional view of prenasalized consonants is that they are essentially a subclass of nasal consonants. This is the view expressed by Ferguson (1966) wherein he treats them as a type of secondary nasal consonant. Haudricourt (1970) classes prenasalized and postnasalized consonants together as *consonnes demi-nasales*. Bouquiaux (1973) uses the term *mi-nasale* for prenasalized consonants. We mentioned in Chapter 2 that the term *nasal compound* is often used synonymously with *prenasalized consonant*. All of the above terms suggest that the nasality is regarded as the primary characteristic of the segment. There certainly exist cases where prenasalized and ordinary nasal consonants seem to function as a natural
class, e.g. Meinhof's Rule in Bantu. However, we argued that these cases to not provide a conclusive demonstration of the underlying specification [\text{+nasal}] for prenasalized consonants since, again, alternative analysis is available. We prefer to use the term nasal-oral sequence when speaking in terms of underlying representation precisely because this term is ambiguous between a unit and a cluster analysis. We argued in Chapter 3 against an underlying unit analysis of prenasalization. Our analysis of the nasal vs. oral subclass question is that when prenasalized consonants function as a subclass, it will be as a subclass of nasal consonants, but at a deeper level of representation they are properly analyzed as clusters and therefore this question is without meaning or import at that level.

4.3 Phonetic Vector Specifications

4.3.1 Consonant Incompatibility

The behavior of prenasalized consonants in the system of consonant incompatibilities in Ngbaka, a Niger-Congo language of West Africa described by Thomas (1963), further suggests that they are not to be analyzed as nasal consonants uniquely. Ngbaka exhibits only prenasalized voiced consonants /mb, nd, nz, ng, Ngb/. The complete consonantal system is:
Thomas notes that there are certain types of incompatibilities of consonants within words. For example, voiced and voiceless consonants of the same point of articulation and same degree of stricture never appear in the same word:

\[
\begin{align*}
p/b, t/d, s/z, k/g, kp/gb \\
b/p, d/t, z/s, g/k, gb/kp
\end{align*}
\]

so that no word contains the sequences *pVb, *bVp, *sVz, etc.

Additionally, a prenasalized consonant and voiced consonant may not appear within the same word if they are of the same point of articulation:

\[
\begin{align*}
mb/b, nd/d, nz/z, ng/g, ngb/gb \\
b/mb, d/nd, z/nz, g/ng, gb/ngb
\end{align*}
\]

The generalization so far would appear to be that consonants are not compatible if they are of the same point of articulation and differ in
another feature specification, e.g. [voice], [nasal]. However, pre-
nasalized consonants are also incompatible with nasal consonants:

\[
\begin{align*}
mb/m, nd/n, nz/n, \eta g/\eta, \eta gb/m \\
m/mb, n/nd, n/nz, \eta/\eta g, m/\eta gb
\end{align*}
\]

These further data might suggest that if it is agreement in feature
specification which determines the acceptability of consonant
sequences in Ngbaka, prenasalized consonants are not only [+nasal] to
determine their incompatibility with voiced oral consonants, but also
differ in their nasal specification from simple nasal consonants. The
question which then arises is whether this is necessarily an under-
lying feature or possibly a phonetic one. We see no way to decide this
question based on the material available in Thomas' description.

The only other incompatibility which occurs in Ngbaka concerns
the labials and labio-velars:

\[
\begin{align*}
p/kp, gb, ngb & \ b/kp, gb, ngb \ \ mb/kp, bg, \eta gb & \ m/kp, gb, ngb \\
kp/p, b, mb, m & \ gb/p, b, mb, m & \ ngb/p, b, mb, m
\end{align*}
\]

Also, the incompatibility between prenasalized labio-velars opposes
them to labial nasals as above: \(\eta gb/m, m/\eta gb\). What is interesting from
this latter type of incompatibility is that the labial articulation
of labio-velars is primary and that no parallel incompatibility
exists between velars and labio-velars. Traditionally, the two
articulations are regarded as equal. We should expect, therefore, that
if labio-velarity were a vector feature as prenasalization, there
should be incompatibility with both the labial and velar series.
The consonant incompatibilities of Ngbaka are interesting for several reasons. First, they involve only consonants of the same point of articulation — if we analyze labio-velars as essentially labial articulations. However, certain consonants of the same point of articulation are compatible, e.g., voiceless consonants are compatible with all other consonants except their voiced counterparts so that, for example, pVm, pVmb, mVp, mbVp are acceptable sequences. We might schematize the incompatibility for a given series as:

```
| t | d | nd | n | nz | z | s |
```

and note that contiguous consonants are incompatible whereas all non-contiguous pairs represent acceptable sequences. If we attempt to state the generalization involving incompatible consonants in feature terms, we find there is no truly elegant manner to do so given our current features:

```
<table>
<thead>
<tr>
<th>t</th>
<th>d</th>
<th>nd</th>
<th>n</th>
<th>nz</th>
<th>z</th>
<th>s</th>
</tr>
</thead>
<tbody>
<tr>
<td>-voi</td>
<td>+voi</td>
<td>+voi</td>
<td>+voi</td>
<td>+voi</td>
<td>+voi</td>
<td>-voi</td>
</tr>
<tr>
<td>-nas</td>
<td>-nas</td>
<td>+nas</td>
<td>+nas</td>
<td>+nas</td>
<td>-nas</td>
<td>-nas</td>
</tr>
<tr>
<td>-pren</td>
<td>-pren</td>
<td>+pren</td>
<td>-pren</td>
<td>+pren</td>
<td>-pren</td>
<td>-pren</td>
</tr>
<tr>
<td>-cont</td>
<td>-cont</td>
<td>-cont</td>
<td>-cont</td>
<td>cont</td>
<td>+cont</td>
<td>+cont</td>
</tr>
</tbody>
</table>
```

Specifying the prenasalized consonants as [+nasal] and using an ad hoc feature [prenasal] to account for prenasalization, the statement of incompatibilities is:

1. consonants which agree in all feature specifications except [voice] are incompatible

2. consonants which agree in their [voice] specification but differ in their [prenasal] specification are incompatible if they agree in their continuant specification.
There is an immediately apparent problem with the specification of /nz/ as [-continuant]. Clearly, /nz/ involves a vectoring or changing value for this feature during its articulation. Using purely binary specifications, we have the alternative of specifying prenasalized continuants as either [+cont] or [-cont], neither of which alternative is intuitively appealing. The use of ad hoc features is not considered a viable solution to the problem.

It seems to us that an attractive solution to this problem is to adopt a modification of the complex symbol proposal. Instead of multicolored matrices, however, we opt here for vectoring, i.e. changing, feature specifications. It is to be noted that vector specifications are quite a different matter from vector features such as that proposed by Myers. Vector specifications make use of ordinary, motivated features and incorporate the same information as an ad hoc feature posited to account for the movement of articulators within a single segment. Thus, for example, the continuant specification for /nz/ would be [-→+cont]. This proposal also does away with the need for multicolored matrices, which were not properly motivated and which presented problematic theoretical implications. We shall also use vector specifications to account for the nasality specification of prenasalized consonants:

\[
\begin{align*}
\text{t} & \quad \text{d} & \quad \text{nd} & \quad \text{n} & \quad \text{nz} & \quad \text{z} & \quad \text{s} \\
\text{-voi} & \quad \text{+voi} & \quad \text{+voi} & \quad \text{+voi} & \quad \text{+voi} & \quad \text{-voi} \\
\text{-nas} & \quad \text{-nas} & \quad \text{→nas} & \quad \text{→nas} & \quad \text{→nas} & \quad \text{-nas} \\
\text{-cont} & \quad \text{-cont} & \quad \text{-cont} & \quad \text{-cont} & \quad \text{-cont} & \quad \text{+cont}
\end{align*}
\]

The statement of consonant incompatibilities in Ngbaka is now as follows:
1. Consonants of the same point of articulation are incompatible if they agree in all their feature specifications except [voice].

2. Consonants which agree in their [voice] specification will be incompatible if they also agree in the specification [nasal] and [cont].

It is necessary to state that a vector specification agrees with both plus and minus specifications. This seems to us intuitively correct insofar as a vector specification is composed of both + and – values.

The Ngbaka incompatibilities are also interesting because they involve not identical, but only near-identical, consonants. Many languages seek to avoid sequences of identical consonants by dissimilation. In many languages, sequences of identical and near-identical consonants are both non-favored. Ultimately, the correct statement of the Ngbaka incompatibilities would seem to rely on a statement of feature hierarchies; the non-compatible consonants involve only two features [voice] and [nasal], which features seem to function frequently in assimilation and dissimilation.

Vector specifications function at times in opposition, rather than agreement, with simple + and – specifications. An example of this opposition is forthcoming from a reanalysis of the Kongo l → n assimilation described in Section 4.2.2. It was stated then that the /l/ of certain suffixes is pronounced [n] when a preceding syllable, not necessarily immediately preceding, contains a simple nasal consonant. However, the assimilation is not conditioned by a preceding prenasalized consonant. In our previous discussion we stated that the assimilation is conditioned by segments which are [+nasal, -prenasal].
We expect, however, that nasal assimilation would be conditioned by all segments which are [+nasal] if phonological features are truly independent units. If we opt for a [+-nasal] specification for prenasalized consonants, the problem is resolved since we do not expect prenasalized consonants to condition the assimilation as they are no longer specified as [+nasal]. This sort of consideration plus the Ngbaka data discussed above would seem to argue for the naturalness of vector specifications. As we mentioned earlier, however, the use of a device such as a vector specification makes theoretical claims beyond the scope of this present work.

Another advantage of vector specifications is that they avoid the question of subclass for prenasalized consonants since the feature specification for [nasal] is both + and -. This specification enables us to capture the generalization that rules most often apply to the specification component nearest to the conditioning element. As we mentioned in our discussion of Dahl's Law, this is not always the case since some rules apply before those processes which produce vector specifications. It must be remembered that at the most remote level of phonological representation, feature values are only + and -.

4.3.2 Diachronic Developments

A vector specification does away with the need for an ad hoc feature such as [prenasalized] since that information which the feature is designed to express is contained in the vector specification itself. We pointed out above that one of the most problematic considerations insofar as a feature [prenasalized] is concerned is its relationship
with the feature [nasal]. We saw that the development of prenasalized consonants diachronically into both nasal and oral consonants was problematic, especially when both developments occur within the same language system. For example, Mbole shows the following development of the Bantu prenasalized consonants:

*mp > f
*nt > t
*ŋk > k
*mb > m
*nd > n
*ŋg > ŋ

Of course, many languages exhibit parallel development of the prenasalized consonants into either all oral or all nasal segments. In fact, in a few languages, the voiced and voiceless series merge into a single series. In some cases, either the voiced or voiceless series exhibits stable prenasalization while the other undergoes some change. For example, in Venda we observe the following developments (Ziervogel and Dau 1961:20):

*mp > ph
*nt > th
*ŋk > kh
*mb > mb
*nd > nd
*ŋg > ŋg

The voiceless series exhibits development into oral consonants more
often than the voiced series does. Presumably, this might be due to the feature specification [-voice] and the low tolerance in many languages for voiceless nasals although they certainly occur in some Bantu languages. The full range of processes affecting prenasalized consonants will be surveyed in Chapter 8. It is interesting to note here, however, that even within a closely related group of languages we find alternative developments of the prenasalized voiceless consonants, e.g. among the Wambo languages of South West Africa and Angola (Baucom 1974) we find:

<table>
<thead>
<tr>
<th></th>
<th>Ndongo</th>
<th>Dombondola</th>
<th>Evale</th>
</tr>
</thead>
<tbody>
<tr>
<td>*mp</td>
<td>*mp</td>
<td>*p</td>
<td>*p</td>
</tr>
<tr>
<td>*nt</td>
<td>*nt</td>
<td>*t</td>
<td>*t</td>
</tr>
<tr>
<td>*qk</td>
<td>*qk</td>
<td>*k</td>
<td>*k</td>
</tr>
</tbody>
</table>

The point here is that we can characterize all these developments quite naturally by means of a vector specification. That is, we can express the Mbole developments formally as:

\[
\begin{align*}
\text{[+nasal]} \\
\text{[α voice]} \rightarrow \text{[α nasal]}
\end{align*}
\]

which says that the prenasalized voiced consonants develop into [+nasal] consonants and the voiceless series into [-nasal] segments. This is surely a much more satisfying characterization than that which we can provide with the features [nasal] and [prenasalized]:

\[
\begin{align*}
\text{[+prenas]} \\
\text{[α voice]} \rightarrow \text{[α nasal]}
\end{align*}
\]

[-prenas]

By satisfying or natural, we do not mean requiring less features to formalize. That a \(\Rightarrow\) specification should develop into [+nasal] in
some cases and [-nasal] in others is a natural consequence of its partaking of both values. Thus, the above schema expands to read:

\[
\begin{align*}
\text{[+nasal]} & \quad \rightarrow \quad [+\text{nasal}] \\
\text{[-voice]} & \quad \rightarrow \quad [-\text{nasal}] \\
\end{align*}
\]

and both developments are characterized as equally natural changes. On the other hand, a feature such as [prenasalized] as a subclass feature within the class of nasal consonants provides the following:

\[
\begin{align*}
\text{[+prenas]} & \quad \rightarrow \quad [-\text{prenas}] \\
\text{[-voice]} & \quad \rightarrow \quad [-\text{nasal}] \\
\end{align*}
\]

i.e., the Mböle changes cannot be described in terms of the simple loss of an underlying feature [prenasalized]. The use of a marking or interpretation rule which will specify [-voice] segments which become [-prenas] as [-nasal] does not really solve the problem, but merely relegates it to another section of the grammar. Similarly, it is bothersome that those languages which exhibit development of all prenasalized consonants into oral consonants, e.g. Pedi (Meinhof 1932):

\[
\begin{align*}
*mp & \rightarrow \text{ph} \\
*n\text{t} & \rightarrow \text{th} \\
*g\text{k} & \rightarrow \text{kx} \\
*mb & \rightarrow \text{p}^\text{?} \\
*nd & \rightarrow \text{t}^\text{?} \\
*ng & \rightarrow \text{k}^\text{?} \\
\end{align*}
\]

cannot be characterized as simply losing the feature [prenasalized]
since the loss involves a change in the specification for [nasal] or the prenasalized consonants need to be specified as [-nasal] which is, we have claimed, counter-intuitive. Our analysis treats such changes as entirely natural -- which indeed they must be.

This same characterization is true of the multicolumned matrix approach proposed by Campbell (1974) and Sasse (1976). (Cf. Section 4.1.2.) This similarity follows from the fact that both treatments make use of primary features such as [nasal] to account for complex sound types. An important distinction between the two approaches is that vector specifications are phonetic whereas multicolumned matrices are proposed for all levels of analysis. At the underlying level, prenasalized consonants are clusters and multicolumned matrices are therefore inappropriate representations. There are more general theoretical problems with the multicolumned matrix approach, which prevents its incorporation into phonological theory.

4.4 Summary

In the present chapter, we have examined the question of whether prenasalized consonants are properly analyzed as a subclass of oral or nasal consonants on a universal basis or whether this is an issue which needs to be decided independently for each language. The latter might seem like an intuitively correct claim, but in this case we arrive at the conclusion that prenasalized consonants are oral consonants in some languages, nasal consonants in others, and both oral and nasal consonants in still others. In the course of our exposition, we demonstrated that the question of subclass is not
necessarily a pressing one since various alternative analyses of data are available which allow us to avoid the question entirely.

In Chapter 3, we argued that there existed no underlying feature [prenasalized] which can be used to account for prenasalized consonants. From this it would appear to follow that the question of subclass is meaningless at the underlying level. The real evidence for this claim will be presented in the succeeding chapters. However, in the preceding discussion, we have demonstrated that an ad hoc feature is not necessary even at the more surface level. By dispensing with the feature [prenasalized] and supplanting it with a motivated vector specification, we effectively do away with the problem of subclass at the phonetic level as well.¹⁰ We do not think that such vector specifications are an ad hoc trick of analysis; certainly no other analysis seems capable of adequately dealing with the data presented.

We also examined the various feature proposals which have been put forward to account for prenasalized consonants. We saw that each proposal embodies certain problems or was simply lacking in supporting evidence. However, our analysis does away with the question of which feature to use in representing prenasalized consonants not only at the underlying level, but at the phonetic level as well. Thus, in the course of the past two chapters, we have attempted to establish that two of the most vexing problems involving prenasalized consonants for a theory of phonology are actually non-problems in that we do not need a feature to account for prenasalization at any level and the problem of subclass is simply without meaning under our analysis.
NOTES

1 This is the view again expressed by Halle in his 1974 class lectures at the Linguistic Institute, University of Massachusetts, Amherst.

2 In fact, the term 'delayed release' seems to us a misnomer since what characterizes affricates in this regard is not really delayed release, but rather early release of primary stricture. Ladefoged (1971:106) points out that because they have no special feature for fricatives, Chomsky and Halle (1968) are forced into the ridiculous position of having to specify all continuants as [+delayed release]. Thus, [s, s, ts, tʃ] are all [+delayed release] as are all vowels and approximates. We agree with Ladefoged's criticism that it makes no sense to speak of [i, ɪ, ɾ, s, ʃ] as being characterized by turbulence during release. Therefore, the opposition delayed vs. instantaneous release will be applied only to oral stops within this work.

3 The historical morpheme division is often not transparent in proper names, e.g. Radnor, Palmer, etc.

4 Cf. also Krohn (1972). The actual notion of multicoloured matrices was earlier proposed by Hoard (1971). This corresponds to the general fact that segments may have internal structure, a notion with a much longer history in linguistics. Sasse's contribution is actually contemporary with Campbell's, but it appeared much later due to publication reasons. In many respects, it is more comprehensive and satisfying than Campbell's treatment. Some of the sound types which Sasse proposed be represented by multicoloured matrices are: palatalized, rounded, velarized, glottalized, aspirated, prenasalized, apicalized consonants, affricates, labiovelars, long consonants and vowels, nasal vowels, etc. It is noted that many of these sound types derive from sequences which are fused into single units. For example, glottalized consonants may correspond to historical sequences of oral consonant plus glottal stop, e.g. Austronesian b'uk < *buʔuk 'hair'. The notion of fusion is examined in greater detail in Stahlke (1976) and Herbert (1977b).

5 Obviously, the multicoloured matrix has definite advantages in terms of formally capturing types of phonological relationships. For example, the changes * th > ts, * f s > ʃ t, * p w > pf, * m h > m, etc. are all somewhat problematic within a standard generative framework. However, they are all easily dealt with in the multicoloured representation. Similarly, multicoloured matrices can represent the various developments of prenasalized consonants, e.g. * m b > b, * m b > m, * m b > mm very neatly. These changes are examined in greater detail in Section 4.3.2.
6 Ladefoged (1971:25) notes that voiceless implosives, i.e., sounds produced with a downward movement of the glottis with the vocal folds held tightly together, occasionally occur, e.g., Tojolabal. This type of sound is very rare, however.

7 Cf. footnote 2 above.

8 The exception to this generalization is presented by those prenasalized consonants which are underlying oral consonants and become prenasalized by a series generating component of prenasalization.

9 An alternative way of stating this generalization is to claim that a single consonant will be incompatible with any complex of which it forms a part.

10 The issue of whether a phonetic feature [prenasalized] exists is a very different issue from that of whether such a phonological feature might exist. The demonstration that one does not exist, insofar as it is possible to demonstrate such non-existence, does not imply that the other does not. Vennemann and Ladefoged (1971) argue explicitly that two sets of features are necessary to specify the phonological component of language and its phonetic output. The number of phonological features is much smaller; these are the so-called "prime" features, which are definable in terms of acoustic or physiological properties, when these are measurable. In addition, there are "cover" features which represent disjunctions of values of related prime features. Such a proposal might be extended to distinguish simply between underlying and derived features.
CHAPTER V

PHONETIC EVIDENCE FOR A CLUSTER ANALYSIS

5.0 Introduction

We have already put forward several times in the course of this work the thesis that prenasalized consonants do not appear as such at the level of underlying representation in any language. The evidence which we have cited in support of this claim has been largely fragmentary. In Chapters 3 and 4, we attempted to demonstrate that the evidence in support of underlying prenasalized consonants on a phonological plane was at best un compelling. On the one hand, we examined the question of underlying unity for prenasalized consonants and saw that some data clearly warrant an underlying cluster interpretation. We then examined the various feature proposals which have been put forward to account for prenasalized consonants. These features were shown to be problematic because of difficulties inherent in the individual features; the real difficulty, however, lies in trying to force prenasalized consonants into any feature analysis. It was shown that in terms of surface phonetic features, a vector specification seems most attractive. The question remains whether such feature specifications exist at the underlying level or whether we need to recognize a sequence of independent specifications which correspond to an underlying cluster. It has already been mentioned
that we will ultimately opt for a cluster analysis for prenasalized consonants; we believe that vector specifications are wholly phonetic in nature. Therefore, the responsibility lies with us to provide a motivated explanation for the derivation of underlying clusters into surface units, which prenasalized consonants certainly are. The processes responsible for this derivation will be described in Chapter 6. In the present chapter, some of the more purely phonetic data which will be cited in support of our analysis will be reviewed. This evidence and the phonological considerations already discussed form the basis of our claim that prenasalized consonants are never underlying phenomenon on a universal level.

The evidence which we will consider in this chapter attempts to demonstrate that prenasalized consonants are responsible for certain phonetic alternations which are not explainable if prenasalized consonants were underlying units. If prenasalized consonants had the same status as other underlying consonants, the extraordinary behavior which they elicit cannot be explained. We have already mentioned one type of data which points to the extraordinary status of prenasalized consonants, i.e. the facts of their distributional limitations. If prenasalized consonants were "ordinary" consonants except that they were specified as [+prenasalized], why should they be barred from C₁ position in radicals and stems in Nzëbi, for example? Why are they barred from final position in Evondo? The explanation which we shall offer for these limitations is that underlying clusters occur more commonly in medial than in initial or final
position. Prenasalized consonants are underlying ambisyllabic phenomena and therefore occur at the juxtaposition of two underlying syllables.

The major evidence to be considered now relates to the interaction of prenasalized consonants with other segments, especially immediately preceding vowels, in a way which warrants principled explanation. Specifically, we will show that certain phonetic facts are explainable only if we posit a close underlying relationship between prenasalized consonants and the vowels which they follow. The evidence which we cite will make reference to four types of phonetic data:

1. vowel quality
2. vowel nasality
3. vowel quantity
4. syllabic alternations

We shall claim that the extraordinary surface perturbations caused by prenasalized consonants can only be explained by reference to their own extraordinary underlying status.

5.1 Vowel Quality

The first type of surface perturbation caused by prenasalized consonants is that the quality of an immediately preceding vowel is often affected by these consonants. We note that the effect is typically of a single sort: preceding vowels often have a somewhat lowered realization before prenasalized consonants. For example, Harries (1950:3) notes that in Mweru underlying /e/ and /o/ each have
two phonetic realizations [a] and [e] and [o] and [o] respectively. The statement of distribution is basically that the lower varieties occur before prenasalized consonants although certain considerations of vowel harmony also enter into the discussion. The same facts are reported for Luvale (Horton 1949). Ménard (1908:2) notes that /u/ is pronounced [o] in Rundi before a nasal compound and that this situation exists even across word boundaries. However, it is unclear whether the examples cited involve a morpheme or word boundary. Finally, Meeussen (1952:4) reports that Ombo /i/ before a nasal compound is difficult to distinguish from /e/ so that alternations such as the following occur:

\[
\begin{align*}
\text{kás} \text{ind} & \rightarrow \text{kásend} & \text{'now'} \\
\text{-lind} & \sim \text{-lend} & \text{'keep, watch over'} \\
\text{ŋ} \text{gu} & \sim \text{ŋ} \text{gu} & \text{'there'} \\
\text{ŋkíne} & \sim \text{ŋkíne} & \text{'another'} \ (\text{Cl. 7})
\end{align*}
\]

It is important to note that this lowering does not obtain before the simple nasal consonants, so reference to the nasality of the contiguous segment will not suffice as an explanation. Obviously, there must exist some explanation for such a phenomenon. We will merely note now that if prenasalized consonants were ordinary consonants as are all the other surface consonants of these languages, then these facts cannot be explained satisfactorily. Although there appears to be a single generalization to be made in all these cases and the process is easily formalized in generative terms, neither the generalization nor its formalization constitute an explanation.
5.2 Vowel Nasality

5.2.1 General Background

The second type of evidence pointing to the extraordinary status of prenasalized consonants concerns processes of vowel nasalization. Before proceeding to a discussion of the relevant facts, it is necessary to distinguish between phonemic and two types of phonetic nasalization. Phonemically nasalized vowels are attributed to independent vowel nasality, i.e. to an underlying contrast between oral and nasal vowels. The term phonetically nasalized vowels is used to describe the situation where vowels are somewhat nasalized in conjunction with nasal consonants. Within this latter class, it is further necessary to distinguish two types of nasalization which we shall term processual and non-processual nasalization. Non-processual nasalized vowels are vowels which exhibit a degree of nasalization which results from a slight non-coordination of the raising (or lowering) of the velum with the movements of other articulators. These vowels are sometimes referred to by the misnomer "inherently nasalized vowels." Typically, the duration of nasalization does not exceed 20 msec. Processual nasalized vowels are vowels which are characteristically nasal but in which the nasalization is irrelevant phonemically. It is sometimes maintained that we need to recognize only two degrees of vowel nasality: phonemic and universal. However, the above distinction between two types of non-phonemic nasalization is a useful and necessary one.
It has sometimes been asserted that processually nasalized vowels have "less distinctive nasality" than underlying nasal vowels. For example, Delattre (1965) notes that the oral vowels of French are more characteristically oral, i.e. produced without nasalization, in conjunction with nasal consonants than in American English. Similarly, the degree of nasalization is greater for the nasal vowels of French than for the nasalized vowels of English precisely because vowel nasality is distinctive in French but not in English. However, this opposition does not obtain universally. In some dialects of Scottish Gaelic there are underlying nasal and oral vowels; this distinction between the two is neutralized in conjunction with nasal consonants (Ternes 1973):

\[
\begin{align*}
[m\text{\={u}}xk] & \quad 'pig' \\
[m\text{\={u}}r] & \quad 'sea' \\
[m\text{\={a}}:har] & \quad 'mother' \\
[m\text{\={a}}ra:v] & \quad 'dead person'
\end{align*}
\]

However, the distinction in underlying and derived nasality is evident in the lenited forms of these same items:

\[
\begin{align*}
[v\text{\={u}}xk] \\
vur \\
v\text{\={a}}:har \\
vara:v
\end{align*}
\]

This situation is not universally attested throughout Gaelic. For example, Oftedal (1956:100) describes the difference between simple nasals and the so-called "nasalized stops" which reflect nasal plus
stop clusters. The nasalized stops are generally limited to initial position; phonetically, the stop element is so strongly reduced that it is often not heard. That is, for *am baile* [(e)mba1e] 'the village' and *an t-athair* [(e)Nahe9] 'the father', one hears [(e)mbe1e] and [(e)Nahe9], but by far the most frequent pronunciations are [(e)mbe1e] and [(e)Nahe9] where ' represents "a certain kind of juncture less close than, e.g., the one found between [m] and [a] in [m3Le] mala 'eyebrow'. The important point here is that the difference between nasals and nasalized stops does not lie in the nasalization of the vowel although /m/ generally nasalized a following vowel whereas /mb/ does not. However, nasal vowels are found after nasalized stops: [(e)m'eN'e] [(e)m'b'eN'e] am bainne 'the milk' (cf. [b5N'e] bainne 'milk') and more importantly, a non-nasal vowel sometimes follows a nasal consonant [mar9v] marbh 'dead'.

This situation as described by Ternes contrasts with the French *bon-bonne* type of distinction mentioned by Delattre wherein there is no neutralization of vowel nasality:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>mon nez</td>
<td>[m3ne]</td>
</tr>
<tr>
<td>Monet</td>
<td>[mone]</td>
</tr>
</tbody>
</table>

The difference between Scottish Gaelic and French is that Gaelic has a process nasalizing vowels in conjunction with nasal consonants whereas French does not. That is not to say that there is always perfect coordination of velic activity and the movements of the other articulators in French; the degree of non-coordination will be slight, however, and therefore nasalization will not be characteristic of
nasalized vowels. Throughout the following discussion, it is to
processually nasalized vowels that we refer, i.e. to underlying oral
vowels which are realized with a distinctively nasal character in
some specified environment.

5.2.2 Prenasalized Consonants and Vowel Nasality

Insofar as we have been able to determine, if a language has a
process or processes nasalizing vowels and exhibits nasal-oral
sequences of consonants, vowels which immediately precede such
sequences will be nasalized. In many languages, vowel nasalization
occur in this environment exclusively, i.e., vowels do not nasalize
before simple nasals. This situation is reported for many languages
of diverse families, e.g. Pashto (Indo-Iranian, Morgenstierne and
Lloyd-James 1928-30), Malagasy (Austronesian, Rousselot 1913; Dahl
1952), Delaware (Algonquian, Voegelin 1946), Kimbundo (Bantu, da
Silva Maia 1964), etc. In some languages, vowels nasalize before both
simple nasals and prenasalized consonants. Karunatilake (1974) reports
this situation for Ceylon Gypsy Telugu (Dravidian) and notes that long
vowels are more heavily nasalized than their corresponding short
vowels and that nasalization is also greater before nasal-oral
sequences of consonants than before simple nasals. Of course, in many
languages vowel nasalization is a progressively determined assimilation
rather than the regressive type described above. An interesting case
involving progressive nasalization is Baule, a Kwa language described
by Stewart (1956). Baule has apparently two rules of vowel nasali-
zation:
Baule

\[ V \to [\text{+nasal}] / \left\{ \begin{array}{c} \text{NC} \\ N \end{array} \right\} \] (but not / \_\_ N) 

i.e., vowels are nasalized both before a nasal-oral sequences and after a simple nasal, but not before a simple nasal. Ganda also has two rules of vowel nasalization (Herbert 1974):

Ganda

\[ V \to [\text{+nasal}] / \left\{ \begin{array}{c} \text{NC} \\ N \_ N \end{array} \right\} \]

i.e., vowels are regularly nasalized before prenasalized consonants and between two simple nasals, but neither before nor after a simple nasal uniquely. Tentatively, we propose the following universal generalization:

If a language has a process or processes nasalizing phonemically oral vowels and has nasal-oral sequences of consonants, vowels preceding such sequences will be regularly nasalized.

The above generalization gains some support from the fact that one of the common origins for surface prenasalized consonants is an oral consonant preceded by a nasal vowel:

\[ /\tilde{\text{C}}/ \to [\text{VNC}] \]

In many languages, there is free variation between \([\tilde{\text{C}}], [\text{VNC}], \) and \([\text{VNC}]\) as realizations of a sequence of underlying nasal vowel plus oral consonant. For example, Taylor (1955:235) notes that in the Hopkins dialect of Island Carib:
Phonetically, forms containing the sequences YbV, YdV, YeV, YgV vary freely with others in which the nasalized V is replaced by its oral counterpart followed by a nasal consonant homorganic with the stop or 'affricate...It may be said that these phonetic clusters differ from all others in the language in that they are never broken up.

Similarly, in Yuchi, a language isolate now located in Oklahoma, but formerly in the Southeast, Crawford (1973:175-6) reports that a phonetically homorganic nasal is inserted after a nasal vowel before a lenis stop:

/søba/ [sœmba] 'grub worm'
/hóte/ [hónte] 'he coughs'
/hókwa/ [hóŋkwa] 'he laughs'

This epenthetic nasal is optional before fortis aspirated stops:

/hóthm/ [hóntm] = [hóhm] 'his heart'

and never occurs before a fortis plain stop or other consonants. In addition to an underlying contrast between oral and nasal vowels, there is a process nasalizing vowels in Yuchi after nasal consonants.

Finally, Osborn (1948:188) notes that the stops /p, t, k/ in Amahuaca are voiced when morpheme-initial after a morpheme ending in a nasal vowel. In other positions, they are phonetically voiceless unaspirated stops. However, when morpheme-internal after a nasal vowel, /p, t, k, ð/ are realized as a nasal-oral sequence in which both the nasal and the oral consonant are voiceless:

/wipis/ [wTŋpis] 'guayaba'
/wʊŋf/ [wʊŋtʃ] 'an animal'
/kɪtʃ/ [kɪntʃ] 'cooking pot'
Diachronically, the same developments are attested. For example, Voegelin, Voegelin and Hale (1962) reconstruct a series of nasalizing vowels, */\text{V}_n\text{/}, for Uto-Aztecan. These nasalizing vowels give rise to phonetic prenasalization before some consonants in some modern languages, e.g. Tübatulabal:

\[
\begin{align*}
*\text{pu}_n\text{ku} & \rightarrow \text{pu}^\text{\text{\textcircled{\text{d}}}gu(\text{?})} & \text{‘dog, pet’} \\
*\text{pu}_n\text{si} & \rightarrow \text{pu}^\text{\textcircled{\text{d}}}\text{z}_l-\text{l} & \text{‘eye’} \\
*\text{na}_n\text{ka} & \rightarrow \text{na}^\text{\textcircled{\text{d}}}\text{ka}-\text{l} & \text{‘ear’} \\
*\text{\text{\textcircled{\text{d}}}l}_n\text{wa} & \rightarrow \text{\text{\textcircled{\text{d}}}l}\text{\text{\textcircled{\text{d}}}wa} & \text{‘to name’}
\end{align*}
\]

We note that counter processes whereby simply nasals are realized as phonetically prenasalized consonants before oral vowels also exist. The relationship between these and the processes exemplified above is treated in Chapter 7.

The importance of the immediately preceding discussion is apparent when we consider Ferguson’s (1966:59) universal concerning the "exclusive relative origin" of nasal vowels. Universal XIV claims that nasal vowels are not primary and that whenever phonemically nasal vowels occur in a language system, the nasalization can be attributed to the loss of a primary nasal consonant. Thus, it would appear that at some earlier period, synchronic sequences of underlying nasal vowel plus consonant represented sequences of oral vowel plus nasal–oral consonant sequences. Shell (1950) reports that in Cashibo nasal vowels are realized as oral vowel plus nasal consonant not only before stops but in final position as well:
Cashibo

/ Ĺ/ → [vN] / — {C} #

which is what we expect on universal grounds. The generalization here is that the distinctive nasality which was formerly on the consonant is transferred to the preceding vowel. Thus, we find that synchronic free variation or contextual variation in some languages mirrors diachronic processes in other languages.\(^2\) We should expect then that some languages exhibiting prenasalized consonants synchronically will at some future time be characterized by underlying nasal vowels and will lack prenasalized consonants in its phoneme inventory. Jacquot (1962) provides such an analysis for Beembe, a Bantu language of the Congo. That is, Jacquot posits underlying distinctive nasality for both consonants and vowels, but no prenasalized consonants. The inventory for Beembre thus has a distinctively non-Bantu character both because prenasalized consonants are absent and nasal vowels are present. According to Jacquot:

Les voyelles nasales devant consonnes sont réalisées comme des timbres plus ou moins teintés de nasalité suivis d'un élément consonantique nasal homorgane de la dite consonne.

Thus, for example:

\[
/p/ \rightarrow [mp^h] / Ĺ \quad [p^h] \quad \text{elsewhere}
\]
Because of lack of data, it is difficult to determine if this unorthodox Bantu analysis is warranted. It would depend on a demonstration of the real independence of underlying vowel nasality, e.g., nasal vowels should occur in final position.3

It is interesting to note that in cases like the Tübatulabal outlined above, nasality has gone the full cycle from consonantal nasality to vowel nasality and back to consonantal nasality. That is, according to Ferguson's Universal XIV, we assume that at some period earlier than the reconstructed Uto-Aztecan provided by Voegelin, Voegelin, and Hale, nasalizing vowels were actually sequences of oral vowel plus nasal consonant in which nasality shifted to the vowel. Then, in the development of Tübatulabal, Southern Piute, etc., the nasality shifted back to a consonantal segment. We note again that some languages exhibit synchronic variations which mirror this diachronic development.

Similar developments are attested wherein prenasalized consonants develop not in conjunction with phonemically nasal vowels, but with processually nasalized vowels. For example, this is the case for Sinhalese for the prenasalized consonants which are not attributable to Sanskrit nasal plus voiced stop:
Wijeratne (1957) attributes these "intrusive nasals" directly to the nasal of the preceding syllable. It seems more likely, however, that the vowel following the nasal was nasalized and this affected the following consonant, i.e.:

\[ \text{NVC} \rightarrow \text{NVC} \rightarrow \text{NVNC} \]

Such cases are clearly to be explained in terms of an original non-coordination of the raising of the velum with the movements of the other articulators. If the velum is lowered throughout the articulation of a nasalized vowel and its raising does not precede or coincide with the consonantal onset, a prenasalized consonant will result.

We note only briefly here the obvious parallels with the nasal prosodies of languages such as Sundanese, Land Dayak, etc. In these languages, nasality is initiated by a nasal consonant and proceeds throughout the word until checked by a supraglottal non-nasal consonant including the oral component of a prenasalized consonant. Tucker and Hackett (1959:26) note that in Zande, an Adamawa-Eastern language, many speakers exhibit a strong tendency to nasalize vowels
which follow nasals and nasal compounds:

$$\text{Zande}$$

$$V \rightarrow [+\text{nasal}] / \{N \}\_$$

The latter part of this rule is unexpected and seems intuitively unnatural. If the velum is raised for the articulation of an oral consonant, why should it again be lowered for the vowel articulation? However, in a later discussion (p. 35), the authors make clear that this nasalization affects the compounds /nz/ and /nv/. The nasal component of these compounds is often realized solely as nasalization of the following consonant, especially between two vowels — both of which will be nasalized:

$$/\text{ūnvūrū}/ \quad [\text{ūvocab}] \quad \text{'older brother'}$$

$$/\text{bīnzā}/ \quad [\text{bīvocab}] \quad \text{'doctor'}$$

At this point, it becomes clear that vowels do not nasalize after nasal compounds, but after nasal and nasalized consonants, i.e.:

$$\text{Zande}$$

$$V \rightarrow [+\text{nasal}] /\{\hat{N} \}\_$$

We assume that a nasalized consonant in this context refers to a consonant produced with lowered velum and incomplete oral closure; this differs from a nasal consonant which has complete oral closure. Cf. Section 8.2.4.

There is a perceptually and articulatorily motivated reason why prenasalized fricatives often exhibit extraordinary behavior, e.g., vowels typically show greatest nasalization before these sounds or
the process may be limited to these sounds exclusively, e.g. Ila (Doke 1928), Bulgarian (Aronson 1968:35), etc. (Cf. Section 6.2.2.) Williamson (1973) notes that in Ijo, CVN syllables occur only before stops and that the degree of nasalization is slight. However, heavily nasalized vowels occur before continuants and in final position. Thus, there is complementary distribution of VN and V syllables, both of which are interpreted as /VN/. A more complete discussion of the distinction between prenasalized stops and fricatives is presented in Chapter 8 wherein we review the various processes affecting prenasalized segments.

Other data which at first sight might be taken as pointing to a rule such as that rejected for Zande:

\[ V \rightarrow [+nasal] / NC \]

include certain comparative forms from Kwa languages cited by Williamson (1973:124):

<table>
<thead>
<tr>
<th>Ahan</th>
<th>Uro</th>
<th>Common Yoruba</th>
</tr>
</thead>
<tbody>
<tr>
<td>änka</td>
<td>kenka</td>
<td>3k3</td>
</tr>
<tr>
<td>intù</td>
<td>into</td>
<td>ërù</td>
</tr>
<tr>
<td>dngù (ugbọrọ)</td>
<td>ogù</td>
<td>'20'</td>
</tr>
<tr>
<td>ongbà</td>
<td>ọngba</td>
<td>ọgbọ</td>
</tr>
</tbody>
</table>

in which Ahan and Uro sequences NCV correspond to Yoruba CV. Similar data are forthcoming from certain freely varying forms in the Kolokuma dialect of Ijo:

\[ ìngù \rightarrow ìgù \] 'lime'
and from a comparison of certain Ijo dialects:

<table>
<thead>
<tr>
<th>Okordia</th>
<th>Normal</th>
</tr>
</thead>
<tbody>
<tr>
<td>ãgbà</td>
<td>ãnjmbà</td>
</tr>
<tr>
<td>ïdò</td>
<td>ïndò</td>
</tr>
<tr>
<td>ïzì</td>
<td>ïndì</td>
</tr>
</tbody>
</table>

The apparent problem here is that independent vowel nasality occurs on a vowel different from that which is processually nasalized in most dialects. Until recently, Proto-Ijo was reconstructed as the "normal" dialect and Okordia as a metathesizing dialect. However, on the basis of a suggestion put forward by Hyman (1972b) and other independent evidence cited by Williamson, it now appears that Okordia is the conservative dialect and that the innovative dialects exhibit a metathesis of VCNV (\*VCVNV) sequences to VNCV. In defense of this analysis, Williamson notes that it is now possible to relate a number of Ijo words to other Niger-Congo forms, e.g.:

Ijo ïndì 'fish' < *îdî! <*îdîN!  
Edo lgs.: Iyayu: ëtènì  
Epie, Egene: ë-sènì  
Andoni: ìrìqì

Also, various words Ijo borrowed from Lower Niger show VNCV corresponding to Lower Niger VCNV:

<table>
<thead>
<tr>
<th>Lower Niger</th>
<th>Ijo</th>
</tr>
</thead>
<tbody>
<tr>
<td>/ãgbnà/ [ãbnà]</td>
<td>[ãnjmbà] 'jaw, cheek' (but cf. Okordia [ãgbà])</td>
</tr>
<tr>
<td>/ïdò/ [ïdnò]</td>
<td>[ïndò] 'yellow'</td>
</tr>
</tbody>
</table>
Thus, there is good evidence of several different types to support the development:

$$\text{VCVNV} \rightarrow \text{VCNV} \rightarrow \text{VNCV}$$

in Ijo and other languages. Nasality appears on the vowel following the oral consonant in Okordia precisely because it was transferred from consonant to vowel before the metathesis of oral-nasal sequences occurred. There is thus no evidence to support an analysis in which vowels are nasalized after nasal-oral sequences.

The claim which we shall ultimately put forward about all underlying nasal-oral sequences, including those which are realized as prenasalized consonants, is that the nasal component always functions in the syllable to its left while the oral component functions in the syllable to the right of the sequence. That is, in their underlying representation prenasalized consonants are ambisyllabic phenomena. Ambisyllabicocity is not defined here as the condition of simultaneously belonging to two syllables, but rather where the two components of a complex surface unit are assigned to distinct underlying syllables. This claim is at variance with the traditional analyses of prenasalized consonants and requires a great deal of justification, some of which is presented below.

The evidence involving vowel nasalization is especially impressing here. In some languages where vowels nasalize preceding nasal-oral sequences, vowel nasalization occurs in only one other environment, i.e. in final position. This is the case, for example, in Bamum as described by Ward (1937-9):
Bamum

\[ V \rightarrow [+nasal] / _N \{C \} \]

/ŋeŋə/ [ŋeŋə] 'caiman'
/mɔnt/ [mɔnt] 'child'
/mɔnə/ [mɔnə] 'my child'

Ward notes that the nasal following is short and "lightly pronounced." In Georgian (Robins and Waterson 1952), we find the same environments and note again that the nasal may disappear entirely except for vowel nasalization, especially before the fricatives /s, z, ʃ, ʒ/. These facts of distribution plus the data regarding the origin of prenasalized consonants from underlying nasal vowels followed by oral consonants discussed earlier lead one to suspect that the real generalization about vowel nasalization is:

\[ V \rightarrow [+nasal] / _N \]

which, according to the mirror image convention supplied by Bach (1968), expands to read:

\[ V \rightarrow [+nasal] / \{ _N$ \} \]

That is, a vowel may be nasalized when it functions in the same syllable as a nasal consonant. There is probably a preference for vowels to nasalize more often before a nasal coda than after a nasal onset. The environment $\rightarrow_N$ is not included in the above schema. This does not claim that vowel nasalization will never occur in this environment, but merely that it is less expected and will occur less frequently. This is what we expect on universal grounds.
5.2.3 Conclusion

In the preceding discussion, we have attempted to demonstrate certain general tendencies relating to vowel nasalization. We noted that in languages which exhibit prenasalized consonants, vowels tend to nasalize before prenasalized consonants but not necessarily before simple nasals. If prenasalized consonants were simply a subclass of nasal consonants, as most traditional analyses maintain, this difference in behavior is difficult to explain. However, we remark that this fact and several others relating to vowel nasalization can be captured by a single generalization if we posit an underlying ambisyllabic nature for prenasalized consonants. The evidence of nasalized vowels is not the only type which points to the fundamental correctness of this claim.

5.3 Vowel Quantity

In addition to the perturbations in vowel quality and nasality, prenasalized consonants often affect the quantity of immediately preceding vowels as well. This is reported, for example, in a large number of Bantu languages in which preceding vowels lengthen before a prenasalized consonant, e.g. Ganda (Herbert 1975), Holoholo (Coupez 1955), Kikuyu (Armstrong 1940), Kuria (Whiteley 1955), Luba-Kasayi (Meeussen 1960), Iwena (White 1949), Songye (Stappers 1964), Sukuma (Richardson 1959), etc. This process is easily schematized:

\[ V \rightarrow [+\text{long}] / \quad \text{NC} \]

Again, the question which must be raised is why prenasalized consonants exact this behavior in preceding vowels. Typically, this is not the
only environment for vowel lengthening in these languages. Vowels also lengthen after a consonant plus glide onset:

\[ V \rightarrow [+\text{long}] / \text{CG} \]

These processes are observed both in languages with an underlying contrast between long and short vowels and those without such a contrast.

Unfortunately, in the case of vowel lengthening, simple reference to the hypothesized underlying ambisyllabicity of prenasalized consonants is insufficient as an explanation. On the one hand, it would be difficult to provide a motivation for this relationship which is not ad hoc. Intuitively, we might expect that vowels would shorten before underlying clusters because the duration allotted to the cluster is necessarily greater than that allotted to a single consonant. This is indeed the case in those few Bantu languages which exhibit non-suspect clusters. For example, Ganda has surface geminates which are approximately twice as long as unit consonants. There is a neutralization of the underlying distinction between short and long vowels preceding these geminated consonants in favor of the short vowel:

\[ V \rightarrow [-\text{long}] / \_\_ \text{CC} \]

The distinction in opposite types of quantity adjustments to vowels preceding prenasalized and geminate consonants in Ganda is perplexing since we claim that the two are very similar in their underlying representations. However, both types of behavior can be accounted for in a non-ad hoc fashion as we shall see below.¹
In languages which exhibit contrastive vowel length, the opposition between short and long vowels is thus neutralized before prenasalized consonants in favor of a long vowel. The lengthened vowel is usually not indicated as such in official orthographies since it is possible to predict its surface length. It is often asserted, or at least implied, in descriptions that these lengthened vowels are identical phonetically to underlying long vowels. For example, Stappers (1964:7) notes that "voor een nasalverbinding is de klinker steeds lang" and provides the following transcriptions of Songye (Songe) orthographic forms which are largely phonemic:

- elonda  [eloonda]
- mulumba  [mulumba]
- kushinga  [kushinga]

In point of fact, however, lengthened vowels are not as long as underlying long vowels. This is problematic because it makes for three distinctions in vowel length: short, lengthened, and long. Similar to the Bantu facts, Voegelin (1946) reports that nasal syllables in Delaware, an Algonquian language, i.e. syllables preceding nasal compounds, have a fixed length of two morae even when the following nasal is realized only as nasalization of the vowel. If syllables preceding a nasal compound have a fixed length of two morae, we might hypothesize that the vowel constitutes one mora and the nasal of the following syllable constitutes the second mora of the syllable. Such a division would indicate that the nasal functions as consonantal offset of the preceding syllables rather than as onset of the
following syllable. This supports our claim that the syllable boundary at the level of timing organization is between the nasal and the following oral consonant. Some support for this analysis is gained from the fact that the preceding syllable retains its two-mora length even when the nasal is realized solely as vowel nasalization.

In an instrumental study of Ganda (Herbert 1975), it was demonstrated that the duration of the nasal component of prenasalized consonants added to the duration of the lengthened vowel is equivalent to the duration of underlying long vowels. This relationship is schematized:

<table>
<thead>
<tr>
<th></th>
<th>ku</th>
<th>tu:</th>
<th>b</th>
<th>a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ku</td>
<td>tu:</td>
<td>n</td>
<td>d</td>
</tr>
</tbody>
</table>

CVV = CV:N

This supports the claim that at a remote level of representation, viz. that at which timing organization occurs, the nasal component of nasal-oral sequences clearly functions in the syllable to its left. That is, we claim that there is a nasal syllable coda which "marks" these syllables as heavy or long syllables. At a later level of organization, this nasal becomes the nasal component of a unitary pre- nasalized consonant, which unit is, by definition, tautosyllabic. The conjunction of nasal and oral consonants into a single unit results in durational reduction of both components since the unit as a whole is accorded the same surface duration as underlying unitary consonants. It has already been mentioned that the degree of reduction of each
component is not constant, but varies with the feature specifications of the oral consonant. The nasal will be shorter before a fricative than before a stop; it will also be shorter before a voiced consonant than before a voiceless consonant. These facts are not unique to unit sequences of nasal plus oral consonant; these relationships are dealt with in more detail in Chapters 7 and 8. The essential point for our present discussion is that vowel lengthening is apparently compensatory for the shortening of the syllable coda, i.e., there is a "trade-off" between vowel and nasal duration. The vowel necessarily lengthens because the underlying syllable coda has marked the syllable as a heavy one. The amount of vowel lengthening is conditioned by the amount of nasal reduction; in those cases where the nasal element is realized only as vowel nasalization, there is durational equivalence between lengthened and long vowels.

Further evidence in support of this analysis is provided by a consideration of other syllable types in Ganda. For example, CGV: syllables exhibit the same length as CVV and CV:N syllables:

<table>
<thead>
<tr>
<th></th>
<th>CVV = CV:N = CGV:</th>
</tr>
</thead>
<tbody>
<tr>
<td>ku</td>
<td>taa</td>
</tr>
<tr>
<td>ku</td>
<td>ta:</td>
</tr>
<tr>
<td>ku</td>
<td>tys:</td>
</tr>
</tbody>
</table>

It was pointed out earlier that Ganda has a rule shortening vowels before geminate consonants. Although acoustic cues for segmentation of the geminates are not present, we find that short vowel plus the first half of the geminate is durationally equivalent to other heavy syllables:
We hypothesize a close underlying similarity between prenasalized and geminate consonants in Ganda. The reason that preceding vowels behave differently is precisely because underlying geminate clusters exhibit no surface reduction whereas underlying nasal-oral clusters do. Reduction of a geminate cluster is unexpected since what distinguishes geminates from their corresponding single consonants is duration. We will discuss the processes involved in the transformation from an underlying cluster to a surface unit in Chapter 6. What is essential for our present discussion is that there exists instrumental evidence to support the postulated ambisyllabicity of prenasalized consonants at a remote level of timing organization.

Similar to the above facts, we note that many languages which exhibit historical loss of medial nasal compounds also exhibit simultaneous development of phonemically long vowels in the preceding syllable. For example, in Bushong:

"Vmb > VVm  *bombo > jboom 'bundle'
"Vnd > VVn  *clndl > jseen 'kind of squirrel'
"Vng > VVn  *cenga > laseeny 'sand'
A few languages show nasal compounds developing into simple oral consonants with the same compensation in vowel length obtaining, e.g. Konabem:

*Vmb > VVp
*Vnd > VVt
*Vng > VVk

It is certainly true that some languages in which nasal compounds are simplified exhibit no parallel development of long vowels in preceding syllables. However, these are typically languages which do not make a distinction in vowel length elsewhere, e.g. those Bantu language in which the original *V/*VV opposition has been lost across the board. The usual explanation for these facts is simplification of the nasal compound by loss of some distinctive feature. To account for the development of length in vowels, however, it is necessary to posit an ad hoc rule lengthening vowels which applies before the consonant simplification rule:

\[
\begin{align*}
1. & V \rightarrow [+\text{long}] / \_ [+]prenasal] \\
2. & C \rightarrow [-\text{prenasal}]
\end{align*}
\]

These two seemingly independent rules are crucially ordered with respect to each other. Under the analysis proposed here, the two phenomena are related processes which have natural phonetic motivations. The development of distinctively long vowels is simply the phonemicization of a previously phonologically predicted fact. The phonetics involved here are somewhat different for the various languages involved depending on whether the simplification results in
a nasal or oral consonant. However, we note in both cases a
tendency to preserve the integrity of the syllable as a unit of
temporal organization while permitting segmental restructuring within
the unit. These facts are returned to in the following chapter.

A somewhat different type of consideration involving vowel
quantity is presented by those languages in which length serves a
configurational function. In these languages, the lengthening of
vowels is conditioned not by immediately adjacent segments but by
their position within a larger phonological unit. Therefore, by the
position of a lengthened vowel within the unit, typically the word,
it is possible to determine the position of phonological boundaries.
For example, in Gitonga the penultimate vowel of a word is lengthened.
Lanham (1955:34-5) notes that this lengthening occurs even before
complex consonants and argues from this fact that such complexes as
prenasalized consonants and affricates are therefore units:

<table>
<thead>
<tr>
<th>Word</th>
<th>Pronunciation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>bambe</td>
<td>[ba:mbe]</td>
<td>'other' (adj., Cl. 2)</td>
</tr>
<tr>
<td>ndanga</td>
<td>[ndra:nɡa]</td>
<td>'village'</td>
</tr>
<tr>
<td>lipfhi</td>
<td>[riːpfhi]</td>
<td>'cloud'</td>
</tr>
<tr>
<td>muca</td>
<td>[muːtsa]</td>
<td>'shade'</td>
</tr>
</tbody>
</table>

The reasoning behind Lanham's argument is unclear. Surely, if length
serves a configurational function in Gitonga, then we expect to find
that penultimate vowels lengthen regardless of what consonants precede
or follow. These facts of vowel lengthening seem irrelevant to the
question of unit vs. cluster analysis for complex consonants in
Gitonga.
We find facts similar to Gitonga lengthening in a number of languages. In Swahili, the penultimate vowel bears word stress and is lengthened. Tucker and Ashton (1942:83) note that when the stressed syllable is immediately followed by a nasal compound, length in the vowel is not so noticeable, "being taken up probably by the resonant nasal elsewhere":

- *mgainga* 'doctor'
- *kupe:nde* 'to love'
- *kho:mba* 'monkey'

It is noted by the authors that this is especially the case when the lengthened vowels are the "weak" varieties of *i* and *u*:

- *li:nda* ~ *linda* 'guard'
- *tu:mbo* ~ *tumbo* 'belly'

Here again, the interrelated behavior of the vowel and the nasal element of prenasalized consonants points to a deeper underlying relationship between the two at the level of timing organization.

5.4 Syllabic Alternations

The final type of background evidence which we shall present in this chapter concerns synchronic alternations between tautosyllabic and ambisyllabic surface realizations of nasal-oral sequences. It has already been mentioned that in Chiricahua Apache (Hoijer 1946), prenasalized consonants have ambisyllabic realizations between a short vowel or syllabic nasal and following vowel:

- */ʔi-ŋbâʔ-ye/ [ʔi-m-ŋbâʔ-ye] 'my coyote'
- */n-ŋde:z/ [n:-dě:z] 'he is tall'
Similarly, in several Bantu languages, prenasalized consonants are sometimes realized as sequences of syllabic nasal plus oral consonant. For example, in Swahili certain forms show an alternation between the two realization when the stress, which is always penultimate, is on the nasal, e.g. the KiVumba dialect:

\[
\begin{align*}
\text{ŋje} & \quad \text{'outside'} \quad (2 \text{ syllables}) \\
\text{awānjē} & \quad \text{'get out'} \quad (3 \text{ syllables})
\end{align*}
\]

In Ndebele (Ziervogel 1959), the realization of the nasal noun class prefix is prenasalization of an initial oral consonant. However, unlike many Bantu languages, the singular and plural forms of Class 9/10 are not identical because there is a synchronic pre-prefix in the plural:

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
</tr>
</thead>
<tbody>
<tr>
<td>ŋgulube</td>
<td>'pig'</td>
</tr>
<tr>
<td>mbut'i</td>
<td>'goat'</td>
</tr>
<tr>
<td>nraba</td>
<td>'mountain'</td>
</tr>
<tr>
<td>ndima</td>
<td>'field'</td>
</tr>
</tbody>
</table>

However, monosyllabic stems prefix a syllabic nasal in the singular whereas the plural is as above:

\[
\begin{align*}
\text{ŋ:ro} & \quad \text{'thing'} \\
\text{ŋ:gwē} & \quad \text{'leopard'} \\
\text{ŋ:ndwa} & \quad \text{'war'}
\end{align*}
\]

Thus, the alternation between nasal component of a prenasalized consonant and syllabic nasal is phonologically conditioned and appears to be very similar to the KiVumba case above.
In Ganda, we observe the same type of alternation which is conditioned syntactically. The presence of an initial vowel prefix in nominal forms is determined by the syntax. Prenasalized consonants which are tautosyllabic after this initial vowel become sequences of syllabic nasal plus oral consonant when initial:

- "embogo" interpreted as "mbogo" 'buffalo'
- "endiga" interpreted as "ndiga" 'sheep'
- "enkuba" interpreted as "nkuba" 'rain'

where all the forms are trisyllabic. When the initial vowel is present, surface syllabification is [V.NCV.CV], but it is otherwise [N.CV.CV]. Thus, even at the level of surface phonetic realization, the nasal component of prenasalized consonants is at least sometimes independent of its oral component in which case the two components are superficially ambisyllabic. Of course, not all languages exhibit such alternations; in many languages no syllabic consonants are permitted at the surface level. These considerations will be returned to in Chapter 6.

5.5 Summary

In this chapter, we have examined two different types of background evidence which will be used to motivate the derivational model to be presented in the following chapter. The first type of evidence attempted to show a close underlying relationship between the initial nasal component of prenasalized consonants and preceding vowels. This evidence included three basic considerations relating to:
1. vowel quality
2. vowel nasality
3. vowel quantity

We demonstrated that certain phonetic facts of vowel realization could not be adequately explained if we posit an underlying unitary status for prenasalized consonants which is similar to that posited for other consonants. The second type of evidence which we briefly examined involved synchronic alternations between surface independent nasal and oral segments and corresponding prenasalized consonants. The traditional explanations for such alternations is to derive the independent units from the prenasalized consonants. However, we maintain that the opposite approach is as tenable an analysis in its own right and that, indeed, the other evidence which we have presented and shall present in the following chapters clearly decides in favor of the latter.
NOTES

1 This statement and the universal claims which follow need to be taken as generalizations. They are based on a consultation of a large number of grammars and descriptions of various languages, many of which are listed in the bibliography. The discovery of a language in which the situation described does not obtain does not invalidate the generalization. We will have more to say about the relationship between universal and generalization in Chapter 9.

2 It is noted that we have not distinguished here between the various types of processes, e.g. obligatory-optimal, careful-fast speech, etc. Although we deal mainly with (near-)obligatory processes of normal speech, it appears that our generalizations concerning pre-nasalized consonants and vowel nasalization is valid for all types of processes. For example, Myers (1974 Ms:108) reports that vowel nasalization is a process characteristic of allegro speech in Kikuyu so that we find the following alternations:

[moonto] - [m33do] 'person'

In deliberate speech, however, the nasality is always on the consonant.

3 That this is not the case is suggested by Jacquot's remark on nasal vowels: "L'opposition entre non-nasales et nasales est neutralisée ailleurs que devant consonne, sauf s'il s'agit d'une consonne nasale."

4 The facts concerning vowel quantity in Ganda are largely abstracted from Herbert (1975). They are presented here in summary form because they form a crucial part of the evidence for our present claim.

5 The parallels with Katamba's remarks on the clap pulse and moric analysis of bakasimba dance songs, which was presented in Section 3.3.2, are evident.

6 These facts are abstracted from Guthrie (1967-70). In some languages, this reduction affects only the velar series */ŋg/ and not */nd/ or */mb/.

7 In fact, there are some syntactic environments in which the initial vowel is apparently a stylistic option.
6.0 Introduction

In the preceding chapters of this thesis, we have repeatedly claimed that prenasalized consonants do not represent primary linguistic phenomena in the sense that they do not occur as such at a deep level of phonological organization on a universal basis. We suggested in Chapter 5 that when a surface prenasalized consonant is represented by nasal and oral consonantal segments in its underlying representation, the nasal functions in the syllable to its left and the oral consonant in the syllable to its right. We do not claim that all surface prenasalized consonants are represented in this fashion. For example, we have already mentioned that in some languages prenasalized consonants are realizations of underlying sequences of nasal vowel plus oral consonant. The full range of phonetic processes which give rise to surface prenasalization will be surveyed in Chapter 7. Our present concern is with the more common type of prenasalized consonant mentioned above, i.e. that which can be attributed to an underlying sequence of two consonantal components.

In this present chapter, we shall attempt to delimit the processes which are involved in the derivation of an underlying cluster of nasal plus oral consonant to a surface prenasalized consonant.
shall demonstrate how these processes interact crucially and shall suggest some reasons why they are active in some languages and absent in others. The discussion of the relationship between the processes involved in the derivation of prenasalized consonants and those active in the derivation of other complex sound types will be reserved until Chapter 9.

6.1 Theoretical Background

6.1.1 Definition

We shall define that situation which exists when two underlying independent units are realized as a single phonetic complex as one of unification, i.e. one in which two components are "unified" or fused into a single complex unit. Also subsumed under the term unification are those processes which result from such derivations, e.g. the subtle timing adjustments which we examined in Section 5.3. We assume that at least some of these processes involved in unification have independent existence, e.g. homorganicity assimilation. It is possible to arrange these processes into a partial hierarchy; as we shall see, however, there are some problems involved in such an arrangement.

For the present, we assume that the single crucial process which defines a state of unification is timing adjustment. That is, there can be no question of a unification of components unless the surface complex exhibits a duration which is approximately that accorded non-suspect underlying units. This same durational criterion was one of the tests presented in Chapter 2 as defining a prenasalized consonant.
However, as we pointed out above, it does not necessarily follow from this claim and our claim about the non-occurrence of prenasalized consonants at the underlying level that all prenasalized consonants are products of component unification. Similarly, although we shall suggest that some other complex units, e.g. some affricates, may be products of unification, we do not claim that all surface complexes result from such processes. (Cf. Section 9.3.1.)

The relationship between some of the processes involved in unification and the actual process of fusion, which is a temporal adjustment, is unclear. For example, another of the defining characteristics of prenasalized consonants is that the nasal and oral components of the unit are homorganic. However, it may be the case that: (1) homorganicity is a necessary prerequisite for nasal-oral fusion, or (2) homorganicity is a necessary consequence of this unification. This is by no means an arbitrary distinction. We could opt for the former analysis on the basis of the non-suspect occurrence of homorganicity adjustment elsewhere and the fact that, as we shall see shortly, in some languages underlying homorganicity is a prerequisite for unification whereas derived homorganic clusters are immune to such process, i.e., underlying /N₁C₁/ clusters unify whereas /N₁C₉/ clusters do not. However, we shall ultimately suggest that the first alternative above is more commonly the case. This question of relationship needs to be raised anew for each secondary process potentially involved in unification, e.g. voicing assimilation, hardening of post-nasal consonants, etc. In most cases, it appears
that the secondary processes precede the actual unification.

6.1.2 Unification in Delaware

We shall begin our discussion of the actual processes involved in unification by examining some data taken from an excellent and precise structural description of Delaware, an Eastern Algonquian language, provided by Voegelin (1946). Delaware presents many series of surface consonant clusters, including nasal plus homorganic oral consonant and nasal plus non-homorganic consonant. According to Voegelin, all underlying stops are voiceless; they are voiced only after a homorganic nasal when followed by a vocalic element. When a non-homorganic nasal precedes a stop, there is no voicing assimilation. Also, the stop is not voiced after a homorganic nasal if it is part of an extended cluster. That is, the /p/ is voiced in /hempes/ 'dress', but it is not voiced in /hempesa/ 'dresses'. Thus, the rule for voicing stops is:

\[
C
\begin{array}{c}
\lbrack - \text{cont} \rbrack \\
\lbrack + \text{nasal} \rbrack
\end{array}
\lbrack + \text{voice} \rbrack 
\lbrack \lbrack \alpha \text{ pos} \rbrack \rbrack
\lbrack + \text{voc} \rbrack
\]

where \lbrack \alpha \text{ position} \rbrack is a formal device to indicate homorganicity.

In addition, nasal syllables, i.e. syllables closed by a pre-vocalic or final /mp, nt, ŋc, ŋk/, are always two morae long in Delaware. Nasalized syllables, i.e. syllables preceding /ns, ňs/, are also two morae long in which the only realization of the nasal is often vocalic nasality of the preceding lengthened vowel. In both cases, the syllable preceding a homorganic nasal–oral sequence is long, i.e. it has a length of two morae, if the sequence is not followed by
another consonant.

We claim that we need to recognize the existence of surface pre-nasalized consonants in Delaware, which consonants are traditionally analyzed simply as clusters of homorganic nasal plus stop. The facts of vowel lengthening and voicing assimilation point to the extraordinary status of these sequences in Delaware. In their underlying representation, these sequences are no different than other consonant sequences, but, at a later level of organization, the consonants are unified and a complex unit sound obtains. The lengthening of the preceding vowel is caused by the reduction in consonantal offset in that syllable involved in unification. This is supported by the fact that the vowel retains its two morae length even when the nasal is realized only as vocalic nasalization. That is, the underlying representation for 'dress' is /hem$_p$s$/.

The question which needs to be asked at this point is why the homorganic sequence in /hemp$_s$s$/ does not exhibit voicing assimilation and does not effect vowel lengthening. In orthodox generative phonology, the explanation for this fact would simply be that the processes are limited to prevocalic sequences. Obviously, this statement has no explanatory value whatsoever. In an earlier unpublished manuscript, I postulated that unification does not obtain in /hemp$_s$s$/ because the stop was part of a consonant cluster with syllable division as in /hem$_p$s$/.$ That is, /p/ did not become voiced and did not participate in unification precisely because it already functioned in a syllable unit /ps/. This syllable division was problematic since
/ps/ does not appear in word-initial position. It is now clear that this syllable division was wrong. It is much more likely that the actual syllable division for hempes and hempsa is: ¹

/he:m$pes/  'dress'

/hemp$sa/  'dresses'

Under such an analysis, the durations of the first syllable of each word are identical. This is, in fact, in keeping with Voegelin's remark:

One gains a general impression that prevocalic consonants syllabify with the following vowel, while one or more prior members of a cluster syllabify with a preceding vowel. (1946:135)

We shall claim below that unification is produced in one case but not the other as a function of the syllable boundaries involved. This point will be detailed below. It will suffice to point out here that unification can occur only across, not within, syllable boundaries. Although this might seem counter-intuitive, there is a functional explanation for it as we shall demonstrate below.

An underlying cluster analysis for the prenasalized consonants of Delaware is not problematic since other, non-suspect, nasal-oral clusters occur and there is surface alternation between units and clusters in pairs such as hempes and hempsa. Indeed, a non-cluster analysis would be especially suspect since the only nasal-oral clusters which would not occur would be homorganic intervocalic sequences, which are, in some sense, the most "expected" type; many languages exhibit only these sequences. However, in some cases, e.g. Bantu, such an analysis as the above would appear to have the unfortunate consequence
of complicating the statement of syllable structure. In general, Bantu languages are characterized as strict open syllable languages which permit no consonant clusters. This fact is often cited, as we saw in Chapter 3, as evidence in support of an underlying unit analysis of surface sound complexes in Bantu. It is, as we mentioned earlier, invalid as evidence since the use of generalization in an analysis of data on which the generalization is based is methodologically unsound. Thus, it would seem in such cases that we have the choice of complicating the statement of syllable structure or increasing the number of segmental units by positing underlying pre-nasalized consonants. Obviously, we shall opt for the former solution in this presentation.

6.1.3 Oates' Bi-Level Approach

Before proceeding to a more in-depth examination of the derivational model which we propose, we shall review in brief detail a model whose spirit is somewhat akin, although it is far removed in nature, to our own. It was put forth by Oates (1967), not as a universal model, but specifically for several Australian languages in which the status of nasal-oral sequences is problematic. Although Oates' model has our sympathies, it will need to be rejected as unmotivated and arbitrary.

We discussed in Section 3.1, Oates' bi-level approach to phonemic analysis. Certain complexes which might be interpreted either as one or two units are assigned "undefined slots" in initial analysis. For example, in Usarufa, sequences of glottal plus consonant [?C] are
interpreted as units at the syllable level allowing a simple statement of syllable structure; these same units are interpreted as clusters at the segmental level, which greatly reduces the number of consonantal phonemes of the language. We mentioned in our earlier discussion of this principle that one crucial problem was its confusion of phonological and phonetic levels of analysis. That is, although [ʔk] is composed of two phonetic units, this does not justify its analysis as two segmental phonemes. These problems are returned to following the presentation of Oates' analysis of nasal-oral sequences.

Oates (1967:33) notes that "there is plenty of evidence to show that homorganic nasal-stop sequences are very close-knit in Australian languages." The question of analysis as one or two units is particularly problematic in languages in which these sequences function as part of larger sequences of more than two consonants, e.g. Gugu-Yalanji, Wik-Munkan, etc. In Gugu-Yalanji, nasal-oral sequences occur intervocally as part of an extended CNC cluster in which $C_3$ is /l, r, ŋ, y/:

- walmba 'log'
- warngu 'sleep'
- yirmba '3-prong spear'
- waymbil 'soft'

Oates' initial interpretation which was to regard NC as two separate phonemes in a medial cluster of three consonants forming a third, limited, consonant-vowel pattern was, he admits, arbitrary. He
therefore proposes to regard nasal-oral sequences as:

1. syllable units mb, nd, ng in certain environments. These are symbolized as NS.

2. two phonemes m-b, n-d, n-g in other environments, symbolized as N-S.

He notes that the component parts of a NS unit both retain phonemic status when viewed solely on the segmental level.

On this basis, Oates proposes that nasal-oral sequences fill two different types of syllable slots in Gugu-Yalanji: a C slot and a CC slot. This creates a two-way, or possibly three, distinction in types of nasal-oral sequences as follows:

I. \text{N-}S_1: \text{CC types where the nasal fills one slot and the stop another. This type occurs except following }/l, r, r, y/ \text{ and as the first consonant of a suffix morpheme. The phonemic evidence for such clusters is based on non-suspect clusters such as } \text{gunba} \text{ 'finish'. Similarly, Oates suggests that the mb of } \text{gambi} \text{ 'clothes' functions as a sequence of consonants. Also, the presence of morpheme boundaries between nasals and stops in some cases suggests component independence:}

\begin{center}
\begin{tabular}{ll}
bunday & 'sit'
\text{bundanday} & 'sitting'
bunday & 'sit'
\end{tabular}
\end{center}

\begin{center}
\begin{tabular}{ll}
dunay & 'went'
dunandunay & 'going'
\end{tabular}
\end{center}

II. \text{N-}S_2: \text{C type which is based on the total permissible sequence of consonants as two. The nasal-oral sequence necessarily fills one slot. This type occurs only following }/l, r, r, y/ \text{ and as the first consonant of a suffix morpheme, e.g. } \text{walmba} \text{ 'log', burnguy 'snore'. Oates' analysis of the suffix morphemes is one based on}
"pattern pressure"; he generalizes the CV shape of the majority of locatives, e.g. -ba, -bu, -na, -nu, to include -mba, -nda, -ndu: buwum-ba 'into the boat', gabay-mba 'on the ant bed' (both CV-CVC-CV) and bana-na' 'for water', bambu-ndu 'to Bambu' (both CVC(C)V-CV).

III. N-S_3 or NS_3: a third type postulated to account for all the data. It is unclear whether this type represents C or CC because the slot is not clearly defined. Oates claims that it occurs in environments other than the two above. This would seem to be a problem since the environment for N-S_1 was other than NS_2. In a word like wampuriga 'to ask', there is some doubt as to whether the syllabification is wam-gu-ri-ga or va-ngu-ri-ga. This question would seem to be in conflict with the criterion of NS_1. Oates concludes:

Thus NS consists on the syllable level of three allotypes, N-S_1 and NS_2 which are in mutually exclusive distribution, and N-S_3 or NS_3 which is regarded to be in free variation with N-S_1 and NS_2 in a third environment. (1967:35)

Oates' approach seems often arbitrary and characterized by little scientific rigor. That is, the nasal-oral sequences are sometimes characterized as units, sometimes as clusters, and possibly sometimes as either units or clusters. This would seem to contribute little towards a solution to the general problem of their analysis. Also, some of the methodological techniques employed by Oates, e.g. the classification as NS_2 based on the total permissible sequence of consonants as two, need to be rejected as unsound, following the discussion in Chapter 3. In fact, we find the whole notion of syllable unit as opposed to that of segmental phoneme unmotivated as
articulated by Oates. Thus, because it is unmotivated and based on unsound methodological principles, we reject Oates' model of analysis. We have presented it in some detail, however, because it is one of the few models which attempt to cope with the problem of nasal-oral clusters in any bi-level approach. That is, Oates' model, although it fails, recognizes the fact that the system of underlying organization need not mirror that of surface realization. Most analyses of nasal-oral sequences are based on surface facts and pattern their underlying representation on these surface facts.

What we find most attractive in Oates' proposal is precisely this independence which he accords underlying organization. Unfortunately, he provides no clue as to how his underlying "syllable units" are realized as a sequence of two segmental phonemes. It is unclear what the relationship between the two levels might be and how they are both related to the level of surface phonetic realization. This is surely a serious shortcoming in any model. We have seen that Oates' proposal is motivated by a desire to keep the number of segmental phonemes to a minimum and the statement of syllable structure to its simplest. In traditional analyses of prenasalized consonants, one generally has the choice of representing them as unit phonemes and thus increasing the number of segmental phonemes or as clusters and thus complicating the syllable structure statement. In Bantu, for example, the former analysis is always accepted. Oates attempts to incorporate both of these "advantages" into his model. In fact, the model which we shall propose differs from Oates' in that it appears to
complicate the statement of syllable structure for many languages. We shall discuss this point in detail below.

6.1.4 Nasals as Syllable Codas

We have already made mention of the high frequency of co-occurrence of prenasalized consonants and open syllable languages. Indeed, we mentioned in Chapter 3 that one criterion used in an interpretation of prenasalized consonants as unit consonants is this fact.

By positing an ambisyllabic underlying representation for the prenasalized consonants of, for example, Kikuyu, it is no longer possible to maintain that all syllables are open. It is essential to keep in mind here that we are speaking in terms of underlying syllables, i.e., underlying units of organization. There is no question of the tautosyllabicity of prenasalized consonants at the surface phonetic level.

Myers (1974 Ms) gives the following statement of Kikuyu syllable structure:

\[
\left\{ \begin{array}{c}
(N)C \\
G
\end{array} \right\}^{v_1^3}
\]

which says that every syllable will be composed of a vocalic nucleus of from one to three vowels and may be preceded by a glide (/w, y/) or a consonant onset, including a prenasalized consonant. Thus, some sample syllabifications are:
The post-consonantal glides are analyzed as underlying vowels in Myers' analysis. It would seem that a more adequate statement of the surface syllable system is:

\[(C) (G) V^3\]

in which \((C)\) represents any consonant, including the prenasalized consonants. Kikuyu thus exemplifies the typical Bantu characteristic of open syllables only.

We do not contest the above surface syllabification. However, we claim that in their most remote representations, we have syllabifications such as:

\[
\text{mondo } \quad \text{mo.ndo} \quad \text{'person'}
\]
\[
\text{nomboka } \quad \text{nom.be} \quad \text{'cow'}
\]
\[
\text{mocungwa } \quad \text{mo.cung.wa} \quad \text{'orange tree'}
\]

so that underlying syllables are of the form: \((C) V^3 (N)\).

We note that the above is not too marked a structure in the sense that many languages which are otherwise characterized by open syllables exclusively allow closed syllables which end in a nasal. This is the case, for example, in Tikar, a Bantoid language of Cameroon (Richardson 1957:49). Additionally, in many languages, a limited range of non-nasal consonants function as syllable codas, but
rarely to the exclusion of nasal codas. For example, among the
Bantu languages of Western Equatorial Africa, Basosi allows closed
syllables which end in a nasal or glottal stop. In Elong, closed
syllables end in /l, N, k, ?, p/. Additionally, many radicals end
with a nasal vowel where neighboring languages have a vowel followed
by a nasal consonant:

\[ \text{akw3 'spear' (cf. akon)} \]
\[ m\ddot{e} 'teeth' (cf. m\ddot{e}n) \]

Closed syllables are common in Nyokon and Djanti; most frequently they
end in /p, N, s, ?, r/ and /r, k?, y, η, n/ respectively. Guthrie
(1953:20) notes that closed syllables do not occur in the languages
of the Duala group although a final syllabic nasal is fairly common
in Duala, e.g. d6m '10', in Ol, Pongo, Mungo, and Molumba. These facts
are by no means limited to Bantu. In the New Guinea Highland languages
Kuman and Pawaiian, syllable codas are /m, n, g, l, k/ and /n, l, t/
respectively (Trefry 1969). The Pawaiian codas occur only word-finally.
Sung (1966) notes that in Kanakanavu, a language of Formosa, only
nasals occur as final consonants so that all the clusters which occur
are of the shape NC or NN, not necessarily homorganic, or result from
the deletion of /u/ after /s, c, k/ in allegro speech. In Campa
(Dirks 1953:302), the only consonant clusters which occur are nasal plus
stop or affricate, and these occur only medially. In a structural
sketch of Tabukang Sangir, an Austronesian language, Maryott (1965:118)
notes that the segmental inventory is:
Tabukang Sangir

Most words conform to one of the following patterns:

\[ C_2V_1C_1V_2 \]
\[ C_2V_1C_3C_1V_1C_4 \]

in which:

- \( C_1 \) includes all consonants
- \( C_2 \) includes all consonants except /w, y, r, ɬ, η/
- \( C_3 \) includes only nasals and glottal stop
- \( C_4 \) includes only /ŋ/ and /ʔ/
- \( V_1 \) includes all vowels
- \( V_2 \) includes all vowels except /ɪ/

A preconsonantal nasal is always homorganic with a following consonant. That only the velar nasal is permitted in final position is somewhat unexpected since we expect that the unmarked member of a series will function in positions of neutralization. The essential point here is that all closed syllables end in a nasal of some point of articulation or in glottal stop. Thus, we claim that no language which exhibits closed syllables will limit syllable codas to non-nasal consonants although the reverse situation frequently obtains.
In fact, there are a few exception types to the above claim which are mentioned later in this chapter.

It is, in a sense, natural that nasals should be allowed to function as syllable codas in languages when other consonants cannot. Very often, liquids also function with the class of restricted syllable codas. We believe that this behavior is a natural reflex of the fact that nasals and liquids, as sonorants, are permitted vowel-like behavior; they thus figure prominently on the hierarchy of permitted syllable codas. In the Didinga-Murle group of Eastern Sudanic languages, voiced nasal compounds are common, but hetero-syllabic junctions occur only with /r/, e.g. Didinga gerba 'bad' (Tucker and Bryan 1966:371). We shall claim that nasal compounds and rC clusters have similar underlying structures and that unification occurs in the former case but not the latter for phonetic reasons which we shall discuss below.

Trubetzkoy (1949:252) also notes that nasals are the most vowel-like consonants. He cites as an example the neutralization of ë-ë and u-ø before [ŋ] in German and notes that:

> Pour provoquer une neutralisation assimilative le phonème du contexte doit à un certain point de vue être plus proche des voyelles que les autres consonnes. Les liquides et les nasales sont plus proches des voyelles puisqu'elles présentent le type d'obstacle le plus faible ou «le degré d'obstacle le plus bas>>, c'est-à-dire qu'elles possèdent aussi peu que possible les particularités spécifiques des consonnes.

Accepting the notion of vowel-like behavior for underlying sonorants, our proposed reanalysis of the underlying syllable structure
of many languages is even less marked. That is, in many languages we already need to distinguish underlying short and long syllables, i.e. syllables with underlying short and long vowel nuclei: CV/CV. In such languages, e.g. Kikuyu, Ganda, etc., we propose that it is necessary to recognize the existence of a limited subtype of underlying long syllables, i.e. CVN syllables, which occur only pre-consonantally.

Further evidence in support of the vowel-like behavior of nasals is the fact that nasals are very often accorded surface syllabic status in these same languages under specified conditions. As we saw in Section 5.4, in Ndebele the nasal noun class singular prefix is syllabic before monosyllabic stems:

<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
</tr>
</thead>
</table>
| nːro     | tʰ'ːnːro 'thing(s)'
| ηːgwe     | tʰ'ːŋɡwe 'leopard(s)'

In many Bantu languages, the nasal noun class prefix (/ⁿi-/ and the first person singular verbal marker (/ⁿi-/ exhibit identical synchronic behavior, e.g. in Ganda they are both /N/ and syllabic in initial position; in other positions, /N/ gives rise to prenasalization:

| mbogo | embogo | 'buffalo' |
| ndlga | endlga | 'sheep' |
| mbakuba /N + ba + kuba/ | 'I hit them' |
| nkukuba /N + ku + kuba/ | 'I hit you' |
| ogkuba /o + N + kuba/ | 'you hit me' |
| ban'kuba /ba + N + kuba/ | 'they hit me' |
In Ndebele, however, it is only the noun class prefix which is ever realized as phonetic prenasalization. The first person verbal marker is always syllabic and homorganic with the following consonant:

mbonile 'I have seen'

nkhambile 'I have walked'

uyamfuna 'he is looking for me'

It would be possible to analyze these nasals which are non-alternating in their syllabicity as underlying /NV/ sequences, which is of course their historical derivation. It seems more likely though that their underlying representation is simply /N/. Thus, parallel to the relationship between CVV and CVN syllables, we need to recognize the existence of a short nasal syllable subtype, i.e. N, which is opposed to (C)V. It is possible that all "vowel-like" nasals have independent syllabic existence and that CVN syllables are really CV.N sequences. Thus, the underlying syllabification for bantu might be either /ban.tu/ or /ba.n.tu/. In fact, both of these alternatives can be incorporated into the present model; we will discuss the merits of each in a later section of this chapter.

It has already been mentioned that the canonical root in Bantu is of the shape -CVC-. In Ganda, prenasalized consonants never occur as the initial consonant of a root although they do occur finally. They are treated as unit consonants in this position precisely because this slot is generally filled by single consonants. Some support in favor of this analysis might be provided by various alternations which occur when certain suffixal morphemes are added to the verb stem.
For example, when a stem ends in a non-nasal consonant which is either [+coronal] or [-anterior], i.e. /t, d, l, j, k, g/, that consonant becomes [+anterior] , i.e. /s/ or /z/ before certain suffixes:

<table>
<thead>
<tr>
<th>Present Stem</th>
<th>Perfective Stem</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>leeta</td>
<td>leesa</td>
<td>'bring'</td>
</tr>
<tr>
<td>lokola</td>
<td>lokoze</td>
<td>'save'</td>
</tr>
<tr>
<td>fuga</td>
<td>fuze</td>
<td>'rule'</td>
</tr>
<tr>
<td>†taka</td>
<td>†tase</td>
<td>'complain'</td>
</tr>
</tbody>
</table>

Roots terminating in a prenasalized consonant also exhibit this same alternation:

<table>
<thead>
<tr>
<th>Present Stem</th>
<th>Perfective Stem</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>†tanta</td>
<td>†tanse</td>
<td>'scatter'</td>
</tr>
<tr>
<td>genda</td>
<td>genze</td>
<td>'go'</td>
</tr>
<tr>
<td>bañja</td>
<td>banze</td>
<td>'demand payment'</td>
</tr>
<tr>
<td>†tanga</td>
<td>†tanze</td>
<td>'pay a fine'</td>
</tr>
</tbody>
</table>

The argument in favor of unit consonants which is forthcoming from these data is that prenasalized consonants, as units, exhibit the alternation. That is, we find nt → ns, ng → nz, ṅj → nz, etc., not *ng → nz, *ŋj → nz. There are several possible explanations for this fact. First, nasal assimilation is a natural process and applies whenever its structural description is met in many languages; we expect only homorganic surface sequences in Ganda. Second, we could simply claim that the alternation occurs after unification and therefore does indeed involve unitary consonants. The behavior of
root-final geminates, which are even more suspect as unitary consonants, is identical in that both members are affected:

\[
\begin{align*}
gatta & \quad \text{gasse} & \quad \text{'Join, add'} \\
ba\text{jja} & \quad \text{bazze} & \quad \text{'carve'} \\
yl\text{gga} & \quad \text{ylzze} & \quad \text{'hunt'}
\end{align*}
\]

where, again, we believe that the correct explanation has to do with various constraints on what constitutes a well-formed string of segments in Ganda and natural assimilatory processes which insure well-formedness.

6.1.5 Myers' Derivational Model

In her generative treatment of Kikuyu phonology, Myers (1974 Ms) observes many of the idiosyncracies in the behavior of prenasalized consonants such as the facts of their distributional limitations and arrives at the conclusion that prenasalized consonants are not part of the underlying consonant system. Prenasalized consonants are consonant clusters in Myers' analysis. Myers attributes the permissibility of underlying NC clusters and no others to vowel-like behavior permitted nasals. Thus, it would appear that Myers' analysis for Kikuyu closely resembles our universal claim about prenasalized consonants, which indeed it does. However, although we agree with Myers as to the underlying status of surface prenasalized consonants, we disagree with her as to how these clusters come to be realized as surface units. We shall claim that the model which Myers proposes provides no more explanatory power than traditional models and that it is incapable of dealing with languages with more complex prenasalized
inventories than Kikuyu which exhibits only [mb, nd, nj, ng].

Basically, Myers proposes that underlying NC clusters come to be realized as surface prenasalized consonants by means of a cluster simplification rule which deletes the oral consonant and specifies the nasal as [+early velar closure]. This is a vector feature as described in Section 4.1. The rule for simplification is formally schematized as:

\[
\begin{align*}
[+\text{nasal}] & \quad [-\text{nasal}] \\
[+\text{cons}] & \quad [-\text{cont}] \\
1 & \quad 1 \\
2 & \quad 2 \\
\end{align*}
\]

\[\rightarrow \quad [+\text{e.v.c}] \quad \emptyset \]

We note that the specification [-continuant] is necessary since nasals are obligatorily deleted before continuants in Kikuyu. Myers paraphrases the working of the above rule as:

A nasal stop will acquire early velar closure when followed by a non-nasal stop, and the stop will be deleted. (p. 95)

It was mentioned above that Kikuyu exhibits only prenasalized voiced stops and that nasals are obligatorily deleted before continuants. However, we expect that nasals should be juxtaposed with voiceless as well as voiced stops and that prenasalized consonants should again result:

\[
\begin{align*}
/N + \text{kai}/ & \quad [\text{ngai}] \quad '\text{god}' \\
/N + \text{coohi}/ & \quad [\text{njocohi}] \quad '\text{beer}' \\
/N + \text{tonga}/ & \quad [\text{ndoonga}] \quad '\text{wealthy person}'
\end{align*}
\]

which compare with forms such as the following in which the prenasalized consonants are phonetically identical to the above:
Thus, it would appear that voiceless stops are voiced following a nasal in Kikuyu, i.e.:

\[
C \rightarrow [+\text{voice}] / N
\]

However, Myers claims that such a rule is not part of the phonology of Kikuyu. She claims that the voicing of prenasalized stops:

seems instead to arise from the fact that at the point where a single segment is created that segment takes its voicing characterization from the nasal ([sonorant]) part of the cluster and not from the following consonant. (p. 88)

We note that this interpretation requires no modification of her Cluster Simplification Rule since nasals are already specified as [+voice]. Similarly, Myers' rule could account for the hardening of continuants after nasals in many languages so that all NC clusters are realized as surface prenasalized voiced stops. That is, in contrast to Kikuyu which has a rule:

\[
N \rightarrow \emptyset / \_ \_ [-\text{cont}]
\]

\[
/N + \text{hiti} / \quad [h+!] \quad \text{'hyena'}
\]

\[
/N + \text{Gaa} / \quad [\text{Gaa}] \quad \text{'clock, hour'}
\]

some languages, e.g. Runyankore, have a rule:

\[
C \rightarrow [-\text{continuant}] / N \_
\]

\[
/N + h / \rightarrow [\text{mp}]
\]

\[
/N + r / \rightarrow [\text{nd}]
\]

as in the following forms:
In these forms, the non-continuant nature of the prenasalized con-
sonant is predicted by Myers' Simplification Rule.

The problem which Myers' analysis fails to come to terms with is
the same problem which most feature proposals are incapable of dealing
with, viz. the more "complex" prenasalized consonants. Although pre-
nasalized voiced stops are the most common variety, prenasalized
voiceless stops and prenasalized continuants also occur. For example,
Rundi exhibits [mb, nd, ng, mp, nt, nk, mv, nz, n3y, n3, mf, ns, nʃy,
ʃ, mpʃ, nʃs, ncʃ, nc] (Meeussen 1959). It is clear that Myers'
model would require substantial revision in order to account for these
consonants. Such revision would be ad-hoc since, as we believe the
existence of these sounds demonstrates, both members of the underlying
cluster contribute to the surface phonetic realization. Contrary to
Myers, we do not believe that one member of the cluster is deleted,
but rather that both members have an eventual phonetic realization.

Of course, it might be possible to claim simply that different
languages should exhibit different Cluster Simplification rules of the
type discussed by Myers. Thus, some languages, e.g. Kikuyu, delete the
oral consonant of a nasal-oral cluster and specify the nasal as
[+e.v.c.]. These languages exhibit only prenasalized voiced stops since
the nasal is specified as [+voice, -continuant]. It might be the case that other languages simplify in favor of the oral consonant, i.e., they delete the nasal and specify the oral consonant as [+e.v.c.]:

\[ [+\text{cons}] [-\text{nasal}] \rightarrow 1 \quad 2 \quad \emptyset \quad [+\text{e.v.c.}] \]

which could account for the prenasalized inventories of, for example, Rundi and Ganda. On the one hand, such an analysis would be problematic from Myers' point of view since she considers the vector feature [e.v.c.] a subfeature of the class of nasal consonants. Additionally, such rules would again require ad hoc motivation to account for languages with only partial inventories, e.g. only prenasalized voiced consonants (stops, fricatives, affricates) or only prenasalized stops (voiced and voiceless). Such languages presumably have processes voicing all post-nasal consonants or hardening post-nasal consonants. Kamba is a language of the former type:

\[ \text{/N + sia/} \quad [\text{nzia}] \quad \text{'feathers'} \]

(cf. usia 'feather')

although it also exhibits some post-nasal hardening:

\[ \text{/N + vi/} \quad [\text{mbi}] \quad \text{'palms (of hand)'} \]

(cf. uvı 'palm')

\[ \text{/N + lıı/} \quad [\text{ndlıı}] \quad \text{'ropes'} \]

(cf. uııı 'rope')

Neither type of simplification rule could completely account for such mixed inventories, which seems a serious argument against such an analysis and in favor of both components contributing to the surface unit. The need to use transformational rules to schematize Cluster Simplification is itself a formal problem in Myers' analysis. The
alternative would be to posit two independent rules which are formally coupled so that the output of the first is obligatorily fed into the second. Of course, fusion analyses, such as that which we propose, are equally problematic since the form of phonological rules within generative theory forces the linguist to think in terms of discreet segments only. The treatment of fusion processes is reviewed in Stahlke (1976) and Herbert (1977b).

We have mentioned in this chapter that, apart from durational considerations, the only necessary phonetic condition which must be present in order for a prenasalized consonant to be defined in the case of a nasal-oral sequence is homorganicity of the components. However, we also mentioned that various other phonetic changes, typically assimilatory in nature, may optionally be present in unification. These include voicing assimilation, hardening of consonants, airstream assimilation, etc. These processes are surveyed in Chapter 8. Within our present model, the optionality of such processes can be fully accounted for whereas within Myers' model they represent a serious gap in the theoretical framework. We also mentioned in the introduction to this chapter that it did not seem possible to motivate any absolute hierarchy of optional processes at the present time although the general trend is towards the development of an optimal series of prenasalized voiced stops. In this regard, we have already mentioned, for example, that some languages exhibit post-nasal hardening and voicing, some languages only the latter, some the former, and some neither process. Kamba hardens
underlying voiced consonants and voices underlying voiceless continuants. Tarascan, a language of Mexico, hardens, but does not voice, underlying voiceless continuants after a nasal although underlying voiceless stops are voiced. This could be used to suggest that these optional processes may be crucially ordered in different ways within different languages. In Kamba, hardening of voiced consonants precedes the process which voices underlying continuants as the following derivations will demonstrate:

\[
\begin{align*}
/N + t/ & \quad /N + v/ & \quad /N + s/ \\
/ & \quad b & \quad \text{Hardening of [+voice] consonants} \\
/ & \quad d & \quad z & \quad \text{Voicing} \\
[nd] & \quad [mb] & \quad [nz]
\end{align*}
\]

Voicing appears to precede Hardening in Tarascan so that derived stops are not voiced:

\[
\begin{align*}
/N + t/ & \quad /N + s/ \\
/ & \quad d & \quad \text{Voicing of stops} \\
/ & \quad c & \quad \text{Hardening} \\
[nd] & \quad [nc]
\end{align*}
\]

Also, different languages may impose different restrictions on these processes so that, for example, only voiced continuants are hardened in Kamba and only stops are voiced in Tarascan. It will be necessary for this type of variation to be incorporated into the ultimate model which is designed to account for the behavior of nasal-oral sequences. Our present model provides the basis for that ultimate model of derivation.
6.2 Relationship of Phonetic Processes and Unification

6.2.1 Homorganicity and Unification

It was mentioned earlier that homorganicity may play one of two roles in unification. It may either be a prerequisite or a consequence of unification. We examined briefly the case of Delaware wherein only underlying homorganic sequences exhibit unification; non-homorganic sequences are realized as non-homorganic surface clusters. In many cases, we cannot be sure of the underlying point of articulation of certain nasals precisely because they are always homorganic with the following consonant. It is common in such cases to opt for an "archiphoneme" representation for the nasal, /N/, which indicates that it is indeterminate in terms of place of articulation features at the underlying level. Of course, it is true that not only languages with surface prenasalized consonants exhibit only homorganic nasal-oral sequences.

Chomsky and Halle (1968:419) capture the generalization that all nasal-oral sequences are homorganic in English and claim that the nasal in such cases is always represented as an underlying /n/ in the lexicon, i.e. as the "unmarked" nasal. Thus, the underlying nasal in the following forms is the same in all cases: limp, lint, link, and its articulation is determined by the point of articulation of the following oral consonant. This is the case in many languages. However, it is unclear whether we want to analyze the underlying nasal as /n/ in all cases. For example, in Tabukang Sangir (Maryott 1965), there is evidence that /ŋ/ is the unmarked nasal. Stem-final nasals are
altered from bilabial and alveolar to velar before pause:

mengilin 'to grind'
nipikun 'be wrapped'

The identity of these nasals can be identified only before a vowel-initial suffix:

gllman 'grinding mill'
papikunaj 'wrappings'

We expect that the unmarked member of a series will appear in positions of neutralization. Similarly, in Sranan, an English-based creole of Surinam, final /m/ and /n/ followed by silence or a non-coronal consonant are pronounced [ŋ] in deliberate speech and are deleted in allegro speech (Hall, Hall, and Pam 1976). In Miao-tseu, a Tibeto-Burmese language, all final consonants were lost except ŋ which absorbed all the nasals (Meillet and Cohen 1952:565). However, on a universal basis, /ŋ/ appears to be more heavily marked than /m, n/, e.g. it is barred from appearing in initial position in Germanic. In fact, it cannot occur initially in Tabukang Sangir either. The essential point of the present discussion is that all these languages permit only nasal-oral sequences which are homorganic.

In some languages, both homorganic and non-homorganic nasal-oral sequences exist. Occasionally, the surface facts of homorganicity merely mirror the underlying facts and there is no process of position assimilation, e.g. Delaware. Even in languages which exhibit such assimilatory processes, there are often restrictions as to which underlying nasals will be affected. For example, in Georgian /m/ does
not assimilate preconsonantally, but /n/ does. In Nyanja, a Bantu language, /n/ (%ni-), the nasal noun class prefix, is assimilated whereas /m/ (%mu-), another noun class prefix, exhibits no assimilation:

<table>
<thead>
<tr>
<th>No assimilation (/m/)</th>
<th>Assimilation (/n/)</th>
</tr>
</thead>
<tbody>
<tr>
<td>mbale 'plate'</td>
<td>mpan! 'knife'</td>
</tr>
<tr>
<td>nzere 'line'</td>
<td>nzere 'line'</td>
</tr>
<tr>
<td>nsaru 'cloth'</td>
<td>nseu 'cleared path'</td>
</tr>
<tr>
<td>njkun! 'firewood'</td>
<td>mkaz! 'woman'</td>
</tr>
</tbody>
</table>

The assimilated prefix is realized as the nasal component of a surface prenasalized consonant. In the case of non-homorganic sequences, there can be no question of a prenasalized unit; the /m/ is realized as a syllabic nasal. In Maidu, a California Penutian language described by Shipley (1964), the opposite situation occurs in which preconsonantal /m/, but not /n/, assimilates.

In still other languages, the assimilation of a nasal appears to be conditioned by non-segmental factors. It was pointed out in Section 3.2 that the "strength" of a boundary is sometimes a factor and that ingrown has [ŋ] less often than inglorious in my own speech. Similarly, Rowlands (1959) notes that in Gambian Mandinka, nasals have their full value in pause position and when not "in close junction" with a following word except that /ŋ/ occasionally becomes [n] in rapid speech. However, if a nasal-final word is in close junction with a following word, nasal assimilation occurs. Examples of close junction cited by Rowlands include:
1. Subject nominal - verb operator
2. Object nominal followed by verb
3. Nominals in genitive relationship
4. Verbs followed by an extension
5. Nominals followed by a postposition
6. Verb operator followed by nominal or verb
7. Connective and nominal

We shall not review here the general question of the interpenetration of phonology and syntax. We merely note that nasal assimilation is apparently conditioned on occasion by non-phonological information. Another example of the same fact is the data from Ndebele discussed in Section 6.1.4.

If all prenasalized consonants are necessarily composed of homorganic units, we might suppose then that homorganicity is the defining criterion for component unification. Such a claim is patently false, however, since many languages exhibit homorganic sequences without unification, e.g. English. It is not even possible to observe that it is the defining criterion in languages which evidence unification. For example, we noted that in Nyanja /n/ undergoes assimilation and is realized as the nasal component of a prenasalized consonant whereas /m/ shows no assimilation. However, if homorganicity were the necessary and sufficient condition for unification to obtain, we should expect that /m/ will induce unification before bilabial consonants since the nasal-oral sequence will be homorganic. There are pairs such as:
in which /m + b/ in the first example, although homorganic, is not
realized as a phonetic unit. Thus, even if we posit homorganicity
as a necessary condition for unification, it is clearly not sufficient
on a universal basis although it is descriptively adequate in a
language such as Delaware.

The alternative to homorganicity as a prerequisite for unification
is homorganicity as a necessary consequence of unification. There is
no doubt that homorganicity is a consequence in those cases where
there in so underlying nasal consonant but in which the nasal is
produced by any of several environmental shielding processes. For
example, in the case of nasal vowel plus oral consonant giving rise to
a surface prenasalized consonant, VN -VNC, the question of underlying
homorganicity is without meaning. Yet, the two components of the
surface unit are always homorganic. These processes of origin are
dealt with in detail in Section 7.2.

In languages which exhibit only homorganic nasal–oral sequences
and unification, e.g. most Bantu languages, we see no compelling way
to decide what the relationship between homorganicity and unification
might be. In the Nyanja case described above, we might distinguish
between a "prenasalizing prefix" and a "non-prenasalizing prefix"
instead of an assimilating and a non-assimilating prefix. The pre-
nasalizing prefix might have the effect of inducing assimilation
instead of vice-versa. We shall claim, however, that homorganicity
assimilation generally precedes unification in these cases and that, in addition to homorganicity, morphosyntactic information such as noun class membership may be crucial to unification in some languages. Our reason for preferring this analysis is simply that in some languages the nasal-oral sequence is always homorganic even when unification does not obtain. For example, in Section 5.4, we discussed several factors conditioning an alternation between prenasalized consonants and sequences of syllabic nasal plus oral consonant. In some cases, stress appeared to be the conditioning factor, e.g. Swahili Ḃje (disyllabic) 'outside' and awānje (trisyllabic) 'get out'. In Ganda, all initial preconsonantal nasals are syllabic: mbogo, embogo (both trisyllabic) 'buffalo'. We note that in such cases where unification cannot occur for whatever reason, the nasal-oral sequence still presents homorganic units. We therefore conclude that homorganicity adjustment precedes and is independent of unification although we recognize the inconclusive status of these arguments.

6.2.2 Secondary Phonetic Processes and Unification

We have already mentioned several times that in addition to homorganicity and durational adjustments, other phonetic adjustments may occur during the course of nasal-oral unification. Contrary to homorganicity, these processes are optional in the sense that a given language may avail itself of any of them or none of them. These processes typically affect the oral component of the prenasalized unit, not the nasal, which is the element which exhibits homorganicity assimilation. There are, however, several processes, such as devoicing
before voiceless oral stops, which do affect the nasal component. These processes will be surveyed in greater detail in Chapter 8, which chapter attempts to delimit all the phonetic adjustments evidenced by prenasalized consonants. We will review only the most commonly occurring processes here in order to attempt to establish their relationship with homorganicity adjustment and the actual process of unification.

As was pointed out at the onset of the discussion of homorganicity adjustment, there are two basic relationships which may obtain between secondary phonetic processes and unification: (1) they may precede unification, or (2) they may follow unification. A third possibility, that these processes are simultaneous with unification, is considered, but it is necessary to remember that the processes are independent of unification as will be demonstrated below. These secondary processes can be neither a prerequisite nor a necessary consequence of unification since they are optional and absent in many languages. In addition, these secondary processes may occur in various sequential relationships with homorganicity assimilation which, as was suggested above, precedes the actual process of component unification. Thus, there are two sorts of relationships whose nature we hope to elucidate during the course of the following discussion.

The latter of the above relationships, that which obtains between secondary processes and homorganicity assimilation, would seem to be the more straightforward of the two. Although not exclusively the case, it appears that secondary phonetic processes such as voicing
assimilation, hardening, aspiration, etc. follow homorganicity adjustment. It is conceivable that a language which does not exhibit homorganicity assimilation might evidence other nasal-oral secondary processes, but we can supply no definitive cases of such at present. This is not to claim, for example, that it is theoretically impossible for some language to voice oral consonants in a post-nasal environment when the nasal and oral consonants are not homorganic:

\[
\begin{align*}
/\text{an} + \text{pa}/ & \quad [\text{anba}] \\
/am + \text{sa}/ & \quad [\text{amza}]
\end{align*}
\]

However, there are no clear examples of such cases. It would seem, therefore, that it is possible to at least establish a tentative hierarchy of processes in which homorganicity adjustment is more highly ranked than other secondary phonetic processes. This will be discussed further below.

The relationship between secondary phonetic processes and the actual process of unification would appear to be somewhat more complex. We have already seen that Myers (1974 Ms), for example, explains the voicing of the prenasalized stops in Kikuyu by positing a Cluster Simplification Rule in which the [+e.v.c.] segment takes its voicing specification from the underlying nasal. We pointed out in our discussion of Myers' model that although it is formally adequate for Kikuyu and languages which exhibit only [mb, nd, nj, ng], it is ad hoc and without any real explanatory value. Additionally, the model was shown to be formally inadequate for languages with more complete
prenasalized inventories. There is, according to Myers, no process voicing stops post-nasally in Kikuyu. The voiced plosive component of the prenasalized stops is created by a rule specifying the nasal as [+e.v.c.]; the voiced plosive component is therefore formally independent of the voiceless or voiced stop which conditions the [e.v.c.] specification.

Contrary to Myers, we believe that there is a process which voices underlying voiceless stops in Kikuyu after nasal consonants. Similarly, we believe that there are processes which make post-nasal implosives /ɓ, d/ into explosives [b, d] in Shona, post-nasal fricatives into affricates in Venda, deaspirate voiceless stops after nasals in Zulu, etc. That is, we believe all of these changes to be processually produced assimilations which are independent in the sense that they are not necessary consequences of nasal-oral unification in these languages. Further, this independence is attested by the fact that most of these processes are exhibited in languages where unification is unknown.

As was the case with the data cited in support of our analysis of homorganicity adjustment preceding unification, the evidence relating to secondary phonetic processes and unification is fragmentary and uncompelling. The crucial type of data in this consideration is provided by languages in which unification of nasal-oral sequences obtains under certain conditions but not others and in which secondary phonetic processes attested in some forms are absent in others. One possible such case is that of Campa (Arawak) as discussed by Dirks
(1953). In Campa, the underlying stops /p, t, ṯ, k/ are generally realized without voice and with slight aspiration. However, after a nasal they are voiced [b, d, ḏ, g]:

/kompirùši/ [kombridsi] 'a palm leaf'

/nišinTyo/ [nišindyo] 'my daughter'

/kirinka/ [kirînga] 'downstream'

However, in the second syllable of disyllabic words in which stress falls on the first syllable, this variation does not occur:

/Inki/ [îngi] 'peanut'

Unfortunately, Dirks does not provide any information about the durations of these sequences. The facts relating to stress are reminiscent of those described in Section 5.4 for Swahili and Ndebele, in which unification was prevented in underlying disyllabic forms since the stress in such cases falls on the nasal prefix. In those cases, instead of a surface prenasalized consonant, there is a sequence of syllabic nasal and oral consonant.

A more informative case of this sort is provided by the Delaware data already discussed in this chapter. We mentioned that a nasaloral sequence is unified when the oral consonant is not part of an extended cluster, e.g., unification occurs in a form such as /hempəs/, but not in /hempsa/. In addition to the various timing adjustments involved in unification, post-nasal consonants are voiced in this situation. This might suggest that voicing follows unification, i.e., that in Delaware only oral consonants which have been unified with a nasal consonant are then voiced. However, there is at least one other
plausible explanation for the non-voicing of /p/ in /hempo/. /p/ is prevented from being voiced because it is in contact with another voiceless sound whereas in /hempo/ the /p/ occurs between two voiced sounds. That is, the environment for voicing is the same as the environment for unification. In this respect, the data relating to the relationship between secondary processes and unification are not unequivocal.

The fact that many languages which do not evidence nasal-oral unification exhibit these secondary phonetic processes points to their independence from unification. Since they are not a crucial part of the actual unification process, it might be hypothesized that in some languages they precede and in others follow unification. This may well be the case. There are some perceptual and physiological reasons why we might hypothesize that the processes are conditioned by unification. These relate to the timing considerations which we have alluded to throughout the course of this work and which we shall discuss below.

We have claimed that the single crucial criterion which distinguishes surface prenasalized consonants from surface nasal-oral clusters is durational in nature. That is, prenasalized consonants as surface units exhibit the duration which is characteristic of non-suspect unit consonants in language systems within which they function. This is what distinguishes, for example, the nasal-oral sequences of Bantu which are true prenasalized consonants from the nasal-oral sequences of Dravidian which are clusters and present the
surface length approximately twice that of unit consonants. Although prenasalized consonants are apparently unknown in Dravidian (R. Asher, personal communication), some secondary phonetic processes of the type discussed above are exhibited in some languages. For example, the sequence nasal plus voiceless plosive has become a long nasal in Malayalam, but its regular development in many other Dravidian languages, e.g. Telugu, is nasal plus voiced plosive (Kumarawami Raja 1969). That these processes are exhibited in non-unit nasal-oral sequences points to their independent status and suggests that if these processes are independent in some languages, then they are independent of unification even in those languages where unification occurs.

Although prenasalized consonants exhibit relatively stable duration as units, in languages with more than a series of prenasalized voiced stops, there are subtle timing adjustments within the prenasalized unit. That is, there is a "trade-off" in the length of the two components of a prenasalized unit which is directly dependent on the nature of the oral consonant. For example, in unit sequences of nasal plus voiced plosive and nasal plus voiceless plosive, the nasal will be shorter before the voiceless plosive which itself will present greater surface duration than the voiced plosive. Similarly, in sequences of nasal plus stop and nasal plus fricative, the nasal reduces more before the fricative than before the stop. In fact, in many languages the surface realization of the nasal of a prenasalized, especially voiceless, fricative is solely nasalization of the
preceding vowel. In Ijo (Williamson 1973), there is complementary
distribution of VN and V preconsonantally with the former occurring
before stops and the latter before continuants as well as word-
finally. In Brazilian Portuguese (Brito 1976), there is a short
nasal consonant between nasal vowels and a following [-continuant]
consonant which is not present word-finally or before [+continuant]
consonants. In Ila (Doke 1928), nasals are "deleted" before /a, s, h/
and the preceding vowel is heavily nasalized:

\[\text{[palsempula]} /\beta a + l a + N + \text{s empul}a/ \text{ 'they carry me'}\]
\[\text{[wa huna]} /wa + N + \text{h}u na/ \text{ 'he loves me'}\]

Similarly, in Bulgarian (Aronson 1968), a sequence of vowel plus
nasal is realized as a nasalized vowel before fricatives. This is
occasionally the case in Ganda, but it is best regarded only as a
tendency and not a phonetic rule. Ziervogel (1952) notes a tendency to
nasalize vowels before nasal-oral sequences when the oral consonant is
a sibilant, lateral, or denti-labial in Swazi as well as before the
nasal click.

It is our analysis that at the level of remote organization, pre-
nasalized consonants are nasal-oral clusters which are later unified
into unitary consonants. At the point at which unification occurs,
timing adjustment necessarily occurs and both components of the cluster
undergo durational reduction. The relative reduction of each component
varies, as we have seen, with the feature specification of the
following consonant. We saw in Chapter 5 that there are other timing
adjustments which also occur at this point. There is a tendency to
maintain the syllable as a unit of timing while permitting segmental restructuring within that unit. For example, in a pair of Ganda words such as kutanta - kutanda, the underlying syllabification is ku.tan.Ca. We have seen, however, that the nasal will be longer in kutanda than in kutanta. Nevertheless, the duration of the whole -tan-syllable is constant. The vowel lengthens more before nasal plus voiceless segment than before nasal plus voiced segment. We suggested in Chapter 5 that the motivation for the vowel lengthening before a prenasalized consonant was largely compensatory for the reduction in duration of the nasal syllable coda. It is clear now that this compensatory lengthening is of a much more subtle nature; the degree of lengthening is directly conditioned by the degree of reduction. Thus, in the case of complete reduction of the nasal before voiceless fricatives, for example, the lengthened vowel exhibits the surface duration of an underlying long vowel. Instrumental analyses for these facts appears in Herbert (1974, 1975).

It might be argued that the motivation for the distinction in nasal durations before the various types of oral consonants is of an articulatory nature. That is, given the duration of a single consonant, more time is needed for the transition from [n] to [s], for example, than from [n] to [d]. The former sequence is articulatorily more complex in that it requires more distinct muscular activities than the latter. Thus, a purely articulatory explanation of these timing distinctions would merely make reference to the degree of articulatory complexity of the transition from nasal to oral consonant. Such
an explanation would need to make reference to the combined duration of the prenasalized consonant as conditioning these adjustments.

However, that these adjustments are not purely articulatorily conditioned in this sense is suggested by the fact that we find similar tendencies in non-unit nasal-oral sequences as well. For example, Lehiste (1974) found that resonants are systematically shorter before voiceless plosives than the corresponding voiced plosives in English pairs such as bent-bend, built-build, etc. Since each segment has its own "normal" duration, we cannot explain this difference in nasal duration within prenasalized consonants by simple reference to articulatory complexity of single units. The shortening or loss of nasal consonants before voiceless fricatives is likewise attested in non-unit nasal-oral sequences. For example, Jackson (1967:796) notes that in the history of Breton *Vns > ñs and *Vnʃ > ñʃ. He describes the situation by remarking simply that "ñ lost articulatory contact." Unfortunately, he offers no explanation or motivation for this phenomenon. Thus, although such phenomena probably have articulatory as well as perceptual motivation, they are independent of nasal-oral unification. They are not conditioned by the timing reductions which occur in unification, but represent more general processes which are optionally applicable to all nasal-oral sequences.

The last set of data which we will consider which suggests that secondary phonetic processes precede the actual process of unification is forthcoming from languages in which a nasal in juxtaposition with an
oral consonant elicits prenasalization in certain cases, but other combinations result in a syllabic nasal followed by an oral consonant which exhibits the effects of secondary processes. For example, in Zulu (Doke 1926):

\[
\begin{align*}
N + p^h & \rightarrow mp^h \\
N + t^h & \rightarrow n^t \\
N + k^h & \rightarrow \eta k^h
\end{align*}
\]

where the nasal elicits loss of aspiration and ejective release. Other combinations produce simple prenasalization \((N + t^h \rightarrow n^t, N + k^h \rightarrow \eta k^h)\), prenasalization with other phonetic changes \(N + f \rightarrow mp^h, N + z \rightarrow ndz\), or a syllabic nasal with prenasalization of the oral consonant \((N + \delta \rightarrow \eta mb, N + \eta \rightarrow \eta n)\). This latter type of prenasalization preceded by a syllabic nasal is relatively rare and is dealt with in Chapter 7. Finally, in initial position, the nasal is never syllabic, so that corresponding to the internal sequences \([mp^h, n^t, \eta k^h]\) above, initially we have simply \([mp^h, n^t, \eta k^h]\). This strongly supports our analysis of secondary processes occurring independently and prior to unification.

6.3 Derivational Model

6.3.1 Sketch of the Model

It is at this point that we propose to sketch the details of the derivational model which we consider necessary to account for nasal–oral surface units which are underlying clusters. We have already mentioned that there are other types of prenasalized consonants which do not arise from underlying clusters. These are the environmentally
produced half-nasal consonants which are discussed in Chapter 7. Obviously, these do not need to be included in the present model since they are not produced by a process of unification as defined in Section 6.1.1.

The model which we envisage draws a fundamental distinction between the segmental and syllabic levels of organization. These two levels of organization reflect directly the distinction which we claim exists between underlying clusters and derived units. In fact, as we shall discuss below, the unification of independent segments into unitary sounds is motivated by the transition from segmental to syllabic, i.e. larger than segment, organization. We do not propose to review the literature in support of the syllable unit here. The evidence is largely fragmentary in this regard and refers to such diverse facts as the "syllable size" domain of prosodic features (Lehiste 1970), constraints on syllable structure defined as "morpheme structure conditions", co-articulation and malfunctioning of production which seem to imply that the unit of articulatory programming is larger in size than the segment (Kim 1971:60, Kozhevnikov and Chistovich 1965, Lehiste 1971, Herbert 1975), and evidence relating to the syllable as the domain of various phonological processes (Hooper 1972, Vennemann 1972). The crucial problem involved in the incorporation of the syllable as a formal unit into generative phonology is a definition for the term syllable. This problem has, of course, a much longer history (cf. Hjelmslev 1939, Kuryłowicz 1960, Hála 1960, 1961) and a great deal of confusion seems to arise
from a failure to fully distinguish the phonetic and phonological levels of organization. To be sure, Grammont (1950) does distinguish between the two types of syllables as do many other authors, e.g. Pike (1967). However, Grammont looks for a physiological correlate of phonetic syllables which, he claims, are formed by the "principle of muscular tension". He treats phonological syllables as purely theoretical constructs which represent the rhythmic element of language. We shall provide a definition of syllable as a highly structured larger-than-segment unit of organization which plays an especially important role in timing organization in spoken language. Organization of structured units occurs at both the underlying and surface levels of linguistic organization; therefore, the syllable, by definition, has both phonological and phonetic existence. We assume that, in most cases, underlying units of organization will be identical with surface syllables. However, there is no a priori reason why this is necessarily the case. Our treatment of prenasalized consonants rests upon the claim that segmental restructuring and reorganization are possible and, in fact, are fairly common phenomena on a universal basis.

Within the earlier, segmental, level of organization, we need to distinguish several independent processes. It has already been mentioned that the input to this level, insofar as prenasalized consonants are concerned, is a sequence of independent nasal and oral consonantal segments. Additionally, we have already pointed out that in many language systems, no processes apply to change either the
relationship between these segments or their phonetic shape. However, in other languages, various phonetic adjustments occur within this level of segmental organization. For example, we treat post-nasal hardening, voicing assimilation, positional assimilation of the nasal, etc. as segmental processes. On the other hand, the temporal adjustments which define prenasalized consonants occur as a function of the syllabic level; the segments are unified by constraints determining syllable structure. We may schematize these levels as:

<table>
<thead>
<tr>
<th>SEGMENTAL LEVEL</th>
<th>1. underlying independence of the two components</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. phonetic adjustments: positional assimilation, voicing assimilation, post-nasal hardening, deaspiration, deimplosion, etc.</td>
</tr>
<tr>
<td>SYLLABIC LEVEL</td>
<td>3. unification and phonetic accommodation: prenasalized consonants function primarily as components of the syllable being subordinated to constraints determining syllable structure; temporal adjustments, etc.</td>
</tr>
</tbody>
</table>

Notice that clusters in many languages, e.g. English, exhibit the positional assimilation of Stage 2, but not the voicing assimilation or any of the other assimilations. This is a very common situation. There are languages in which only Stage 1 is exhibited, i.e. languages in which various homorganic and non-homorganic combinations of nasal plus oral consonant freely occur. Also, there are languages in
which several stages are attested. For example, in Delaware non-
homorganic sequences remain at Stage 1, but underlying homorganic
sequences, i.e. those produced by Stage 2 in some languages, undergo
the voicing assimilation of Stage 2 and the timing adjustments of
Stage 3 when they are not part of extended clusters:

\[
\begin{align*}
&/\text{šuvánpi}/ &/\text{hempša}/ &/\text{hempšes}/ &\text{Stage 1} \\
&\text{hembšes} &\text{Stage 2} \\
&\text{he:mbšes} &\text{Stage 3} \\
&[\text{šuvánpi}] & [\text{hempša}] & [\text{he:mbšes}]
\end{align*}
\]

In Tarascan (Foster 1969), there is a contrast between voiceless
aspirated and unaspirated stops. It appears that sequences of nasal
plus unaspirated stop advance to Stage 2 where position and voicing
assimilation occur, but nasal plus aspirated stop show another type
of phonetic adjustment, viz. loss of aspiration: \(^9\)

\text{Tarascan}

\[
\begin{align*}
1. & [-\text{asp}] \rightarrow [+\text{voice}] / N \underline{\underline{\_\_\_}} \\
2. & C \rightarrow [-\text{asp}] / N \underline{\underline{\_\_\_}} \\
&/kɔ + kə + ni pə + ʃ/ [kɔkəmbə] 'take it away quickly'
&/xi + ke + ni phə + a + ra + a + ka/ [xikəmpšəɾəskə]
'I will touch you'
\end{align*}
\]

The exact status of position assimilation as a process is unclear in
Tarascan. Foster gives the underlying stop system as /p, p\(^h\), t, th,
c, c\(^h\), č, c\(^h\), k, k\(^h\)/ and two underlying nasals /m, n/. In medial
clusters, /m/ occurs with /p, p\(^h\), t\(^h\), c\(^h\), c\(^h\), k\(^h\)/ and /n/ occurs with
/t, th, c, c\(^h\), č, c\(^h\), k, k\(^h\)/; /n/ is velar before velar consonants.
This pattern of occurrence is schematized as:

<table>
<thead>
<tr>
<th></th>
<th>p</th>
<th>t</th>
<th>c</th>
<th>c'</th>
<th>k</th>
<th>pʰ</th>
<th>th</th>
<th>ch</th>
<th>ch'</th>
<th>kʰ</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>n</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
<td></td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Because many of the clusters arise by extensive vowel deletion processes and because the gaps in the above schema represent a distinctive pattern, we assume that there is a principled explanation for the gaps. It would appear that /n/ shows assimilation to all positions. This is suggested by the absence of np, npʰ and by Foster's remark that /n/ is [ŋ] before velars; similarly, /n/ is probably [n̠] before palatals. /n/-assimilation applies equally to aspirated and unaspirated stops. However, /m/-assimilation applies only to unaspirated stops; in pre-aspirated stop position, /m/ exhibits no assimilation. The problem here is that not only must two separate rules of nasal assimilation be written to account for what appears to be a single natural process, i.e. nasal assimilation, but also that one of them must be blocked from applying before [+aspirated] consonants. More information is required before an explanation for this situation can be proposed. We expect, of course, that a possible direction of linguistic change in such a situation is rule generalization of the nasal assimilation rules into a single process.
A similar situation requiring two separate rules of nasal assimilation occurs in some Eastern Bantu languages. There are two nasal noun class prefixes in these languages, /n/ (Class 9/10) and /m/ (Class 1 and 3), both of which can be reconstructed as canonical Bantu CV prefixes, i.e. */ni-/ and */mu-/. The rule giving /n/ from */ni/ can be reconstructed for Proto-Bantu whereas that giving /m/ from */mu/ is much more recent and is attested in various areas within the Bantu domain. In some languages, /n/ assimilates before a following consonant; the unit is realized as a Stage 3 prenasalized consonant. /m/ shows no assimilation and there is thus no possibility of a unit segment. In these cases, /m/ is realized as a syllabic nasal. Stage 1 is maintained even when /m/ precedes a bilabial consonant:

### Nyanja

<table>
<thead>
<tr>
<th>/m/</th>
<th>/n/</th>
</tr>
</thead>
<tbody>
<tr>
<td>mbale</td>
<td>mbale</td>
</tr>
<tr>
<td>mzere</td>
<td>nzere</td>
</tr>
<tr>
<td>mkazi</td>
<td>nkuni</td>
</tr>
</tbody>
</table>

Nyanja

Here too, we expect that rule generalization should occur. In fact, in a small number of Bantu languages, the nasal assimilation rule applies to all nasal-oral sequences, e.g. Sykuma:

- *mu-pejl*    *mpejl*    mpejl    'runner'
- *mu-teml*    *teml*     teml     'chief'
- *mu-klima*   *nklima*   nklima   'woman'
- *mu-guusa*   *mguusa*   nguusa   'man'
Most Bantu languages lack the *mu > m rule, and all nasal-oral sequences are realized as Stage 3 prenasalized consonants.

It might be hypothesized that when a language distinguishes between assimilating and non-assimilating nasals, the assimilating nasal will be the unmarked nasal /n/. This is true of the examples discussed above, but it is not universally the case. For example, in Maidu, a California Penutian language, preconsonantal /m/ undergoes assimilation whereas /n/ does not. However, it is apparently the case that non-homorganic nasal–oral sequences with /m/ are more common than with /n/ (Welmers 1973:64).

The derivational model which we propose is obviously correct for surface prenasalized consonants which arise via morphological affixation, i.e. nasal–oral sequences which belong to different underlying morphemes:

**Runyankore**

- **embango** /e + N + bango/ 'spear shafts'
- **embindi** /e + N + bindi/ 'pots'
- **ente ṅkye** /e + N + te. N + kye/ 'small cows'
- **ndëebire** /N + reebire/ 'I saw'
- **anteera** /a + N + teera/ 'he hits me'
- **mwakïŋkorera** /mu + aa + ki + N + kor + era/ 'you (pl.) did it for me'

There can be no question of underlying unit prenasalized consonants in these cases. Since the phonetic evidence (cf. Chapter 5) has shown that these morphologically produced sequences are identical in
behavior with those prenasalized consonants which are traditionally analyzed as unit segments, we hypothesize that there is underlying identity as well. Thus, we have the following underlying representations:

Runyankore

- orubaḫja /o + ru + baNja/ 'judgement'
- omuntu /o + mu + Ṣtu/ 'person'
- ebicoñco /e + bi + coñco/ 'gifts'
- kwenda /ku + eNda/ 'to go'
- ariyatandika /a + rya + taNdika/ 'he will begin'

The model which we propose has a great deal of explanatory power. It enables us to make significant generalizations about all types of nasal plus oral consonant sequences and also to explain different types of nasal–oral sequences in some languages. We note that our elimination of prenasalized consonants from the underlying inventory of languages like Runyankore is based on solid phonetic fact. One of the generally unchallenged methodological principles of generative phonology mentioned by Zwicky (1975:159) is:

(X) If some occurrences of a segment $x$ are derived from a remote representation distinct from $x$, then all occurrences should be derived from remote representations distinct from it.

That is, whenever possible, eliminate $x$ from the underlying inventory. Given this principle, we could simply claim that since some prenasalized consonants are necessarily derived from independent nasal and oral segments, then all prenasalized consonants are so derived. Apart from the simplistic notion of economy, this principle might
receive support from the hypothesis that children, learning a language, generalize in exactly this manner. Of course, no empirical support for this hypothesis has been forthcoming. Thus, on its own merits, we find that this principle does not warrant the adoption of any analysis of data. As Zwicky points out, this principle is, in fact, often in conflict with other, more generally accepted, principles. Nevertheless, we believe that our analysis of prenasalized consonants is correct and is supported by an overwhelming amount of evidence. It must be noted that the purpose of the present discussion is not to cite Zwicky's Principle (X) in support of our analysis, but rather to provide some support for Principle (X) from our analysis.

6.3.2 Explanatory Value of the Model

We note that the proposed model which posits an ambisyllabic origin for prenasalized consonants explains why, in so many languages, prenasalized consonants do not occur morpheme-initially. On its own merit, this represents an interesting distributional fact about these languages. In terms of markedness, we could point out that prenasalized consonants are marked and that only unmarked consonants are found in this position. However, this statement contains no explanatory value. We want to explain, when we can, why a particular sound or any other type of marked item is marked. Our analysis properly explains this markedness. Since prenasalized consonants are underlying ambisyllabic phenomena, they should not appear morpheme-initially. The overwhelming percentage of word-initial nasal compounds in Bantu have their origin in morphological prefixation. There are a few stem morphemes which
exhibit initial prenasalized consonants in some languages, e.g. 
*-ntu 'entity'. These are themselves marked stems since the canonical 
stem form in Bantu is -CVCV. These roots must be explained 
historically by vowel loss and simply accorded marked status in the 
lexicon. We will have more to say about the proper representation 
of these stems shortly.

It was mentioned in Chapter 3 that the proposed analysis of pre-
nasalized consonants appears to have the unfortunate consequence of 
complicating the traditional statement of syllable structure in many 
of the languages in which they function. These languages are usually 
analyzed as "open syllable" languages. We criticized the use of this 
characterization in a unit analysis of prenasalized consonants as 
methodologically unsound. That is, the fact of open syllable 
structure, insofar as it is a fact, is of a different nature than the 
fact that water boils at 212\degree F. which is demonstrably true under 
certain conditions and false at others, e.g. at extremely high 
altitudes, and the fact that the half life of radon gas is 3.82 days 
which is true under all conditions. These are all "facts" which 
incorporate certain theoretical biases. We do not propose to examine 
the nature of the fact of open syllable structure here, but rather the 
nature of the complication for syllable structure statements as was 
discussed in Section 6.1.4 and its relation to various natural processes.

First, our analysis does not reject totally the open syllable 
nature of these languages. The open syllable nature at the surface 
level of organization cannot be dismissed. The revision which we
propose occurs at the underlying level of organization, and our derivational model is designed to reconcile that revision with the open syllable nature of surface organization. Second, as was discussed in Section 6.1, our revision does not claim that underlying syllables of all shapes occur, but rather than underlying syllables are most often open although a very limited subset of closed syllable types may occur. In fact, this subset includes a single type: closed syllables with nasal codas. Third, we pointed out that, on a universal basis, CVN syllables are the least marked type of closed syllable. Many languages permit only nasals syllable-finally; languages with more extensive syllable coda inventories never exclude the nasal consonants from this position. In this respect, our revision is the least marked of possible complications. Fourth, we suggested an explanation for this relatively unmarked status of CVN syllables relating to the vowel-like behavior permitted underlying sonorants. For example, Dixon (1976:263) notes that the most common type of medial consonant cluster in Australian languages involves an apico-alveolar first member (n, l, or r) followed by a peripheral stop or nasal (b, g, m, n). That n, l, and r are all underlying sonorants seems to us a significant generalization.

The very important question which needs to be raised is simply why unification occurs in any language. That is, granting the correctness of our analysis, we want to explain, if we can, the motivation for the discrepancy between underlying and surface syllable organization. We note that, both synchronically and diachronically,
changes in syllable structure, i.e. changes in the number of segments and/or the syllabic organization of the segment string of a linguistic form (Bell 1971:52), are not rare. Bell lists various phonetic and morphological processes which shape syllable structure: vowel loss, nuclear fusion, cluster simplification, consonant loss, consonant vocalization, vowel epenthesis, consonant epenthesis, metathesis, word combination, analogic extension of inflectional and derivational elements, and metanalysis. We propose to add consonantal fusion (i.e. unification) to that list.

A great deal of work has been done attempting to delimit the conditions under which, for example, vowel loss is most likely to occur. It appears that such factors as the quality of the vowel, the position of accent within the word, position of the vowel with respect to various boundaries, the nature of contiguous segments, and constituent membership are potentially important. It is apparently the case that consonantal fusion is a process of a different type although a few of these factors are necessary to the complete statement of unification in a few languages. However, the above facts do not explain why vowel loss occurs; they simply delimit the more probable contexts for such loss. In contrast to vowel loss, we understand the motivation for vowel addition somewhat better. It is generally the case that vowels are epenthesized to break up impermissible consonant clusters, i.e. /C____C/, or to make various initial clusters conform to the morpheme structure constraints of a language, e.g. Spanish /#____sC/. Some examples from Ganda exhibiting the effects of
nativization of foreign words with impermissible initial and medial
clusters follow:

<table>
<thead>
<tr>
<th>Ganda</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>fulano</td>
<td>flannel 'vest'</td>
</tr>
<tr>
<td>bulangeti</td>
<td>blanket</td>
</tr>
<tr>
<td>ssepurungi</td>
<td>spring</td>
</tr>
<tr>
<td>egirasi</td>
<td>glass</td>
</tr>
<tr>
<td>ssukuru</td>
<td>school</td>
</tr>
<tr>
<td>ssaazlde</td>
<td>Thursday</td>
</tr>
<tr>
<td>basikoti</td>
<td>basket</td>
</tr>
</tbody>
</table>

Similarly, loan words in many languages are subject to vowel paragoge
as they become more nativized, final vowels are added to words which
are consonant-final in the source language:

<table>
<thead>
<tr>
<th>Ganda</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>ettikiti</td>
<td>ticket</td>
</tr>
<tr>
<td>sementi</td>
<td>cement</td>
</tr>
<tr>
<td>gavumenti</td>
<td>government</td>
</tr>
<tr>
<td>ffutl</td>
<td>foot (measurement)</td>
</tr>
<tr>
<td>essati</td>
<td>shirt</td>
</tr>
<tr>
<td>ettipoota</td>
<td>tea pot</td>
</tr>
<tr>
<td>lipotl</td>
<td>report</td>
</tr>
<tr>
<td>esabliti</td>
<td>sabbath</td>
</tr>
</tbody>
</table>

A vowel is added in the nativization of these foreign words because
all surface syllables must be open in Ganda. Thus, vowel paragoge
is directly motivated by constraints governing syllable structure
and, in this respect, is similar to nasal-oral unification.

A series of interesting examples forthcoming from a study of
loan words in Ganda involves words in which an oral consonant in the
source language is nativization as a prenasalized consonant:

\[
\begin{align*}
\text{mlnsani} & \quad \text{mission} \\
\text{benseni} & \quad \text{basin} \\
\text{erementi} & \quad \text{helmet} \\
\text{kalltunsi/kalltusi} & \quad \text{Eucalyptus} \\
\text{bulungi} & \quad \text{bugle}
\end{align*}
\]

At present, we are unable to provide any explanation for the development of prenasalization in these cases. The first three examples above exhibit nasals in contiguous syllables; however, this is not true for the two final examples.

We argue that the motivation for consonant unification, at least insofar as nasal-oral fusion is concerned, is provided by constraints or general tendencies for preferred syllable structures. Specifically, unification is initiated by the same general preference for surface open syllables as vowel paragoge. Although we claimed that underlying CVN syllables were not too marked a structure, it appears that there are, nevertheless, processes which attempt to convert all such forms into syllables of the optimal CV shape. The unmarked status of CV syllables in well-established. For example, Jakobson and Halle (1956) note that this is the only universal syllable type and that in some languages every syllable is of this form.15
Bell (1971) criticizes the typological approach to the study of syllable structures wherein syllables are treated as "disembodied units" and proposes instead a processual approach. He states:

This convenient simplification, which treats syllables as abstracted from segment strings, fails to capture the role of the syllable as a unit of organization of strings of segments. The view of syllable structure as consisting of the ways that segment strings can be organized into syllables is a prerequisite to our deeper understanding of it. (1971:27)

That is, a typological statement of the sort CV > CVC is less valued than a processual statement such as V -> Ø / CVC# or V -> [-syllabic] / C_VC, all of which state that a former CV syllable became part of a CVC syllable.

Martinet (1955) investigated diachronic tendencies which conspire to produce open syllables. For example, he notes that the development of French up to the sixteenth century exhibits simplification of geminates, loss of preconsonantal _a internally, loss of final nasals with nasalization of preceding vowels, simplification of diphthongs or restructuring of the sort [oʃ] -> [we], etc. where:

On est légitimement tenté de voir là toute une série de faits connexes pour lesquelles on peut parler d'une tendance à l'ouverture des syllabes. (1955:326)

It has already been mentioned that various factors apart from syllable structure considerations may have an influence on the process of nasal-oral unification. In some languages, the quality of the preconsonantal nasal determines whether unification will obtain. It was demonstrated that stress may play an important role in preventing
unification, e.g. in Swahili and Ndebele. Similarly, in Campa (Arawak) (Dirks 1953), underlying stops /p, t, t^̄, k/ are voiced after a nasal consonant except in disyllabic words in which stress falls on the first syllable. We previously mentioned that grammatical information is at times relevant to unification. In Ndebele, nasal plus oral sequences generally give rise to prenasalized consonants when the nasal is the Class 9 prefix, but to syllabic nasal plus consonant when the nasal is the first person singular subject marker or the copulative prefix:

'/n + bubulc/ [mbubulc] 'a nose'

'/n + bonile/ [mbonile] 'I have seen'

'/n + bami/ [mbamî] 'they are mine'

Likewise in Gambian Mandinka (cf. Section 6.2.1), assimilation of a word-final nasal to the position of a following oral consonant is conditioned by the degree of juncture between the two words. Finally, the position of the sequence within a word may impede unification as in several Bantu languages in which preconsonantal nasals are syllabic in initial position. In Motilone (Carib) (Hanes 1952), /m, n/ are syllabic before homorganic stops in initial position. Thus, the same factors which occasionally serve to prevent unification in languages which exhibit the process may prevent simple assimilatory processes such as voicing assimilation in languages without unification. This fact again points to the independence of unification and these other phonetic processes and to the two different levels on which they operate. This distinction is directly reflected in our derivational
model proposed above.

6.4 Initial Prenasalization and Unification: An Alternative Model

An interesting complication is posed for our model by the occurrence of initial prenasalized consonants. That is, since we posit an underlying amisyllabic nasal-oral sequence, it has been convenient to assume that the nasal always belongs to an underlying preceding syllable; this is obviously not possible when the nasal is initial. We note that the vast majority of initial prenasalized consonants arise from morphological prefixation. We pointed, in fact, to the extreme infrequency of morpheme-initial prenasalized consonants as evidence in support of their amisyllabic nature. The essential point is that we cannot consider the nasal component of a word-initial prenasalized consonant as the underlying nasal coda of a preceding syllable. Rather, we must posit an underlying syllabic status for these nasals. Thus, Kvangari forms such as mbunga 'crowd', nsingo 'neck', nганze 'barren woman' are all bimorphemic forms:

/\text{STEM}/. We assume the underlying syllabic organization of these forms is: 16

\[
\begin{align*}
/N.buN.ga/ & \quad [\text{mbunga}] \\
/N.siN.go/ & \quad [\text{nsingo}] \\
/N.gaN.ze/ & \quad [\text{nganje}]
\end{align*}
\]

in which the nasal prefix comprises a separate syllable, i.e. unit of organization. We note that the corresponding plural forms to the above: nombunga, nonsinga, nonganze are actually ambiguous as to whether the second nasal of the prefix is a separate unit or not:
Historically, complex prefixes of this form were actually composed of a prefix and a pre-prefix, i.e. two units. The question is whether the pre-prefix maintains its independent status synchronically. In some languages, it clearly has since the pre-prefix appears only under certain specified grammatical conditions; in other cases, e.g. Kwangari, the data are unclear.

The question arises at this point as to whether it is possible to consider the nasal component of all prenasalized consonants as a separate unit of organization. That is, is the nasal always an underlying separate unit of organization?17

\[
\begin{align*}
\text{[nombunga]} & \quad /\text{no.N.bu.N.ga}/ \\
\text{[nonsingo]} & \quad /\text{no.N.si.N.go}/ \\
\text{[nonganze]} & \quad /\text{no.N.ga.N.ze}/ 
\end{align*}
\]

We note that such a hypothesis is still in keeping with our general thesis that prenasalized consonants are underlying ambisyllabic segment sequences. Further, this schema is easily incorporated into our general argument that nasals are permitted underlying vowel-like behavior. We likened CVN syllables to CVV syllables; the above hypothesis treats them as CV.N sequences, similar to CV.V sequences. In fact, this possibility was first suggested by Homburger (1914:26) for Bantu:
En bantou commun les nasales étaient peut-être non de simple consonnes, mais des sonantes, c.-à-d. qu'elles pouvaient se trouver entre deux occlusives et être tonique; malheureusement les faits modernes qui obligent à envisager cette hypothèse sont peu clairs, et ne permettent ni de la démontrer ni de la rejeter.

We mentioned in an earlier discussion that, in certain languages, a preconsonantal nasal may bear underlying and surface tone. For example, in Ganda, initial preconsonantal nasals are syllabic and tone-bearing:

- ꞇʊŋkɪ 'bee'
- ꞈɲa 'give me'
- ꞈkúbə 'rain'

The tone-bearing status of these nasals coincides nicely with their analysis as underlying syllable units. In fact, although the nasal component of prenasalized consonants, including morpheme-internal consonants, does not bear a tone, various perturbations in the tone of preceding vowels suggest that these nasals also bear underlying tone. For example, Ganda has two underlying tones: high ['] and low [']. A third surface tone appears when a high tone and low tone are compressed onto a single syllable, viz. a falling tone [^].

This falling tone often occurs on the vowel preceding a prenasalized consonant:

- ꞉ʊnmbɔ 'to mould'
- ꞇnɔnɔnt 'tailor'
- ꞈnɔntu ꞈnɔntɔŋ 'good people'
- ꞈŋɔnɔmbɔ 'songs'
It is not the case that only falling tones appear on these vowels. We noted in Chapter 5 that these vowels are always lengthened; they may bear any of the surface tones of Ganda:

- ꦗꦱꦩ꧀ꦱꦸꦺ 'rumors'
- ꦗꦱꦸꦤ꧀ꦱꦸꦺ 'to cook'
- ꦗꦱꦤ꧀ꦱꦶꦸ 'many people'
- ꦗꦱꦱꦶ ꦱꦸ 'to help'
- ꦗꦱꦸꦤ꧀ꦱꦿ 'death rites'
- ꦗꦱꦱꦶ ꦱꦸ ꦱꦸ 'five boys'

The second toneme of these lengthened vowels is not predictable and it is therefore necessary to posit a tone on the underlying nasal consonant. Historically, this tone was associated with a vowel found between the nasal and oral consonants. There is no evidence for such a vowel synchronically. If we assign this extra tone to the nasal consonant, it is necessary to assign an underlying independent status to that nasal:

- ꦗꦱꦸꦤ꧀ꦱꦺ /kʊ.r.ʊ.ŋ.ɓä/ 'to cook'
- ꦗꦱꦱꦶ /kʊ.ə.ŋ.ɓä/ 'to help'
- ꦗꦱꦱꦶ ꦱꦸ /kʊ.ɓ.ʊ.ŋ.ɓä/ 'to mould'

However, since we treat underlying preconsonantal nasals as vowel-like phenomena, this may not be necessary if we allow underlying CVV syllables as a single unit of organization: kijiko 'spoon', kitooke 'banana tree', keediimo 'riot'. There is some evidence which suggests that it is more profitable to view such sequences at the most remote level of organization as CV.V sequences, i.e.:
If this is the case, the alternative analysis of CVN syllables as CV.N sequences is not problematic. That is, it appears that this represents an even more remote level of organization than that presented in the model given earlier.

Ganda also exhibits a wide range of geminate consonants, including voiceless obstruents in initial position, which must be specified for tone in the underlying representation:

\begin{itemize}
  \item \text{bpáta} \quad 'hinge'
  \item \text{ccúpá} \quad 'bottle'
  \item \text{bíkkó} \quad 'valleys'
  \item \text{kífáfó} \quad 'our father'
  \item \text{kúbíkkó} \quad 'to cover'
\end{itemize}

Tone must be specified on these consonants in order to predict their effect on the tone of preceding vowels, especially across boundaries. The relationship between gemination and prenasalization is discussed in Section 8.4. The facts of Ganda tone are extremely complex. Heny (1971) has argued, not unconvincingly, that Ganda is not a tone language, i.e. tone is not specified for every underlying syllable in the lexicon, but rather a pitch accent language in which one syllable per word is marked not for tone but for accent.

The exact relationship between our analysis of CVN units and CV.N sequences is not clear on all points. Further support for the
latter type of analysis comes from languages such as Igbo where every preconsonantal nasal is syllabic (Welmers 1973:67). Noun prefixes in initial position are homorganic:

- ṣẹ̀pẹ̀ 'smallness'
- ṣẹ̀dà 'knife'
- ṣẹ̀fì 'people'
- ṣẹ̀kọ́ 'palm'
- ṣẹ̀gbọ̀ 'wrestling'

There is also a first person singular pronoun /m/ which occurs non-initially as well as, in a few cases, a word-final syllabic /m/:

- ì bárá 'I came'
- ì ńjọ̀ nì 'I saw oil'
- ì̀jì 'all'
- gbọ́gbọ́ 'sheet metal'

In Akan (Welmers 1973:66), initial preconsonantal nasals are always syllabic. These nasals are always separate morphemes and sometimes occur non-initially where they are still syllabic:

- ṣẹ̀pẹ̀ 'mat'
- ṣẹ̀dàm 'haste'
- ṣẹ̀ndú 'water'
- ṣẹ̀ndà 'he doesn't sleep'
- ṣẹ̀gbọ̀ 'I didn't come'
- ṣẹ̀gbọ̀ 'they should come'
There are also non-syllabic nasals in Akan which occur medially before consonants and finally:

\[ \text{Akan} \]

<table>
<thead>
<tr>
<th>Akan</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ åkåmfù ]</td>
<td>'Akan people'</td>
</tr>
<tr>
<td>[ ñnsùm ]</td>
<td>'spirit'</td>
</tr>
</tbody>
</table>

What the Akan data seem to suggest, and which seems intuitively correct, is that nasal morphemes have an independent existence at the underlying level of organization whereas other nasals may or may not. Those nasals which occur preconsonantally function as syllable codas while those which do not are syllable-initial. This analysis again explains why preconsonantal nasals generally do not occur morpheme-initially. In some languages, this distinction is obscured by the surface facts of organization so that nasal morphemes preserve their independent existence only in initial position as in Ganda or not at all as in Kikuyu.

In Chapter 5, we discussed the facts of vowel nasalization in relation to nasal-oral sequences. We claimed that vowels tend to be nasalized before such sequences precisely because the nasal functions in the same syllable as the vowel to its left. Thus, we might expect that vowels which precede preconsonantal syllabic nasals which maintain their independent syllabic status who should not exhibit vowel nasalization. Thus, we find, for example, in Gwandara, a Chadic language of N. Nigeria described by Matsushita (1972), that vowels are nasalized before nasal-oral sequences:

<table>
<thead>
<tr>
<th>Gwandara</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ /ñänci/ ]</td>
<td>[ṣntçi]</td>
</tr>
<tr>
<td>[ /jänkyi/ ]</td>
<td>[dzæŋkjì]</td>
</tr>
</tbody>
</table>
However, the vowel is not nasalized if the nasal is syllabic:

\[ /g\hat{\text{a}}\hat{\text{n}}\text{ya}/ \quad [g\hat{\text{a}}\text{n}ya] \quad 'leaf' \]

However, this is not universally the case. In Zulu, for example, Doke (1926) claims that vowels are nasalized before preconsonantal syllabic nasals. The phonetics are extremely complex involving a set of very extensive morphophonemic alternations. It may be possible to argue that the syllability of these nasals is determined by a surface rule, not their underlying status.

A final piece of evidence which is used to support an underlying syllabic status for nasals comes from Gugu-Yalanji, an Australian language described by L. Oates (1964) and W.J. Oates (1967). We mentioned in Section 6.1.3 that Gugu-Yalanji permits a large number of medial consonant clusters. The interesting data come from clusters composed of three consonants:

\[
\begin{align*}
\text{walmba} & \quad 'log' \\
\text{warngu} & \quad 'sleep' \\
\text{burnguy} & \quad 'snore' \\
\text{yirmba} & \quad '3-prong spear' \\
\text{warnbil} & \quad 'wake up' \\
\text{waymbil} & \quad 'soft'
\end{align*}
\]

Only /l, r, ř, y/ appear as the first member of these clusters and only the nasals appear in medial position. We discussed W.J. Oates' interpretation of these clusters earlier in this chapter. Oates treats nasal-oral sequences as clusters in general, but as units when /l, r, ř, y/ precede. This latter interpretation is based on the total
number of permissible consonants in sequence as two.

If we do not allow for underlying nasals as separate syllable units of organization in well-defined contexts, then we are left with the choice of positing the medial nasals in three-consonant clusters as members of either the syllable to its left or its right, e.g.

walmba /walm.ba/ or /wal.mba/

of which the second alternative seem intuitively more attractive. However, to accept this alternative is to reject the fundamental thesis of this work that nasal-oral sequences are never underlying units and that they are universally represented as underlying ambi syllabic sequences. The obvious solution to this dilemma is to regard the medial nasal in CNC sequences as representing a separate unit of underlying organization:

walmba /wal.m.ba/

The fact that only nasals appear in this position is explained by the special vowel-like status afforded nasals. That we do not find NNC clusters in Gugu-Yalanji is probably evidence for a general NN → N rule. This is an extremely common process among the world's languages. Although L. Oates (1964) mentions nasal plus nasal clusters, no examples are cited. Such an analysis claims that the same set of codas which appears in two-consonant clusters also occurs in three-consonant clusters. Thus, we believe that /m, n, ñ, ñ, l, r, r, y/ all may occur preconsonantally, the nasals interconsonantally, and any consonant prevocalically. The limited class of preconsonantal segments are characterized as underlying sonorants and the
interconsonantal nasals as the most "vowel-like" of these sonorants.

An even more dramatic example of similar nasal patterning occurs in Kunjen, a language of North Queensland described by Sommer (1968). Kunjen exhibits consonant clusters of up to four consonants, but there are very severe restrictions on which consonants may combine and in which order. The following CC clusters occur:

1. mn, nm, nη
2. NC (homorganic)
3. CN (C is unaspirated) (homorganic)
4. l/··· · p, b, k, g, f, y, m, n, w, y
5. r/··· · t, d, t', d', n, w, y
6. r/··· · b, d, g, t, k, f, m, n, η, η, w, y
7. w/··· · n
8. y/··· · b, k, f, m, w
9. g/··· · w

The first member of CCC clusters must be /l, r, η/ and must be followed by CN or NC, though not all combinations occur. A second type of CCC cluster also occurs of the form CNC: /bmb, And, dnb, dng, d'nd'y, gng/, i.e., the initial consonant and medial nasal must be homorganic. Finally, only six types of CCCC cluster occur. The initial consonant is always /l, r, η, y/ followed by CNC. These occur only word-initially and only the following occurrences have been noted: /lbmb, lgn, r'nd, rnd, ymb, yngg/. A complete analysis of these data is beyond the scope of this present thesis. It is interesting to note that the functioning of sonorants, especially nasals, in extended
clusters further points to their extraordinary status.

Tryon (1967) notes that in Nengone, a language of the Loyalty Islands, a nasal may be preceded or followed by any consonant, or both preceded and followed by one. In these cases, the nasal has syllabic value and acts as a vowel for purposes of syllabification; no consonant clusters are allowed. The same situation obtains in other languages of the area.

In many languages, nasals function as syllabic when they occur interconsonantally. For example, in Shilha (Applegate 1958):

\[ N \rightarrow [\text{+syllabic}] / C \_\_\_ C \]

This syllabic \( N \) occasionally appears as \([\varepsilon N]\) or \([N\varepsilon]\). This situation is comparable with those languages which exhibit no medial clusters, but in which initial preconsonantal nasals are syllabic, e.g. Ganda. Finally, in Tolowa, an Athapaskan language (Bright 1964), nasals are syllabic interconsonantally, preconsonantally after a pause boundary, and preconsonantally after a long vowel, i.e. in positions where they cannot function as syllable onsets or codas.

Of course, certain types of sonorants seem to be more vowel-like than others. For example, there are numerous cases of velarized \( l \) developing into a back, rounded glide. Latin \( l \) was vocalized preconsonantally after /a, e, i, o/ and absorbed after /u/ in French sometime before the twelfth century (Anglade 1965:60-1):
malvam > mauve
altam > haute
falsam > faux
capillos > (chevels) cheveux
illos > (els) eux
pulicem > puce

More recently, the so-called "dark l" of most educated Polish speakers have been replaced by [y] except in extremely careful pronunciation of the theatre. The alternation between [y] and [l] in different forms is exhibited in the following plural forms of the past tense:

<table>
<thead>
<tr>
<th>Masc. Persons</th>
<th>All Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>byliśmy [bliśmi]</td>
<td>bylyśmy [bliśmi] 'we were'</td>
</tr>
<tr>
<td>kochali [koxal]</td>
<td>kochały [koxały] 'they loved'</td>
</tr>
<tr>
<td>umieli [um'el']</td>
<td>umiały [um'ał'] 'they knew'</td>
</tr>
<tr>
<td>pisaliśmy[pisaliśmi]</td>
<td>pisałyśmy [pisąłśmi] 'we wrote'</td>
</tr>
</tbody>
</table>

The pronunciation of l with a velar [t] is still heard in more conservative dialects although the [y] pronunciation is much more extensive. For many speakers of American English, words such as film and milk are pronounced [fɪlm] and [mɪlk]. Also, [w] is often substituted for syllable final [l] or syllabic [l], e.g. Bill [bɪl], bottle [baːl] (Ohala 1974a:256). Ohala provides an acoustic explanation for these facts founded in the similarities in the formant space of these sounds. The same interchange is involved in perceptual errors, e.g. social-historical is heard as socio-historical and in reverse misperceptions such as O Most Holy Savior perceived as Almost
Holy Savior.

The same interchange between consonantal and vocalic elements obtains with nasal consonants less commonly. For example, Proto-Wambo exhibited the following morphophonemic changes (Baucom 1975):

- $N + p > mp$
- $N + v > mb$
- $N + y > Rj$
- $N + t > nt$
- $N + l > nd$
- $N + t\tilde{s} > R\tilde{t}\tilde{s}$
- $N + k > \eta k$
- $N + w > mbw$
- $N + g > Rj$

However, in the northern languages, the rule for /w/ is:

- $N + w > lw$

In fact, Evale has generalized this to a single "nasalization rule", so we have the following comparative forms (Baucom 1975):

<table>
<thead>
<tr>
<th></th>
<th>Ndongo</th>
<th>Kwanyama</th>
<th>Evale</th>
</tr>
</thead>
<tbody>
<tr>
<td>$N + p$</td>
<td>$mp$</td>
<td>$\eta$</td>
<td>$Ip$</td>
</tr>
<tr>
<td>$N + t$</td>
<td>$nt$</td>
<td>$\eta$</td>
<td>$It$</td>
</tr>
<tr>
<td>$N + k$</td>
<td>$\eta k$</td>
<td>$\eta$</td>
<td>$Ik$</td>
</tr>
<tr>
<td>$N + l$</td>
<td>$nd$</td>
<td>$\eta$</td>
<td>$Il$</td>
</tr>
<tr>
<td>$N + w$</td>
<td>$mbw$</td>
<td>$lw$</td>
<td>$lw$</td>
</tr>
<tr>
<td>$N + y$</td>
<td>$Rj$</td>
<td>$Rj$</td>
<td>$ly$</td>
</tr>
<tr>
<td>$N + v$</td>
<td>$mb$</td>
<td>$mb$</td>
<td>$lv$</td>
</tr>
</tbody>
</table>

The preceding examples point clearly to the vowel-like nature of underlying nasal consonants. To what extent the proposed analysis of initial preconsonantal nasals and interconsonantal nasals can be reconciled with this nature is a topic with wide implications which is beyond the scope of the present treatment. We noted that our extension of such a model to include, for example, all preconsonantal...
nasals within Bantu is far from novel. Homburger (1911) suggested essentially such a treatment. Further, we cited Trubetzkoy's (1949) observation that liquids and nasals are the most vowel-like obstruents in that they represent the weakest type of obstacle, i.e., they least exhibit specifically consonantal properties. We conclude this section with a rather extended quotation by Trubetzkoy which appears to have anticipated almost in toto such an analysis of prenasalization as was developed in the present chapter:

It may happen that a language contains only a single 'nasalized vowel.' For such a vowel neither a particular class of timbre nor a particular degree of aperture is relevant. These could only become relevant in contrast with other nasalized vowels. The coloration of such a single nasalized vowel is therefore determined by its consonantal environment alone. Its aperture is not present at all. In other words, such an 'indeterminate' nasal vowel is nothing but a syllabic nasal that is assimilated to the following consonant. In sketches of African languages where such phonemes occur, they are usually represented by the letters m, n, ñ, etc. But it is very questionable whether this phoneme can really be identified with m, n, ñ, etc. It must be kept in mind that in most such languages consonant combinations do not occur at all (or that only the combinations 'obstruent + liquid' are permitted). The phonemes in question can therefore only form distinctive oppositions with the vowel phonemes, while m, n, etc., stand in a relation of direct, distinctive opposition only to the other consonants. Furthermore, the 'syllabic nasal' in the particular African languages shows the same distinctive features of tone (differences of tonal register) as the vowels. All this favors the view that in cases such as Ibo 'mbɛ' (bisyllabic, high-tone m, low-tone [turtle]) the 'syllabic nasal' may be considered an 'indeterminate nasalized vowel.' However, even with this interpretation certain difficulties remain. For in languages such as Ibo, Efik, Lamba, Ganda, etc., which do not have any nasalized vowels nor a nonnasalized indeterminate vowel, the 'syllabic nasal' stands in a relation of distinctive opposition to the vowels only, but this relation is always multilateral. In such a
case, the 'syllabic nasal' can probably be regarded as an 'indeterminate vowel in general.' Its nasalization, however, is a purely phonetic, phonologically irrelevant property. In languages such as Ewe, Yoruba, Fante, etc., on the other hand, where the correlation of nasalization comprises the entire vowel system, this 'syllabic nasal' would have to be grouped within the category of nasalized vowels. A curious situation would result: the system of nasalized vowels would then contain one phoneme more than the system of nonnasalized vowels, which would contradict everything we know about the correlation of nasality. (1969:120-1)

While we cannot accept the nonnasality of Trubetzkoy's "indeterminate vowel" in systems without contrastive nasality in vowels, we agree wholeheartedly with his assignment of these surface nasal consonants to the underlying category of vowels.

6.5 Summary

In the course of this chapter, we have examined several proposals for the derivation of prenasalized consonants and demonstrated that they are associated with various problems. These proposals were not, however, without merit. We presented our own idea of what such a derivational model must incorporate, and we attempted to explain how the underlying and surface levels of organization may differ in this model. We examined in brief detail the processes, both obligatory and optional, involved in consonant unification; we also attempted to clarify the relationship which holds between these various processes and unification. These processes are dealt with in greater detail in Chapter 8.

Although at first glance the model we propose appears to have the serious shortcoming of complicating the statement of syllable structure in many languages, we explained how this complication was
a minor and natural one. Our model also has the advantage of explaining why prenasalized consonants occur most commonly in open syllable languages, i.e., we provide a motivation for prenasalized consonants derivation which is directly tied to syllable structure considerations. Finally, we demonstrated that the vowel-like behavior which we attribute to underlying sonorants is not a trick of analysis, but has real foundation in concrete linguistic facts, e.g. the fact that sonorants, especially nasals, are often tone-bearing and also the data of various sound changes.

Thus, we have established that prenasalized consonants do not occur as such at the underlying level of organization. We have examined in detail the most common type of prenasalized consonant, viz. that which has its origin in underlying nasal and oral consonantal components. We have shown that these components always represent independent underlying segments. In the next chapter, we survey other types of processes, largely phonetic, which also give rise to surface prenasalized consonants. These data too do not warrant the postulation of underlying prenasalized units.
NOTES

1 I am grateful to Ilse Lehiste for first suggesting this syllabification and its advantages to me.

2 We will deal with the syllabification of initial prenasalized consonants in a later section of this chapter.

3 Bell (1971:51) notes that among the stop consonants, glottal stop is the least marked as syllable coda.

4 Actually, the analysis which we shall ultimately propose is that nasals represent one end of the continuum of syllable codas, that which is closest to pure vowels. The other extreme is represented by glottal stop, which is, in a sense, the most obstructant-like obstructant. The frequency of nasals as syllable codas may be explained by their functioning as part of complex syllable nuclei, similar to the gliding elements of diphthongs. Thus, under this interpretation nasals are not really codas in the usual sense.

5 In fact, I need to acknowledge the debt which I owe to Myers' analysis of Kikuyu, which originally stimulated much of my own research in Ganda and then in other languages.

6 Stahlke (1976:42) criticizes the "segmental discreteness postulate", i.e. the view that both segments of a fused consonant contribute to the phonetic identity of that consonant. However, he cites homorganic nasal assimilation in Yoruba as an example of a situation in which the postulate works:

/n + bo/  ñòòó 'coming'
/n + fi/  ñííi 'taking'
/n + ge/  ñííe 'cutting'

7 It is probably true that our analysis of /n/ as the unmarked nasal represents an overgeneralization. It seems more likely that /n/ is the unmarked nasal in the unmarked position for consonants, i.e. prevocally. There is a great deal of evidence which suggests that the velar nasal is unmarked in final position, e.g., the normal attrition for final nasals is m > n > n > ñ > Ǿ. Also, speakers of English and German, when learning French, substitute Vŋ sequences for V. The unmarked nasal preconsonantly is a nasal homorganic to the following consonant.

8 A possible counter-example to this generalization is the de-aspirating of voiceless stops postnasally in Tarascan which occurs regardless of the homorganicity of the sequence. The expected process is aspiration of voiceless stops in this environment. Cf. Section 8.1.6.
9 Note that both of these processes are subsumed under the general heading of "post-nasal strengthening" and are described in Chapter 8.

10 It may be the case, however, that syllability of non-assimilating nasals may be lost first before consonants which are homorganic, precisely because these sequences would permit unification. Although this does not occur in Nyanja, Welmers (1973:69) mentions that the noun and concord prefix /m/ of Swahili occurs before all consonants, but its syllabic character is lost before /b/ and /v/.

11 Givón (1974) has argued that even in languages where the nasal assimilation rule is generalized, e.g. Sykuma, other processes insure that the phonetic realizations of Class 9/10 and Class 1 and 3 noun prefixes are distinct. For example, in Sykuma /n + Q/ → [Nh] whereas /m + g/ → [Ng]. Givón attributes this to the paradigmatic and functional load considerations which have been claimed to play a role in constraining phonological change. However, it is not clear that the prenasalized voiced stops do not directly counter Givón's claim. They appear to be identical whether their source is /n + C/ or /m + C/.

12 The representation we employ for the nasal component of non-morphologically derived prenasalized consonants, /N/, does not necessarily mean that the nasal is unspecified for point of articulation as we believe, for example, is the case for many noun class prefixes. Naturally, morpheme-internal prenasalized consonants show no alternation. Our representation is intended to exhibit the non-unit status of the nasal and oral segments. In orthodox generative phonology, all preconsonantal nasals would be unspecified for point of articulation; we believe this to be a moot question.

13 An apparent exception to this generalization would be languages with an extensive CVC inventory, but no syllables of the shape CVN. However, in such cases as attested, we find CV syllables where we expect CVN. In fact, in some languages CVN and CV syllables are in complementary distribution; both are to be analyzed as /CVN/. Some of the languages surveyed by Bell (1971) appear to allow closed syllables not closed by nasals, e.g. only glottal stop as a coda. These require further investigation.

14 It is not the case, of course, that "vowel-like" behavior of underlying sonorants is identical with the behavior of underlying vowels. For example, Beach (1938) notes that Hottentot roots in CV.V have variants in CV?V whereas roots in CV.N do not have CV?N variants.

15 However, cf. Sommer (1968), who discusses some Australian languages with only VC. syllabification.
16 See footnote 12.

17 This possibility was first suggested to me by Gillian Brown.

18 A low-high sequence is obligatorily converted into a long low tone in Ganda, where we might expect a rising tone [\~].
CHAPTER VII
PRENASALIZED CONSONANTS: PROCESSES OF ORIGIN

7.0 Introduction

In the preceding chapters of this thesis, we have demonstrated in detail how underlying sequences of nasal plus oral consonants come to be realized as surface prenasalized consonants. The claim was put forward that all prenasalized consonants which are represented at the underlying level by nasal and oral consonantal components are in fact underlying clusters. This claim was reconciled with the facts of surface phonetics and syllable structure. It was demonstrated that the model which is proposed allows for the explanation of certain facts such as the high co-occurrence of prenasalized consonants and open syllable languages, which traditional analyses do not. Further, it will be demonstrated in Chapter 8 that the proposed theory makes certain other types of predictions about linguistic behavior which are borne out. In this respect, it is preferable to a theory which makes no predictions and merely analyzes data via theoretical biases although any theory necessarily incorporates a certain amount of bias.

In the present chapter, we will survey the various linguistic processes which ultimately result in surface prenasalization. These will be divided into three major categories:
1) processes which cause a nasal consonant to abut upon an oral consonantal segment. These would be included within the scope of the derivational model presented above.

ii) "environmental" processes which cause an oral or nasal consonant to be realized as a prenasalized consonant in certain well-defined environments. These typically occur most regularly in languages with distinctive vowel nasality.

iii) spurious processes of nasalization. These are generally sporadic and rarely productive, which makes the determination of their nature somewhat difficult.

7.1 Nasal Abutment

In this section, we will examine those processes which cause nasal and oral consonantal segments which are not adjacent in the underlying representation of single morphemes to buttress one another. Although we refer to the sum of these processes as Nasal Abutment because it is the nasal which is more active in the majority of cases, the oral consonant is also responsible for certain abutments. Of course, in some cases, it is inappropriate to speak of either consonant as being more "active" than the other. All types of processes will be subsumed under our general heading.

7.1.1 Morphological Processes

The most common process which results in nasal abutment is morphological in character and involves the juxtaposition of two separate underlying morphemes. Cases which result in prenasalized consonants generally involve prefixation although some cases of infixation are also claimed to exist. There is no theoretical reason why incidents of suffixation should not occur, e.g. of /-CV/ suffixes being added to nasal-final stems. However, we have no examples of
such which result in surface prenasalization. We interpret this as an accidental gap in the data base; it needs to be mentioned that the vast majority of languages which we have examined in detail are prefixing, not suffixing, languages. Also, there are cases, of course, of morpheme juxtaposition in which it is inappropriate to speak in terms of affixation on any level.

A large percentage of the cases examined in earlier chapters of this thesis were examples of a nasal prefix /N-/ or a nasal-final prefix /(C)VN-/ being added to a consonant-initial base. The canonical examples of this were the Bantu noun class prefixes for Class 9/10 nouns which, in most languages, are /N-/, e.g. Lomongo (De Roop 1958):

/N + kema/ nkema 'monkey'
/N + se/ nse 'fish'
/N + bati/ mbati 'possessor'

and the first person singular subject prefix:
/N + ka/ nkà 'I go'
/N + bata/ mbata 'I possess'

This type of morphological abutment is well-treated, with numerous examples, in the previous chapters of this work, and we shall not deal with it any further in the present chapter.

Another morphological process which results in nasal-oral juxtaposition is reduplication. For example, in Southern Piute (Sapir 1930) reduplication accounts for a large number of intervocalic "nasalizations", e.g. qaŋqaŋ-ı 'houses' (< qaŋ-ı 'house'). This type of reduplication is especially common among the Austronesian languages,
which make widespread use of reduplication as a morphological device. A large number of the *CVCCVC roots reconstructed for Proto-Austronesian are actually reduplicated monosyllables, some of which have the form *CVNCVN. Other roots with medial NC do not arise by reduplication, and there is no identity between the two syllables of the root. This type of Austronesian root is discussed further below.

Dahl (1951) gives several examples of historically reduplicated CVN roots in Malagasy:

*baŋbaŋ 'large' Mlg. bambana 'boundless space'
*ɗamɗam 'quiet' rendrem/ana 'sleepy'
*bĩbĩŋ hold in hand' vimbina id.
*k'ĩŋk'ĩŋ 'lift up' tsiŋtsina id.
*d'und'ũŋ 'wear on head' jonjona 'go without turning the head'
*tunũŋ 'strike' tontona id.
*pũpũŋ 'reunite' fompona id.

In these examples, the preconsonantal nasal assimilates in position to the following oral consonant in Malagasy and:

le complexe est réduit à une prénasalisée avec le même lieu d'articulation et la même sonorité que l'occlusive. Ces prénasalisées secondaires ont, à leur tout, subi la même évolution que les pré-nasalisées de l'indonesien commun. (1951:61)

However, it is not the case that all nasals which come to be preconsonantal in Austronesian as a result of such reduplication undergo these processes. For example, Blust (1971:76) notes that these nasals undergo position assimilation in Malay and Javanese:
In Madurese, however, preconsonantal nasals in reduplicated monosyllables are unchanged (Stevens 1968):

- *banban*  
  - Jv. bamban  
  - 'bast-producing plant'

- *banbəŋ*  
  - Ml. bambaŋ

- *DemDem*  
  - Ml. dəndəm
  - Jv. dəndəm

- *sunsun*  
  - Ml. sonsono
  - 'go against'
  - Jv. sunsun

Wilbur (1973) argues, on the basis of such forms, that assimilation fails to apply since there is a universal tendency to preserve the identity of the two syllables in reduplicated forms. Latta (1976 Ma) argues convincingly against this interpretation by citing cases where instead of resisting linguistic changes to preserve their identity, reduplicated syllables regularly undergo change. Indeed, as Latta suggests, it is unclear why there should be such a tendency as that put forward by Wilbur since reduplicated forms contain redundant information and redundant material is often eliminated in linguistic change.

Reduplication of syllables, stems, and words is also characteristic of many Bantu languages. It is generally associated with a clear semantic function -- usually, though not always, emphasis or intensification. Reduplication is, however, much less productive in Bantu than in Austronesian. I have found no cases where a nasal
comes to be preconsonantal as a result of reduplication, i.e., only multiples of (C)V units are reduplicated. Where we might expect the nasal of a nasal-oral sequence to function in the syllable to its left, we find instead that the sequence functions as an indivisible unit, even when morphologically complex. The behavior of prenasalized consonants in reduplicated forms thus parallels their behavior in word games as discussed in Section 3.3.

Another alleged source for nasal-oral abutment is infixation. Although infixation of nasal morphemes undoubtedly occurs, many cases which are so termed in the literature are actually misnomers. For example, in his description of Lomongo, De Rop (1958) writes of "l'infixe objet [qui] est placé immédiatement devant le radical verbal." This terminology is found in many other descriptions of Bantu languages. The person object "infixes" in Lomongo are:

1. -n-  
2. -ko-  
3. -o-  
4. -to-  
5. -lo-  
6. -a-

[oŋkəa]  /o + n + kəa/  'that you give me' (subj.)
[əmbonə]  /o + n + bonə/  'that you wait for me'
[ŋkoome] /n + ko + oms/  'that I kill you'

De Rop also mentions les infixes formatifs such as tense markers which are placed before an object infix. It should be clear that both the object and tense "infixes" are actually prefixes. There is no question of the addition of an affix within an operand here, but rather of a succession of prefixes. Such forms are often termed infixes because
they generally cannot stand in initial position; however, this is not the correct use of the term.

Another incorrect use of the term, although the facts are less clear here, is found in some discussions of Austronesian languages and concerns the reconstructed prefixes *paN-, *maN-, *paR-, *maR-. Many scholars, e.g. Dahl (1973), have pointed to the possibility of further decomposing these morphemes into *pa-, *ma-, *-N-, *-R-. (Dahl uses the symbol γ for the latter.) Some descriptions of this reconstructed system refer to the *CV- prefix and -R- and -N- infixes. Here again, there is no question of the addition of an affix into an operand and therefore of an infix. However, this use of the term might be justified if its proponents are ultimately able to demonstrate that this is the same morpheme which participated, for example, in the derivation of medial clusters within certain roots. Gonda (1942) has suggested that the medial NC clusters of Austronesian result from the infixation of a nasal morpheme into certain stems with a meaning of emphasis. Dahl (1973) seems to accept this interpretation, but this is somewhat puzzling since "prenasalization as an indicator of emphasis has never been related to regular patterns of verbal inflection in any living AN language" (Blust 1976:233).

The preceding discussion is not to claim that nasal infixation does not occur. If substantiated, the Austronesian examples cited above would be a case in point. It should be noted, however, that the status of these preconsonantal nasals in reconstructed roots is very controversial. Dempwolff (1934-38) reconstructed CVNCVC roots, the
NC cluster represents the only kind of consonant cluster allowed in unreduplicated forms although in earlier works, Dempwolff also allowed *RC clusters. Blust (1971) argues in favor of analyzing the nasal and *R as an infix in order to make a more general statement of Proto-Austronesian canons. This analysis might be taken a step further to allow for the generalization of an analysis where the nasal of *CVN- and the liquid of *CVR- prefixes are treated as infixes into CV syllables, formally identical to a suffix. It remains, of course, for the proponents of the infixation hypothesis who do not accept Gonda's emphasis analysis to provide a meaning for these infixed elements. Blust (1976:234) rejects the infix analysis for the regular nasal of *man- and *pan-.

7.1.2 Phonological Processes

In addition to the morphological processes which are outlined above, there are a number of phonological processes which result in the abutment of underlying nasal and oral consonants. These derived nasal-oral sequences may be subject to unification and be realized as prenasalized consonants. Chief among the phonological phenomena which produce this abutment is vowel deletion. There are numerous cases of such deletion occurring as sandhi phenomena. For example, Foster (1969) describes vowel deletion in Tarascan, a Mexican language, whereby /i/ is deleted word-finally after /n/:

/kɔ + ka + nI pạ + 0/ [kɔk̚amb̚] 'take it away quickly'

/xI + ke + nI pɔɔ + a + ra + a + ka/ [xIk̚emp̚araskA]

'I will touch you'
in which forms the derived abutment causes the nasal to assimilate in place of articulation to the following oral consonant. However, this /n/ is deleted or lost before either /s, ŋ/: 

/cimáni sunúnta/ [cimásunúnta] '2 serapes'

The instability of nasals before fricatives, especially voiceless fricatives, has been mentioned several times during the course of this thesis; it is dealt with in detail in Section 8.2.

Similarly, there are regular vowel deletion processes in Malagasy which result in nasal abutment. For example, in a complex series of sandhi rules affecting closely knit units and reduplications, final syllables of the form /-na/ are lost before nasal-initial words (Dahl 1951:93):

midimidina 'to keep coming down'
   < midina (R) 'come down'

sampanato 'nato branch'
   < sampana + nato
   branch + type of tree

However, before stems beginning with an oral consonant, only the vowel is deleted, and the initial consonant is then prenasalized. In the orthography the deletion is indicated by a hyphen, but the prenasalized consonant belongs entirely to the surface syllable to its right:

oram-be 'big rain'
   < orana + be
   rain + big
enlm-polo  'sixty'
- erina + folo
  6 + 10
sampantsampana3  'several branchings off'
- sampana (R)  'branching off'

In all cases, the nasal assimilates in position to the following consonant and is realized as phonetic prenasalization of that consonant.

It is, of course, true that many cases which are synchronically analyzed as nasal abutment due simply to morphological affixation are historically cases of vowel deletion. For example, in the often cited case of the Bantu Class 9/10 noun prefix /N-/ , there is a great deal of evidence, both comparative and internal, that the prefix needs to be reconstructed as */ni-/. It should be noted that the loss of this prefix vowel is a very old development, reconstructible to the time of Proto-Bantu.

An identical process operates synchronically in Navaho ( Sapir and Hoijer 1967 ). Prefixes of the shape NV are generally realized as syllabic nasals before consonants; the nasal bears the tone of the deleted vowel. Forms with the undeleted vowel are considered "overly precise". The parallels with Bantu languages such as Ganda where the prefix nasal is syllabic and tone-bearing in absolute initial position are evident. ( Cf. Section 5.4. )

Knowledge of such processes suggest, but do not demonstrate, that nasal-oral sequences within these same languages which are not morphologically complex may be derived historically via vowel deletion.
That is, we might hypothesize that those Bantu roots of the shape -CVNC- are historically *-CVNVC-. This analysis seems especially likely in the case of those anomalous roots with initial NC, e.g. -ntu, whose structure cannot otherwise be explained. (Cf. Section 7.5.3.) Guile (1973:147) notes that vowel deletion processes which are constrained to produce only preferred, i.e. non-obstruent, syllable codas are fairly common.

7.1.3 Metathesis

A much more limited source of nasal-oral abutment is the metathesis of CN clusters in various languages. The only well-documented case of such metathesis is that of the Kwa languages as discussed by Hyman (1972b) and Williamson (1973). The evidence for this analysis is very convincing; it is not reviewed here since the critical examples have already been cited in Section 5.2. Basically, the claim is that CN clusters were derived by vowel loss and the non-preferred CN cluster was metathesized, thus producing a NC cluster. This analysis explains the vocalic nasality which is often found on the vowel following the metathesized cluster:

*VCVN̄ > *VČN̄ > VNC̄

The presence of vocalic nasality after a prenasalized consonant is otherwise in violation of the universal proposed in Section 5.2.

Although no other cases of similar metatheses are reported in the literature, we might expect that they should occur. The basis for this expectation is the statistical fact that nasal-oral sequences occur much more frequently among the world's languages than
oral-nasal sequences. Zuckerman (1972:20) concludes that the velum can be lowered more quickly and with greater precision than it can be raised, based on a study by Björk (1961) and other researchers. This leads one to expect that an obstruent + nasal sequence will be "easier to articulate" than a nasal + obstruent sequence. That is, reference to "ease of articulation" gives the wrong prediction in this case. Zuckerman herself (p. 32) notes that CN sequences are considerably rarer than NC sequences, but she is unable to provide an explanation for this fact. There is a principled reason for the greater frequency and preferred status of nasal-oral sequences which is directly related to the syllable structure considerations discussed in Chapter 6 and in greater detail in Herbert (1976b). Another problem with examples such as the above is that metathesis as a phenomenon is more poorly understood as a synchronic fact about languages than, for example, either assimilation or dissimilation. Ullman (1971:37) notes, but does not explain why, more resonant segments are especially prone to metathesis, especially nasals and liquids. Accounts of metathesis in the literature are usually restricted to sporadic historical examples of the sort pre-Old English *hros > *hors (King 1969:106) or to speech errors. The only other example of metathesis as a regular synchronic feature which comes to mind is Chomsky and Halle's (1968:360-2) somewhat suspect treatment of Kasem nominals. This same criticism could be applied to dissimilation as a phenomenon to a lesser extent. Further research should concentrate on providing solid examples of these phenomena in order to discover
their true nature and establish the conditions under which they are most likely to occur.\textsuperscript{5}

7.1.4 Conclusion

The preceding section has listed the most common processes, both morphological and phonological, which result in the abutment of a nasal consonant upon an oral consonant. There is no claim that the above survey is exhaustive in nature. We shall return briefly to some of these processes in Section 7.3, which section deals with several cases of "spurious nasalization" which we claim must be reanalyzed as cases of nasal abutment.

7.2 Environmental Shielding Processes

7.2.1 Theoretical Considerations

As we have noted several times throughout the course of this thesis, not all prenasalized consonants are to be represented at the underlying level as sequences of nasal and oral consonantal components. Specifically, there is a large class of complex nasal segments, i.e. segments with internally structured nasality in the sense of Anderson (1976a), which are produced by "environmental processes" designed to protect the nasality or orality of underlying single consonantal segments. It will be shown that these processes affect both underlying oral and nasal consonants in various ways, and, in combination with contrastive vowel nasality, they produce prenasalized and postnasalized consonants.

We discussed in Section 4.2.2, the nasal prosodies of Sundanese, Land Dayak, Sea Dayak, etc. We noted that nasalization, once it has
been initiated by a [+nasal] segment, continues throughout a phonological word until checked by a supraglottal oral consonant, including the prenasalized stops. In Sea Dayak, underlying nasal-oral sequences are occasionally realized as simple nasals, and it is the absence of nasality on the following vowel which indicates that the surface nasal is not an underlying nasal:

/naŋa/ [nəŋə?] 'straighten'

/naŋa/ [nəŋə?] 'set up a ladder'

In Land Dayak, the combination of nasal plus voiced plosive does not occur phonetically, but it is necessary to distinguish a simple nasal from other consonants involving nasality. Final nasals are sometimes preceded by a short homorganic oral stop:

[kəldn] 'cloth' (S.D.: kain)

The presence of this stop is conditioned by the nasality of the preceding syllable: if it is a nasalized syllable, then a final nasal is realized as a phonetically simple nasal:

tanTn 'story'

nan

However, when it is not nasalized, the homorganic stop is inserted:

əmTsdn 'invite'

dpdn

pantudn 'song'

The interesting cases of this phenomenon are those which exhibit a surface simple nasal corresponding to Malay and Sea Dayak nasal plus voiced plosive sequences, i.e., in which surface nasals in Land Dayak
serve to check the spreading of nasality:

| 乡镇 | 'dew' | Mal. BackgroundColor
|---|---|---
| 孩 | 'sickness' | Mal. mandam
| 与 | 'prawn' |

which contrast with:

| 爷 | 'arm' | Mal. BackgroundColor
|---|---|---
| 顶 | 'dizzy' | Mal. peniŋ
| 伊 | 'feeling' |

in which no homorganic stop is inserted.

It appears that the Land Dayak case is a classic example of the "environmental processes" which are designed to preserve an underlying contrast between nasal and non-nasal segments. That is, there exists on the one hand a phonological process of nasalization in this language which it shares with Sea Dayak, Sundanese, etc. However, Land Dayak has systematically replaced nasal plus voiced plosive sequences by simple nasals. In these forms, the distinctive role of nasality which was formerly borne by the consonants is now transferred to the vowel. It is at this point that the prosody of nasality is fully phonologized, i.e., it loses its purely phonetic status since nasalization occurs after N (≠ *N) but not after N (≠ *NC). Opposing the phonological process which nasalizes vowels after certain nasals, there is a universal phonetic process, more or less applicable in every language, which nasalizes vowels before syllable coda nasals. If the vowel in forms such as [乡镇] (Mal. BackgroundColor) were to nasalize, speakers could not distinguish Land Dayak nasals which correspond to
Sea Dayak nasals from nasals which correspond to nasal–oral sequences. In order to insure the non-neutralization of this distinction, a homorganic stop is inserted before final nasals in non-nasal syllables. Thus, there is a clear, functional explanation for this phenomenon which is directly related to considerations such as the preservation of a valued opposition.

An interesting fact about the environmental processes which we discuss in this section is that they result in consonantal segments with internally structured nasality, i.e. either prenasalized or post-nasalized consonants. In an important paper presented to the X International Congress of Linguists, Haudricourt (1970) deals with "half-nasal consonants" (les consonnes demi-nasales) and attempts to establish the panchronic conditions for their evolution. He notes that one condition of mutation is the presence of vocalic nasality, i.e. of a V:V opposition. This is certainly true in the vast majority of cases; however, it appears that there are a few cases in which this condition does not obtain although they seem to involve synchronic alternations and not phonological evolutions. Hyman (1975a) makes the same claim as Haudricourt although he includes total denasalization (N → C) as well as partial denasalization (N → NC) in his scope. This is clearly too strong a claim since there are examples of initial nasals becoming denasalized in languages without contrastive nasality. For example, the case of Proto-Austronesian *n has already been discussed; *n has oral reflexes, either l or r, in initial position although there are consistent nasal reflexes in medial and final
position in many Formosan languages (Dahl 1973). There are other cases of the loss of initial nasality, suggesting that initial position may be the least stable position for nasality although nasals seem very stable in this position in Indo-European, Semitic, Niger-Congo, etc. Although we do not understand what processes govern this instability at present, Hyman's claim is falsified, and we accept Haudricourt's earlier and weaker formulation as a working hypothesis. It would seem that the evolution of these half-nasal consonants is designed to provide a consonantal shield or buffer to protect vocalic nasality or orality.

Accepting the critical role of vowel nasality in the conditions necessary for the evolution of complex nasal segments, we note that there are eight possible sequences which represent juxtapositions of oral and nasal vowels with oral and nasal consonants, four of which represent consonant-initial sequences and four consonant-final sequences:

\[
\begin{array}{ccc}
NV & VN \\
NV & VN \\
CV & VC \\
CV & VC \\
\end{array}
\]

Following our discussion in Section 2.1.2, we expect that only certain of these sequences will undergo environmental processes, viz. those in which the consonant and vowel do not agree in nasality. That is, we expect that NV, CV, VN, and VC do not need to develop any phonetic buffer and that developments such as NV → NCV, CV → CNV, etc. will
not occur. Indeed, were such processes to be attested, we would need
to abandon our theory of environmental buffering as an explanation
for these processes. We do observe, however, on a fairly wide scale,
the following developments:

1. NV > ũCV
2. CV > ũNV (ũNV)
3. VN > VCŨ
4. VC > VNŨ (VNŨ)

These sequences also evidence other types of developments which do not
result in complex nasal segments and involve neutralizations of con-
sonantal or vocalic nasality, e.g. VN > ũN, VC > ũN, etc. These are
not of interest in the present discussion although it should be noted
that half-nasal consonants may be intermediate steps in certain of
these developments, e.g. VN > VCŨ > VC. Finally, it needs to be
mentioned that in some languages, internally structured nasality is
lost instead of produced in the context of vowel nasality. For example,
in Gbeya (Samarin 1966), presnasalized consonants never precede or
follow nasal vowels, but are realized as simple nasals in these
contexts, i.e. ũCV > ũN and VNŨ > VN.

7.2.2 Shielding of Oral Vowels

Of the processes involving complex nasal segments derived from
simple nasals, we have already examined one of the subtypes in detail.
That is, the Land Dayak realization of final nasals as postnasalized
stops represents an example of Process 3 above: VN > VCŨ. A process
which is more widely attested and of greater relevance for the present
thesis is Process 1, by which nasal consonants preceding oral vowels are realized as prenasalized consonants.

In Jukun, a Benue-Congo language of Nigeria, there exists a series of phonetic nasal plus stop sequences [mb, nd, ng] which Welmers (1973:66) analyzes as allophones of the simple nasals /m, n, η. He cites two important considerations which motivate his analysis: 1) the pitch of the nasal is conditioned by (identical with) that of the following vowel, and 2) the sequences occur only before oral vowels whereas the simple nasals [m, n, η] occur only before nasalized vowels:

\[
\begin{align*}
[mb] /\text{mù}/ & \quad \text{'white'} \\
[nd] /\text{nè}/ & \quad \text{'noise'} \\
[ng] /\text{ŋà}/ & \quad \text{'try'}
\end{align*}
\]

Although it is not stated in Welmers' analysis, the tone-bearing nature of these nasals suggests that they comprise separate syllables. This is certainly not the most common realization of what results from the insertion of an oral shield after nasal consonants.

In Amahuaca (Osborn 1948), a Ge-Pano-Carib language, the underlying nasals /m, n/ are realized as sequences of nasal plus homorganic voiced stop when they occur intervocally. That is:

\[
N \rightarrow NC / V \quad \text{[-nas]}
\]

/\text{tambɔ}/ [tambɔ] 'cheek'
/\text{honɔ}/ [hondɔ] 'man'
/\text{rama}/ [ramba] 'now'
Similarly, in Sirionó, a Tupi-Guarani language of Bolivia, nasals are replaced by prenasalized consonants before an oral vowel when the following syllable, if a suffix, does not contain a nasal consonant (Firestone 1965):\(^8\)

\[
\begin{align*}
[\text{ámi}] & : [\text{ámbifura}] & \text{'grandmother: good grandmother'} \\
[\text{nípi}] & : [\text{ndípikusu}] & \text{'sweet potato: large swt. pot.'} \\
[\text{níkáre}] & : [\text{níjkarekišbv}] & \text{'alligator: alligator lard'}
\end{align*}
\]

Of course, in some languages the process is not completely regular, but admits a good deal of free variation. Hendon (1966) claims this to be the case for Ulu Muar Malay, e.g. /banw/ 'doorsill' may be either [banu] or [bándu]. Hendon attributes this simply to a non-coordination of the velum; as we have seen, this is a motivated "non-coordination".

Finally, there are cases in which data from a single language do not permit us to recover the process. That is, once the process has been phonologized by the loss of its purely phonetic conditioning, the phonological system is open for reinterpretation and it is necessary to make reference to historical and comparative data in order to recover the workings of the process. For example, Haudricourt (1970) mentions the case of Unia, a New Caledonian language, with forms such as:

\[
\begin{align*}
\text{pie} & : \text{'earthworm'} \\
\text{mble} & : \text{'money'} \\
\text{mle} & : \text{'vet'}
\end{align*}
\]

in which vowel nasalization is not distinctive. However, comparison
with other dialects, such as Goro, demonstrates that vowel nasality was once contrastive and that Unia prenasalized consonants are rephonologized nasals before oral vowels:

\[
\begin{array}{ll}
\text{Unia} & \text{Goro (more conservative)} \\
\text{pie} & \text{m\textipa{b}l\textipa{e}} \\
\text{m\textipa{b}l\textipa{e}} & \text{m\textipa{i}e} \\
\text{m\textipa{i}e} & \text{m\textipa{i}\textipa{\varepsilon}} \\
\end{array}
\]

As Haudricourt describes this reinterpretation:

le trait distinctif qui était sur la voyelle (nasalité/oralité) se reporte sur la seconde moitié de la consonne précédente. (1970:105)

Thus, we have seen in this section how perceptual factors, viz. the need to preserve a distinction between oral and nasal vowels, may lead to a process whereby nasal consonants become prenasalized stops before oral vowels. It should be noted that in all cases, it is a prenasalized voiced stop ([mb, nd, nj, ng]) which substitutes for the simple nasal; this point will be returned to shortly. There is one other type of process (cf. Section 7.3) by which simple nasals come to be realized as prenasalized consonants. The perceptual or articulatory basis of this latter process is less clear.

7.2.3 Shielding of Nasal Vowels

According to the schema set forth in Section 7.2.1, we expect to find protective environmental processes which provide a consonantal shield in environments of contrastive consonant and vowel nasality. One of these processes would produce postnasalized consonants and the other prenasalized consonants:
In both cases, the vocalic nasality is liable to be transferred to the contiguous consonant, providing a context for possible re-phonologization.

The first of the above two processes, that in which sequences of oral consonant and nasal vowel are realized as postnasalized consonant plus vowel, is not widely attested. In fact, we have observed occurrences of it only in systems with complete series of protective processes whereas other individual processes may occur independently or in conjunction with other processes. An example of a language with a complete series of shielding processes is Kaingang, discussed in Section 7.2.4.

On the other hand, the process whereby sequences of nasal vowel plus oral consonant are realized as vowel plus prenasalized consonant is met with extremely frequently. Several examples of this process were discussed in Section 5.2, which dealt with the process of vowel nasalization. For example, Crawford (1973) reports that in Yuchi, a language isolate now located in Oklahoma, a phonetic homorganic nasal is inserted after a nasal vowel before a lenis stop:

/sōba/ [sōmba]. 'grubworm'
/hōte/ [hōnte] 'he coughs'
/hōk'aw/ [hōnk'aw] 'he laughs'

This insertion is optional before a fortis aspirated stop:
/hōthaw/ [hōnθaw] - [hōθaw] 'his heart'
but never occurs before a fortis plain stop. In Amahuaca, /p, t, k/ are voiceless stops which are voiced when morpheme-initial after a morpheme ending in a nasalized vowel. When morpheme-internal after a nasalized vowel, /p, t, k, q/ appear as [mp, nt, nk, nq]:

/wɪpɪs/  [wɪmpɪs]  'guayaba'
/wʊtɪ/  [wʊntɪ]  'an animal'
/kɪtɪ/  [kɪŋtɪ]  'cooking pot'

There are also languages in which the process of nasal insertion is optional. For example, Noble (1965:14) notes that in Goajiro, an Arawakan language, nasalization may occur with any vowel or alternatively a nasal assimilated to the immediately following consonant may be inserted. Similarly, in Island Carib (Taylor 1955), VC and VNC sequences vary freely.

Voegelin, Voegelin, and Hale (1962) reconstruct "nasalizing vowels" for Uto-Aztecan. The complete series of reconstructed vowels includes:

\[ V_n \text{ - nasalizing vowels} \]
\[ V_s \text{ - spirantizing vowels} \]
\[ V_u \text{ - unaltering vowels} \]

In many languages, particularly those of the Aztec branch, \#V_n and \#V_u merge, e.g. Yaqui-Mayo, Tarahumarar, etc. There is little effect of the different vowels in the Sonoran branch, but their effects can be observed in many languages of the Shoshonean branch, e.g. Southern Piute, Comanche, Tübatulabal, Luiseño, etc. In Tübatulabal:
It should be noted that Davis (1966) has criticized this reconstruction of "progressively determining vowels" because such an analysis sheds no light on the phonetic factors involved. He argues that, more probably, prenasalization itself will need to be reconstructed.

Delattre (1965:107), in a comparison of the role of nasality in French and English, notes that many English speakers insert a homorganic nasal whenever the sequence nasal vowel plus oral consonant occurs in French:

- honte [3nt]
- onze [3nz]
- bomber [bɔmbe]
- tank [tæŋk]
- tanguue [tæŋg]
- comfie [kɔŋf]

Delattre explains this tendency as "l'anticipation consonantique, un phénomène psychologique." In fact, the nasal vowel is often realized without significant nasalization in many such cases. Similarly, nasal vowels in final position may be rendered as [Vŋ] or [Vŋ] sequences by language learners from linguistic backgrounds where vowel nasality is not an independent variable. We assume that the motivation here is largely the same as it is in the synchronic facts.
described earlier, i.e. a perceptual one designed to insure the nasality of the syllable.

The interest of the above examples and of cases where VC sequences have been historically reinterpreted as VNC sequences is that nasality has run the full cycle here. That is, as was mentioned in Section 5.2.1, it is generally agreed that, on a universal basis, independent vowel nasality can be attributed to the loss of a primary nasal consonant. For example, we know this to have been the case in French and a great many other languages with synchronic phonemic vowel nasality. Thus, in those languages where VC sequences are realized as VNC, nasality has gone from consonantal nasality to vocalic nasality to consonantal nasality. These cases provide a good example of how conflicting factors can emerge and then be overriden during the course of language development.

7.2.4 Complex Shielding Series

A rather spectacular example of the role which consonantal shielding can assume in some languages is found in Kaingâng, a language of Brazil. The following facts are abstracted from Wiesemann (1972) and are frequently cited in the literature. Basically, the series of underlying nasals has the following realizations in Kaingâng:

i) prenasalized stops (post-shielding) between nasal vowels and oral vowels,

ii) postnasalized stops (pre-shielding) between oral vowels and nasal vowels,
iii) fully nasal between two nasal vowels,
iv) medionasalized (pre- and post-shielding) between two oral vowels.

For example:

\[
\begin{align*}
/m/ & \rightarrow [m] / \tilde{\nu} \quad \tilde{\nu} \\
[\hat{m}] / \tilde{\nu} \quad \tilde{\nu} \\
[\hat{b}m] / \nu \quad \tilde{\nu} \\
[\hat{b}\hat{m}] / \nu \quad \tilde{\nu}
\end{align*}
\]

Henry (1948:196) points out that the nasality of underlying nasals in Kaingang may be lost entirely when they precede certain voiceless consonants /t, k, Ȝ, c/, regardless of the nasality of the preceding vowel:

\[
\begin{align*}
m, \hat{b}m & > p \\
n, \hat{c}n & > \hat{t} \\
\eta, \hat{\eta}n & > k
\end{align*}
\]

He notes that all syllables in Kaingang end in either a vowel or a nasal consonant; these changes are thus encountered with great frequency.

7.2.5 Excursus on Formalism and Explanation

Alternations such as the above are cited by Anderson (1974, 1975, 1976a) to argue for internally structured features. Two other examples cited by Anderson are of direct interest to the present discussion and are therefore reviewed in brief detail here. In Maxakali, there are two series of obstruents: voiceless /p, t, c, k/ and voiced /m, n, ŋ, η/. In syllable-initial position, the nasals are
realized as simple nasals before nasal vowels and as prenasalized stops before oral vowels unless an oral consonant precedes in which case they are realized as simple voiced stops:

\[
/m/ \rightarrow [m] / \quad \$ \quad \not{\note
A more informative schematization of the alternations is:

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>N</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>/p/</td>
<td>V</td>
<td>p</td>
<td>bm</td>
</tr>
<tr>
<td></td>
<td>¬V</td>
<td>mp</td>
<td>-</td>
</tr>
<tr>
<td>/m/</td>
<td>V</td>
<td>-</td>
<td>bm</td>
</tr>
<tr>
<td></td>
<td>¬V</td>
<td>mp</td>
<td>m</td>
</tr>
</tbody>
</table>

Several important facts emerge from such a representation which Anderson, in his discussions, fails to note. As has already been mentioned, his primary concern is arguing for a particular formal representation for such facts, viz. internally structured features. Throughout the course of this thesis, we have purposely avoided an over-concern with formalism, precisely because we believe that the available formalism either cannot adequately deal with the phenomena which we discuss or misrepresents the true nature of these phenomena. Ignoring for the moment the question of how to formally represent these alternations, we note that there is non-occurrence of either /p/ or /m/ exactly in the environment where the other phoneme has simple realizations (either [p] or [m] respectively) and that in all other positions /p/ and /m/ have identical surface realizations. Thus, given the environment, the realization is completely predictable:
That is, this most interesting distinction between state and process is completely ignored in Anderson's discussions. The issue which we propose to examine is what processes explain this state of affairs. For example, what processes explain the following gaps in the data:

- *VVpN
- *VVp#
- *VMp
- *VM#

We turn our attention first to the nonoccurrence of /p/ and /m/ in final position after vowels of contrasting nasality. These gaps are explained, presumably, by (1) the nasalization of vowels before nasals which occur in absolute final position, and (2) either the (a) nasalization of oral consonants between nasal vowel and word boundary or (b) a lack of Vp sequences explained historically by a gap of *VMp# sequences which would produce Vp via vowel nasalization and nasal deletion. We note, however, that the first alternative is by no means phonetically implausible since there is a great deal of evidence suggesting that in this position "nasal release" is a natural development. For example, in Kaingang the voiced plosives are [b^m, d^n, g^n] finally. Also, in Iguã Tupi (Abrahamson 1968), the
voiced stops are \([b^m, d^n, g^o]\) finally after an oral vowel whereas they are \([m, n, \eta]\) in this position after a nasal vowel.\(^{10}\)

The non-occurrence of \(/p/\) between a nasal vowel and a nasal consonant follows, it appears, from a general constraint which bars \(/p/\) syllable finally after a nasal vowel. This explains the \(\#\tilde{v}_p\) gap noted above as well. The only occurrence of a syllable final \(/p/\) after a nasal vowel cited by Anderson is:

\[
/\tilde{m} + \text{ptlc}/ \quad /\tilde{\text{ptlc}}/ \quad [\tilde{Tmpt\tilde{y}l}] \quad \text{"it is heavy"}
\]

i.e., \(/p/\) becomes syllable final via certain vowel deletion phenomena which never produce sequences \(\tilde{v}_pN\), probably because the orality of \(/p/\) would be so unstable in this environment so as to produce \(\tilde{v}_mN\).

Similarly, there appear to be no underlying cases of oral vowel followed by a nasal within the same syllable which are not derived sequences. Thus, the only example cited involving a tautosyllabic sequence of oral vowel plus nasal consonant occur before another nasal via vowel deletion:

\[
/ce + m\tilde{nn}/ \quad /c\text{nn}/ \quad [\tilde{c}\text{nnnT}] \quad \text{"black hair"}
\]

Again, a constraint prevents vowel deletion when it would result in a NC cluster after an oral vowel precisely because nasality is characteristic of larger than segment units in Maxakalí.

Anderson proposes that [nasal] specifications are deleted for consonants by rule and that their ultimate phonetic realizations are specified by "possible language specific" conventions that fill in the gaps left by feature deletion in the necessary way. For example,
there is a rule which he formalized as (1974:273):

$$\begin{align*}
[\pm \text{Nasal}] \rightarrow \emptyset / & \quad [-\text{syll}] \\
\end{align*}$$

which applied to underlying forms such as /mɪmkoc/ 'canoe', /cokop

fɪɪcɪc/ 'yellow animal', /məhəm fɪɪcɪc/ 'yellow fish', etc. so that they

have feature specifications such as:

$$\begin{array}{|c|c|c|}
\hline
\text{syll} & + & - & - \\
\text{cons} & - & + & + \\
\text{nasal} & + & - & + \\
\hline
\end{array}$$

The phonetic specification for nasality is provided by convention so

that:

$$\begin{array}{|c|c|c|}
\hline
\text{nasal} & + & - \\
\hline
\end{array}$$

become:

$$\begin{array}{|c|c|}
\hline
\text{nasal} & + \\
\hline
\end{array}$$

However, there are numerous problems, some of them quite serious,

with Anderson's proposal although the idea of nasality being supplied

by rule in such cases is at first very attractive. First, the

proposal loses some of its elegance when cases such as the medionasals

of Kaingang are considered, i.e. where /m/ is realized as [mbm]

between oral vowels:
Ignoring for the moment the fact that we cannot totally delete the nasal specification for the consonantal segment, the question is: how much nasality gets specified? Rather than arguing for his proposal, as Anderson claims, these forms seem to argue against it since the answer to the above question is arbitrary.

Too, there is the serious problem of "feature deletion". That is, isolated features are deleted, it is proposed, without affecting the integrity of the segment; the same feature which is deleted by rule is later specified by convention. As Anderson notes, certain suprasegmental features are lost without affecting segmental articulation. However, as the feature status of suprasegmentals is so uncertain, as is their relationship with segmental features, this appeal to suprasegmental patterning is unconvincing. There are certainly cases, however, where nasality is characteristic of larger than segment units, so we will not pursue this formal problem now.

Another problem with the specifications which Anderson provides has to do with their role in linguistic systems. For example, we examined in Section 4.1.2 Campbell's (1974) complex symbol proposal that segments be represented as columns of distinctive feature
matrices. Campbell proposed that rules can apply to either or both matrix columns. It was unclear in this event exactly what advantages the proposal provided. In the case of Anderson's proposed specifications, the question arises as to whether such features ever play a significant role in analysis which is not purely descriptive. For example, given a specification such as:

<table>
<thead>
<tr>
<th>V</th>
<th>NC</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>√</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

i.e. VNCC, does a rule ever delete that portion of the articulation which is specified as [+nasal]? These are by no means theoretical extras which would be further support for the analysis, but rather necessary demonstration of the non-arbitrary nature of the formalism.

Certain more practical problems with the proposal arise when we consider how it might work in various language systems. As was demonstrated in earlier sections, not all languages have the complete range of shielding processes as exhibited in Maxakali or Kaingang. Many languages have a single process: NV → NCV. These languages have a phonological syllable inventory which includes oppositions such as:

/ma/ /mˠa/
/ba/ /bˠa/

but the corresponding phonetic syllable inventory is:

[mba] [mˠa]
[ba] [bˠa]

e.g. certain Jukun dialects (Welmers 1968). Any vowel, oral or nasal, may precede these syllables. If we "erase" the nasal specification
for /Vma/ and /Ṽma/:

\[
\begin{array}{c|c|c}
V & (m) & a \\
\hline
\text{nasal} & - & (+) \\
\end{array}
\quad
\begin{array}{c|c|c}
\tilde{V} & (m) & a \\
\hline
\text{nasal} & + & (+) \\
\end{array}
\]

which are realized as:

\[
\begin{array}{c|c|c}
V & \text{mb} & a \\
\hline
\text{nasal} & - & + \\
\end{array}
\quad
\begin{array}{c|c|c}
\tilde{V} & \text{mb} & a \\
\hline
\text{nasal} & + & - \\
\end{array}
\]

That is, the proposal works when the preceding vowel agrees in nasality with the following consonant, but fails when it does not. There is no way, in Anderson's proposal, to explain /Vma/ being realized as [Vmba]. It should be noted that if we applied Anderson's "erasing" rule completely, the wrong result is obtained:

\[
\begin{array}{c|c|c}
V & m & a \\
\hline
\text{nasal} & - & - \\
\end{array}
\rightarrow
\begin{array}{c|c|c}
\tilde{V} & b & a \\
\hline
\end{array}
\]

i.e., the proposal predicts that /Vma/ will be pronounced [Vba], which it is not.

Similarly, even in languages with more complex shielding processes consonants which occur next to boundaries are problematic. Given a language which has the following processes:

/\textit{NV}/ \rightarrow \text{[NCV]}

/\textit{CÑ}/ \rightarrow \text{[CÑV]}

Anderson's proposal will predict surface homophony with /CV/ and /NV/ syllables initially:
The problem is, simply, that in order to predict the correct surface forms, the word boundary will need to be specified as [+nasal] in the first form, but as [-nasal] in the second. Further, the nasal value of word boundary will need to be exactly that of the "erased" specification. Thus, there can be no real question of feature erasure in such cases.

Further, it is not at all evident in Anderson's treatment why this particular process should be exhibited only in languages with contrastive vowel nasality. If this is a simple "assimilation" as Anderson (1974:271) suggests, why are there no attestations of the following process:

\[
/\text{NV}/ \rightarrow [\text{NCV}]
\]

except in languages which also have /\text{NV}/ syllables?

At no point does Anderson address the basic question of why any of these processes occur. That they occur only in languages with distinctive vowel nasality is ignored. We discussed in Section 7.2.1 the perceptual motivation of these processes. Many languages exhibit \( \text{NV} \rightarrow \text{NCV} \), but not \( \text{CV} \rightarrow \text{CNV} \), precisely because these languages have processes of nasalization which need to be prevented, but no corresponding denasalization processes. Anderson's concern is, admittedly, with formalism and representation. However, it seems self-evident at this point that formalism should follow understanding.
Before we decide the question of how to represent such alternations, we need to examine the systems in which they occur in order to discover the role which shielding plays in these same languages. Anderson's theory cannot explain, for example, why a language with a four-way opposition /ba, bã, ma, mã/ is likely to merge the last two of these syllables into [mã]; since he does not ask what role the processes play, he cannot predict what will occur in their absence.

In summary, we have examined in detail Anderson's proposal for the phonetic specification of prenasalized consonants. The proposal does not deal with prenasalized consonants which are underlying nasal-oral sequences, but only those which are phonetically derived from primary consonants. We demonstrated that the mechanism of the proposal is problematic, that it incorporates several theoretically questionable notions, that, in many cases, it is formally inadequate and requires revision and that, in others, it gives the wrong result. We feel that the proposal to extend current theory in this manner must be rejected. Further, Anderson's failure to investigate the nature of the processes, their motivation, and the role they play in linguistic systems, seems to us a very large problem. There is a fast growing re-recognition of the fact that language is behavior and therefore warrants principled explanation. Unfortunately, this explanation is not forthcoming in many approaches to linguistic data. The question is not what formalism most elegantly schematizes a process but rather what formalism provides the most insight into the nature of the process. As long as we wish to maintain the claim that
phonetics-phonology is a science, it is necessary to realize that the
goal of science is explanation, not mere description. Thus, we feel
that not only does Anderson's model give the wrong answers and
predictions, it also asks the wrong questions.

A similarly unsatisfactory treatment of nasalization in Guarani
is offered by Rivas (1974). The data concern the spreading of
nasality from a [+nasal] segment in both rightward and leftward
directions within a phonological word. Spreading is blocked to the
left at a word boundary, but to the right by a word boundary, a pre-
nasalized stop, or certain irregular suffixes when a stressed oral
vowel follows. In addition to blocking the rightward spread of
nasality, prenasalized consonants initiate its spreading only to the
left.

Rivas characterizes prenasalized stops as complexes of specifica-
cations: [+nasal][-nasal]. In an attempt to explain the Guarani
phenomena, he poses a number of interesting questions, among them:

1) why is nasalization stopped only by word boundary to
the left, but by complex conditions to its right?

2) why does [+nasal] spread in both directions, but
subsegmental [+nasal][-nasal] only to the left?

Ignoring for the moment the complication posed by the blocking of
nasality under certain conditions when a stressed oral vowel follows,
the phonetic explanation of these facts is clear. It was demonstrated
earlier that in many nasal prosody languages, e.g. Sundanese, nasality
is blocked by prenasalized stops; if it were not blocked, prenasalized
stops would be phonetically identical to simple nasals.

Rivas claims that the explanation for these facts is a sub-
segmental nasal boundary, represented as / . His representation for
[mb] is now:

[-syll, -son, -cont, +voice]
[ [+nasal] / [ -nasal] ]

This enables him to restate the nasalization process more elegantly:

Nasalization is spread from [+nasal] in both
directions. It is stopped by either a word
boundary or a subsegmental nasal boundary.
(1974:140)

Rivas claims that the fact that prenasalized consonants do not transmit
or initiate nasality to the right is now "explained" by the sub-
segmental nasal boundary. Of course, the subsegmental boundary
explains nothing. This analysis represents another misguided
generative attempt to explain via formalism instead of using formalism
to capture significant generalizations and to schematize a necessarily
prior understanding of process.

We will discuss briefly one last attempt which has been presented
in the literature to formally account for processually produced pre-
 nasalized consonants. The proposal was originally put forward by
Goldsmith (1976a, 1976b) and again concerns the nonsegmental status
of nasality in several languages, i.e. in languages with nasal
prosodies. This treatment is part of Goldsmith's "autosegmental
theory of phonology", which was designed to account for the relative
independence of certain types of phonetic features, especially the
suprasegmental features, with respect to others.
The example cited by Goldsmith is that of Guaraní which had been previously discussed by Lunt (1973) and Rivas (1974). A presentation of the formal workings of the autosegmental treatment is beyond the scope of this section, involving as it does an exposition of a major revision or extension of phonological theory. Briefly, however, it is proposed that underlying elements are marked as nasal, oral, or unmarked. Accented syllables may not be unmarked. Thus, the forms /hašhu/, /hëndu/, /nupë/ are formally represented as:

\[
\begin{array}{ccc}
\ast & \ast & \ast \\
hašhu & heDu & Dupa \\
\ast & \ast & \ast \\
0 & NO & N N
\end{array}
\]

where 0 symbolized [-nasal], N [±nasal], and * indicates an accent. Thus, nasality is specified at an independent level of representation than that on which, for example, segmental features are specified. By various conditions which associate the "tiers" of phonological representation, which are discussed in detail by Goldsmith, /hašhu/ is realized as all oral whereas /heDu/ and /Dupa/ become:

\[
\begin{array}{cc}
\ast & \ast \\
heDu & Dupa \\
\ast & \ast \\
NO & N N
\end{array}
\]

By a language-specific postoralization rule, nasal consonants which come to be associated with an 0 marking are realized as prenasalized consonants:
Thus, /heDu/ becomes [h3n̂du]. The real interest of the proposal comes from its ability to predict the occurrence of nasality within larger phonological units. For example, the affixes /no/, /ro/, and /i/ all have both oral and nasal forms:

a) n^do - ro - haihu - i (oral stem)
b) n̂ñ - r̃ - n̂ñdu - i (nasal-oral stem)
c) n̂n - r̃ - n̂ñ - i (nasal stem)

which are derived from the following forms on the left-hand side and are realized as those forms on the right:

a) Do - ro - haihu - i
   N  O  N  O
b) Do - ro - heDu - i
   N  NO  N  NO
c) Do - ro - Dupa - i
   N  N  N  N

The language-specific postoralization rule is applied to the initial consonant in (a) and the root-medial consonant in (b), giving the
correct surface forms.

An evaluation of the autosegmental theory of phonology is beyond the scope of the present work. It must be mentioned that the treatment of nasality is the least impressive of the phenomena discussed by Goldsmith. However, the immediately apparent explanatory value of the proposal is rather limited.

7.3 Shielding within Clusters

We claimed in Section 7.2 that the motivation for the development of complex nasal consonants in many cases was perceptually motivated to protect the nasality/orality of vowels. It might be claimed for individual languages that the motivation is actually articulatory, i.e. a simple noncoordination of the velum with the movements of the other articulators. Upon a closer examination, it becomes clear that the opposite is the case, i.e., these processes are designed to prevent noncoordination which would result in the neutralization of an obviously valued $V/\bar{V}$ distinction. The reason we do not find such cases in languages without distinctive nasality in vowels is simply because it is irrelevant and therefore the language takes no measures to prevent it.

However, there may be cases of prenasalized consonants arising from such a noncoordination. These cases differ significantly from those discussed in Section 7.2. Unlike the above cases, these do not arise in the environment of contrasting consonant and vowel nasality, but rather in consonant clusters within which the consonants differ in nasality. These processes are not described as often as one might
expect. Nevertheless, there are examples of prenasalized consonants arising from both oral and nasal consonants in such situations. These processes are informally schematized:

1. $N \rightarrow \hat{N}C / \underline{\hspace{1cm}} C$
2. $C \rightarrow \hat{N}C / N \underline{\hspace{1cm}}$

As might be expected, the latter process occurs more frequently than the former.

7.3.1 Prenasalization of Nasal Consonants

Prenasalized consonants which arise from primary nasal consonants in the environment of oral consonants are described by Langdon (1970) for Diegueño. Briefly, an oral consonant homorganic to the nasal is inserted when the nasal occurs before certain oral stops:

$m \rightarrow m^p / \underline{\hspace{1cm}} ^{/ \pm }, k$

$n \rightarrow n^+ / \underline{\hspace{1cm}} k$

This phenomenon might have an articulatory motivation in the difficulty of the transition from non-homorganic nasal to following consonant. However, this seems more likely for the cases to be discussed below wherein oral consonants are realized with prenasalization following nasal consonants. Many authors speak of the "sluggishness" of the velum in raising, which accounts for the progressive nasalization of segments following nasals. There is apparently no corresponding tendency for the velum to raise too quickly which results in the denasalization of nasals before oral segments. Although we do not rule out an articulatory motivation for Diegueño, a preceptual motivation is also possible. This may be the result of two distinct
processes: (i) as with the cases of shielding of vowel nasality, the homorganic stop may be inserted to prevent nasalization of the following consonant, or (ii) the motivation may be more closely related to nasal acoustics. That is, nasals as a class are highly distinct from other consonants, but they are very much confused among themselves (Ohala 1975 and the references therein). This fact accounts, in large part, for the extreme frequency of nasal assimilation rules. Additionally, the acoustic cues present in the release of consonants may provide more information than cues present in vowel transitions (Wang 1959). The preconsonantal position for consonants is the position in which there exists maximal possibility for perceptual confusion since there are no following vowel transitions and consonants in this position show a tendency to be unreleased. Thus, a language which aims to avoid nasal assimilation might insert an oral release for nasal consonants in this position.

Although a perceptual motivation may seem plausible, the frequent occurrence of epenthesis of this type in languages without distinctive nasalization processes, e.g. English, may argue for a more articulatorily based motivation. Barnitz (1974) cites many examples of diachronic and synchronic epenthesis in English. He notes that nasal-liquid and nasal-fricative clusters are most susceptible to epenthesis although other environments, e.g. nasal-stop, liquid-liquid, etc. also induce epenthesis:
OE bremel - bramble
OE Gymle > Mod. Eng. thimble
OE spinle > spindle
OE Gunrian > thunder
OE umtig > empty
OE [alre] > alder

Thompson [ms] > [mps]
Hampshire [mʃ] > [mpʃ]

Barnitz finally concludes that this is an "asynchronism of articulation." Anderson (1974, 1975, 1976a) discusses examples such as English warmth which have a homorganic epenthetic stop [...mpθ] in many pronunciations. He notes that this epenthetic consonant differs from other consonants in that it has shorter than average duration. Anderson appears to argue for a perceptual motivation:

...it is important to have the velum fully lowered during the following consonant (in order to maximize the acoustic energy produced at the oral articulation)
...This corresponds to an anticipatory extension of the domain of the following [-nasal] specification, without a consequent shift in any other feature. (1976a:339)

Thus, the process does not involve change in features, but only changes in feature scopes. Anderson schematizes this process as:
and claims that this gives a more accurate picture of the process in question and its motivations that the usual type of a rule which simply inserts a stop element. We agree completely with the insufficiency of an insertion rule analysis. Barnitz (1974) has criticized King's (1969) characterization of epenthesis:

There is the indisputable existence of cases such as loss, metathesis, and epenthesis in which any kind of gradual process strains the imaginative faculties as well as the set of distinctive features that one assumes to be universal. (1969:109)

Part of the problem here is terminological. King is clearly referring to another type of epenthesis than that which is under discussion at present. The example he cites (pp. 111-2) is of vowel epenthesis in some environment, where it seems correct to assume a rule of the sort \( \emptyset \rightarrow [e] \), for example, rather than an implausible gradient of sounds between silence and [e]. This latter type of epenthesis is more clearly phonological in character. While the more phonetic type of epenthesis may be phonologized by causing a change in the lexical representation, we have already commented in this thesis on the frequent failure to
distinguish the phonological and phonetic levels of organization and the confusion which results therefrom.11

While Anderson's schematization adequately represents the phonetic continuum, we do not agree with his claim that it provides an accurate picture of the motivation of this process. It is unclear how the schematization represents the perceptual motivation which Anderson himself argues for although it is an attractive model from a simple articulatory viewpoint. Also, because of the problematic status of "shifting" feature boundaries at present, we prefer to represent this type of epenthesis not as insertion:

\[ \emptyset \rightarrow p / m \quad C \]

but rather as the addition of an oral release to a nasal consonant:

\[ m \rightarrow mp / \quad C \quad \text{[-nas]} \]

7.3.2 Prenasalization of Oral Consonants

A second type of process which produces prenasalized consonants in a non-vowel environment operates on oral consonants preceded by nasal or nasalized consonants:

\[ C \rightarrow NC / N \]

Again, unlike the processes discussed in Section 7.2, the presence of contrastive vowel nasality is not a prerequisite for the operation of this process although it may optionally be present. Key (1961:147) describes phonetic nasalization of the consonants /b, β, d, j, h/ in Cayuvava, which is initiated by adjacent nasality, either consonantal or vocalic:
The nasal onset also occurs optionally in utterance-initial position where Key treats it as a free variant of oral onset.12

In Kaingang, there is a large class of verbs which change initial /k/ to \[Ng\] when a nasal or nasally released (e.g. \[bm, d^n\]) consonant precedes. Thus, the verb *kedn* is pronounced \[Ng\] in this environment (Henry 1948). There is also a complex series of processes producing complex nasals from underlying nasals in conjunction with oral vowels in this language. (Cf. Section 7.2.4.)

Finally, we have already mentioned that in Zulu a nasal consonant has various effects on a following oral consonant. These include hardening (/n + s/ \[nts\]) and loss of aspiration (/n + pʰ/ \[mp\]). The nasal will be realized as a syllabic nasal or as prenasalization of the oral consonant depending on the feature specification of the consonant. Before underlying stops, it is usually syllabic, except in initial position, where nasals are never syllabic, e.g.

\[mp\] 'flutter' (R)

Thus, we have the following series of changes:

\[
\begin{align*}
N + p^? & \rightarrow mp^? \\
N + p^h & \rightarrow mp^? \\
N + b & \rightarrow mmb \\
N + \delta & \rightarrow mmb \\
N + m & \rightarrow m \\
N + f & \rightarrow mf
\end{align*}
\]
Of interest to the present discussion are forms involving the juxta-
position of a nasal consonant and a voiced stop: 13

u:bekesha izimbeke:sa 'quarrelsome person(s)'
aba:li ezimbi:li 'two' (Cl. 2 and 10)

Thus, the informal rules for predicting syllabic and prenasalization
in Zulu appear to be:

1. \(N \rightarrow [+\text{syllabic}] / [-\text{cont}]\)

2. \(C \quad N\)
\([-\text{cont}] \rightarrow [+\text{prenasal}] / [+\text{syll}] \quad [+\text{voice}]\)

which, in conjunction with other processes to be detailed in Chapter
8 and the derivational model presented in Chapter 6, predict the
correct surface forms.

This particular type of partial nasalization of an oral consonant
after a preceding nasal is not especially uncommon. They are probably
to be explained in articulatory terms, at least originally. We have
already mentioned the tendency of the velum to raise more slowly and
with less precision than it lowers (Björk 1961). When this raising is
not coordinated with the movements of the other articulators, a pre-
nasalized consonant will result in this environment, i.e. an essentially
oral consonant with a nasal onset.

7.3.3 Conclusion

We have examined in this section several processes which may
produce phonetic prenasalization of underlying nasal and oral con-
sonants. Unlike the examples discussed in Section 7.2, these processes
result from the abutment of two consonants with different
specifications for the feature \{nasal\}. There are similarities between the two types of processes. We argued that those processes which involve consonants and vowels are perceptually conditioned and never obtain in languages which do not oppose nasal and non-nasal vowels. The processes discussed in the present section, involving the abutment of two consonants, may all be perceptually motivated although a good case can be made for articulatory conditioning in some subtypes. This has not been an exhaustive survey of the various subtypes of such processes. At present, it seems most likely that they are both articulatorily and perceptually motivated although it is unclear whether there is any significant degree in overlap for any single subtype.

7.4 Spurious, Spontaneous, and Intrusive Nasalization

In the present section of this chapter, we will examine various reputed cases of "spurious" nasalization, "spontaneous" nasalization, and "intrusive" nasalization, wherein the nasalization of an oral consonant, either complete or partial, is traditionally not explained by nasal abutment or by any of the processual nasalizations discussed in Sections 7.2 and 7.3. We will examine a few such cases in brief detail and demonstrate that these too can be reanalyzed as examples of the more transparent processes which produce prenasalized consonants.

7.4.1 Sinhalese

In an article dealing with the phonology of early Sinhalese inscriptions, Wijeratne (1957) makes several important observations about
nasal–oral sequences. Inherited nasal plus stop clusters remained unchanged in Middle Indic and preceding vowels are always short. In most Modern Indic dialects, the nasal is lost and the preceding vowel is lengthened and nasalized although this compensatory lengthening does not always occur (e.g. Sindhi) nor does the simplification (e.g. Panjabi, Lahnda). In Sinhalese, we have the following developments:

i) nasal + voiceless stops are simplified to a simple stop:
   अन्क > अ, पण्ड > प, कान्ताक > कातु, सान्ताक > सातु,
   कृपमाक > कपु

ii) nasal + voiced stops become prenasalized stops, i.e.
nasal oral sequences in which the nasal is realized as a "half-nasal" or "short/reduced nasal"; this corresponds to vocalic nasalization in many Modern Indic languages:
   अंगुव > अंगुल, अंजन > अंदुन, झुंड > झुंडा,
   स्कंद > स्कंडा, गंभीर > गंभीरु.

Wijeratne (p. 505) speculates that "the complete loss of the nasal before unvoiced stops was perhaps due to its being less fully heard before them than before voiced stops."

However, there also exist numerous prenasalized consonants which are not inherited and which do not correspond to Sanskrit nasal plus voiced stop sequences:
Wijeratne attributes these to an "intrusive nasal/ due to the nasal of the preceding syllable. It seems more likely, however, that the vowel following the nasal was nasalized and this, in turn, affected the oral consonant (Herbert 1976c). Thus, these "intrusive nasals" result from the same sort of processes as discussed in earlier sections. Although there was doubtlessly variation in the early stages of this process, it appears to have been phonologized, i.e. to have caused relexicalization, by the end of the tenth century. This would also explain why some inherited forms with prenasalized consonants show alternants with simple stops. Some speakers, aware of this tendency to nasalize oral consonants, overcompensate for the process and de-nasalize inherited prenasalized consonants:

\[
\begin{align*}
\text{maľgul} & \rightarrow \text{magul} \\
\text{piľd} & \rightarrow \text{piľ} \\
\text{daľd} & \rightarrow \text{daľ} \\
\text{maľdulu} & \rightarrow \text{maľulu}
\end{align*}
\]

although this may be due to other evolutionary tendencies. It needs
to be noted that there still exists certain cases which we are unable to explain at present. In these forms, Sinhalese shows a prenasalized consonant although no neighboring nasal is attested:

\[
\text{dijin} \quad \text{(Mod. Sin.dijin)}
\]

Pa. daįidda, Skt. daridra

girițițak and ghurgurā, ghurghurīkā

These seem analogous to the so-called "spontaneous nasalization" of Middle and Modern Indic.

7.4.2 Apache

Another case of problematic nasalization of an oral consonant occurs in White Mountain Apache as discussed by Campbell (1974b), based on a description by Greenfield (1973). Greenfield posits a single prenasalized phoneme /mb/ for White Mountain Apache, which occurs initially in a restricted series of words dealing with wild animals and their derivatives: /mbaʔ/ 'fox', /mboh/ 'owl',

\[
\text{/mbaʔbiseegoʔi/} \quad \text{'bob cat'}, \quad \text{/mbaʔdooose/} \quad \text{'coyote'}, \quad \text{/mbaʔnteelēh/} \quad \text{'badger'}, \quad \text{/mbaʔcoh/} \quad \text{'wolf'}. \quad \text{/mb/} \text{ is realized as } [b] \text{ utterance medially, e.g. } [?aibʔaʔ] \text{ 'that fox'}, \text{ but as } [mb] \text{ initially,} \text{ /mbaʔ totʔiʔi/ } \text{ 'blue fox'}. \text{ For younger speakers, } [b] \text{ and } [mb] \text{ freely vary in initial position, and for some speakers } [mb] \text{ is always replaced by } [b]. \text{ In Chiricahua Apache (Osgood 1949), this phoneme is attested in a single form /mbaiʔ/ 'coyote' and its derivatives.}

\[
/mb/ \text{ is a reflex of Proto-Athapaskan } *y \text{ which also became}
\]

White Mountain /m/ and /b/; the original distribution can be
reconstructed fairly simply. Campbell argues for sound change with clear semantic conditioning and limitations in order to explain /m/b/, i.e. a change of the sort:

\[ *w > /m_b/ \]  

which seems suspect. However, as Campbell himself acknowledges in a note, it appears that related languages have a nasal prefix with certain noun classes, such as animals. Thus, the prenasalization here is, in all probability, not explained as the development from an oral consonant in a semantic class of items, but rather as the incorporation of a noun class prefix into a nominal stem.

The real point of interest which arises from the data under consideration is not the origin of /m/b/, but rather the phonetic nature of the reconstructed Southern Athapaskan nasals. *w is the only labial of Proto-Athapaskan, and its usual realizations are m, b, ɫ. In a classic article establishing the unity of the Southern Athapaskan group, Hoijer (1938) cites the different development of the nasals as one of the evidences for an East-West dialect split. As the initial consonant of a stem syllable *m (*b- *) (< *PAth ɰ) becomes b-, m- in all of the Southern languages except that Kiowa Apache often has m- corresponding to b- in the other languages. The majority of stems have b-, but m- is attested.

The development of *n is less clear. *n > n in Navaho; *n > nd in San Carlos, Chiricahua, Mescalero, Jicarilla, Lipan, *n > d in Kiowa Apache. As the initial consonant of prefix syllables, *m > b, but there is only a single prefix illustrating this: bi-, third
person singular pronominal prefix. In derivational prefixes, \*n > n in the Southern languages, but in paradigmatic prefixes, diverse developments are attested: \*n > n in Navaho, San Carlos, Chiricahua, Mescolero, \*n > \*nd in Lipan and Jicarilla, \*n > d in Kiowa Apache, e.g. the completive perfect prefix:

Nav, SC, Chir, Mesc  \*n1-
Jic, Lip  \*nd1-
K.A.  \*d1-

Although it is tempting to reconstruct prenasalized phonemes, i.e. phonemes with nasal and oral characteristics, in such cases, the evidence presented in earlier chapters suggests that prenasalization is never primary in this sense. We are unable, at present, to provide any plausible explanation for these Southern Athapaskan data, but they certainly represent an area where further research is necessary.

7.4.3 West Atlantic, Celtic, Nilotic, and Austronesian

Many West Atlantic languages exhibit a complex series of consonant alternations whose exact nature has puzzled analysts for many years. In Fula, these alternations are schematized:

Grade 1: r w w y y f s h b d j g
Grade 2: d b g g j p c(f) k b d j g
Grade 3: nd mb ng ng \*fj p c(f) k mb nd fj ng

The grade in which a particular consonant will appear is determined by morphological factors:
Anderson (1976b) discusses such forms and argues, correctly, that we are dealing here with the morphological remnant of a phonological rule. In certain other West Atlantic languages, e.g. the Cur dialect of Manjaku, the conditioning factors for the three grades of consonants are purely phonological. /b, d, j, g/ appear initially as [b, d, j, g], intervocally as [v, r, z, y] and with a nasal as [mb, nd, nj, ng]:

<table>
<thead>
<tr>
<th></th>
<th>imper.</th>
<th>3 sg.</th>
<th>1 sg.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bandi</td>
<td>avandi</td>
<td>mambandi</td>
</tr>
<tr>
<td></td>
<td>do-an</td>
<td>aro</td>
<td>mando</td>
</tr>
<tr>
<td></td>
<td>jon-an</td>
<td>azon</td>
<td>mañjon</td>
</tr>
<tr>
<td></td>
<td>gac-an</td>
<td>ayac</td>
<td>mangac</td>
</tr>
</tbody>
</table>

Anderson's analysis of the Fula data is that the original prefix class markers were copied as suffixes and the prefixes were then lost. The phonological variation conditioned by the prefix became morphological variation after the prefixes ceased to exist.

Anderson's analysis of Fula is reminiscent of the facts of Celtic mutation where the initial consonant of certain nouns,
adjectives, and verbs appears in a mutated form when they function as
the non-initial element in certain closely knit phrases. Basically,
the consonants /p, t, k, b, d, g, m, f, s/ are liable to a change
called aspiration or lenition which changes them into spirants. The
other type of mutation, known as eclipsis, occurs only in Manx and
Irish synchronically within Goidelic. It effects the voicing of
voiceless sounds and the complete nasalization of voiced ones. In
Manx (Kneen 1931), eclipsis has the following effects:

\[\begin{align*}
    p & \rightarrow b & \text{padjer} & \text{badjer} \\
    t & \rightarrow d & \text{tonn} & \text{donn} \\
    k & \rightarrow g & \text{cabbyl} & \text{gabbyl} \\
    f & \rightarrow v & \text{fuill} & \text{vuill} \\
    b & \rightarrow m & \text{bard} & \text{mard} \\
    d & \rightarrow n & \text{darragh} & \text{n'gharragh [n]} \\
    g & \rightarrow \eta & \text{guilley} & \text{n'ghuille [\eta]} \\
\end{align*}\]

The eclipsed forms appear after the possessive adjective nyn, after
the demonstrative ny in the genitive plural, after other particles
cha 'not', a, an 'whether', cre 'where', nagh 'whether...not', dy, gy
'that', managh (my nagh) 'if not', ga dy 'although', dy, 'if', etc.

These facts suggest that the mutation was originally a phonetic
sandhi phenomenon, and comparative evidence clearly demonstrates that
eclipsis was originally conditioned by a preceding word-final nasal.

Another example of the morphologization of a phonological process
effecting the interchange of oral and nasal consonants is the active
morphological process in Dinka and Shilluk which substitutes a nasal
stop for an oral consonant when root-final on nouns followed by possessives, adjectives, or noun modifiers. Hall, Hall et al. (1975) relate this to the process in Luo and Alur whereby under similar syntactic conditions final nasals become nasal plus homorganic voiced stop. In both cases, they argue that the triggering mechanism was the relativizer *na. However, the Luo and Alur alternations are part of much larger processes of consonant polarity discussed in Sections 2.2.3.6 and 3.4 in which nasals become prenasalized voiced stops, voiceless stops are voiced, and voiced stops are devoiced. The phonetics of the reconstructed situation are very unclear; a great deal of further information is necessary before it is possible to accept the notion of a morphologization of a phonological process in this case.

As a final example of the morphologization of a phonological process which involves prenasalized consonants, we will consider some data from Malagasy. Dahl (1951) notes that certain verbal prefixes, among them ma-, cause alternations in root-initial consonants. These changes are basically the following: voiceless consonants become nasal, voiced consonants become prenasalized, nasals remain nasals. Some examples of these alternations:
It seems clear that we need to reconstruct a final nasal for this prefix, i.e. *man-, which was responsible for certain phonetic alternations which were later morphologized after the nasal was lost. In fact, comparative evidence clearly points to such a reconstruction, probably to *man-, a form which occurs prevocally in many languages. (Cf. Section 7.1.1.) It is interesting to note that these alternations are very old, going back at least to Western Austronesian. We reserve our discussion of the actual phonetics of the situation until Chapter 8. We simply note at this point that the following changes:

1. \( N^\gamma \rightarrow N \)
2. \( NG \rightarrow NJ \)
3. \( NN \rightarrow N \)
are rather common among the world's languages. There is a tradition among Africanists and Austronesianists to view the first of these as a complete assimilation of the oral consonant to the nasal and then simplification as in (3), i.e. \( \text{NG} \rightarrow \text{NN} \rightarrow \text{N} \). This is untenable as an analysis in many cases as will be detailed in Chapter 8.

In summary, we have examined in this section a number of processes involving consonant alternations of which one of the phonetic alternants is a prenasalized consonant. Although, at first glance, the phonetic motivation for prenasalization is not always transparent, all of these cases are interpreted as morphologized phonological processes which involve the former abutment of nasal and oral consonants. The crucial distinction between these cases and those discussed in Section 7.1 is that the phonological conditioning factor has been lost in the former although its effect continues to be felt.

7.4.4 Kikongo

One of the claims made in the early chapters of this thesis was that prenasalized consonants, as a class of sounds, are phonologically marked in language systems in which they function. This markedness differs, perhaps only in degree, from that of front rounded vowels, for example, in that we are able to explain why these prenasalized consonants are marked. The explanation makes reference to their non-primary status universally and to the fact that in language systems where they are opposed to simple voiced oral consonants and nasals, they are derived from underlying sequences of consonants. The explanation for their markedness lies not in their articulatory
complexity, but in the fact that they are not underlying units. The same facts which explain their markedness also explains their articulatory complexity; this view of markedness is obviously not devoid of content in the way some earlier statements, such as those regarding the markedness of front rounded vowels, appear to be.

As a corollary of their marked status, we do not expect to find prenasalized consonants developing from either simple oral or simple nasal consonants unless we can delimit the phonetic motivation for such development as we did the case of the prenasalized stops of Sinhalese and the morphological derivations of Fula, Malagasy, etc. Therefore, when presented with the development of nasals into prenasalized stops in certain languages, we need to seek explanation for these facts as well.

There are a number of derived nominals and first person singular verb forms in Kongo with initial prenasalized consonants for which the corresponding verb form and the reconstructed Bantu form both exhibit simple nasals:

<table>
<thead>
<tr>
<th>Form</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>mbinnunu</td>
<td><em>-mina</em> 'throat'</td>
</tr>
<tr>
<td>mbinni</td>
<td><em>-mina</em> 'I have swallowed'</td>
</tr>
<tr>
<td>ndika</td>
<td><em>-nika</em> 'grinding'</td>
</tr>
<tr>
<td>mbana</td>
<td><em>-mana</em> 'ending'</td>
</tr>
<tr>
<td>ndwini</td>
<td><em>-nwa</em> 'I have drunk'</td>
</tr>
</tbody>
</table>

These are all forms with initial nasal prefixes, */n-/ (< *n-*), and we can decompose them into prefix plus stem as follows:
\[
\begin{align*}
N + \text{minunu} & \rightarrow ^*\text{minunu} \rightarrow ^*\text{minunu} \\
N + \text{mana} & \rightarrow ^*\text{mana} \rightarrow ^*\text{mana} \\
N + \text{nika} & \rightarrow ^*\text{nika} \rightarrow ^*\text{nika}
\end{align*}
\]

which we expect to develop into the starred forms at right. It might be suffected that such forms as those which are actually attested arose by dissimilation, i.e. to preserve the segmental structure or to differentiate these forms from their underlying stems, initial nasals became denasalized and then prenasalized in conjunction with a nasal prefix. However, such dissimilation is highly suspect. It is especially suspect since the output of dissimilation is exactly the environment where many Bantu languages, including Kongo, show assimilation of prenasalized consonants to nasal consonants; cf. the discussion of Meinhof's Law in Section 3.4. The above forms are formally the reverse of Meinhof's Law, generally:

\[
\text{NN} \rightarrow \text{NC} / \text{VN}^{17}
\]

While this is not a felicitous situation in terms of helping to clarify the phonetic motivation for Meinhof's Law, it is theoretically possible.\(^{18}\)

However, the true explanation lies in various facts of assimilation as they operated in Kongo. In Kongo, the working of some assimilations was restricted in certain cases to a particular morphological class.\(^{19}\) Thus, while certain verb stems of the form \(^*\text{-CVN-}\) show assimilation to \(-\text{NVN-}\), derived nominals of the same form show no assimilation, e.g.:
Thus, the Kongo speaker was aware of a restricted pattern of derivation in which \( \mathrm{N} + \) nasal in certain derived forms gives \( \mathrm{NC} \):

\[
/N + \text{mona}/ \rightarrow \text{mbona} \quad (*-\text{fona})
\]

This pattern is the key to the development of prenasalized consonants from nasals in the forms cited earlier. Aware of this pattern, the Kongo speaker overgeneralized the process, applied it in cases where historically there is no oral consonant to recover, and "derives" a prenasalized consonant from a sequence of two underlying nasals:

\[
/N + \text{mana}/ \rightarrow \text{mbana} \quad (*-\text{mana})
\]

and similarly for the first person singular subject marker:

\[
/N + \text{minini}/ \rightarrow \text{mminini} \quad (*-\text{mina})
\]

Meinhof (1932:166) discusses such forms and analyzes them as an "analogy" with the forms above. Of course, there is no question of a formal analogy in these cases, but rather of a morphological reanalysis via back formation, i.e. Kongo speakers interpreted the nasal as a result of assimilation and "restored" the oral consonant after nasal prefixes, even in cases where no historical oral consonant existed.20

7.5 Some Problematic Cases

There are a number of cases of the development of prenasalized consonants for which we are unable at present to provide any motivated
explanation. In many of these cases it may simply be a lack of adequate information which prevents an analysis of the data.

7.5.1 Narragansett

For example, in Narragansett (Hamp 1970), Proto-Algonquian *a* develops into a sequence of vowel plus prenasalized stop when it occurs with certain stops:\[1

\[
p, t, k \rightarrow mp, nt, nk / *a*\]

\*ahša:ke'wa > Nr. ash-aunft-teaug 'lobsters'

\*takwa:kì > taquöñck 'fall of leaf and autumn'

\*wexpwa:kana > hopuöñck 'a pipe'

The real phonetic nature of *a* as well as that of the Narragansett reflexes are not recoverable.

7.5.2 Breton

In Section 7.2, we mentioned the development of nasal release of stops in absolute final position in several languages, i.e. C → C\(\uparrow\) / \#. We also mentioned that in Cayuvava, certain consonants occur with optional nasal onset in initial position, i.e. C → NC / \# . We hypothesized that this might be related to the lowered position of the velum during rest position, an explanation which is neither satisfying nor convincing. Further, it is clearly insufficient since examples of the reverse process exist. Jackson (1967:785) notes that final -m in Primitive Breton has occasionally yielded -mp or -mb, which are phonetically the same due to the neutralization of -p and -b in final position. Jackson describes this as "a purely mechanical dissimilation, due to the cutting of the final
labial continuant \( m \) by the development of the homorganic labial stop, in a kind of 'chopped pronunciation'."

Mid. Bret. chomp 'to remain' for chom
ezomp 'need' ezom

later Bret. lamp 'leap' ord-lamm
Vannetais memb 'same' (< Fr. même)

We are told that "such a dissimilation is of course even more natural before a continuant", e.g. Mid. Bret. amser 'time' appears as ampsar, cons 'speech' as comps, etc. These are two different types of phenomena, neither one a dissimilation, and the latter is clearly related to the epenthetic stops discussed in Section 7.3.1. We are, however, unable to explain the development of oral release in final position especially since final nasal–oral sequences usually simplify to simple nasals in Breton. Again, further information and more examples of this phenomenon are necessary to determine its true phonetic nature. A similar phenomenon is perhaps operative in Korean whereby /m/ tends to become a prenasalized stop before pause position or before a voiceless consonant (Cho 1967:49).

7.5.3 Bantu

We discussed in Section 7.1 the reconstructed Austronesian roots of the form #CVCCVC. After eliminating those which are reduplicated CVC syllables, there remain a number of roots with homorganic nasal clusters which Dempwolff reconstructed as clusters. Austronesianists have attempted to reanalyze these #CVNCVC roots as containing a nasal infix and thus to simplify the statement of phonological and
morphological structure for the ancestor language. There is no agreement as to the meaning of this infix; there is very little evidence to support an "emphasis" or "intensification" analysis. The intent here is clear nevertheless, viz. to demonstrate that NC clusters are not part of the original phonological makeup of the reconstructed language. It is important to note that the positional occurrence of these homorganic clusters is severely limited; they can occur neither initially nor finally.

Similarly, we believe that it may ultimately be possible to demonstrate that, in its earliest form, nasal-oral sequences were unknown in Bantu. For those sequences which are derived by affixation, there remain a small class of medial -NC- clusters in roots of the shape *CVNCV. These are traditionally analyzed as variants of the more canonical *CVCV roots; this analysis is then used to argue for the unitary status of the reconstructed nasal-oral sequences. It must be noted, however, that the sequence is never initial except in the extremely rare, otherwise anomalous, monosyllabic roots of the form *NCV, e.g. -ntu. It may be that all nasal-oral sequences are ultimately derived via vowel deletion from *CVNVCV forms. Alternatively, it may be necessary, as Homburger (1914) speculates, to reconstruct nasals which were "non de simples consonnes, mais des sonantes, c.-à.-d. qu'elles pouvaient se trouver entre deux occlusives et être tonique." However, neither theory will be able to explain all the forms.
Meinhof (1932) cites forms such as Konde -funga 'tame' alongside Swahili -fuga 'domesticate' where the reconstructed form is clearly the nasalless ^tflya. This may be related to the fact that, in Konde, the suffixes -ga, -ge are replaced by -nga, -nge when the enclitics -mo, -po, -ko are suffixes, e.g. jondangako 'seek there', u-sokengemo 'go out this way'. Meinhof relates this strengthening to the shifting of accent caused by the enclitics. Dynamic accent falls on the first syllable before -ga, -ge. Why this "strengthening" should result from an accent shift is unclear.

Further, in an examination of tendencies/constraints on word structure in various Bantu languages, Gillian Brown (personal communication) found a high percentage of stems with C$_1$--C$_2$ between N and NC/N occurring as opposed to, for example, non-nasal stems. Finally, there are some admittedly rare couplets which suggest that prenasalization in radicals may occasionally be due to affixation. Guthrie (1948:66) cites the example of Kwanyama d/nd: -dudum- 'growl' and -ndudum- 'thunder'. Exactly how widespread a phenomenon this might be has never been determined. All of these facts suggest various avenues for further research of a type which has not been actively pursued in Bantu studies. It should be mentioned that the failure to isolate the various phenomena responsible for the origins of prenasalization in Bantu does not count as evidence in support of their being primary consonants.

7.5.4 Conclusion

We have examined in this section a few questions regarding the origin of prenasalized consonants in various languages and language
groups which remain to be answered. These do not represent all the
directions which we believe future investigation should take. For
example, there are several important topics which have gone
untreated in this thesis for reasons of time and space. These
topics include, *inter alia*, the substitution of prenasalized stops
for nasals in both normal and pathological language acquisition.
Similarly, we have not investigated the relationship between pre-
nasalized consonants and paraphonological uses of nasality. For
example, it is apparently the case that nasal voice quality may be
used paraphonologically, e.g. when addressing a superior in Cayuvava.22
There is also an interesting relationship between tone and half-
nasal consonants in some languages (Haudricourt 1968). Finally, we
have not examined, in any detail, the origin of the series generating
component of prenasality which is found so commonly throughout
certain areas of the Pacific, which accounts for the realization of
all voiced stops with nasal onset. Our neglect of these topics does
not stem from a belief that they are inherently uninteresting, but
rather from practical considerations and the fact that these topics
do not directly concern the central claims of this thesis.

7.6 *Summary*

In this chapter, we have provided a survey of the various types
of processes which give rise to surface prenasalized consonants. The
processes are of two major types: (i) those which affect underlying
nasal-oral sequences and (ii) those which affect underlying simple
oral or nasal consonants in juxtaposition with segments of
contrasting nasality. Various problematic cases of prenasalization and its origin were then reexamined, and we attempted to demonstrate that these cases might be profitably reanalyzed as examples of one of the processes described in Sections 7.1 and 7.2. We also examined in detail some languages with complex rules of nasal realization in the context of certain proposals by Anderson (1974, 1975, 1976a), Rivas (1974), and Goldsmith (1976a, 1976b). Finally, some brief details of cases wherein we have been unable to account for the origin of prenasalization were presented. We argued that in some of these cases it was simply a lack of adequate data which may delay our understanding, but in others, e.g. Bantu, the key to our understanding of the origin(s) or prenasalized consonants may lie buried in prehistory. Nevertheless, there would seem to be several potentially fruitful avenues of research even in these cases.
NOTES

1 The non-homogeneity of N\_\_ clusters is somewhat of a puzzle in Austronesian studies. Dempwolff (1922) suggested that \( n\_\_ \) derives from "\( \ast n\_\_ \) via dissimilation. This seems unlikely. Dahl (1973:99) argues more convincingly that \( \eta \) represents the original consonant in these cases and that we are dealing not with a dissimilation, but with a failure to assimilate. Dahl provides no suggestion as to why the assimilation of \( \eta \) to fricatives is "less necessary" than assimilation to stops and affricates. This topic is treated in Chapter 8.

2 An example of nasal infixation which comes immediately to mind is Latin imperfectives which add a nasal infix immediately before the stem-final consonant (Matthews 1974):

<table>
<thead>
<tr>
<th>Imperfective</th>
<th>Past Participle</th>
</tr>
</thead>
<tbody>
<tr>
<td>rump-</td>
<td>rup-t</td>
</tr>
<tr>
<td>relinqu-</td>
<td>relic-t</td>
</tr>
</tbody>
</table>

3 The development of affrication in this environment is one of the natural processes discussed in Section 8.1.

4 This is not quite true since various sporadic metatheses of stop plus nasal sequences are attested. For example, Ultan (1971:14) cites such metatheses in conjunction with nasal presents and nouns derived from them in older Indo-European languages:

- Skt. īmpāmI
- Lith. īmpū
- OCS prllı\(p\)ng (from "\( \ast lēp \) 'smear, stick'"
- Lat. fundus
- Gk. pŪndaks
- Skt. budhṇas 'bottom'

Ultan attributes the metathesis of root-final consonant and \( n \) to a "phonological analogy based on the fairly common nasal + stop type of cluster as opposed to the relatively infrequent reverse" (1971:32-3).

5 Webb (1971) provides a reanalysis of Chomsky and Halle's treatment of Kasem and several other purported cases of synchronic metatheses. The rarity of examples and the possibility of reanalysis lead her to claim that metathesis is not a possible synchronic rule in any grammar, which conclusion requires further investigation before it can be accepted.

6 The instability of nasals in initial position must be distinguished from the loss of nasals in final position. In the former case, it is a single feature which is unstable whereas in the latter it is the entire segment. Ferguson (1974:6) states that initial position is the position of maximum stability for nasal consonants. We have already mentioned that Proto-Austronesian "\( n \) has non-nasal reflexes in Formosan languages only in initial position. Haudricourt (1970) mentions the neutralization of nasal and oral consonants in Kan-on, an ancient Chinese dialect of Japan, initially in favor of the oral consonant. It seems rather that the position of maximum
stability for nasality in consonants is intervocally although we agree with Ferguson that final-position in non-clustering languages and before the last consonant in clusters in clustering languages represent the positions of minimum stability.

7 However, in an earlier publication providing a comparison of two Jukun dialects, Welmers (1968:8) makes no mention of this, merely noting that for the nasals /m, n, ñ/ before oral vowels "cessation of nasalization precedes release", i.e. [mbV, ndV, ñgV].

8 The specification preceding a non-nasal syllable is necessary in Sirionó since we also find the process whereby nasal-oral sequences are realized as nasals when the following syllable contains a nasal:

[\"m\b\^\^\]^T\[: [\m\m\m\^\^\]^T\] \[\"look:look like this\"
[\m\m\]^T\[: [\m\m\m\^\^\]^T\] \[\"how:how is the other\"

This process is known in Bantu as Meinhof's Law. It is discussed in Section 3.4 and in detail in Herbert (1976a).

9 Some linguists have failed to recognize the independence of vowel nasality in these cases, e.g. Schane (1968) derives nasal vowels in French from sequences of vowel plus nasal consonant.

10 This may be associated with an assimilation to the rest (i.e. lowered) position of the velum. The facts of "rest position" have a very unclear status, but they may account for certain facts such as the problematic status of neutralization in favor of the marked member, as opposed to the unmarked member, of the opposition of vowel nasality when it occurs.

11 The non-rule status of this type of epentheses helps to explain the wide variation in the duration of the "inserted" element which may vary from zero to normal consonant length. Of course, when phonologization occurs, the consonant becomes a "normal" consonant.

12 See footnote 10 above.

13 These forms with syllabic m (< *ni) must be distinguished from syllabic m < *mu which causes no changes in the following consonants. Doke even cites examples of this latter m preceding mm:

\[\m\m\m\m\] \[\m\m\m\m\m\] \[\m\m\m\m\m\m\] 'to the beast'

Only the latter syllabic m (< *mu) may bear stress and contrastive tone. Syllabic m (< *ni) never takes stress or length although it bears tone, the tone always being that of the preceding syllables or the tone on which the preceding syllable ends if it is a non-level tone.
One of the universals mentioned in Section 2.1.2 was that every language opposes nasal and non-nasal consonants.

There is wide variation in the nasalized equivalents of occlusives within Scottish Gaelic, which alternations are not generally recognized as morphologically conditioned as they are in Manx and Irish. In many areas, there is a strong tendency to reduce the oral element in clusters such as /mb, mp/ which may be realized as [m] and [mʰ]. However, at least in Applecross and Duirinish, younger speakers show a tendency which is more akin to the general Goidelic pattern, viz. to reduce the nasal and voice the following occlusives, e.g. an taigh 'the horse' [ə daːj] (Borstrøm 1941:132). Similarly, in certain areas of Lewis, the oral element of the groups nasal plus voiced occlusive is generally lost, e.g. am bata 'the boat' [(ə)məːʰ+(ə)]. Cf. Section 4.2.2.

This is Dempwolff's "prenasalization by substitution", a less than felicitous term since the process involves neither prenasalization nor substitution. The actual reconstructed phonetics are discussed in Herbert (1977c).

It is notes that *nnika does not fit this schema. In fact, *nnwini shows a nasal suffix only by assimilation: *nu + ili → *nwini.

The dissimilation is less plausible as an analysis when other nominal forms are considered which also show a nasal prefix: /N-/ (≠ */mu-/), e.g. nnwa 'mouth' ≠ *-nwa; nnwe 'drinker' ≠ *nwa. The prefixes in these cases are syllabic, however.

This situation is not too unusual. In Lamba (Doke 1922), Meinhof's Law, also an assimilation, is optional in verb forms but obligatory in nominals.

An interesting question arising from this discussion is whether original forms such as mbona (≠ *m + pona) have analogically restored oral consonants next to -mona, or whether the nominal stem was, in fact, never assimilated. In the absence of written records, this question is difficult to decide.

There is a traditional problem with the failure of */k/ to nasalize when a nasal occurs in a contiguous syllable, which is discussed by Hamp (1970). This may be related to the Kwanyama type of dissimilation of nasal compounds in Bantu (not Meinhof's Law); cf. Herbert (1976c).

Even in English, nasalization is used expressively and may affect oral consonants. For example, good may be pronounced [ŋgud] with the nasal being syllabic or not.
8.0 Introduction

In Chapter 7 we surveyed the various processes which effect the surface realization of nasal-oral sequences, with special attention to those which frequently result in prenasalized consonants. In the present chapter, we turn our attention in somewhat greater detail to the processes, not which produce nasal-oral sequences, but which affect the surface realization of either or both components of the sequence. It will be demonstrated that the similar behavior of nasal-oral units and clusters again points to their fundamental identity in the sense that we have described earlier in this thesis, i.e. that prenasalized consonants which are underlying nasal and oral components are, in fact, underlying clusters. There are two types of evidence which will point to this identity in the present chapter:

i) identity of behavior for underlying clusters which are realized as units and those which are not

II) identity of behavior for the historical treatment afforded prenasalized units and that afforded clusters.

These two types of evidence are of course closely related and the parallels in synchronic and diachronic behavior, between derivation and evolution, point to the universal nature of the processes which will
be described below.

In the following sections, we have attempted to isolate the various processes affecting nasal-oral sequences. These processes are by no means mutually exclusive; many languages exhibit several processes simultaneously. Thus, for example, rather than treat changes of the sort: /N + f/ → [pf], /N + s/ → [ʦ], etc., we prefer to treat such examples as composites of individual changes, i.e. affrication and nasal deletion. Both processes are attested independently in many languages.

8.1 Processes Affecting Oral Consonants

The processes which affect the oral, as opposed to the nasal, member of nasal-oral sequences are by far the more common of the two types. The only exception to this generalization is positional assimilation of the nasal consonant, an extremely common process, which is treated in Section 8.2.1. Meinhof (1915:66) notes that position assimilation of the nasal occurs with great frequency in African languages. He explains the various other changes which are effected by nasal-oral juxtaposition as follows:

Frequently, however, the speaker modifies the sound still further. In sounding m or n, his vocal chords [sic] are set vibrating. This should not take place in the subsequent p or t sound. But his attention is still fixed on the earlier sound, and the vibration of the vocal chords is kept up. Thus we get mb for mp and nd instead of nt. These phonetic processes are very numerous, and they vary greatly in different languages.
8.1.1 Post-Nasal Voicing

Perhaps the most common process to apply to the oral consonant in nasal-oral sequences is post-nasal voicing of voiceless consonants:

\[ C \rightarrow [+\text{voice}] /N \]

e.g. Luyia /N + p, t, k, ts, c/ → [mb, nd, ng, nz, ŋ]. This is presumably a simple assimilation of articulatory origin which begins as a phonetic tendency resulting from a non-coordination of the velum. That is, in the sequence nasal plus voiceless stop, there are two primary active motions which serve to distinguish the nasal and the oral consonant: (1) raising of the velum and (2) cessation of vocal fold vibration. If these two motions are not coordinated, the following sound sequences may obtain: (a) *NGG, in which raising precedes the cessation of vocal fold vibration, or (b) *NGC, in which vocal fold vibration ceases before the velum is raised. In many languages, this former tendency has, over the course of time, been phonologized so that all consonants which follow nasals are voiced. This occurs both in languages with underlying [voice] contrasts and those without it. As with many of the processes which have been discussed during the course of this thesis, it is not always easy to factor out an explanation for this development. On the one hand, it may simply be that the tendency gained prominence until it was acquired by a later generation of speakers as a phonological rule. However, it is also possible that the process was phonologized with a perceptual motivation, i.e., to prevent the devoicing of the nasal, the voicing of the consonant may be phonologized. The desire to avoid nasal devoicing, i.e. the
series of changes which proceeds as \( N \rightarrow N \rightarrow N \), is not surprising since voiceless nasals are extremely prone to loss. Cf. Section 8.2.2.

It is, of course, not the case that only stops are voiced in a post-nasal environment although the process may be limited to a particular subset of voiceless consonants in some languages. For example, voicing affects only underlying stops in Kikuyu whereas another process deletes nasals before fricatives so that all nasal-oral sequences in the language are prenasalized voiced stops. In other languages, all voiceless consonants are affected so that the prenasalized inventory is composed entirely of prenasalized voiced consonants, both stops and fricatives, e.g. Kamba. The Kikuyu situation is not uncommon although there are a number of processes which conspire with post-nasal voicing to produce a prenasalized inventory which includes only voiced stops, e.g. hardening, nasal deletion, de-implosion, etc.3

8.1.2 Post-Nasal Hardening

There is another very common process which, in many languages, accounts for the fact that the prenasalized inventory contains only stop consonants. In conjunction with post-nasal voicing, the absence of prenasalized voiceless sounds and prenasalized fricatives is explained in many systems by reference to this process. The frequency of such processes and systems is reflected in the fact, as discussed in Section 4.1, that most treatments of prenasalized consonants, especially the various feature proposals which have been put forward, deal only with prenasalized voiced stops.
An example of the widespread effect of Hardening is exhibited in Ndali (Vail 1974), which has the following consonant inventory:

\[ \begin{align*}
&\text{p} \quad \text{t} \quad \text{k} \\
&\text{f} \quad \text{s} \quad \text{j} \quad \text{h} \\
&\text{β} \quad \text{γ} \\
&m \quad \text{n} \quad \text{ŋ} \\
&w \quad \text{l} \quad \text{γ} \\
\end{align*} \]

but the prenasalized inventory includes only \([\text{mb}, \text{nd}, \hat{\text{ŋ}}, \text{ŋg}]\) since the following changes occur:

\[
\begin{align*}
/N + \text{p}/ & \rightarrow \text{mb} \\
/N + \text{β}/ & \rightarrow \text{mb} \\
/N + \text{w}/ & \rightarrow \text{mb} \\
/N + \text{t}/ & \rightarrow \text{nd} \\
/N + \text{l}/ & \rightarrow \text{nd} \\
/N + \text{c}/ & \rightarrow \hat{\text{ŋ}} \\
/N + \text{y}/ & \rightarrow \hat{\text{ŋ}} \\
/N + \text{k}/ & \rightarrow \text{ŋg} \\
/N + \text{γ}/ & \rightarrow \text{ŋg} \\
\end{align*}
\]

and the nasal is deleted before \(/\text{f}, \text{s}, \text{j}, \text{h}/\).

Hardening actually includes two subtypes, closely related, which may be independently present in a language. The effect of both subtypes is the same, i.e. to increase the obstruency of the oral consonant. These types are informally schematized as:

1. continuant $\rightarrow$ affricate /$N$___
2. affricate $\rightarrow$ stop /$N$___

Since many languages exhibit these processes in conjunction, it is perhaps best to view this situation as a continuum:

\[
\begin{align*}
&1 \quad 2 \\
\text{continuant} & \rightarrow \text{affricate} \rightarrow \text{stop} / N___
\end{align*}
\]
Although theoretically possible, no clear cases of an independent rule such as (2) above have been found where rule (1) is absent. There appears to be a hierarchical relationship between the two subtypes of a negative nature. That is, the presence of (1) implies that (2) will not occur, i.e. if continuants are hardened into affricates, then affricates will not be hardened into stops. Further, we would expect that a language which hardens affricates into stops will likewise harden continuants, or in some way eliminate nasal plus continuant sequences. This relationship is not yet firmly established, however.

The hardening of continuants into affricates is clearly related to the insertion of epenthetic stops which was discussed in Section 7.3.1. Schuhmacher (1972:268) notes that this insertion occurs "almost automatically in-between as it is easier to articulate nasal plus affricate." Viewed in an articulatory framework, it is easy to understand how such a stop might result. In the articulation of a nasal plus fricative sequence, raising of the velum and reduction of degree of stricture must be coordinated. If raising of the velum precedes reduction of stricture, an affricate will result. Coordination of the movements of the various articulators is even more difficult in the cases of voiceless continuants since the above movements must be coordinated with cessation of vocal fold vibration as discussed above. This fact, along with the facts of partial nasal devoicing, accounts for the very frequent deletion of nasals before voiceless fricatives as will be discussed in Section 8.2.3. These facts are themselves intimately related to the facts of the relative lengths of nasal and
oral consonants in prenasalized units discussed in Section 5.3. Basically, although the total duration of the unit is relatively stable, the oral consonant is longer when it is voiceless than voiced, and longer when it is a continuant rather than a stop. The articulatory and perceptual motivations for these differences were briefly discussed in Chapter 5.

In many cases, the hardening effect of a nasal is evident even after the nasal is lost historically. For example, Bartholomew (1960) proposes to reduce the reconstructed inventory of Proto-Otomi in a number of ways; among them is the elimination of *ə*. She argues that /ə/ developed from (a) *ə* preceded by a morpheme *en, and (b) from *ə* in diminutive speech style. Traditionally, it was necessary to reconstruct alternate forms for certain items, e.g. 

- 'eagle'
- 'harvest'

but other words do not have alternate forms, e.g. *gúci* 'girl'. However, in some languages the first two of the above pairs show an initial nasal, e.g. Tlacotlapilco nəuni. Bartholomew hypothesizes that in earlier Otomi, nouns with initial *ə* had a form with initial *n* sometimes, the meaning of which has been lost. "Where the *ə* form survived, the reflexes of *ə* have consistently been *n*. Where the *nə* form survived the *n* has conditioned the development of *ə* in some cases." This is a good example of the use of universal process in phonetic reconstruction and demonstrates how the effects of nasally induced changes can be phonologized. In many Bantu languages, the
nasal of Class 9/10 prefixes has been lost, but its effect continues to be felt and hardening is now a morphological process, e.g. Hungu
/N + t, s, s/ [pf, ts, t].

8.1.3 De-implosion

Another change which oral consonants in juxtaposition with nasal consonants are subject to is the loss of implosion of imploded stops, i.e., implosive stops become explosive. By definition, the process can affect only voiced stops since only they may be produced with the glottalic ingressive airstream which defines implosives. In Shona (Fortune 1955):

/N + G/ [mb]
/N + d/ [nd]

Similarly, in Swahili /b, d, j, g/ are normally pronounced implosively (Ashton 1971:4) although in some dialects there is free variation with pulmonic egressive stops. However, these consonants are always pronounced explosively within nasal compounds. Spotts (1953) notes that in Mazahua (Otomi) implosives are realized as simple voiced plosives after nasals. Also, Greenberg (1970c:131) reports that glottalic consonants are generally much less free in their clustering than the corresponding plain consonants. This is especially evident in the avoidance of nasal plus implosive stop sequences.

The motivation for this alternation would seem to be largely articulatory. In the short time allotted for the production of voiced stops in close union with nasal consonants, there is possibly not enough time to coordinate the various movements necessary to
induce a negative pressure in the vocal tract. However, the loss of implosion is not universal after nasal consonants. For example, in the Karanga dialect and Manyika dialect of Shona, /N + ɔ/ is pronounced [nd], not [nd] as in the Zezuru dialect described above (O’Neill 1935). Tucker and Mpaayei (1955:xv) report that Maasai /b, d, g/ are pronounced as in Coastal Swahili, i.e. implosively with a slight "gulp". Unlike Swahili, however, this "gulp" is also heard in the corresponding nasal compounds. Also, in their description of the complex series of consonant alternations in Shatt (Section 3.4), Tucker and Bryan (1966:232) note that the following alternations occur: p - b, b - bb/mb, ɔ - ɔɔ - mɔ, etc. in which implosion is not lost after a nasal.

Finally, it is not possible in some languages to discover whether the absence of prenasalized implosives is historically caused by a process making the implosives explosive or a process which deletes the nasal before implosives. The complex relationship between state and process will be discussed briefly in Section 8.1.7. Davey (1975:23) infers that Xhosa mb is derived from an original *mɔ as Bantu *b > ɔ. However, it may be that *b never became imploded after nasals, therefore the hypothesized *mɔ stage may never have existed. In many cases the nasal has been lost so that /b/ and /ɔ/ both coexist synchronically and both derive from Bantu *b.

8.1.4 Ejectives

It might be expected that the treatment of ejectives in a postnasal environment should parallel that afforded implosives since they
are both marked airstream mechanisms produced with movement of the
glottis and they are characterized by various similarities in origin
and behavior otherwise (Greenberg 1970c). That is, we expect that
there might be a tendency to eliminate a marked mechanism in favor of
the neutral pulmonic egressive airstream. In fact, this does occur
in some languages, but there is a greater tendency for the ejective
to be preserved after a nasal. For example, in Zulu (Doke 1926),
implosion is lost after nasals, but ejectives remain as such:

\[N + B/ \rightarrow [\text{mmb}]\]
\[N + d' \rightarrow [\text{ndd}]\]
\[N + p' \rightarrow [\text{mpp}']\]
\[N + t' \rightarrow [\text{ntt}']\]
\[N + t's' \rightarrow [\text{ntts'}]\]

(Cf. Section 7.3.2 for discussion of the syllabic nasal and nasal onset
of oral consonants in Zulu.) In fact, there are several languages in
which consonants become ejective in a post-nasal environment. Doke
notes that aspirates become ejectives after nasals in Zulu:

\[N + p^h, t^h, k^h/ \rightarrow [\text{mp}?', n^t?', \eta k?]\]. Similarly, non-velar voiceless
fricatives are pronounced ejectives in this position: \[N + f, s, l/ \rightarrow
[f?', n^t's?', n^t'l?]\]. This tendency is found in several related languages,
e.g. in Xhosa (Davey 1975), \[N + t^hj, x, p^h/ \rightarrow [n^tj', \eta kx', (m)p?]\].
In Ndebele (Ziervogel 1959), Bantu *ni + k > kx?, e.g. \[\eta kx?\text{w} \text{c} \text{m} \text{'beast'} + ?'kx?\text{w} \text{c} \text{'beasts'}, but this does not obtain in modern deri-
vations, e.g. \[\eta khud\text{d} \text{c} \text{m} \text{'rest'}. In S. Sutho, we have the following
historical developments:
where the development of aspirates from prenasalized voiceless stops
is explained by common processes detailed in Section 8.1.6, but the
development of prenasalized voiced stops into ejectives is rather
unique and remains unexplained.

There is no apparent reason why ejectives should be acquired
in a post-nasal environment. Doke (1926) notes that the ejectives in
Zulu are accompanied by an increased tenseness in the tongue, an
observation which is based on greater wipe-off area in palatographic
studies. However, we are unable to explain at present why union with
a nasal consonant should induce "greater tension".

8.1.5 Clicks

Another airstream mechanism, perhaps the most heavily marked of
all, also occurs in close union with nasal consonants in some
languages. That is, in several Bantu languages, the click sounds
(cf. Section 2.2.2) occur in nasal-oral sequences. Zulu contrasts
four series of clicks:

a) voiceless (t, c, s)

b) aspirated (th, ch, sh)

c) voiced (γ, l, r)

d) nasal (n, ɲ, ɲ̊)
The following changes obtain when the clicks undergo nasal influence, i.e. abut upon a nasal consonant:

1) nasal plus voiceless click becomes syllabic nasal followed by voiced click with nasal onset ($\eta'$, $\eta$, $\eta$)
2) nasal plus aspirated click becomes simple nasal click
3) nasal plus voiced click becomes as in (1) above
4) nasal plus nasal click becomes simple nasal click

Similarly, in Xhosa a nasal causes an unaspirated voiceless click to be realized as nasalized and murmured (i.e. voiced) which is identical to nasal plus murmured click sequence. A nasal is deleted before a nasal click, but it causes an aspirated click to be realized as a simple voiceless click:

\[
\begin{align*}
/N + \text{z, ts, w}/ & \rightarrow [\eta', \eta, \eta'] \\
/N + \text{z, ts, w}/ & \rightarrow [\eta, \eta, \eta] \\
/N + \text{th, th, th}/ & \rightarrow [\eta, \eta, \eta]
\end{align*}
\]

Unfortunately, all of the instrumental research which has been done on clicks has concentrated on the click mechanism and its acoustic effects. There has been no treatment of facts such as the relative duration of nasal and click components which would enable us to determine whether transcriptions such as [$\eta'$, $\eta$, $\eta$] represent prenasalized consonants or clusters. In some preliminary researches on this question, I found that, in general, these sequences have much greater surface duration than other prenasalized consonants. In some cases, the duration was fully double that of single consonants and corresponded
to a true nasal plus click cluster. However, there is wide variation here; occasionally a true prenasalized click was produced. It needs to be mentioned that these preliminary results are based on a very limited sample and further investigations, especially of continuous speech, are necessary before any firm conclusions can be drawn.

The essential point of this present discussion is that although the click sounds may be subject to various modifications, which modifications are also attested with non-click consonants, when they occur with nasal consonants, their essential characteristic, i.e. velaric ingressive airstream, is preserved in all cases.

8.1.6 Aspirates and Aspiration

The situation with regard to the development or loss of aspiration of voiceless consonants in close union with nasal consonants is not entirely clear. On the one hand, some languages exhibit clear patterns which demonstrate the loss of aspiration in this environment. However, in other languages, it appears that voiceless consonants develop aspiration when they function within a nasal compound. Thus, there are conflicting tendencies which exist with regard to aspiration. This is less than a felicitous situation, especially since in other cases which we examined it appeared that a general direction of evolution could be discerned. For example, consonants tend to be hardened and voiced after nasals. While changes of the sort $\text{Ng} \rightarrow \text{N}$, $\text{N} + \text{Stop} \rightarrow \text{Nasal} + \text{Affricate}$ may occasionally occur, they are rare and we find other factors and processes which can explain these otherwise anomalous developments.
8.1.6.1 Loss of Aspiration

We have already mentioned that in Zulu aspiration is lost in contact with nasal consonants. Doke (1926) reports the development of ejectives from aspirates in this context, but not all grammars are clear on this point. Doke's *Phonetics* is the most rigorous instrumental study to date; it may be simply that ejection is weak:

> It is noticeable that when emphasis is required the ejection becomes very pronounced. In ordinary speech, however, to the untrained ear the ejection of the explosives is scarcely perceptible. (1926:47)

In the series of click sounds, aspirated clicks are replaced by simple nasal clicks when they are brought under nasal influence in Zulu. In Xhosa, they simply lose their aspiration in this context. Tarascan (Foster 1969) has two series of underlying non-nasal obstruents /p, t, c, č, k/ and /ph, th, ch, čh, kh/. In contact with nasal consonants, the simple voiceless consonants are voiced and the aspirated consonants become simple voiceless consonants:

\[
/N + p/ \rightarrow [mb] \\
/N + p^h/ \rightarrow [mp]
\]

Devine (1974:19) notes that it may be best to regard this as a sliding scale of complexity. He notes that the normal state for voiceless consonants in contact with preceding sonorants is unaspirated.

8.1.6.2 Development of Aspiration

In his very useful survey of the noun class system of Bantu, Kadima (1969:63-5) notes that the most common developments of the sequence nasal plus voiceless stop are as follows:
Other developments are common too, e.g. [mb, nd, ng], [m, n, g], etc.

The relationships between these developments are complex; we are concerned at present only with the development of aspiration. In Venda (Ziervogel and Dau 1961), Bantu nasal compounds develop as follows:

\[
\begin{align*}
\text{Venda} & \\
*mb & \rightarrow \text{mb} & *mp & \rightarrow \text{ph} \\
*nd & \rightarrow \text{nd} & *nt & \rightarrow \text{th} \\
*ng & \rightarrow \text{ng} & *nk & \rightarrow \text{kh}
\end{align*}
\]

However, when initial with monosyllabic stems, the nasal is retained in both series although it comprises a separate syllable: \(\eta^k\) 'large pot', \(\eta^h\) 'louse'. The nasal is always retained when it represents the first person singular object marker. When the simple stops are not under nasal influence, they develop into spirants:

\[
\begin{align*}
*\text{p, t, k} & \rightarrow \theta, r, h \\
*\text{b, d, g} & \rightarrow \beta, l, \emptyset (j)
\end{align*}
\]

However, not all languages which develop aspiration show lenition of stops otherwise, so it is not possible to attribute aspiration to a general weakening of stops.

Hinnebusch (1975) attempts to reconstruct the phonetic processes in Swahili by which \(*mp, *nt, *nk\) become \(\text{ph, th, kh}\). He notes that traditional analyses of a two-stage rule:
are inadequate from an explanatory point of view. He proposes instead a first stage which is unattested in Swahili, viz. the devoicing of nasals before a voiceless consonant:

\[ N \rightarrow [-\text{voice}] / [-\text{voice}] \]

There is also a rule of nasal deletion:

\[ N \rightarrow \emptyset / (a) \text{ fricatives} \]
\[ \quad \quad \quad \quad \quad \quad \quad (b) \text{ stops} \]

Subpart (a) is attested in Pokomo, Shambala, Zigulu and parts (a) and (b) in Swahili; Lower Pokomo exhibits neither stage. Hinnebusch speculates on the development of aspiration:

Perceptually, native speakers have reinterpreted the period of initial noisiness as post-aspiration rather than pre-aspiration, or a change in timing has occurred in that velic closure occurs before the air pressure has been totally expended in the production of the voiceless nasal and carries over into the release of the stop. [In the Pokomo clusters [\\(\text{NCh}\)] air pressure is spread out over the articulation of both the nasal and the stop with the eventual elimination of the period of devoicing in pre-stop position in favor of post-stop position which results in a less marked and more natural distribution. (1975:38)

Givó attributes to John Ohala the step-by-step model for such changes which is schematized (1974:110):
\(N^h\) is realized most often as \([N\#]\), i.e. the \(h\) is voiced by assimilation, e.g. Tswa. The two unattested stages represent periods of variation in which the assimilation is purely phonetic and does not affect the phonological system. Givón explains the development of aspiration by reference to three facts:

1) assimilatory devoicing of nasals before voiceless stops
2) voiceless nasals tend "to be perceived as breath"
3) voiceless stops tend to be universally aspirated (i.e. aspiration is a natural feature for these consonants).

Therefore, a perceptual confusion arises and there is a metathesis in which nasal breath is interpreted as aspiration of stops.

Ignoring for the moment the fact that aspiration is the natural, unmarked state for voiceless consonants universally, which is a universal of doubtful validity, the metathesis analysis proposed by Givón and Hinnebusch seems at least plausible.
The variability of realizations of nasal plus voiceless stop sequences is confirmed in many non-Bantu languages. For example, Rousselot (1913) provided an instrumental study of three Malagasy speakers and found that the following realizations of /mp/ occurred: [mp, mp, ṭp, p, ph, ph]. The general difficulty, perceptual and articulatory, of *Nc clusters gives rise not only to devoicing of the nasal, but also to nasal deletion:

It is important to note that aspirated stops produced in this manner are liable to other developments after the nasal has been lost. For example, aspirated stops frequently develop into fricatives⁹ (ph > f, th > θ, kh > x) or affricates (ph > pf; th > fθs, kh > kx). Languages may pass through an affricate stage before the fricative inventory is established. Hyman (1974) argues that even when there is no evidence for such a stage, we may assume a "telescoping" of processes. The important point here is to note that these developments occur only after the nasal consonant has been lost; this explains why correspondences such as *mp, *nt, *ŋk > f, θ, x do not violate the principles of Hardening discussed in Section 8.1.2. Similarly, the correspondences such as Sango *ŋk > x must have passed through an intermediate stage *ŋkx in which the aspiration is interpreted as a velar fricative due to the great acoustic similarities between the two. This intermediate stage is entirely plausible when we view the rest of the prenasalized voiceless stop series: *mp > mh, *nt > nh. In fact, for the aspirated velars of Scottish Gaelic, the aspiration is often phonetically [x] (Ternes 1973). Thus, these represent explainable
phenomena which do not pose any problems for the general directionality of hardening in a post-nasal environment. Finally, in some languages, voiceless stops were voiced historically except after a nasal. This is problematic since we claimed in Section 8.1.1 that this is the preferred environment for voicing, e.g. Bulu:

*p > v
*mp > f
*t > l
*nt > t
*k > ṣ
*nk > k

It is necessary to explain the non-voicing of /f, t, k/ as resulting from the aspiration of *mp, *nt, *nk, which aspiration prevented voicing in this position.

8.1.7 Nasal + /h/

The last type of sequence which we wish to examine in this present section is the type nasal plus h. Again, the primary examples in our discussion will be drawn from Bantu, but the same processes are attested in many non-Bantu languages. In a great many language systems, nasals are deleted before /h/, e.g. Kikuyu, but in some languages /h/ is hardened as discussed in Section 8.1.2. The problem with the hardening of /h/ is that its directionality is not predictable. That is, at the very least, the following realizations of /N + h/ are attested: [p, ph, h, kh, ηkh, mp, ns, η, ʰ]. Some examples are:
This situation is problematic for a number of reasons. First, in all the other cases which we examined, we were able to predict a general direction of change that would occur after a nasal consonant although we are not able to predict if a given change will take place or not or to what degree. Second, the validity of our synchronic analysis is questionable when the rules which we are required to posit counter established universals. For example, the development $^{#s \rightarrow h}$ is not uncommon whereas it has been asserted that the reverse change $^{#h \rightarrow s}$ never occurs (Ferguson 1966). In languages like Bolia, Ntomba, Sango, etc., we are forced to write a rule which is:

$$/h/ \rightarrow [s] / N$$

Note that it is not possible to analyze these forms as having an underlying /s/ initially and deriving [h] in all contexts except post-nasally since there are /s/-initial stems which are also realized as [ns] under nasal influence:
There are further a few /h/-initial stems which sometimes behave as if they have initial /s/:

lohal ~ losal nsal 'vanity'
lohako ~ losako nsako salutation to chief

Thus, a synchronic s → h rule is not possible unless individual stems are marked in the lexicon as to whether they undergo the rule or not. A synchronic h → s rule is problematic from a universal viewpoint, especially when we consider other rules of this sort which would need to be posited for other languages, e.g. h → p, h → k, etc.

Historically, of course, there is no problem since /h/ in all these cases is the development of */p*, */k*, */s* etc. That is, in forms such as Runyankore:

empene 'goat(s)' cf. akahene 'small goat'
emplira 'grass fires' oruhilia (sg.)
mpaire 'I have given' /N + ha + ire/

*p (> *pʰ) > h* in all positions except after a nasal. As we have seen, however, these rules cannot be mirrored in the synchronic grammars of
these languages.

These examples point again to the important distinction between state and process. The analysis of these data which seems most plausible at present is that these forms are synchronically suppletive in the sense defined by Hudson (1974). That is, for example, in Ntomba s and h are not related synchronically and those forms which exhibit s–h alternations are not related. Hudson's proposal would list such forms in the lexicon as:

(h, s  
-abo)

along with the relevant facts of their noun class membership which specify which prefix and dependent concords the items will generate.

A more extreme position, based on proposals by Vennemann (1974), is that the lexicon contains two independent entries:

Cl. 11 -habo 'work'

Cl. 10 -sabo 'works'

i.e., there is no relationship between singular and plural forms. In fact, Vennemann claims that all singular/plural pairs are suppletive in this sense and that the lexicon contains words, not formatives:

lohabo 'work'

nsabo 'works'

This is clearly too strong a position. The question of suppletion is Bantu noun class forms is examined in greater detail in Herbert (1977a).

8.1.8 Conclusion

In this section, we have examined various processes to which the oral consonant in nasal–oral sequences is subject. This survey has
not been exhaustive, but we have examined the major tendencies exhibited by oral consonants in this environment. Several general tendencies are evident which all point to the status of voiced stops as the unmarked oral consonant in a post-nasal environment. We mentioned several times that in many languages the prenasalized inventory consists solely of voiced stops. In addition to cross-language frequency, other factors also point to prenasalized voiced stops as the unmarked type. For example, textual frequency counts of languages with extensive prenasalized inventories give such results unambiguously. In 1000 phone counts of several languages, the following figures were obtained:

**Rundi**

Prenasalized consonants - 30

Voiced : 25

Stops: 21

Continuants: 4

Voiceless: 5

Stops: 4

Continuants 1
Kamba exhibits only prenasalized voiced sounds \([mb, nd, ng, n\theta, nz]\). In a similar count, the prenasalized stops occurred 56 times as compared with three occurrences of prenasalized continuants. Although we have demonstrated the unmarked character of prenasalized voiced stops, the question of the relative markedness of, for example, prenasalized voiceless stops and voiced fricatives remains. No language which exhibits distinctive voicing in consonants limits prenasalized consonants to only voiceless consonants although all prenasalized consonants may be voiceless in languages without a voice contrast in the consonant system.

Some of the processes which we examined, e.g. voicing of consonants, development of aspiration, etc. are possibly related to the articulatory difficulty of \(N\)\(_C\) sequences in which the onset of voicelessness is coordinated with cessation of nasality. In fact, the nasal consonant is also affected by several processes which result from such articulatory and perceptual difficulty. For example, the same devoicing which may be interpreted as aspiration of the oral
consonant may lead to nasal deletion. These processes which affect
the nasal consonant in nasal-oral sequences are examined below.

8.2 Processes Affecting Nasal Consonants

8.2.1 Nasal Assimilation

We have already mentioned several times that the single most
common process affecting nasal-oral sequences is positional assimil-
ation of the nasal, which results in a homorganic sequence. Several
authors have hypothesized that this process has an articulatory
motivation. That is, especially within complex units, there may not
be enough time to articulate a nasal at one point of articulation and
an oral consonant at another. However, a perceptual motivation is as
likely, particularly in the case of nasal-oral clusters where each
consonant has its normal consonantal length. The perceptual explana-
tion makes reference to the great stability of nasals as a class and
the fact that they are acoustically similar to each other (Ohala 1975).
Further, since no following vowel transitions are present for pre-
consonantal nasals, an important cue for position identification is
not present. It is not unreasonable to assume, therefore, that the
nasal would be perceived as homorganic to the consonant under such
conditions.

We have already given numerous examples which illustrate position
assimilation of nasal consonants: 10

\[ N \rightarrow [\alpha \text{ pos}] / \quad [\alpha \text{ pos}] \]

In fact, homorganicity was a crucial part of the definition of pre-
nasalized consonants provided in Section 2.1.1. We noted then that
before complex oral consonants such as the doubly-articulated stops of many West African languages, the nasal is still homorganic. In various orthographies, these sequences are represented as mgb, mkp, ngb, nkp, but they are phonetically [ŋmgb], [ŋmkp].

An interesting exception to the homorganicity within units, the only one which we have noted, may be found in Margi, a Chad language of Nigeria described by Hoffmann (1963). Among the doubly-articulated stops of Margi are the following series:

a) labio-alveolars
   bd, bd', bd!, bdz, ps, pt, pts

b) labio-alveopalatals
   bj, pc (j = [j])

c) labio-palatals
   bghy, phy (ghy = [j], hy = [c])

In his discussion of nasal compounds, Hoffmann notes:

It is remarkable that there are combinations of m + alveolars or alveopalatals (both plosive and affricates), which correspond to the ordinary labio-alveolars and labio-alveopalatals. (1963:29)

That is, the nasal compound inventory includes /mb, mp, md, mt, mdz, mts, mj, mc, nd, nt, ndz, ntz, nj, ngy, nc, nky, ng, nk/. From this description it might be supposed that the labiality of the underlying labio-alveolars and labio-alveopalatals is absorbed by the initial nasal.

However, it is more likely that careful instrumental studies will show the nasal to be doubly-articulated in these cases as well, i.e.
[m̩nb̩d̩], [m̩nb̩j̩], etc. In fact, Ladefoged (1968:65) cites a word list in Margi in which his transcription includes doubly-articulated preconsonantal nasals: m̩nb̩d̩a 'surpass', m̩nptsaku 'pick up' and at least /m̩npt/ for Bura, a related language. Ladefoged also cites an independent labio-alveolar nasal, e.g. m̩na 'mouth', which makes this analysis even more plausible. There are apparently no languages which contrast labio-velars and labio-alveolars or other double articulations. In certain languages, however, labio-alveolar stops function as allophones of /kp, gb/ before front vowels, e.g. certain Gur languages such as Dagbani (Ladefoged 1968:11).

There are other groups of consonants which do not constitute definite units in Margi: /mtl, msh, mny, mdl, ntl, mn, mgby, mhy, mky/, according to Hoffmann.

In these latter cases it is hardly possible to decide whether they are real, i.e. tautosyllabic nasal compounds or a hetero-syllabic juxta-position of a nasal and another consonant. (1963:31)

In view of this latter comment and Ladefoged's analysis, the validity of the universal relating to the homorganicity of nasal-oral sequences within compounds will not yet be amended, pending an instrumental analysis of these sequences which includes durational considerations. 12

8.2.2 Nasal Devoicing

In Section 8.1.1, we discussed the frequent voicing of oral consonants when they follow nasal consonants and the possible motivations for this process. There is a corresponding process, affecting the nasal consonant, which devoices nasal consonants when they precede voiceless oral consonants. This process also affects both unit and
non-unit nasal-oral sequences. Similar to our analysis of post-nasal voicing, nasal devoicing has its origins in a phonetic process which may be phonologized in some languages, i.e.

\[ NC \rightarrow N\bar{C} \rightarrow NC \]

This stage is reported for Pokomo, Ndonga, etc., but is liable to be reinterpreted, possibly due to the perceptual non-distinctness of voiceless nasals.

One possible reinterpretation of NC sequences is the loss of the oral consonant, i.e. \( NC \rightarrow N \) as in Sukuma, Kwanyama, etc. However, the oral consonant may be deleted in this position precisely to avoid nasal devoicing. That is, given the instability of NC sequences, a language might delete the voiceless consonant in order to preserve the distinctness of the nasal. This occurs, on a very wide scale, in Western Austronesian languages, e.g. Madurese (Stevens 1968);

- /paŋ + puti/ pamu'ti 'bleach'
- /paŋ + temu/ panamu 'opinion'
- /paŋ + cukur/ paŋukur 'razor'
- /paŋ + keraŋ/ paŋeraŋ 'slicer'
- cf. /paŋ + bagi-an/ pambaglan 'distribution'
- /paŋ + asi/ paŋasi 'love potion'
- /paŋ + niser/ paniser 'pity'

i.e. \( N + \bar{C} \rightarrow N \). The traditional analysis of this situation is that the oral consonant assimilated fully to the nasal consonant (\( NC \rightarrow NN \)) and was then simplified according to the general process NN \rightarrow N (Dahl 1973). However, this analysis is problematic for a number of reasons. Most
importantly, Hutcheson (1973) has demonstrated that, on a universal level, the complete assimilation of unlike segments formally implies the complete assimilation of like segments. That is, the complete assimilation \( N_C \rightarrow NN \) implies that \( N_C \rightarrow NN \), but this situation does not obtain in Western Austronesian. It seems clear that the "substitution" of a nasal for an oral consonant in these cases is the result, not of deletion, but of a perceptually conditioned deletion. To prevent the voicing of the oral consonant \( (N_C \rightarrow N\tilde{C}) \) or the devoicing and therefore possible loss of the nasal \( (N\tilde{C} \rightarrow N\tilde{C} \rightarrow \tilde{C}) \), the oral consonant is deleted. This topic is treated in greater detail within the framework of Austronesian in Herbert (1977c).

8.2.3 Nasal Deletion

We have already mentioned that in the event of nasal devoicing, the nasal consonant in nasal-oral sequences is subject to loss or deletion. This is presumably due to the acoustic non-distinctness of voiceless nasals, particularly in a preconsonantal position where they are liable to be reinterpreted as "breath" or aspiration of the following oral consonant (cf. Section 8.1.6.2). Given (1974) claims that the nasal is never deleted, in any language, without the aspiration of voiceless stops in this position. However, there are a great many languages which appear to contradict this claim. In the case of diachronic nasal loss in all voiceless nasal compounds, e.g. \(*mp\), \(*nt\), \(*nk \rightarrow p, t, k\), it is not possible to recover completely the phonetics of nasal loss; the actual sequence of events may have been:
There are many languages which have synchronic derivations of the sort /N + C/ → C without exhibiting aspiration of voiceless stops in this context. Therefore, Givón's proposal requires much greater testing before it can be invoked in reconstruction. His analysis rules out a perceptual deletion of the nasal in order to avoid the neutralization of voiced and voiceless consonants in this position.

Another factor which conditions nasal loss is the presence of a following continuant, particularly a voiceless continuant. In many languages, this is the only position in which the nasal consonant is deleted. This type of deletion differs from that above in that the motivation is much less clear here. That is, in some cases at least, it appears that the motivation for nasal deletion before fricatives is more articulatorily based. It has already been mentioned that the relative durations of the nasal and oral components of prenasalized consonants and surface clusters varies systematically with the feature specification of the oral consonant. The nasal will be shortest before a voiceless fricative; presumably because the transition from nasal to voiceless fricative is the most complex, involving the greatest number of muscular adjustments. Similarly, this sequence is the most complex perceptually since after the nasal, a period of voiceless friction must be perceived. Thus, there might also be a perceptually based reason for allotting greater time to the production of the fricative in order to insure that this period will be correctly perceived. The articulatory and perceptual factors both
contribute to this patterning. In many languages, the nasal becomes so short that no period of nasal stricture is produced before fricatives. This type of nasal loss differs from loss before voiceless stops in that the present type often leaves behind nasalization of the vowel whereas this does not occur as frequently with the type which develops into aspiration. In fact, the higher probability of deletion before fricatives is directly paralleled by the greater probability of nasalization of the preceding vowel in this environment. As we mentioned in Section 5.2, vowel nasalization preceding nasal compounds is conditioned only by this type of compound in many languages.

8.2.4 Nasal Absorption

The final process which we will examine, which is closely related to certain subtypes of nasal deletion, is nasal absorption. Nasal absorption refers to the process whereby the nasality of the nasal component of nasal-oral sequences is absorbed not by a preceding vowel, but by the following oral consonant. This oral consonant must be a continuant. There are diachronic correspondences of the sort: *mp -> m, *mp -> ɲ, etc., but it is best to regard these as the loss of oral consonants via other processes, either deletion of the oral consonant, or assimilation and cluster simplification. In fact, the attested range of consonants affected by nasal absorption is rather small since the process itself is not especially common.

In Zande (Tucker and Hackett 1959), the nasal compounds mv and nz are often realized as [v] and [z] intervocally. This explains why
vowels following are often nasalized whereas nasal compounds usually induce nasalization only to the left:

/ʊnvurʊ/ [ʊʊvrʊ] 'older brother'
/bɪnzâ/ [biʔzâ] 'doctor'

Zande also exhibits [ɾ] which is probably a reduction of the complex /nr/ although it is never heard as such, e.g. [nzəɾ] 'bell'. The group /nv, nz, nr/ functions as a class, as opposed to the pre-nasalized stops /mb, nd, ng, ngb/ in that the former condition, but are not affected by, nasal compound reduction of the Meinhof's Law type.

In Ampinaye (Burgess and Ham 1968:10), /mb/ is realized as a nasalized bilabial approximate when it occurs between an oral vowel and /v/. Nasalized continuants also arise from other sources in other languages. For example, in Celtic languages the lenited form of /m/ is [v] in some languages although the nasality is lost in some dialects. In Boma, a fricative nasal *n, *nd in C2 position although not from other nasals and nasal compounds (Guthrie 1967-70). The exact phonetic nature of this fricative nasal is not clear from Guthrie's description. In all cases, however, the nasal continuants are voiced, a fact which again points to the marked status of voiceless nasals.¹⁴

8.2.5 Conclusion

In the preceding section we have examined the most common processes to which nasal consonants in nasal-oral sequences are subject. This included position assimilation of the nasal, the most
common process to affect nasal-oral sequences, which process accounts for the surface homorganicity of the components. The additional processes, which are clearly related in certain cases, of nasal devoicing and nasal deletion were also examined as well as nasal absorption. An articulatory motivation was proposed for certain of these, but both perceptual and articulatory motivations seem more likely for others. The degree of overlap in motivation in individual cases is a topic with much wider implications and remains for future research.

8.3 **Summary**

The present chapter has been a survey of the most frequent processes to affect the phonetic realizations of the oral and nasal components of nasal-oral sequences. These processes conspire to produce prenasalized inventories which are composed only of pre-nasalized voiced stops in many languages, the unmarked type of pre-nasalized consonant (Section 2.2). This can be achieved in a variety of ways. For example, in some languages all consonants are hardened and voiced after nasal consonants so that there is complete neutralization of oral consonants at each point of articulation in this position, e.g.

\[
\begin{cases}
/N + b/ \\
/N + p/ \\
/N + v, \beta/ \\
/N + f/ \\
/N + u/
\end{cases}
\rightarrow \ [mb]
\]
That is, every oral consonant has a prenasalized equivalent which is the prenasalized voiced stop of that point of articulation. However, this is a relatively infrequent situation. More commonly, languages with only prenasalized voiced stops have various processes which delete either the oral or nasal consonant in certain non-preferred sequences, e.g. \(N + p/ \rightarrow [p], N + p/ \rightarrow [m]\), etc. There are languages which also exhibit a certain subset of these processes, e.g. Kikuyu voices underlying stops post-nasally and deletes nasal consonants before continuants. Thus, there are, in fact, a number of ways in which the state of only prenasalized voiced stops within an inventory can be achieved and explained.$^{15}$

Although we claim that prenasalized voiced stops are the unmarked type of prenasalized consonants, this is not to claim that this series never develops further. In some languages, the prenasalized voiced stops become simple voiced stops or nasals; occasionally the prenasalized voiceless stops are then reinterpreted as prenasalized voiced stops, e.g. Matumbi:

\begin{align*}
  *mb & \rightarrow m \\
  *mp & \rightarrow mb
\end{align*}

This is as expected. Greenberg (1970a:95) notes that one of the chief dynamic tendencies of diachronic developments is for more complex items (marked) to lose their mark whenever they no longer contrast with the corresponding unmarked items.$^{16}$ Further, the primacy of prenasalized voiced stops is not absolute synchronically, but violations of the general principle do require an explanation.
The complex interactions of process and inventory here point again to the fact that diachronic process explains frequency in phonology (Greenberg 1970a:99).

It should be mentioned that some languages exhibit none of the processes which we have discussed in the present chapter except for position assimilation of the nasal. That is, the prenasalized equivalent of every oral consonant is the same consonant preceded by nasalization. This too is a rather uncommon state of affairs, but it is attested, for example, in Ganda, Rundi, etc. These languages therefore have extensive prenasalized inventories, e.g. Ganda [mb, mp, mv, mʃ, nd, nʃ, nz, ns, ṃj, ṃc, ṃg, ṃk]. Thus, although we are able to demonstrate the general directions of change, it is not possible to predict to what degree, if any, a language will avail itself of these processes. For reasons of time and space, we have not investigated the implicational hierarchies among the various processes treated in this chapter. This is a very complex topic which necessarily involves the determination of feature hierarchies and the relative weightings of sound types, which we leave for future research. Presumably, certain language specific prejudices are involved since, for example, some languages tolerate only prenasalized stops [mb, mp, nd, nʃ, ng, nk] whereas others tolerate only prenasalized voiced consonants [mb, mv, nd, nz, ng]. The relative unmarked status of prenasalized voiced stops with regard to other prenasalized types has been demonstrated, but, of course, even prenasalized voiced stops are highly marked on a more general level. We return in Chapter 9
to the implications of surveys such as the above and that provided in Chapter 7 and their uses in linguistic analysis, particularly in inferring historical states and processes.

8.4. Gemination of Consonants and Prenasalization

We have made reference throughout the course of this thesis to the close relationship which obtains between prenasalized and geminated consonants in some languages. Although the scope of this topic prevents a full treatment of it here, the following brief remarks and examples are appropriately appended to Chapter 8 since one of the relationships which obtains between these two sets is precisely that prenasalized consonants occasionally develop into geminates, i.e. consonant clusters composed of two identical members. For example, in Kiganna, Bantu *mb, *nd, *ng > mm, nn, ng in C2 position. This fact constitutes an important piece of evidence in favor of an underlying cluster analysis for prenasalized consonants. The effect of Meinhof's Law in Ganda is to cause prenasalized consonants to be realized as geminate, i.e. double, nasals (Section 3.4):

/əŋganda/  əŋganda  'family'  (cf. sg. oluganda)
/embambo/  emmambo  'pega'  (cf. sg. olubambo)

It is true that the output of Meinhof's Law in most languages is a single nasal, but these languages exhibit a general process NN → N elsewhere, which Ganda does not. In fact, very few Bantu languages tolerate surface clusters of any sort.17
There are similar problems posed by long consonants and prenasalized consonants for linguistic analysis in many languages, especially those in which other consonant clusters do not occur, e.g. Ganda, Lega, Tetela, etc. Lega (Meeussen 1964) has the following inventory:

*Lega*

\[
\begin{array}{ccccccc}
\text{m} & \text{n} & \text{ŋ} \\
\text{b} & \text{v} & \text{(d)} & \text{z} & \text{g} & \text{mb} & \text{mv} & \text{nd} & \text{nz} & \text{ŋg} \\
\text{p} & \text{t} & \text{ʃ} & \text{k} & \text{mp} & \text{nt} & \text{ns} & \text{ŋk} \\
\text{m:} & \text{n:} & \text{ŋ:} & \\
\text{b:} & \text{d:} & \text{z:} & \text{g:} & \\
\text{t:} & \text{s:} & \text{k:} & \\
\end{array}
\]

Meeussen (1964:2) notes that the status of the complex consonants is not clear. In both cases, the complex consonants may be analyzed as either a sequence of phonemes or as a phonological feature since the complexity is pervasive throughout the consonant system.

There is, of course, a crucial difference between prenasalized consonants and geminates. Part of the definition of prenasalized consonants presented in Section 2.1 was that they present the surface length approximate to simple consonants in those consonant systems within which they function. Obviously, this is not possible in the case of geminates since it is duration alone in many cases which distinguishes geminate and single consonants. These durational considerations are easily reconciled with the derivational model
presented earlier. One of the adjustments initiated by the transition from clusters to complex units, corresponding to the transition from segmental to syllabic organization, is durational. Since geminates do not participate in the transition in exactly the same manner as nasal-oral sequences, precisely because of their phonetic structure, there is no reduction. That is, reduction can occur with nasal-oral sequences since the crucial perceptual factors include a sequencing of articulatory gestures whereas the corresponding factor for geminates is duration.

The parallels in analysis for prenasalized and geminate consonants are more fundamental than the remark cited by Meeussen above. We mentioned in Chapter 2 that part of the confusion arising in the traditional treatment of prenasalized consonants stemmed from the question of whether prenasalization represents a phonetic or a phonological phenomenon. The same is true for the analysis of geminates (Carnochan 1962). Clearly, to speak of the articulations themselves as prenasalized or geminated is to make the term wholly phonetic, and this is incorrect.

Another interesting relationship between prenasalized and geminated consonants is that, although both features may be pervasive throughout the consonant system, they are mutually exclusive, i.e. the presence of one feature implies the absence of the other. Thus, for example, in Lega there are no prenasalized geminates, [mbb], [ntf], etc. or geminated prenasalized consonants, [mbmb], [ntnt], etc.19 This fact also points to the special status of both types of
consonants; proponents of simple feature analyses are unable to explain either of these gaps. Further, in many language systems the distributional limitations of prenasalized and geminate consonants are identical.

There are some interesting alternations which again show parallelism for these two types of consonants in many languages. For example, there is the complex series of morphologically conditioned consonant alternations in Shatt which was discussed in Section 3.1 (Tucker and Bryan 1966:232). Basically, the effect of this alternation is to cause voiceless consonants to become voiced, sonorants and voiced stops to be geminated, and voiced sounds to become prenasalized. There is thus some overlap for the class of voiced stops between prenasalized and geminated consonants, which is not predictable. A good argument could be made in this case for treating prenasalization and length as additive components similar to voicing.

There are also some New Guinea languages which point to a close relationship between geminates and prenasalized consonants. In Fore (Nicholson 1962), initial consonants undergo certain changes when they are phrase-medial. The form of the change is determined by the class of the preceding morpheme; there are three different morpheme classes:
The stops are realized with aspiration in initial position; the only other consonants which occur are /s/ and /ʔ/. Some examples of this alternation are:

<table>
<thead>
<tr>
<th>initial</th>
<th>phrase medial</th>
</tr>
</thead>
<tbody>
<tr>
<td>/p/</td>
<td>b p: p:</td>
</tr>
<tr>
<td>/t/</td>
<td>ɾ t: t:</td>
</tr>
<tr>
<td>/k/</td>
<td>g k: k:</td>
</tr>
<tr>
<td>/m/</td>
<td>m ŋm mp</td>
</tr>
<tr>
<td>/n/</td>
<td>ɾ n nt</td>
</tr>
<tr>
<td>/w/</td>
<td>ɾ w ɾk¹</td>
</tr>
<tr>
<td>/y/</td>
<td>ɾ y ɾy nt</td>
</tr>
<tr>
<td>ø</td>
<td>(vowel ŋ k)</td>
</tr>
</tbody>
</table>

The counterpart of gemination in stops is glottalization or pre-nasalization for sonorants. It is tempting to speculate that Class 2 morphemes originally ended in /ʔ/, which would account for glottalization and for gemination of stops by assimilation, e.g. *ʔp > p:.

The situation with respect to Class 3 morphemes is less transparent. An original final nasal might be possible; assimilation would again account for length in stops, *Np > p:, but this would require a
dissimilation with initial nasals *Nm → mp, which may be problematic. It does seem clear, however, that a morphologization of an original phonological process has occurred. Cf. Section 7.4.3.

It is not the case that all alternations of this sort can be traced to original clusters caused by morpheme abutment. For example, in Kamano (Young 1962), the underlying consonant system is: /p, t, k, ?, b, z, g, f, s, r, m, n/. The voiceless stops are realized as such after glottal stop and initially, but elsewhere they are prenasalized:


The consonant system of the closely related language, Kanite, is /p, t, k, ?, b, y, f, s, gl, m, n/. However, the rules for the realization of voiceless stops are different. /p/ and /t/ are simple stops initially, but medially they show alternation between [p:, t:] and [mp, nt]:


Ignoring for the moment the general questions of what the correct underlying specification for the set of voiceless stops in Kanite might be and the processes responsible for their phonetic realizations, we again see a close relationship between length in consonants and prenasalization.

A final example in which prenasalized consonants and geminates pattern together is taken from dialect variation in Modern Greek as
described by Newton (1972). The usual realization of underlying clusters /mp, nt, ηk/ is [b, d, g]; there is no neutralization since /b, d, g/ are absent from the underlying system. However, in fact there is wide variation in the surface realization of /Np, Nt, Nk/ clusters. For purposes of this presentation, this variation is explained by rules of position assimilation (A), complete assimilation (B), and degemination (C). Dialects of Northern Greece and much of the Peloponnese exhibit rule A only. Dodecanesian dialects of Simi and Kalimnos have rule B; Cretan, Thracian and East Macedonian dialects have rules B and C. Some sample derivations are:

<table>
<thead>
<tr>
<th></th>
<th>/kunpɪ/</th>
<th>/pɛnte/</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A</td>
<td>kumbɪ</td>
<td>pɛnde</td>
</tr>
<tr>
<td>2. B</td>
<td>kubbɪ</td>
<td>pɔdde</td>
</tr>
<tr>
<td>3. B and C</td>
<td>kubɪ</td>
<td>pɔde</td>
</tr>
</tbody>
</table>

All dialects exhibit voicing assimilation of post-nasal consonants. The facts are actually much less neat than presented above. Newton (1972:94) notes that many speakers in Northern Greece and the Peloponnese actually have only a slight nasal onset, [pɛn̥dɛ], [ku̯mbɪ], and often show fluctuation in the clarity with which the nasal is articulated. For some speakers, there is variation between light and zero nasality in such cases. Thus, prenasalized consonants, nasal-oral clusters, and geminated consonants are all derived from underlying clusters. These Greek data are at least suggestive that a feature analysis for such cases of prenasalization and length is inappropriate.
The determination of the exact relationship between prenasalization and gemination is a topic for future research. The analysis of geminates is also a matter of debate, i.e. there are cases where a cluster analysis seems appropriate and other cases where a feature analysis seems more plausible. Of course, in many analyses, the choice between the two is determined on purely descriptive grounds by the bias of the analyst. The fact that prenasalized consonants function with geminates in many languages brings into question the status of prenasalized consonants in these languages. If [long] and [prenasal] are orthogonal features on the phonological level, they should combine to produce complex segments; such combinations do not occur. The data we have presented suggest strongly that a feature analysis is inappropriate from an explanatory viewpoint in many cases. A more complete analysis of data is required along with many further examples before solid claims about this relationship can be put forward.
1 In these examples, the complex symbols $\bar{\gamma}$, $\bar{\eta}$, etc. should not be interpreted as clusters. These represent unit sounds which are phonetically complex, e.g. a nasal which is devoiced during the latter part of its articulation. Such units are never phonological; there is wide variation in the degree to which devoicing or voicing may be present ranging from zero to total.

2 In some views of phonological theory, such as that proposed by Stampe (1973b), such a phonologization would be viewed, not as the acquisition of a process which voices consonants, but as the loss of an older phonological rule. That is, the natural state of affairs for consonants in a post-nasal environment is voiced. Therefore, in languages where $N + \bar{\gamma} \rightarrow N\bar{\gamma}$, no process is learned by children, who merely apply the natural process to that effect, whereas in languages where $N + \bar{\gamma} \rightarrow N\bar{\gamma}$ children must active learn to suppress a natural tendency.

3 The single exception to these generalizations concerning the voicing of consonants in a post-nasal environment which we are unable to explain at present is the devoicing of consonants in this environment in certain of the Sutho-Tswana languages. In these languages, /N + b, p/ → [(m)p], /N + l, r/ → [(n)t], etc., e.g. Tswana:

lobaka | l|paka | 'time(s)'
loleme | l|teme | 'tongue(s)'
lobu | l|mpu | l|pu | 'salt earth'
|lo| | l|nt| | 'cord(s)'

These are certainly anomalous changes in Bantu, and a much more complete examination of the sound systems in which they occur is necessary before we can provide a complete explanation for them. It appears that the role of tone is especially important in these changes.

4 However, various restrictions may be placed on the operation of such a process. For example, in Mixtec (Hunter and Pike 1969:29), /a, ə/ are affected post-nasally, but /a/ is not. This is presumably related to the fact that /tə/ exists independently, and affrication of /ə/ would therefore result in surface opacity.

5 Cf. footnote 6, Chapter 4.

6 Davey (1975:39 ff.) refers to the voiced clicks as clicks with simultaneous murmur. He uses Ladefoged's diacritic " to represent these, i.e. [ɬ, ʟ, ɻ]. The preceding nasal is also realized with murmur or "breathy voice." Also, Davey uses the I.P.A. diacritic " to symbolize the nasal clicks [ɬ, ʟ, ɻ]. We have preferred to continue using the symbols provided by Doke (1926) although his use of a diacritic to mark aspiration is at variance with his general policy; the same diacritic is so used throughout the consonant system, however.
7 The use of the velar nasal symbol [ŋ] to indicate prenasalization of clicks of all points of articulation stems from the fact that, due to their method of production, all clicks are produced with two points of oral closure, one of which is velar and the other pre-velar. This differs from nasal clicks which are produced with lowered velum throughout their articulation and in which the more anterior release precedes the velar release.

8 We need to establish what, if any, is the hierarchy in which stops are aspirated. For example, in Nyanja (Kadima 1965), /k/ is aspirated after a nasal, but /p, t/ are not. Also, cf. Devine (1974) who claims that the unmarked state for voiceless stops in union with a sonorant consonant is unaspirated.

9 There is much comparative evidence to support this, e.g. Tswana mhaxo, Pedi mphayo, Sutho mofao 'provisions'. Cf. also the development of postnasalized stops into aspirates and fricatives in many New Caledonian languages (Haudricourt 1964, 1971).

10 Zuckerman (1972) notes that the preconsonantal nasal segment can be either consonantal or vocalic when it is realized as vowel nasalization. She hypothesizes that preconsonantal nasals are therefore nonsyllabic glides with feature specifications which are [+nasal, +high, +back, -syll, -round], i.e. phonetic [ŋ]. Apart from the great unexpectedness of such a segment and the fact that it is never realized as such, she claims that the nasal assimilation process in some languages, e.g. French, is actually a two-stage process:

1) n → [ŋ] / _ _ _ [-coronal]
2) ɡ → [a position] / _ _ _ [a position]
There is, of course, no evidence to warrant or justify such an unnatural analysis.

11 However, we noted in Section 4.3.1 that one or the other articulation of labio-velars may be primary phonologically. In Ngbaka, they are classed with labials, but in other languages with velars.

12 Ilse Lehise (personal communication) reports that in Ewondo, the nasal which appears before the labio-velar stops is unambiguously [ŋ], not [ŋm].

13 The terms used to describe this phenomenon by Austronesianists are "Nasal Substitution" and "Prenasalization by Substitution."

14 Cf. Section 2.2.3.2. There are numerous other facts which point to the marked status of voiceless nasals, e.g. they never combine with oral consonants to form nasal compounds, even in languages with extensive compound inventories.
15 There are, of course, cases in which it is not possible to reconstruct by which series of processes a given state has been obtained. This parallels an analysis of some vowel inventories with nasal vowels, e.g. /i, e, a, o, u, ə, ɔ, ɔ/. Occasionally, it is not possible to determine whether /i, u/ never nasalized or were later lowered to / ə, ɔ/. This points again to the great importance of viewing change as part of a system, not something abstracted from that system. This point is taken up again in Chapter 9.

16 This is, by no means, an unusual phenomenon. For example, after the voiceless stops /p, t, k/ were lenited in Tsogo, the prenasalized voiceless stops lost the "extra mark" of prenasalization and replaced the simple voiceless stops:

*p > b  *mp > p
*t > t  *nt > t
*k > y  *nk > k

17 These facts are treated in greater detail in Herbert (1976a).

18 Ladefoged (1971:25) claims that the so-called "strong" consonants of Ganda are not only longer, but also pronounced with greater pulmonic pressure than their single counterparts. In fact, in initial position, it is this greater pressure alone which distinguishes simple and geminate voiceless stops, e.g. teeka 'put', teeka 'rule'. There is, however, some question as to whether this greater pressure is systematically present for all consultants (Herbert 1974).

19 There is some question as to what the geminated equivalent of a prenasalized consonant would be. In addition to the example cited, which is extremely improbable phonetically, it might be [mmb], [mmb], or [mmbb], none of which occur as such. We do find sequences such as [mmb], but these are unambiguously clusters of nasal plus prenasalized consonant, not geminated prenasalized consonants. Sasse (1976:127) notes that this is a problem of fairly wide occurrence. In general, the geminated equivalents of all consonants with secondary articulation are long consonants with a single secondary articulation. For example, a geminate glottalized [k?] is [kk?], not [k?k?]. The same is true for palatalized and labialized consonants as well as affricates.

20 /k/ behaves differently, in a way which does not bear on the present discussion. Basically, /k/ is [k] after glottal stop and initially, [y] between central and low vowels, and [g] between other vowels.
CHAPTER IX
IMPLICATIONS AND CONCLUSIONS

9.0 Introduction

The present chapter will serve a dual purpose within this work. On the one hand, this concluding chapter will reconcile the analysis of data which we have presented and the various universal we have proposed with the theoretical considerations cited in the introductory chapters of this thesis. Additionally, we will attempt to show how this treatment of prenasalization may be incorporated into the framework of a larger theory of phonology by pointing to areas of future research where the model we propose has particular relevance.

9.1 Explaining Markedness

9.1.1 Class Markedness

One of the earliest claims which we presented in this thesis was that prenasalized consonants, as a class of speech sounds, represent a highly marked type. This claim was examined in Chapter 2 in light of numerous observations on markedness, particularly those cited by Jakobson (1968) and in numerous works by Greenberg. These included considerations involving the status of prenasalization within implicational hierarchies, cross-language and language internal frequency of distribution, neutralizations with oral and nasal consonants,
distributional limitations within phonological words, etc. Further, we also discussed in detail the interesting relationship between phonological and grammatical markedness as it concerns prenasalized consonants and their signalling of various marked grammatical categories.

The balance of evidence certainly weighs heavily in favor of analyzing prenasalized consonants as a marked category with respect to both oral and nasal consonants. There are, however, some surprising complications in this regard where individual factors run counter to general expectations of markedness. For example, one of the most firmly established of such expectations has to do with the number of oppositions within marked and unmarked categories. It is asserted that the number of oppositions within the marked category never exceeds that within the corresponding unmarked category (Greenberg 1970a). This holds true for prenasalized consonants vis-à-vis oral consonants, but in many languages the relationship is reversed for prenasalized consonants and nasals. Rundi has 14 prenasalized consonants and 3 nasals, Nyanja 9 prenasalized consonants and 3 nasals, Zande 7 and 3, Malagasy 10 and 3, Maanjan 9 and 4, Yaka 5 and 2, etc. We mentioned that this was especially problematic since prenasalized consonants are generally classed as a subtype of nasal consonants (cf. Ferguson 1966). Similarly, textual frequency counts in some languages show greater frequency for prenasalized consonants than for nasal consonants, e.g. in a 1000 phone count of Ganda, 65 prenasalized consonants were counted as opposed to 55
simple nasal consonants. These observations are problematic since both types represent rather basic relationships of the marked/unmarked opposition.

We discussed in some detail a proposal by Lass (1972) to replace the universal bases of markedness theory with a much weaker formulation of "family universals". (Cf. Section 2.2.) The thrust of Lass' argument is that the current theory is without empirical foundation and therefore devoid of content. Clicks may be marked sounds in English and Japanese, but they are not marked in Zulu and Xhosa, precisely because the latter are "click languages". Lass would presumably explain the problematic observations concerning prenasalized consonants in a similar manner, i.e., prenasalized consonants occur more frequently in Ganda, Zande, etc. simply because that is "the nature of the beast in question" (1972:60). We countered Lass' arguments with several factual observations on the status of clicks within the Southern Bantu languages where they occur. Assuming then that the markedness of clicks does have some foundation within a universal theory of markedness, we are still left with the problematic status of prenasalized consonants within this universal theory.

We explained these observations with reference to the origin and underlying status of prenasalized consonants. We claimed, on a universal basis, that prenasalized consonants as such never occur at the level of underlying organization. Although there are several processes by which prenasalized consonants may arise and several roles
which they may play within a linguistic system (Chapter 7), in those systems where problematic markedness observations obtain, they are underlying nasal-oral sequences. Thus, the fact that consonant inventories frequently contain a larger number of prenasalized consonants than nasals is in some sense explained by the fact that these surface units are underlying /N - C/ sequences in which the oral consonant contributes to the surface phonetic realization as the consonant inventory of Ganda, for example, indicates:

<table>
<thead>
<tr>
<th>Ganda</th>
</tr>
</thead>
<tbody>
<tr>
<td>m</td>
</tr>
<tr>
<td>n</td>
</tr>
<tr>
<td>ń</td>
</tr>
<tr>
<td>ñ</td>
</tr>
<tr>
<td>p</td>
</tr>
<tr>
<td>f</td>
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<tr>
<td>ć</td>
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<tr>
<td>k</td>
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<tr>
<td>mp</td>
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<tr>
<td>ńf</td>
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<tr>
<td>nt</td>
</tr>
<tr>
<td>ns</td>
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<tr>
<td>ńc</td>
</tr>
<tr>
<td>ñk</td>
</tr>
<tr>
<td>b</td>
</tr>
<tr>
<td>v</td>
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<tr>
<td>d, l</td>
</tr>
<tr>
<td>z</td>
</tr>
<tr>
<td>j</td>
</tr>
<tr>
<td>g</td>
</tr>
<tr>
<td>mb</td>
</tr>
<tr>
<td>ńv</td>
</tr>
<tr>
<td>nd</td>
</tr>
<tr>
<td>nz</td>
</tr>
<tr>
<td>ńj</td>
</tr>
<tr>
<td>ñg</td>
</tr>
</tbody>
</table>

This same observation, coupled with the facts of nasal assimilation, also explains why the places of articulation for preconsonantal nasals often exceed those for primary nasals, e.g. many languages have [m, ń, n, ń, ñ] preconsonantly, but only /m, n/. This follows from the general fact that a language may have more clusters involving some class of segments than there are members of that class.

A great deal of evidence was presented in Chapters 3, 4, and 5 which points to the non-unit underlying status of prenasalized consonants. This evidence involved many different types of considerations which viewed prenasalized consonants as part of the language systems within which they function and as phonetic entities
abstracted from these systems. Further, we discussed in detail the problems involved in the incorporation of prenasalized consonants into the universal phonological inventory in terms of how they might be characterized within such a universal theory, particularly in terms of their relationship with oral and nasal sounds. We cited examples wherein prenasalized consonants appear to function as a sub-class of oral consonants which contrast with their more usual functioning as nasal consonants. This fact itself point to the correctness of a cluster analysis for this type of prenasalized consonant.

In Chapter 6, we provided the bases for a model which we believe will be necessary to account for prenasalized consonants. This model draws a fundamental distinction between the segmental and syllabic levels of organization, which distinction corresponds to the difference between underlying clusters and surface units. We posited a process of consonant unification which is directly motivated by the transition from one level of organization to another. Other possible examples of this process of consonant unification are briefly discussed in Section 9.3.1.

Granting the correctness of a cluster analysis, we still need to explain why these clusters and not others occur since so many non-cluster languages exhibit prenasalized consonants. In this regard, reference was made to the vowel-like status of underlying nasals and to the fact that nasals often function as syllable codas where other consonants cannot. In this respect, our analysis correlates with
the general observation that NC is the medial unmarked cluster. There is some question as to how initial prenasalized consonants are to be included within the model. We presented one hypothesis which reconciles initial prenasalized consonants with the underlying ambi-
syllabic nature of prenasalized consonants. Finally, although NC clusters occur finally in many languages, prenasalized consonants which are underlying sequences never appear in that position. This follows logically from our claim that they are underlying ambi-
phomena; cf. the discussion of Delaware in Section 6.1.2. The absence of final prenasalized consonants can also be predicted from universal rules of syllabification which do not permit segment strings such as CVCVNC to be organized as CV.CV.N.C#. The relationship between universal syllabification rules and consonant unification is treated in detail elsewhere (Herbert 1977d).

Thus, in the early chapters of this thesis we provided an explanation for the markedness of prenasalized consonants as a class of sounds which is directly tied to their derivation. Since pre-
nasalized consonants are never primary, either synchronically or historically, we expect that in some sense they will be more "costly" than underlying unitary sounds. Although nasal-oral clusters may be the unmarked type of cluster in certain positions, it seems self-
evident that clusters should be more highly marked than single consonants. This parallels the markedness of diphthongs and long vowels with regard to single vowels of unchanging quality. In this way, the underlying complexity directly parallels phonetic markedness
of prenasalized consonants in a way which, for example, the marked-
ness of front rounded vowels cannot be explained. We have demon-
strated that insofar as the markedness of prenasalized consonants as
a class of speech sounds in concerned, the theory is not merely one
of observation and weak statistical probability; it is not devoid of
content and interesting theoretical considerations as Lass (1972)
claims. It is perhaps significant in this explanatory context to
note that the content is forthcoming, not from physiological and
perceptual investigations as Postal (1968:170-1) hopes, but from
more purely phonological patterning which is itself intimately tied
to the phonetics of the units involved. Markedness theory seeks not
only to determine which phonological systems are more common, but
whenever possible, to determine reasons for these tendencies.
9.1.2 Markedness within the Class

During the course of this work, we surveyed not only the various
relative origins of prenasalized consonants (Chapter 7), but also
the factors affecting the derivation and evolution of prenasalized
consonants as units or affecting their individual components. That
is, in Chapter 8 we examined the directionality of processes which
affect nasal-oral sequences. Although there are relatively few
processes which affect the sequence nasal plus voiced stop, really
only simplification in favor of the nasal or the oral consonant, a
number of processes conspire to produce prenasalized inventories which
include only prenasalized voiced stops. These include both direct and
indirect processes, i.e. those which change feature specifications
of the components involved and those which eliminate non-preferred sequences. We mentioned that apart from the primacy of prenasalized voiced stops, there may be language specific variation in terms of the relative weightings of other prenasalized types. This topic is left for future research.

9.2 Universals in Reconstruction

9.2.1. Reconstructing Process

Part of the value of surveys of processes of evolution such as that presented in Sections 8.1. and 8.2 is that this information is often useful in historical reconstruction. This idea is far from novel. Jakobson (1958) notes that such studies are the touchstone of validity for all reconstructed systems. For example, it is generally agreed that the existence of nasal vowels in a synchronic system points to former sequences of vowel and nasal consonant. The interaction of processes of change is another useful tool in reconstruction. We discussed in Section 8.2.3 how the "Nasal Substitution" of Western Austronesian is not an assimilatory process, but rather a perceptual deletion. This analysis is based, not on the facts of Austronesian alone since the phonetics of Nasal Substitution are buried in prehistory, but also upon established cross-linguistic universals such as that proposed by Hutcheson (1973) who claims that the complete assimilation of unlike sounds implies the complete assimilation of more like sounds. Finally, the directionality of change itself often provides insight into the problems of historical reconstruction. Thus, studies of this sort
point not only forwards to future directions of possible change, but also backwards to possible sources of origin.

Bennett (1967), in discussing the voicing of post-nasal stops in several Eastern Bantu languages, reconstructs the phonetics of change as:

\[
\begin{align*}
*mp & \rightarrow *m* \rightarrow *m\beta \rightarrow mb \\
*n* & \rightarrow *n* \rightarrow *n\delta \rightarrow nd
\end{align*}
\]

In some languages when nasality is lost \( *mp \rightarrow f \) or \( f \). However, there are some serious problems with the above reconstruction. Specifically, the change \( *mp \rightarrow mb \) is highly unnatural since oral consonants tend to harden rather than lenite in a post-nasal environment. In fact, the sequences \([m\delta, m\beta, n\theta, n\delta]\) are extremely rare. Although \([m\beta]\) is occasionally attested, it always represents \(/m\beta/\), never \(/mb/\), and the more common realizations of such a sequences are \([\beta, b, mb]\). I am aware of very few cases of pre-nasalized interdental fricatives; among these is that of Sherbro \([n\theta]\) reported by Ladefoged (1968:47). The existence of \([n\theta]\) in Sherbro is especially surprising since it also contains the fricatives \(/f, v, s/\), none of which appear prenasalized. Interdental fricatives are rather rare as a class of sound, however. Kikuyu has \(/\delta/\), but no \([n\delta]\) since nasals are obligatorily deleted before all continuants; Kamba, a closely related language, exhibits surface \([n\delta]\).

Further, the fact that intervocalic voiceless stops are often lenited cannot be used as evidence that post-nasal stops also lenite. There are numerous examples which demonstrate that the two develop
differently. For example, Londo *mp, *nt, *nk > p, t, k whereas *p, *t, *k > p, t, k. In Mbole and Bushong, we have the following correspondences:

<table>
<thead>
<tr>
<th>Mbole</th>
<th>Bushong</th>
</tr>
</thead>
<tbody>
<tr>
<td>*mp</td>
<td>f</td>
</tr>
<tr>
<td>*nt</td>
<td>t</td>
</tr>
<tr>
<td>*nk</td>
<td>k</td>
</tr>
<tr>
<td>*p</td>
<td>θ</td>
</tr>
<tr>
<td>*t</td>
<td>t</td>
</tr>
<tr>
<td>*k</td>
<td>θ</td>
</tr>
</tbody>
</table>

However, the crucial fact here, despite the development of fricatives from prenasalized stops, is that nasality is lost. In these cases, it is clear that we need to reconstruct intermediate stages such as:

*mp > *mpʰ > *ph > f

That is, the fricative develops from an aspirated stop after nasality has been lost. Cf. Section 8.1.6.2. Such intermediate stages are attested, e.g. Lwena *mp > pʰ, *nt > tʰ, *nk > kʰ and *p > h, *t > t, *k > k.

There are a few cases where nasal plus stop sequences do become nasal plus fricative, e.g. in Dsiso (Sengeju) *mp > mv, *mb > mb, *p > v, *b > θ. It is important to note here that the post-nasal fricative is voiced. There are several possible explanations for this fact. First, we might explain it as a dissimilation. The language obviously had a process voicing post-nasal consonants, *nt > nd, *nc > θ. To prevent neutralization of the *mp/*mb distinction,
mb (< *mp) might become mv, especially since speakers know that the non-nasal correspondent of the derived *mb (< *mp) is v (< *p). It might be necessary to establish a complete hierarchy of features and processes before such changes can be satisfactorily analyzed. Still, it seems clear that Bennett's proposed reconstruction of chronology as *mp > m$$ > m$$ > mb cannot be justified, especially in view of the frequency and naturalness of the simple alternations where consonants simply voice after a nasal consonant. The point here is that although it is necessary to make inferences about the phonetic systems which we reconstruct, these inferences must be solidly grounded in a theory of universal processes and phonetics.

Similar to Bennett's analysis of Bantu, the traditional reconstructed history of the clusters *mp, *nt, *nk in Common British (cf. Lewis and Pedersen 1961) is that they became mf, nθ, n◊, and that, in certain cases, the nasal was lost leaving the voiceless spirant. Otherwise, these clusters "reverted" to mp, nt, nk, except in Welsh where they became mh, nh, n◊. That is, for example, British *nk has the following history:

*nk > *nx > nk  

except in Welsh where:

*nk > *nx > n◊  

Jackson (1953) has attacked this position for several reasons. First, he points out that it is unlikely that clusters of this sort would develop since they are impermissible in the language normally. Second, the "reversion" to voiceless stops in all languages except
Welsh seems unlikely; the intermediate stage is posited only to bring Welsh, Cornish, and Breton under a single treatment.

Jackson argues that just as British *mb, *nd, *ng became m(m), n(n), η(η) in the fifth or sixth century, so Welsh *mp, *nt, *nk became (m)m, (n)n, (η)η in the eighth or ninth century which explains the Middle Welsh spellings mmh, nnh, etc. to express "a geminate nasal the second part of which is voiceless" (1953:500). Note that this (near-) complete assimilation of unlike segments is paralleled by the complete assimilation of more like segments. Jackson further cites in support of his analysis the fact that nasal mutation in Welsh affects the voiced and voiceless stops in the same manner when they occur within internal clusters. Internal *mp, *nt, *nk are preserved in Cornish and Breton; final nasals in Cornish and Breton evolved into a "denasalized catch" in such a way so as to induce spirant mutation of following stops. Thus, in Welsh from the eighth or ninth century onwards:

\[-n p - n t - n k - n b - n d - n g -\]

| mh | nh | ηh | m | n | η |

There are also analogous developments in some dialects of Scottish Gaelic, which has lost the Goidelic pattern of nasal mutation. For example, in some areas of Lewis (Oftedal 1951:101), the nasalized stops mp, nt, nt', nk', nk consist of a voiced nasal consonant followed by aspiration, which is occasionally heard as a long nasal, the second half of which is voiceless, e.g. an t-athair 'the father' /Ntaheò/ [Nhaheò]. Occasionally, however,
the raising of the velum precedes the release of oral occlusion, and there is an impression of a voiced or voiceless stop, e.g. \[ N^hahs\] or \[ N^dahs\]. Jackson's reconstruction is cited here as a good example of the use of knowledge of cross-language processes in reconstruction.

Although knowledge of universal processes is a useful and often necessary tool in reconstruction, there are definite limitations to be placed upon the importance attached to such processes for other purposes, e.g. genetic classification, linguistic subgrouping, etc. The fact that languages share a number of rules may be used, in conjunction with other facts, to demonstrate their relatedness. However, it is only on the basis of shared innovations, i.e. changes which can be traced to some period of common development, that subgrouping can be performed (Hoenigswald 1960). In both cases, however, it is necessary to recognize the fact that common rules may represent, not only a common source or joint development, but also parallel innovations. That is, especially when dealing with rules or processes of great frequency, parallelism may point only to the naturalness of certain developments and processes.

Hyman and Voeltz (1971) cite the commonness of alternations \( p/h, l/d, y/g, y/\text{f} \) in Bamileke and Bantu to argue for their genetic relatedness. The voiced stops occur only when prenasalized in Bamileke, e.g. the following verb forms:
It seems questionable that parallel rules such as post-nasal hardening have, on their own merit, any value in arguing for relatedness. Since these rules occur so frequently in so many languages, their value in this regard must be marginal.

Similarly, Dahl (1951), in a comparison of two Austronesian languages, Malagasy and Maanjan, notes that in both languages the nasal element of prenasalized consonants tends to be longer before voiced consonants than before voiceless consonants. He writes:

Cette convergence entre les deux langues dans la réalisation phonétique des phonèmes est remarquable. (1951:50)

However, this is a universal process which has been instrumentally verified in a number of languages, both for unit and non-unit sequences. There is nothing remarkable about this similarity between Malagasy and Maanjan; this fact has no value whatsoever in a determination of the degree of relatedness between the two languages.

Thus, although common processes in two languages may date from a common period, we need to discount processes which are universal, e.g. the tendency for a slight period of nasalization to occur with vowels in conjunction with nasal consonants. Further, processes of great frequency, though not universal, are also of limited value. In the case of Bamileke and Bantu post-nasal hardening, it can in fact
be demonstrated that the hardening rule does not date from a common period since at the time of the Bantu diaspora, post-nasal oral consonants were unaffected by the nasal, mirroring the situation which occurs synchronically in Ganda, Rundi, etc.

9.2.2 Reconstructing State

In addition to inferring diachronic universals of processes of change from synchronic universals which we are able to observe, the survey of origins in Chapter 7 has a different role in historical reconstruction. It was demonstrated that, unlike the case of nasal vowels reviewed in Section 2.1.2, there is no Exclusive Relative Origin for prenasalized consonants. Thus, although we can infer that all nasal vowels represent historical sequences of oral vowel plus nasal consonant, prenasalized consonants have several possible origins. The role of a theory of relative origins then becomes largely one of invalidation. Given that certain conditions are a necessary prerequisite to the development of prenasalized consonants, if we can demonstrate that these conditions were not present, then we can discount that particular origin as a possibility. For example, contrastive vowel nasality is generally a prerequisite for the development of prenasalized consonants which serve environmental shielding processes (Section 7.2). If it can be ascertained that the language under investigation did not have contrastive vowel nasality at the time prenasalized consonants arose, then this is not a possible origin for the prenasalized consonants of that language.

Further, shielding processes give rise only to prenasalized
stops. Thus, if a language contrasts prenasalized stops and continuants, it is probably true that prenasalization did not arise as a shielding process. That shielding gives rise only to prenasalized voiced stops in most cases follows naturally from the fact that shielding usually affects nasals and voiced stops. However, there are cases, e.g. Maxakali, where shielding affects underlying voiceless stops. In these cases, we can discover directly the origins of prenasalized consonants whereas for shielded [mb, nd, ng] we need to examine the complete system to determine, which is not always possible, whether they represent original /m, n, η/, /b, d, g/, or both. In the case where both nasals and voiced stops were shielded, reconstruction is more difficult since both */VmV/ and */VbV/ > [VmbV] or, if vowel nasality is lost, [VmbV].

Further, there are certain other inferences about the reconstructed system which can be made from the prenasalized inventory. For example, it appears that, if a language shields a series of voiceless stops, voicing in stops is non-contrastive in that language although the language may contrast, for example, plain and aspirated stops. This is true of all the cases which we have examined. In fact, it is generally true that if a language exhibits only prenasalized voiceless consonants, voicing is non-contrastive within the consonant system.³

9.2.3 Conclusion

In this present section, we have demonstrated how various claims made by Jakobson (1968), Greenberg (1966a, 1970a, 1970c, etc.), and
others, which were reviewed in Chapters 1 and 2, may be profitably applied to the study of prenasalized consonants and the consonant systems in which they arise and function. This included a demonstration of the relationship between synchronic universals and diachronic processes and between typology and universals. Greenberg (1970a:61) points out that the former relationship, that which obtains between diachronic process and synchronic universals, follows logically from the fact that no change can produce a synchronically unlawful state and that all states are the outcome of diachronic processes. We have attempted, at several times, to make clearer the distinction between state and process. The value of typological studies is that they give support to predictive power in linguistics, both in a backwards, i.e. reconstruction, and forwards direction. There is thus a complex interaction between the shape and patterning of phonological systems, including the directions of change and evolution.

9.3 Implications and Directions for Future Research

Although this work can be viewed as a unified whole which presents a relatively complete theory of prenasalization as it arises and functions within normal language systems, it is clear that this theory also forms part and has obvious implications for a larger theory of phonology, particularly a theory of complex sound types.

9.3.1. Complex Sound Types

We mentioned in Chapter 6 that the notion of phonological unification or fusion is far from novel. For example, it has long
been asserted that diphthongs in many languages may be decomposed into a sequence of syllabic and non-syllabic vowel on a phonological level; in many cases, it is possible to demonstrate that historically the diphthongs represent juxtapositions of two underlying vowels. Similarly, suprasegmental fusion has been treated by Leben (1971), for example, who demonstrated that a contour tone may be decomposed into a sequence of two level tones in certain cases. Thus, for example, the tone of a certain class of syllabic nasals in Zulu is identical with the tone of the preceding vowel or the tone on which that vowel ends if it bears a non-level tone. The notion of consonant fusion has played a much lesser role in the theory although it has occasionally been cited in defense of various analyses.

Stahlke (1976) attempts to provide some generalizations concerning vocalic, suprasegmental, and consonantal fusion; he criticizes the inadequacy of what he terms the "segmental discreteness postulate" which has dominated most linguistic research. However, the most detailed and, if substantiated, dramatic example of fusion involving consonants which he cites is that of root-final palatals in Tswana. Stahlke argues that certain processes such as:

\[
\begin{align*}
\text{p} + \text{l} & \rightarrow \text{t} \text{f} \text{w} \\
\text{b} + \text{l} & \rightarrow \text{d} \text{3} \text{w} \\
\text{f} + \text{l} & \rightarrow \text{f} \text{w}
\end{align*}
\]

represent processes in which both input segments contribute to the resulting phonetic unit. However, this analysis cannot be accepted since comparison with other dialects and languages of the group
demonstrates that the interesting cases which lead Stahlke to a fusion analysis are actually morphologically conditioned alternations. It is possible to provide a step-by-step reconstruction of the process in Tswana which does not make reference to consonantal fusion or to unnatural phonetic changes. This reanalysis of data appears in Herbert (1977b).

Obviously, it is not the case that we question the general principle that consonants can participate in fusion processes. The central claim of this thesis has been that prenasalized consonants result precisely from such a unification of underlying segments. It seems clear that other complex sound types also result from similar fusion, e.g. long consonants in some languages parallel the behavior of long vowels in which both can be decomposed into underlying sequences. Cf. the discussion of consonant gemination and prenasalization in Section 8.4. Further, we discussed in Chapters 3 and 4 the many similarities between the problems posed by prenasalized consonants and affricates. Articulatorily, there are similar in that they both involve a sequencing of events within a single unit. Also, just as prenasalized consonants and postnasalized consonants both occur, so stop plus fricative and fricative plus stop sequences both occur, the latter usually being analyzed as a cluster. Affricates, as opposed to surface clusters, present the length of simple consonants and the elements are at least quasi-homorganic. It is interesting that the first component of the sequence, i.e. the stop consonant, is that which is the more natural syllable coda.
This fact is based on statistical observations of the sort surveyed by Bell (1971). The preferred status of obstruents in syllable coda position is presumably reflected in the fact that glottal stops often function as the only non-nasal coda within language systems.

A potential problem for the universal treatment of affricates is posed by languages in which unit and non-unit stop plus fricative sequences contrast. This parallels those languages in which pre-nasalized consonants and nasal-oral clusters are purported to contrast, e.g. Sinhalese and Fula. However, as we mentioned in Section 2.1.2, alternative analyses of both cases are available; such a reanalysis of Sinhalese if provided in Feinstein (1977 Ms), which reanalysis seems entirely convincing. The classic example of unit and non-unit stop-fricative sequences is exhibited in Polish pairs such as:

- **czech** [čex] 'Czech'  
  **trzech** [tʃex] '3' (gen.)
- **czyśta** [ciʃta] 'clean'  
  **trzysta** [tʃiʃta] '300' (fem.)
- **paczy** [paçi] 'warps'  
  **patrzy** [paʃri] 'looks' (instr.)
- **oczyma** [oçi ma] 'eyes'  
  **otrzyma** [oʃi ma] 'obtains' (inetr.)
- **czy** [çi] 'whether'  
  **trzy** [tʃri] '3'

In which both unit and non-unit sequences are tautosyllabic generally. Such a situation is attested rather rarely although there are other examples. Newton (1972) notes that in some parts of Lesbos, an affricate [tʃs] contrasts with a cluster [ts], e.g. [ðtʃs] 'so', [mʃtsa] 'I got drunk'. Obviously, in order to extend the derivational model proposed in Chapter 6 to include affricates, it will be necessary to motivate a distinction between the two types of sequences.
which is not ad hoc and which does not refer to facts of surface
duration. Feinstein's reanalysis of Sinhalese data refers to
universal rules of syllable boundary placement and various language
specific rules which move the boundaries in motivated fashions. This
seems to be a profitable line of research which investigations should
pursue.

Another type of complex unit to which this same research strategy
might be profitably applied is certain types of complex laterals. We
mentioned in Section 6.1.4 that very often liquids function with nasals
in the group of restricted syllable codas. For example, in the
Didinga-Murle group of languages (Tucker and Bryan 1966:371), hetero-
syllabic clusters occur only with [r] as the first member, e.g.
[gerōs] 'bad', and the only other type of sequence is tautosyllabic
nasal-oral sequences. Thus, Didinga has a process which fuses NC
sequences, but not RC sequences; this presumably reflects certain
constraints in the universal phonetic inventory. (Cf. also the
discussion of Australian clusters in Section 6.1.3 and 6.4.) It seems
at least plausible that certain complex laterals represent under-
lying LC sequences which are realized, not as articulatory sequences
in most cases, but as superimposed articulations. The more common
sequence involving laterals, however, seems to be CL sequences, i.e.
consonants which are released through the lateral.

9.3.2 Universals of Secondary Nasality

In additional to extending the derivational model to include
other complex sound types, there is another area of research to which
the present work points. We discussed in Chapter 6 how our treatment of prenasalized consonants relates to postnasalized consonants. It seems clear, however, that not all secondary nasal consonants are derived from underlying clusters. A great deal of work has already been done with a view towards cataloguing nasal processes, but a crucial problem with much of the research to date had been a failure to distinguish state from process.

There has been no attempt to survey and provide a unified treatment of secondary nasal consonants. Ferguson (1966) lists the following types: voiceless nasals, aspirated nasals, glottalized nasals, palatalized nasals, "emphatic nasals", prenasalized (voiced) stops, "nasalized clicks". However, this listing is not exhaustive; in addition to the other types of prenasalized consonants, nasalized fricatives, prosthinalized stops, etc. also exist. All of these consonants have in common the fact that their most characteristic allophone is not a voiced nasal stop. In addition to nasality, the "extra" feature may be either superimposed upon the nasal articulation, e.g. voicelessness, or may be sequences with respect to nasality, e.g. oral release.

A comprehensive treatment of nasality in consonants should set out to determine what underlying representations and uses of the feature [nasal] are possible. The major thesis of this present work has been that a feature [prenasalized] or, in fact, any other ad hoc feature is not necessary to account for prenasalized consonants since they do not occur at the level of phonological representation. We
believe that the underlying uses of nasality will be demonstrated to be relatively simple. Secondary nasal consonants are most probably to be represented by simple [+nasal] specifications. Their surface complexity is the result of either (1) some other phonological feature which is pervasive throughout the consonant system, or (2) adjacent segments or specifications which affect the ultimate phonetic realization of the segment specified as [+nasal]. The former seems more likely in the case of, for example, emphatic nasals or nasal clicks, and the latter for prenasalized consonants. Additionally, there will remain those secondary nasal consonants which are processually produced from underlying primary consonants, e.g. the contextually produced prenasalized consonants discussed in Sections 7.2 and 7.3 although these can be incorporated into (2) above. As we have demonstrated, it is necessary to examine the systems in which these secondary nasal consonants arise and function in order to determine their true underlying nature. The interest in such a project is in determining how a feature with direct and relatively consistent phonetic realizations is used on an underlying level and how it interacts with other features and feature complexes.

9.4 Summary

In this chapter, we have briefly reviewed the major claims and conclusions relating to prenasalized consonants which were presented in the central chapters of this thesis. We reconciled our analysis of data with various theoretical considerations presented in Chapters 1 and 2. Finally, we discussed how universals of process might be
profitably applied in historical reconstruction and the relation between typology and universals. These latter are, of course, general methodological questions which the theory of markedness originally addressed.

In addition to providing a unified theory of prenasalization, this thesis stands within a larger theory of phonology. Two topics are of particular relevance in this regard. First, there is the general question of complex sound types, particularly complex consonants, and how they are to be integrated into any phonological model. Although it is clear that the derivational model proposed in Chapter 6 will not be able to account for all the complex types, we mentioned several types which might successfully be integrated into such a treatment. Second, this treatment of prenasalization has implications for a complete theory of nasality. It is possible that the underlying uses of nasality are simpler than has previously been assumed and that "non-normal uses of nasality" (Ferguson 1975) are a result of derivational processes and simple facts of surface realization. It is hoped that the present study has pointed the way for research in these directions and that the methodology here employed will prove useful in this research.
NOTES

1 Diachronic correspondences such as Makua *mb, *nd, *ng > p, t, k must be analyzed as involving two distinct stages: (1) nasal loss, (2) later devoicing of stops. This devoicing is historically later than a general lenition process whereby *b, *d, *g > (v), l, Ø since the simple stops produced by nasal loss are unaffected. Note that there is no neutralization of *NC sequences since *mp, *nt, *nk > ph, th, kh, though later neutralization of simple voiceless and aspirated stops is a possibility. Whenever there is a one-step neutralization of *NC series, it is in favor of the voiced series, e.g. Yao, Bangubangu *mp, *mb > mb, *nt, *nd > nd, *nk, *ng > ng. Similarly, in many Austronesian languages (Haudricourt 1965) where *mb, *nd, *ng > p, t, k, it is necessary to posit a two-stage development. It is interesting that in none of these languages is there complete merger of the two series since at least part of the original voiceless stop series is lenited, e.g. *p, *t, *k > h, f, ? in Rotuman and f, t, ? in Samoan.

2 Strachan (1937) mentions that the facts are slightly more complex. *mp, *nt, *nk remain in final position, medially they become mb, mh, nh except in the penultimate syllable where they are mm, nn, nn. It is important to note that the penultimate syllable bore word stress in Middle Welsh.

3 This is not a one-to-one implication, however. For example, a language may exhibit [ŋk] but not [ŋg] since many languages have processes whereby /ŋg/ is realized as [ŋ]. The implication is merely that some prenasalized voiced stops will be present if voicing is contrastive in the consonant system.

4 Properly speaking, the Tswana case is not one of simple consonantal fusion since the input segments represent both consonants and vowels.

5 Trubetzkoy (1968:19) claims that Polish ć (orthographic cz) must be treated as a single phoneme because its duration does not exceed that of a normal consonant and, in intervocalic position, it belongs to the succeeding syllable. However, the duration of Polish tʃ (orthographic ćsz, tʃsz, tʃrz) does exceed that of a normal consonant and, in certain cases, e.g. podzyswać, the sequence is distributed over two syllables, i.e. podzyswać.
BIBLIOGRAPHY

Abbreviations Used

AfLgS - African Language Studies (London)
AfStud - African Studies (Johannesburg)
AmAnthro - American Anthropologist
AnthroLing - Anthropological Linguistics
BSOAS - Bulletin of the School of Oriental and African Studies, University of London
IJAL - International Journal of American Linguistics
JAfL - Journal of African Languages (East Lansing)
JWAL - Journal of West African Languages (Cambridge)
Lg. - Language
NTS - Norsk Tidsskrift for Sprogvidenskap
PL - Pacific Linguistics (Canberra)
SAL - Studies in African Linguistics (Los Angeles)
SLS - Studies in the Linguistic Sciences (Champaign-Urbana)
UCPL - University of California Publications in Linguistics
WPLU - Working Papers in Language Universals (Stanford)
ZfES - Zeitschrift für Eingeborenen Sprachen (Hamburg)
ZfKKS - Zeitschrift für Kolonialsprachen (Hamburg)


Crosby, K.H. 1944. An Introduction to the Study of Mende. Cambridge: W. Heffer & Sons Ltd.


Feinstein, Mark. 1976. On some problems in the representation of vowel length. CUNYforum 1:156-175.


Franklin, K.J. The dialects of Kewa. PL, Series B, No. 11.


Jackson, Kenneth H. 1955. *Contributions to the Study of Manx Phonology.* Edinburgh: Thomas Nelson and Sons Ltd.


Needham, Doris and Marjorie Davis. 1946. Chicateco phonology. IJAL 12:139-146.


Stampe, David. 1968. Yes, Virginia,... Unpublished manuscript.


