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As evinced by the following title pages, this paper comprises the complete and unrevised text of the author's Doctoral dissertation. A series of shorter papers based on sections of this work, extensively revised and expanded, is currently in preparation for publication elsewhere.

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BY

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B. A., University of Nebraska, 1963

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DISSERTATION

Submitted in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Philosophy in Anthropology
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Albuquerque, New Mexico
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ABSTRACT OF DISSERTATION

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A partial phonological component of a transformational-generative grammar of Teton Dakota is motivated and discussed, with primary emphasis on the phonology of the verb. Although the analysis is neither exhaustive nor definitive, it serves to outline the central and most characteristic phonological processes of the language. It is shown that Dakota has relatively shallow phonology, in that the abstract representations of lexical formatives are not too far removed from their surface phonetic counterparts. It is also shown, however, that Dakota phonology is by no means simple, and a number of phonological processes of considerable complexity and theoretical interest are presented and partially formalized. The analysis presented sheds considerable light on the phenomena of velar palatalization, stress patterns, verbal ablaut, and the complex possessive, reflexive, and benefactive constructions of the verbal theme. Although the analysis is primarily concerned with the rules of the phonological component proper, considerable attention is also given to phonological redundancy, and a fairly exhaustive set of morpheme structure conditions is formalized and discussed.

A brief analysis of problems of rule interaction tentatively suggests that a formal account of Dakota phonology would be considerably simplified

by intrinsic ordering principles, and that the establishment of such principles as formal universals would obviate the need for extrinsic ordering conditions in all but a few rules. It is shown that Dakota possesses rules with global and cyclical interactions, the latter being largely predictable by an intrinsic ordering principle. It is further suggested that recent attempts to constrain the power of global rules do not correctly handle such rules in Dakota, and that further work on this problem is required.

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PREFACE

Dakota is a language of the Siouan Family that is presently spoken, in one degree or another, by some thirty thousand persons, most of whom live on reservations in the northern Great Plains region of the United States and Canada. The language has four major dialects: Santee, spoken by groups living in southwestern Manitoba, eastern North and South Dakota, northeastern Nebraska, and western Minnesota; Yankton, spoken by groups in east-central North and South Dakota; Teton, spoken by groups living primarily west of the Missouri River in North and South Dakota; and Assiniboine, spoken by the groups of that name in Montana and southern Alberta. Each of the major dialects is lexically and phonologically distinct from its congeners, although the degree of divergence is not great. Minor dialects occur within each of the four major groupings.

This study examines in detail the phonological component of a transformational-generative grammar of the Dakota language. Although it deals almost exclusively with the Teton dialect, the largest of the four major dialects in terms of number of speakers, the low order of divergence among the major dialects should make much of this work applicable to the other three. It seems unlikely that the major dialects will differ phonologically in more than a few rule statements. Although there are a number of minor Teton dialects, the differences between them appear to be strictly lexical in nature; phonological processes are essentially identical for all.

Teton is the principal dialect of five Dakota reservations: Lower Brule, Cheyenne River, Standing Rock, Rosebud, and Pine Ridge, all of which are located in North and South Dakota. Teton is also spoken by a number of persons at Fort Peck Reservation in Montana and by a few people on reserves in southern Saskatchewan. In recent years many Teton speakers have left their reservations for better employment opportunities in urban areas; hence, a few Teton speakers may generally be found in any of the larger American cities.

This study is based, in large part, on data collected during several periods of field research. In the summer of 1964, with the aid of a Summer Fellowship from the National Science Foundation, I spent three months at Lower Brule Reservation in central South Dakota, studying contemporary shamanistic practices. Although I was not primarily concerned with language at that time, the inevitable consequence of three months' residence in a Dakota-speaking household was a small collection of linguistic data. Brief visits to Lower Brule in 1966 and 1968 also produced small amounts of linguistic material. Armed with this "prior exposure", and with the aid of a research grant from the Phillips Fund of the American Philosophical Society, I returned to Lower Brule in the summer of 1969 and spent two months in the systematic acquisition of linguistic data. An additional six weeks in the spring of 1970 were spent at Rosebud Reservation in southern South

Dakota, where I conducted further linguistic investigations. During the 1970-71 academic year I supervised a course in Dakota grammar at the University of South Dakota; my colleagues in that effort, all from Rosebud Reservation, contributed a great deal of additional linguistic information.

During the full course of this work the collection of lexical and paradigmatic material was emphasized. As the excellent grammar of Teton Dakota published by Boas and Deloria (1941) contains a phonological sketch, considerable time was devoted to checking and re-eliciting data from the pertinent sections of that work. I have also utilized some material from the Lakota-English Dictionary of Rev. Eugene Buechel, published in 1970 by the Red Cloud Indian School, under the editorship of Rev. Paul Manhart.

In preparing this analysis of Teton Dakota phonology I have profited greatly from the diachronic Siouan studies of G. H. Matthews. Although synchronic grammars cannot and should not appeal to diachronic information for their motivations, it nevertheless remains clear that diachronic studies often provide the linguist with valuable insights as to how synchronic problems might best be approached. I am also indebted to Prof. Matthews, and to Robert C. Hollow, for specific suggestions as to possible solutions for Dakota phonological problems. Any errors or shortcomings in this presentation, however, are strictly my own.

I would like to acknowledge my enormous debt to my many informants, and especially to Mr. and Mrs. Noah Grassrope, Mr. Moses

Big Crow, Mr. Noah Kills In Sight, Mr. Lloyd One Star, Mrs. Christine Dunham, and Mr. Joseph Marshall, Jr., for their willing assistance and great patience. I would also like to thank my major teachers, Stanley Newman and Bruce Rigsby, for their continual help and advice, and the American Philosophical Society, for its generous financial support. I also owe a great deal to my wife Lorna, who typed the manuscript, and who cheerfully surrendered more than a few summer vacations to make all of this possible.

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1. Introduction

1.1 Purpose of the Study

The purpose of this work is essentially two-fold: to test the current theory of generative phonology, and to contribute to our knowledge of the structure of Siouan languages. The analysis presented is obviously neither exhaustive nor definitive in scope; in particular, it emphasizes the more abstract areas of phonology, paying little attention to "superficial" phonetic detail. Indeed, the rules which produce the universal richness of detail characteristic of "surface" phonetic representations seem to be fairly straight-forward, and have attracted little theoretical interest.[1] This study also concerns itself only with the regularities of the language, and has little to say about phonological exceptions; *i.e.*, it makes no significant attempt to account for the behavior of those forms that are marked in the lexicon as either subject to "special" phonological processes or not subject to one or more "regular" phonological processes. (For a brief discussion of this issue, *cf.* Rigsby and Silverstein 1969:52-53.) This is not to say that phonological irregularity is entirely ignored, however, as cases of apparent

[1]It might be claimed, however, that such rules are more "complex" than the deeper rules, in that they operate with multi-valued features, rather than strictly binary ones.

irregularity are listed throughout the body of the text. In point of fact, it has often been the case that apparently exceptional forms have pointed the way to "deeper" regularities, so that we cannot afford simply to disregard their existence. Suffice it to say, however, that an adequate theory of those processes which are clearly regular in nature is prerequisite to any theory of exceptions.

Since the body of theory which comprises transformational-generative grammar has been derived almost exclusively from research on European languages, particularly English, it may well prove to be the case that this theory will require a significantly broader data base for increased maturity and predictive power. The present work should thus be viewed as similar in kind to other recent works (e. g., Kuroda 1967; Kisseberth 1969, 1970a, 1970b, 1972) that have tested the validity of generative phonology, and in several cases suggested refinements to its theoretical basis, by applying it to American Indian languages. In particular, it will be shown that the principles of generative phonology are applicable to a Siouan language, and that the resulting analysis is both revealing and insightful, in that it captures strong and significant generalizations about Dakota phonological processes.

There is at present no publication of major proportions that deals primarily with the phonology of a Siouan language, although a number of grammars contain phonological sketches. (Cf. Kennard 1936; Boas and Deloria 1941; Whitman 1947; Wolff 1952; Robinett 1955) Most of these brief descriptions are either prephonemic or cast in the mold of taxonomic phonemics; while some provide valuable insights into Siouan phonology, most do not. It might even be claimed that, with the ready availability of scholarly materials on comparative Siouan, we find ourselves in the rather anomalous situation of knowing more about Siouan diachronic phonology than we know about the phonological structure of any contemporary Siouan language.

Two recent papers have dealt with aspects of Dakota phonology, but both are brief and restricted in scope. Matthews' (1955) "A Phonemic Analysis of a Dakota Dialect" is a taxonomic phonemic study of a somewhat unusual idiolect; it is not concerned with phonological processes, and contains little in the way of abstract phonological generalizations. Hollow's (1970) brief "A Note on Assiniboine Phonology" addresses itself only to the treatment of obstruents and consonant clusters within morpheme boundaries. While most revealing with regard to morpheme structure conditions, it is also little concerned with phonological processes *per se*. Since Dakota is one of the "best known" Siouan languages, it is thus apparent that there is a notable lack of information on Siouan phonology in the linguistic literature. It is hoped that the present study will help to remedy this situation, and that it may serve as a point of departure for further research into the phonological structures of Siouan languages.

It should be noted at the outset that we have, in many cases, made fairly strong claims about Dakota phonological structure, often with what can only be described as meager empirical evidence. Such a stance is logically consistent with the general truism that a strong claim is much easier to refute than is a relatively weaker claim, and we have thus attempted to offer the strongest hypotheses that the data will support. Often these hypotheses will run counter to sound diachronic hypotheses, based on strong comparative evidence; for such cases we can only suggest that the parallels between diachronic changes and synchronic processes, although significant, are by no means perfect. The phenomenon of lexical restructuring, normally triggered by the addition of a phonological rule to a grammar, usually results in a situation where the ultimate synchronic organization of a grammar only indirectly reflects the diachronic changes which have produced it.

It is also the case that the Siouan languages, unlike many of the American Indian languages that have been examined in recent phonological studies (e.g., Yawelmani Yokuts, Tonkawa, and Klamath), are characterized by a relatively low order of allomorphy, particularly in stems. We have thus been obliged to pay rather more attention to distributional and structural evidence than has been customary in such studies, due to the relative lack of the "richer" data that surface "morphophonemic" alternations normally provide. Concomitantly, we are forced to place greater reliance on the principles of economy and formal simplicity as criteria for evaluating the resulting grammar.

1.2 Basic Theoretical Assumptions

Transformational-generative grammar is the name given to a linguistic metatheory which assumes that the sentences of a natural language can be produced by an <u>algorithm</u>; a set of instructions, or rules, at least partially ordered, which is capable of generating all of the well-formed sentences of the language in question, but no ill-formed ones. Although the number of well-formed sentences in a natural language has no upper bound, the algorithm which produces those sentences is assumed to be finite, and must thus be recursive in some fashion. Such an algorithm, or <u>grammar</u>, for a natural language thus purports to be a <u>model</u> of the native speaker's <u>competence</u> in that language.

The metatheory further assumes that a grammar for a natural language contains four sub-parts, or components: a semantic component, a syntactic component, a phonological component, and a lexicon. These components produce, or define, three significant levels of linguistic structure: a level of semantic representation, a level of syntactic representation, and a level of phonetic representation. The semantic component of a grammar generates an unbounded set of semantic representations, each of which underlies a well-formed sentence in the language concerned.[2] The set of semantic representations is projected

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[2]This is not to deny Perlmutter's recent claim that surface structure constraints on syntactic derivations may result in situations where well-formed semantic representations are not syntactically realizable. Such issues are simply outside the scope of the present discussion. (Perlmutter 1971)

onto a set of syntactic representations by the syntactic component, a group of rules known as <u>transformations</u>, among whose primary functions are those of linearizing and lexicalizing the abstract configurations of semantic units which comprise the semantic representation of a sentence. The set of syntactic representations, also known as surface syntactic structures, is in turn projected onto a set of phonetic representations, each element of which underlies the actual sequence of articulatory movements which comprises the pronunciation of some sentence. The lexicon of a language is roughly analogous to linguistic memory; it contains the semantic and phonological information that is essential for the appropriate utilization of the lexical formatives of a language. (For thorough discussions of the philosophical and empirical bases of the entire metatheory, <u>cf</u>. Chomsky 1957, 1965; Chomsky and Halle 1968; Chafe 1970b; and Postal 1972.)

As our concern here is strictly phonological, we pay no further attention to the semantic or syntactic components of the grammar, or to the level of semantic representation. We <u>do</u> have to examine the nature of syntactic representations, phonetic representations, and the rules of the phonological component proper. In each case we must distinguish between those properties or phenomena which are presumed to be universal, and thus properly incorporated into the metatheory, and those which are essentially idiosyncratic to the language under analysis, in this case, Dakota. It is only the latter, idiosyncratic phenomena which must be explicitly accounted for in a formal grammar, and only those which contribute to the over-all complexity, or "cost", of such a grammar.

The syntactic representation of a sentence is assumed to be a string of lexical formatives, subdivided into proper sub-strings by labeled brackets. The formatives within any proper pair of brackets comprise a syntactic constituent of the total string, or sentence, and the labels on the brackets, drawn from a presumably universal set, define the syntactic category to which that constituent belongs. For our purposes here we may assume that a lexical formative is taken from the lexicon in the form of a sequence of abstract phonological segments, or <u>systematic phonemes</u>, each of which consists of a configuration of distinctive phonological features, the latter again drawn from a presumably universal set. Each distinctive feature is marked for one of two values, plus or minus, <u>i.e.</u>, at this level of abstraction the features are strictly binary. Lexical formatives are thus represented in the lexicon and in syntactic representations by matrices of phonological features, in which each column of the matrix represents a phonological segment and each row contains the sequence of binary values for some one phonological feature. By a convention of the metatheory, each lexical formative is automatically preceded and followed by a formative boundary, discussed in more detail below.

The syntactic representation of a sentence, the output of the syntactic component of the grammar, serves as the input to the rules of the phonological component; as such, the phonological rules are presumed to have access to all information present in the syntactic representation, including the brackets and their labels. It has been suggested, however, that the syntactic representation of a sentence may not always be entirely appropriate for the application of phonological rules. We thus follow Chomsky and Halle (1968:9-10) in assuming the existence of a set of rules whose function is to prepare the syntactic representation for phonological interpretation. These <u>readjustment</u> <u>rules</u>, as discussed below, seem to insert and manipulate phonological boundaries in various ways.

Phonetic representations, like the abstract phonological representations of lexical formatives, are assumed by the metatheory to be matrices of distinctive features. The rules of the phonological component of the grammar, which project the syntactic representation of a sentence onto its phonetic representation, must thus be viewed as processes which map matrices into matrices. As such, they may insert columns of features into matrices, delete columns, alter the sequence of columns, or change the values of features within columns; <u>i. e.</u>, they may insert segments, delete segments, re-order segments, or alter segments. Although phonetic representations are assumed to be matrices of distinctive features, it is normally the case that, for heuristic purposes, they are written in alphabetic characters, the latter serving as a simple and efficient "shorthand" for the more complex and space-consuming matrices. This convention is normally applied also to the lexical matrices of syntactic representations, as well as to the statement of many types of phonological rules. Needless to say, this results in a kind of systematic ambiguity, as a particular alphabetic character might represent a segment at either the abstract phonological level or the surface phonetic level. This is generally in keeping with the view that abstract phonological segments are not fully abstract; they do have intrinsic content, intimately related to surface phonetic form by the mediating distinctive features. However, the reader should not lose sight of the fact that use of alphabetic representations, at either level of abstraction, is simply an abbreviatory device. A number of orthographic conventions, designed to assist the reader in distinguishing between underlying and surface representations, are used in the main body of this work; they are presented and discussed in the final section of this introduction.

1.3 On Rule Ordering

It has long been empirically known that the rules of the phonological component proper are at least partially ordered, although the precise nature of the ordering is open to some question. Until recently it has been a working assumption of linguists operating within the framework of transformational-generative grammar that the rules of a grammar are <u>extrinsically</u> ordered; <u>i. e.</u>, that the sequence of application of grammatical rules is language-specific, and must be incorporated into the grammar in the form of explicit statements. In many cases such explicit statements have become exceedingly complex; for example, Chomsky and Halle (1968) have motivated an analysis of English stress placement in which a subset of the phonological rules must be ordered cyclically. Similar analyses have been offered for such phonological processes as vowel epenthesis in Klamath (Kisseberth 1972), and palatalization in Ojibwa (Kaye and Piggott 1973). In each case for which cyclical ordering of phonological rules has been proposed, the cyclical rules have access to syntactic information; the rules are first applied within the innermost brackets of the syntactic representation, those brackets are erased, and the rules are applied again within the brackets which have become the innermost as the result of the previous erasure. This process is continued until all brackets have been erased from the string, at which point the cycle terminates and later phonological rules are applied. As the last application of the cyclical rules automatically removes all syntactic information from the string, those phonological rules which are ordered after the cyclical subset cannot have access to such information. Thus, rules which require syntactic information for appropriate application, but which are not part of the cycle, must be ordered before the cyclical rules.

Arguments such as these led to the assumption of an over-all organization of the phonological component of the grammar into four subcomponents: a set of Pre-cyclical Rules, which have access to syntactic information but are not a part of the rule cycle; a set of Cyclical Rules, which apply in the above-described fashion; a set of Post-cyclical Rules, which are ordered in simple sequence and have access to phonological information only; and a set of _Feature Interpretation Rules_, which convert the binary feature values of abstract phonology into the "scalar" values characteristic of phonetic representations. Indeed, the total complexity of this type of organization was magnified by the occasional incorporation of such devices as _Last-cyclical Rules_; rules ordered with the rules of the cycle, but marked as applying only on the "last pass" of the cycle. (For more thorough discussions of extrinsic rule ordering, _cf._ Chomsky and Halle 1968; Harms 1968; and King 1973.)

In the past three years a number of linguists have been working with the explicit assumption that grammatical rules are _intrinsically_ ordered; _i. e._, that the sequence of application of grammatical rules is determined, at least for the most part, by universal principles, and that statements regarding ordering of rules need not be explicitly incorporated into formal grammars. The major version of this approach has been labeled the _unordered rule hypothesis_, in which rules are seen as being essentially unordered; a rule applies whenever its structural description is met. Whenever a point is reached in a derivation where more than one rule can potentially apply, an order of relative precedence is determined by a small (thus far) set of universal ordering conventions. Needless to say, intrinsic ordering of rules would constitute a very powerful formal constraint on the set of possible grammars for natural languages. It is equally clear, however, that the whole notion is as yet insufficiently tested. Wider confrontation with a broad range of linguistic facts may show that the constraint is too powerful. That some sequences of rule application are more "natural" than others, though, is now well established, and some formal means of capturing these generalizations will have to be incorporated into any successful linguistic metatheory. (For fuller treatment of the notion of intrinsic rule ordering, cf. Koutsoudas, Sanders and Noll 1971; Koutsoudas 1972, 1973; Ringen 1972, 1973; and Iverson 1973.)

A closely interrelated problem is that of global rules; that is, rules which have access to derivational history. The usual phonological rule has access only to information present in the phonological string at the time of its application; global rules, on the other hand, can "look back" or "look ahead" at earlier or later stages in a derivation, and whether or not they apply is dependent, in part, on just this kind of derivational information. As in the case of rule ordering, it has been suggested that whether or not a particular phonological rule interacts in such fashion can be determined on universal grounds; thus, no specific statements regarding global interaction would be required in a formal grammar. (Cf. Kiparsky 1973)

Since the nature of rule interactions is ultimately an empirical question, and since our purpose here is to test current theory against the facts of Dakota phonology, we make no a priori assumptions in regard to the debate over rule ordering, cyclical application, and the viability of global rules. Rather, we examine each of these metatheoretical problems during the course of our analysis, with the idea of utilizing Dakota phonological data to suggest possible solutions.

1.4 On Phonological Boundaries and the Abstractness Question

In the standard theory of generative phonology, as exemplified in The Sound Pattern of English (Chomsky and Halle 1968), a major role is played by the notion of phonological boundary. Such boundaries, although they most commonly have no direct phonetic realizations, strongly affect the operations of phonological processes. Besides serving the basic and essential function of delineating the margins of morphemes, both in the lexicon and in the phonological string, phonological boundaries affect derivations in two other, distinct ways. First, it is normally the case that a phonological rule will not apply when some particular boundary falls within its domain; application of the rule is blocked by the presence of the boundary. Second, it may also happen that a phonological rule requires that a particular boundary be present at some point within its domain for appropriate application; in such a case the rule is said to be triggered, in part, by the presence of the boundary. Empirical investigation in a variety of languages has shown that phonological boundaries, in terms of their "rule blocking" function at least, are hierarchically ranked; if a rule is blocked by a particular boundary, then it is also blocked by any "stronger" boundary in the hierarchy. Whether the "triggering" function of phonological boundaries also exhibits such hierarchical ranking of boundary phenomena is, at present, an open question. (Chomsky and Halle 1968:364-372; Stanley 1971)

The Chomsky-Halle version of boundary theory admits at least three distinct boundary types: the universal formative boundary, symbolized as +; a second universal boundary, usually referred to as the word boundary, symbolized as #; and a third boundary, required at least for an adequate treatment of English phonology, symbolized as =. The formative boundary is the weakest in the hierarchy:

> The most elementary boundary is the formative boundary, which we have symbolized in our informal transcription by the plus sign. The formative boundary ... indicates the point at which a given formative begins and ends. It is, therefore, part of the representation of every formative in the lexicon. In this respect the formative boundary differs from all other boundaries, for the latter are introduced by means of special rules, some universal, others language-specific. (Chomsky and Halle 1968:364)

It was largely in recognition of this "special" status of the formative boundary that the authors adopted certain metatheoretical conventions regarding its function. One of these simply claims that no rule may insert or move this boundary; a second claims that no rule may be blocked by this boundary. Thus Chomsky and Halle explicitly deny the possibility that a natural language can possess rules which apply only within single morphemes. Certain implications of this claim are more thoroughly examined below.

The strongest boundary of the Chomsky-Halle hierarchy is the word boundary, which they claim is inserted into the phonological string by a universal rule:

> The boundary # is automatically inserted at the beginning and end of every string dominated by a major category, i.e., by one of the lexical categories "noun," "verb," "adjective," or by a category such as "sentence," "noun phrase," "verb phrase," which dominates a lexical category. (Chomsky and Halle 1968:366)

The authors are most careful to point out, however, that the term "word boundary" is informal usage; many English words, for example, have internal occurrences of this boundary. They assume that the notion word is delineated by additional conventions, presumably language-specific. In English, the word is defined by a small set of configurations of the # boundary with labeled brackets of the surface syntactic structure.

The third (=) boundary in the Chomsky-Halle hierarchy is motivated on the basis of specific boundary phenomena in English, and is intermediate in strength between the formative and word boundaries. The possibility of other boundary types in other languages is apparently left open by them, but it certainly seems to be the case that they would admit other boundaries only on a language-specific basis. Such boundaries, like the = boundary of their English phonology, would presumably be introduced into the phonological string by special rules. In addition, their position admits of the existence of all boundary types within lexical entries; e. g., many lexical entries in English are assumed to contain internal = boundaries, which device accounts for certain idiosyncrasies in their phonological behavior. (Chomsky and Halle 1968:371)

In a more recent metatheoretical review, Stanley (1971) offered a somewhat more complex version of the boundary hierarchy. He agrees with Chomsky and Halle in assuming a special, universal status for the formative (+) and word (#) boundaries, and essentially accepts their views regarding the origins, or sources, of those boundaries in the phonological string. In particular, the boundary # is again inserted in pairs on the basis of information from the labeled brackets of the surface syntactic structure. Stanley's position, however, admits of a considerable number of other, language-specific boundaries, derived from the # boundary by principles of "boundary weakening":

> At this point I would suggest that an elaborate set of principles apply to weaken various occurrences of the boundary #. These principles would first involve setting up a hierarchy of classes of affixes, where class membership is determined by how closely the affix combines phonologically with adjacent material. ... The principles for weakening # would depend on the class of associated affix, and there would be as many different weakened versions of # (each of which would be regarded as a distinct boundary type) as there are affix classes. Further, I would suggest that each time # between a prefix and what follows (or between a suffix and what precedes) is weakened in this way, the occurrence of # on the other side of the stem that is paired with this (weakened) # be simply eliminated. This convention makes sense since, for example, the addition of a suffix to a stem does not affect how closely this stem combines phonologically with what precedes it (the stem). (Stanley 1971:27)

Stanley adopts the further convention that "zero affixes" simply delete both # boundaries of a pair, rather than weakening one and deleting one. He also assumes, apparently, that if two boundaries appear in sequence, the weaker is deleted. Thus he can make the following claim:

> In such a system, every word would be surrounded by #___#, and a single boundary weaker than # would occur at every word-internal juncture. ... In short, every addition of an affix causes weakening and/or deletion of the pair of boundaries associated with the constituent affixed to. (Stanley 1971:27-28)

The role of the formative boundary is maintained, but formative boundaries now have two possible sources: some come from the lexicon, and some come from weakening of #.

> It seems likely that some of the weakened versions of # will turn out to be identical with the formative boundary + present in the lexicon (and perhaps other weakened versions of # will be identical with other boundaries present in the lexicon), but this is exceedingly difficult to decide. (Stanley 1971:28)

In fact, formative boundaries from lexical entries are apparently to be preserved in only one type of situation; Stanley adopts the general convention that affixes from the same affix class, when appearing together in the same string, may not be separated by any boundary stronger than the + boundary.

The blocking function of phonological boundaries is explicitly recognized by Stanley in the form of a somewhat more useful notion, which he terms "rule ranking":

> I will apply the term "ranking" to those cases where a phonological rule is blocked by a strong boundary but applies whenever weaker boundaries are present. This is the situation that obtains where a phonological rule will affect a segment A in the environment B__C just in case the string B A C doesn't contain boundaries stronger than a certain type. A rule can be said to be ranked by the weakest boundary that blocks its application... (Stanley 1971:3)

Stanley states further:

> Having assigned the boundaries in the way just described, we will assume that each rule is ranked by one of the boundaries. Some such assumption is needed to avoid having to specify in an ad-hoc way for each rule what boundaries it can and can't apply across. (Stanley 1971:29)

The way in which the ranking of a rule is to be formalized is not made explicit. Stanley supports two empirical claims, though, which shed some light on this issue. First, he apparently accepts the claim made by Chomsky and Halle that all rules apply across the formative boundary; <u>i. e.</u>, no rule is ranked by +. Second, he suggests that no rule applies across the word boundary (#) <u>unless</u> that boundary explicitly appears in its structural description; <u>i. e.</u>, all rules are ranked by #. (Stanley 1971:24-25) One might then adopt the convention that a rule with no stated ranking boundary is automatically ranked by #; since most phonological rules seem to be "word level" rules, this convention would apply in the majority of cases, resulting in greater over-all economy of statement. The minority of rules ranked by some boundary between + and # would each require an explicit statement to that effect, possibly in the form of a condition on the rule.

For our purposes here we assume, as a working hypothesis, that Stanley's view of phonological boundaries is essentially correct. We further assume that the "principles" weakening intra-word occurrences of the # boundary are most appropriately viewed as readjustment rules, of the type suggested by Chomsky and Halle; i. e., we explicitly claim that insertion and "weakening" of phonological boundaries constitutes a modification of surface syntactic structure. Our task here, then, is to determine which intra-word "morphological" boundaries in Dakota correspond with the "phonologically significant" boundaries of the Stanley model. Assuming that phonological boundaries reflect surface syntactic structure implies that the location and relative strengths of the various boundaries motivated here should be independently corroborated by syntactic evidence; unfortunately, our knowledge of Dakota syntax is so deficient that such independent corroboration is, at present, precluded. It is to be hoped that future research will alleviate this situation.

A crucial issue in current phonological theory is that of the degree of abstractness to be permitted in phonological (lexical) representations.

Although we shall not delve deeply into the abstractness controversy at this time, it may prove advantageous to point out two ways in which phonological boundaries and the abstractness question are interrelated. First, let us return to the empirical claim that no phonological rule is ranked by the formative (+) boundary. The intent of this claim is to prevent "vacuous" abstract representations at the lexical level, i.e., abstract representations with no "explanatory" function. It is implicitly assumed that any phonological rule ranked by the + boundary would simply act to restructure the lexical entry for each morpheme in which it could apply, thus eliminating its own function. In general, however, this should be true of any rule permitted to apply within morpheme boundaries, leading one to inquire about the rationale for allowing this type of rule application. That some rules do apply in this fashion is clear, but to allow any type of rule to apply within morpheme boundaries is probably too strong. Suffice it to say that this is an important issue within the over-all context of the abstractness controversy, and we comment on it further in subsequent sections of this work. (Cf. Kiparsky 1973:8-12)

A second type of relationship between boundary phenomena and the abstractness of phonological representations has been described by Stanley:

> In closing, I will mention a potentially quite interesting consequence of rule ranking. In any grammar, rules of low rank will apply to relatively short chunks of representations; the lowest ranked rules will apply only within single morphemes and within stem plus affix (or affix plus affix) combinations that are fused

> together considerably phonologically (and, supposedly, rather non-productive semantically). Higher ranked rules will become progressively more general until we reach word level rules, where the bulk of the most widespread and regular rules of the language will lie. When we consider the problem of language acquisition, it seems clear that the first rules to be incorporated actively and productively in the child's grammar are the high ranking rules. The morpheme combinations that are related by the low ranking rules are probably simply learned as indivisible units. As his knowledge of the language grows, the child will learn rules of lower and lower rank, and will thus learn how to analyze some of these formerly indivisible units, but when he reaches a certain point, he might find it easier to simply memorize certain paradigms of morpheme combinations, than to incorporate rules of still lower rank; thus, perhaps the competence grammar of adults is not fully in terms of rules, but partially in terms of memorized paradigms. (Stanley 1971:29-30)

We present a case of such "paradigm memorization" below, a case in which an abstract analysis is possible, but where there is evidence that native speakers have not performed that analysis during the course of their language-learning experience. We dispute Stanley's suggestion that the phenomenon is restricted to semantically non-productive morpheme sequences, however.

1.5 On Redundancy

In another important metatheoretical review, Stanley (1967) has presented a compelling series of arguments in support of a new formal device for the treatment of phonological redundancy, a device to replace the morpheme structure rule of earlier authors. This new device, the <u>morpheme structure condition</u>, serves two basic functions: it formally captures the kind of constraint which defines the notion of "possible lexical matrix" for the language under analysis, and it allows for extensive savings in the lexicon by permitting an incompletely specified lexical entry to "select" the appropriate, fully specified lexical matrix from the universe of all such matrices. Lexical entries thus need only contain non-redundant feature specifications. Stanley argues that, as statements of constraints on lexical matrices, the morpheme structure conditions should not be viewed as "rules", and that the formalism of a grammar should make this distinction clear. The conditions are viewed as unordered, and thus act simultaneously in selecting fully specified matrices from the universal set. Morpheme structure conditions thus serve as a kind of screen, or filter, and the analogies with such current formal devices as "derivational constraints" are readily apparent. Although Stanley's arguments in favor of this proposal are not summarized here, we adopt his suggested formalism without modification.

Stanley claims that there are three distinct types of morpheme structure condition, and offers a definition and formalism for each type. The fundamental type of morpheme structure condition is what Stanley has called an if-then condition, defined as follows:

> An if-then condition C is a pair of matrices I(C) and T(C), the 'if' and the 'then' part of the condition respectively, where I(C) and T(C) are each incompletely specified matrices which have n rows (one for each distinctive feature) and entries '+', '-', or no entry (blank). Further, I(C) and T(C) have the same number of columns and are disjoint. The if-then condition C has the following interpretation: for all matrices M in U [the universal set - RTC] such that I(C) is a sub-matrix of M, C accepts M if T(C) is also a sub-matrix of M, and C rejects M if T(C) is distinct from M; if I(C) is distinct from M, then C accepts M regardless of what T(C) is. ... Intuitively, the if-then condition C says that if a matrix M in U meets condition I(C), then M must also meet condition

> T(C) if it is to be accepted by C; the condition C says nothing about matrices M which don't meet condition I(C) since it accepts all such matrices indiscriminately. (Stanley 1967:426)

The accompanying formalism for the if-then condition contains two lines, the first defining matrix I(C) and the second defining matrix T(C). The relationship between the matrices is expressed by a downward directed arrow linking the two lines; for clarity, each line is labeled with I(C) or T(C), as appropriate. If the matrices contain a single column the condition serves to capture a segmental redundancy; matrices with more than one column capture sequential redundancies.

A second type of morpheme structure condition is the positive condition, defined by Stanley as follows:

> Each positive condition consists simply of an incompletely specified matrix P(C). Its interpretation as a MS condition is straight-forward: all matrices in U of which P(C) is a sub-matrix are accepted, all other matrices in U are rejected. (Stanley 1967: 427)

The formalism consists of a single line defining matrix P(C), with the initial label P(C). Positive conditions serve only to capture sequential redundancies. In discussing the role of positive conditions, Stanley suggests a new constraint on linguistic metatheory, namely that all constraints on syllable structure be stated solely in terms of positive conditions, on the grounds that if-then conditions are too powerful for this task. That is, if-then conditions allow highly unnatural types of syllable structure to be simply described, whereas positive conditions do not.

The third type of morpheme structure condition defined by Stanley is the negative condition:

> Like positive conditions, each negative condition C consists of a single incompletely specified matrix; in this case we will denote the matrix by the symbol N(C). The interpretation of a negative condition C is that all matrices in U of which N(C) is a subset are rejected, all other matrices are accepted. (Stanley 1967:427)

The corresponding formalism consists of a single line defining matrix N(C), preceded by the symbol of logical negation ($\sim$). Again, the line is headed by a label, in this case N(C). Like the if-then condition, negative conditions can capture both segmental and sequential constraints. In his discussion Stanley suggests that, of the three types of morpheme structure condition, the negative condition is the least highly motivated, and in the greatest need of empirical support. (Stanley 1967:433)

1.6 Orthographic Conventions

As noted above, the use of alphabetic symbols for both phonetic representations and underlying phonological representations can lead to ambiguity in a presentation of this type. In order to keep such ambiguities to a minimum, we adopt the following orthographic conventions:

1. All phonetic forms appear in slanted bars, as /abcd/.
2. Prefixes appear with a trailing hyphen, as /ab-/.
3. Suffixes appear with a preceding hyphen, as /-cd/.
4. Single phonetic elements or clusters of such elements are underlined, as ab.
5. Underlying representations of single morphemes are bracketed with the formative boundary, as +ab+.

6. Underlying representations of words are bracketed with the word (#) boundary, often with other boundaries in internal positions, as in #ab+cde=fghj#.

Also in keeping with the goal of clarity is the usual convention, followed here, of naming each phonological rule with some descriptive epithet, normally written in capital letters; e.g., VELAR PALATALIZATION. Derivations are presented in vertical columns, with the hypothetical underlying form at the top and the derived phonetic representation at the bottom. The usual conventions for writing individual phonological rules are followed throughout; for explication of those conventions, cf. Chomsky and Halle 1968.

1.7 Summary

Our purpose here is to examine in detail the phonological component of a transformational-generative grammar of Teton Dakota. We motivate a set of phonological rules which project surface syntactic representations of Dakota sentences onto their corresponding phonetic representations, and which accordingly model the phonological competence of the native speaker. In performing this task we are subjecting the entire metatheory, including the above-discussed assumptions and conventions, to a significant empirical test.

2. Dakota Phonological Structure: Basic Observations

Our intent here is to make a number of preliminary generalizations about Dakota phonological structure from an examination of the phonetic shapes of individual morphemes, primarily stems. Many of these generalizations are attributable to constraints on sequences of phonological segments in lexical formatives, and can thus be stated as morpheme structure conditions. These are all formalized in this chapter. Other generalizations can best be viewed as products of the operation of phonological rules; although we discuss the effects of such rules here, they are not formalized until a later time. We argue that these rules, applying within morpheme boundaries, are rather "late" rules, serving to produce relatively "shallow" phonetic assimilations. We also comment here on some distributional phenomena which have been produced by fairly recent changes in the phonological component of the grammar, with subsequent lexical restructuring.

2.1 Phonetic Representations

The Teton dialect of Dakota utilizes a total of thirty-five phonetic segments and two stresses, a primary and a secondary. Table 1, on the following page, presents these phonetic segments, with their abbreviatory alphabetic representations, in the form of a fully specified

Table 1. Teton Dakota Phonetic Segments

	a	ą	i	į	u	ų	e	o	w	y	l	m	n	p	p'	p̓	b	t	t'	t̓	s	z	č	č'	č̓	š	ž	k	k'	k̓	g	x	ɣ	h	ʔ
sonorant	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
syllabic	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
consonantal	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-
coronal	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
anterior	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-
low	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
high	-	-	+	+	+	+	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+	+	+	+	-	-
back	+	+	-	-	+	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	-	-
round	-	-	-	-	+	+	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
continuant	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	+	+	-	-	-	-	+	+	+	-
nasal	-	+	-	+	-	+	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
lateral	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
delayed rel.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-
tense	+	+	+	+	+	+	+	+	-	-	-	-	-	-	+	+	-	-	+	+	-	-	-	+	+	-	-	-	+	+	-	-	-	-	-
ejective	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-
h. s. p.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	-	+	-	-	-	-	+	-	-	-	-	-	-
voice	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	+	-	-	-	-	+	-	-	-	-	+	-	-	-	+	-	+	-	-

distinctive feature matrix. Note that the version of distinctive feature theory used here is essentially that developed and discussed by Chomsky and Halle in The Sound Pattern of English. Their suggestion that the feature vocalic might be appropriately replaced by a feature syllabic seems well motivated, and that revision has been accepted here. (Chomsky and Halle 1968:293-329, 354-355) Two abbreviations have been used in the left-most column of Table 1: "delayed rel." represents the feature delayed release, while "h. s. p." represents the feature heightened subglottal pressure.

The three major class features of the Chomsky-Halle system here define five major classes of phonetic segments:

Vowels	(+ sonorant, + syllabic, - consonantal)
Semivowels	(+ sonorant, - syllabic, - consonantal)
Resonants	(+ sonorant, - syllabic, + consonantal)
Obstruents	(- sonorant, - syllabic, + consonantal)
Voiceless Glides	(- sonorant, - syllabic, - consonantal)

Each of these five major classes is set off from its congeners in Table 1 by double vertical lines.

Vowels are treated as being universally tense, whereas in fact there is considerable variation in degree of tenseness. In no case is the variation a criterion for distinctness; rather, degree of tenseness is produced by a feature interpretation rule of the type that is not dealt with here. Suffice it to say that this type of variation is totally automatic and completely predictable. For example, stressed vowels are always more tense than their unstressed counterparts; unstressed vowels in word-final position are always less tense than unstressed vowels in other environments.

The non-continuant obstruents fall into four series, for which we use the names medial, sonant, aspirate, and ejective. The medials, p, t, č, and k, are lax, voiceless, and completely unaspirated. Hollow (1970:298) reports that the corresponding series in Assiniboine is voiced. In Teton, however, the onset of these segments seems to be clearly voiceless, although some voicing may appear during the release, presumably in anticipation of a following vowel. In clusters before a second obstruent there is no sign of any voicing at all. The two sonants, b and g, are lax, unaspirated, and voiced throughout. They occur only in consonant clusters before resonants, an environment which is never occupied by medials; we thus argue that b and g are derived from underlying p and k by a phonetic rule of voicing assimilation. Note the lack of symmetry in this series, as d and ǰ do not occur. The aspirates, p', t', č', and k', are tense, voiceless, and aspirated. Buechel's dictionary records two degrees of aspiration; it is quite clear, however, that the strength of aspiration is non-distinctive, being automatically determined by a feature interpretation rule. Heavy aspiration often appears phonetically as velar friction; an aspirated segment in an environment producing heavy aspiration could just as well be recorded phonetically as a cluster with following x. The ejectives, p̓, t̓, č̓, and k̓, are quite tense, voiceless, and produced with an egressive glottalic air-stream.

Our treatment of the continuant obstruents differs somewhat from those of previous investigators. We recognize only two series, voiceless and voiced, whereas most earlier works recognize an "ejective" series as well. We have chosen to represent the latter as phonetic clusters of spirant plus glottal stop, our decision being motivated on both empirical and metatheoretical grounds. Empirically, we note that the non-continuant ejectives exhibit virtually simultaneous release of their oral and glottal closures, the glottal release lagging slightly behind the oral release. They are clearly true ejectives in that, as indicated above, they are produced by means of an egressive glottalic air-stream. The "ejective spirants", however, are clearly post-glottalized, the glottal closure lagging behind the oral release; the air-stream used is egressive pulmonic. As for metatheoretical support, we note that the Chomsky-Halle version of distinctive feature theory claims that the feature ejective is only available to segments in which there is a complete oral closure, i.e., non-continuants. (Chomsky and Halle 1968: 517-518, 523) Chomsky and Halle thus claim that "ejective continuants" are simply impossible. Needless to say, proper treatment of all these segments is intimately bound up with the analysis of consonant clusters, discussed in the following section.

Some distinctive differences between phonetic representations may be quite difficult for the non-speaker to detect. The thorniest problem here is undoubtedly the status of the nasalized vowels. In most phonetic environments the presence or absence of nasalization in vowels is clear and unambiguous; in other environments, however, and particularly after other nasal segments, nasalization of vowels may be very difficult to determine. That this is not an idiosyncratic problem is indicated by the following:

> . . . į when closing a syllable is so slightly nasalized that the speaker himself is often in doubt whether there is any nasalization. (Boas and Deloria 1941:4)

In Assiniboine, however, Hollow (1970:298) indicates that the contrast between oral and nasal vowels is clear after nasal segments; in a following section we offer a possible historical explanation for this interdialectal difference. When in doubt about the presence or absence of phonetic nasalization in our own material we have chosen to follow Deloria, as she was a native speaker of Teton.

Stress in Dakota is marked by a combination of amplitude and pitch, a stressed syllable being somewhat louder and higher in pitch than an unstressed syllable. We here attempt only to predict the location of primary and secondary stresses at the word level; the subsidiary stresses which together comprise the over-all, complex prosodic patterns characteristic of Dakota phrases and sentences are simply outside the scope of the present endeavor. Other suprasegmental phenomena, such as length and tone, are clearly non-distinctive in Dakota, and are not examined here.

2.2 Intramorpheme Consonant Clusters

There are two distinct types of consonant clusters in Dakota: those which occur within morpheme boundaries and those which occur across morpheme boundaries. The latter set contains a number of elements that do not occur in the former set, and *vice versa*. For the moment we confine our attention to the clusters of the former set, since the constraints which are statable as morpheme structure conditions are reflected there.

The list of forms on the following page is exhaustive with regard to exemplifying the occurrence of intramorpheme consonant clusters. In each form the relevant cluster is unambiguously within morpheme boundaries, although not all of the forms consist of single morphemes; an initial hyphen has been used here to indicate stems which are obligatorily accompanied by a prefix. The clusters occurring in the forms of this list have been diagrammatically summarized, by list number, in Table 2, on page 37. (For a virtually identical presentation of intramorphemic consonant clusters in Assiniboine, *cf*. Hollow 1970:296-297.)

Inspection of the list and table reveals a number of constraints on possible consonant sequences, the most obvious of which is the constraint against sequences of more than two consonants. We note also that the aspirate and ejective obstruents do not occur in sequence with another consonant. There are only two apparent exceptions to this latter generalization, both verbal enclitics: /tk'á/ "disjunctive, counterfactual", List 1. Intramorpheme Consonant Clusters

1. /pté/ "bison cow"
2. /pčéčela/ "short"
3. /psíča/ "to jump"
4. /pšį́/ "onion"
5. /tké/ "heavy"
6. /sįkpé/ "muskrat"
7. /kté/ "to kill"
8. /kčá/ "loose"
9. /-ksá/ "to cut"
10. /-kšíža/ "doubled up"
11. /spáya/ "wet"
12. /stáka/ "weary"
13. /sčú/ "to show off"
14. /ská/ "white"
15. /slí/ "to ooze out"
16. /sná/ "to ring"
17. /smáka/ "concave"
18. /-swá/ "to ravel out"
19. /sʔá/ "to hiss, splash"
20. /-špá/ "to break off"
21. /-štą́/ "to finish"
22. /škáta/ "to play"
23. /šlá/ "bare, bald"
24. /šníža/ "withered"
25. /šmá/ "deep (as water)"
26. /šwú/ "to drip"
27. /šʔáka/ "strong"
28. /xpáya/ "to lie down"
29. /xtálehą/ "yesterday"
30. /xčá/ "to blossom"
31. /xlá/ "to rattle"
32. /xná/ "to grunt"
33. /xmų́/ "to hum, buzz"
34. /xwá/ "sleepy"
35. /xʔá/ "to stink"
36. /blé/ "lake"
37. /mní/ "water"
38. /gléza/ "striped"
39. /gnašká/ "frog"
40. /gmų́ka/ "to set a trap"
41. /gwú/ "curdled"

Table 2. Phonetic Intramorpheme Consonant Clusters

FIRST ELEMENT	SECOND ELEMENT: p	t	č	k	s	š	l	n	m	w	ʔ
p	-	1	2	-	3	4	-	-	-	-	-
t	-	-	-	5	-	-	-	-	-	-	-
k	6	7	8	-	9	10	-	-	-	-	-
s	11	12	13	14	-	-	15	16	17	18	19
š	20	21	-	22	-	-	23	24	25	26	27
x	28	29	30	-	-	-	31	32	33	34	35
b	-	-	-	-	-	-	36	-	-	-	-
m	-	-	-	-	-	-	-	37	-	-	-
g	-	-	-	-	-	-	38	39	40	41	-

and /šk'á/ "quotative". The former is clearly derived from independent /tuk'á/ "disjunctive", by contraction; the latter form is probably a similar contraction, although no plausible antecedent is known.

It is also clear from inspection of Table 2 that p is in complementary distribution with b and m, and that k is in complementary distribution with g, when functioning as first elements of consonant clusters. We assume a process of voicing assimilation: p and k become b and g, respectively, when they appear before a non-vocalic, voiced segment. Support for such a rule is provided by the simple fact that phonetic b and g occur only in consonant clusters of just this type; neither segment occurs in any other phonetic environment. (We note here a single exception, the verb stem /bú/ "to make a loud noise". Despite its phonetic similarity to English boo, the total semantic field of this form is such as to preclude its being a recent loan from English; it seems more likely that it is onomatopoeic.) It is shown later that this voicing assimilation rule is also required to account for surface alternations. Thus, we are forced to conclude that all phonetic b and g are produced by this voicing assimilation process from underlying p and k, and that b and g do not occur as systematic phonemes in Dakota.

We are also led to assume a rule of nasal assimilation, whereby p becomes m before n. We might let this process operate directly on the pn sequence, or we might allow voicing assimilation to apply first, deriving bn from pn, and then state the nasal assimilation rule as b becomes m before n. We opt for the latter solution, as a rule mapping b into m before n is independently motivated from surface alternations.

Having derived all bC, mC, and gC clusters from underlying pC and kC, we can now see another significant generalization to be made about intramorpheme consonant clusters: before the voicing assimilation and nasal assimilation processes have applied, the set of potential first elements is limited to medial obstruents. Inspection of Table 2 also reveals that sequences of two spirants do not occur. The set of possible intramorpheme consonant sequences is thus restricted to stop plus stop, stop plus spirant, stop plus sonorant, spirant plus stop, and spirant plus sonorant.

Another constraint on first elements is also quite apparent from Table 2, this being the peculiar status of the non-continuant coronals. The segment *č* never occurs as the initial element of a consonant cluster, and *t* apparently occurs only before *k*. Noting that *t* is in complementary distribution with *p* before *k*, Hollow has suggested an analysis in which a morpheme structure condition prevents all non-continuant coronals from functioning as the initial element of a consonant cluster; phonetic *tk* is then derived from underlying *pk* by a phonological rule. (Hollow 1970:297) Although neat, in that the "extraneous" *tk* and the "missing" *pk* are both accounted for at one stroke, the following considerations make this analysis appear somewhat dubious.

First, the phonological rule needed to map *p* into *t* before *k* would function only in these intramorphemic consonant clusters. Unlike our assumed processes of voicing assimilation and nasal assimilation, discussed above, this rule would have no independent motivation. It is not needed to account for any surface allomorphy. It also would be a more unnatural rule, in that the structural description would be more complex in terms of the number of features needed to appropriately describe the situation. Such a rule would clearly pose an interesting problem for models of language acquisition: in the absence of surface alternation, what would lead a child, in the course of his language learning experience, to postulate the existence of such an unnatural rule?

Second, we shortly motivate an analysis in which the aspirate and ejective stops are derived from underlying consonant sequences. We thus postulate the existence of four other, underlying clusters with non-continuant coronals as first element; one realized as t', one realized as t̓, one realized as č', and one realized as č̓. This analysis cannot be reconciled with the morpheme structure condition proposed by Hollow.

We also note that the analysis proposed by Hollow is difficult to reconcile with the diachronic situation. Matthews has reconstructed the tk sequence in Proto-Siouan, on the basis of cognates with phonetic tk clusters from three of the four constituent branches of the Siouan family. Matthews also reconstructs a wk sequence, with an accompanying statement to the effect that, in consonant clusters, initial w contrasts with initial p only before Proto-Siouan r. The normal Dakota reflex of this wk sequence is k'. (Matthews 1958:1, 27-28)

In light of these arguments, it seems necessary to accept the existence of systematic consonant sequences with non-continuant coronals as first elements. The morpheme structure conditions needed to prevent underlying pk, and the many tC and čC sequences which do not exist, are considerably more complex than in the solution proposed by Hollow. Nevertheless, the full range of facts seems to favor an analysis that is less than optimal at the lexical level; the model developed here sacrifices some elegance at the level of lexical representation for a gain in explanatory power elsewhere. We simply claim that the constraints on occurrence of non-continuant coronal obstruents as initial segments of consonant sequences are in fact complex, and as such require complex explanations.

As indicated above, appropriate treatment of the aspirate and ejective obstruents is intimately bound up with the treatment of consonant clusters. Two opposing analyses of these segments seem feasible: the aspirates and ejectives can be derived from unitary underlying segments, a solution which explicitly claims that they are properly included in the inventory of Dakota systematic phonemes, or they can be derived from underlying consonant sequences by phonological rules. Each of these analyses has its advantages and disadvantages, and each analysis has had its adherents. We now examine each of these positions in some detail, and muster the empirical evidence necessary for making a principled choice between them. We show that the data most strongly supports the alternative in which both aspirate and ejective obstruents are derived from underlying consonant clusters, and that this alternative leads to a more elegant over-all model of Dakota phonology than does any other.

The first of the "modern" Dakota grammars, that of Boas and Deloria, explicitly opts for this latter hypothesis:

> The morphological treatment of verbs suggests that the aspirate and glottalized consonants must be considered as double consonants, because in bisyllabic stems the second syllable which begins with one of these sounds is treated like a syllable beginning with two consonants. Furthermore these consonants rarely appear in consonantic clusters. Since no triconsonantic clusters are admitted, this may be conceived as a corroboration of our assumption. (Boas and Deloria 1941:5)

The first line of reasoning presented in this quotation is later clarified, as follows:

> Verbal stems may be divided in two main groups; those in -a with accent on the first syllable when appearing without prefix; and those with varying vocalic ending, monosyllabic or bisyllabic generally with accent on the second syllable.
>
> The former have the type CVC (consonant, vowel, consonant) or CCVC, rarely VC, all followed by the suffix a. Only single, medial stops (p, t, c, k), or single voiced spirants (z, ż, ġ) appear at the close of stems of this class. When reduplicated the whole stem VC, CVC, or CCVC is repeated with the phonetic changes required in forms losing their terminal vowel, or in consonantic clusters originating through contact of terminal and initial consonants. For short the whole class will be designated as CVC.
>
> The second class has the forms V, CV, or CCV when monosyllabic. In bisyllabic stems the first syllable has the same form, the second syllable of almost all those ending in a has the type CCV, provided we interpret the aspirates p', t', c', k' and the glottalized p’, t’, c’, k’ as double consonants. The whole class will be designated as CV and CVCCV. When reduplicated the monosyllabic stem is repeated. In bisyllabic stems the second syllable is repeated. The terminal a of the stems with terminal vowel is treated differently from the a of the CVC verbs. All this suggests that these bisyllabic stems must be considered as consisting of two parts, each ending in a vowel, while all the CVC stems end in a single consonant. (Boas and Deloria 1941:25-26)

The morpheme structure condition relevant to this situation, which is formalized later, states simply that no morpheme may terminate in anything but a vowel, a vowel followed by a medial stop, or a vowel followed by a voiced spirant. Consonant clusters, aspirates, and ejectives are all prohibited in this position. The point of the argument for Boas and Deloria is that bisyllabic verb stems whose second syllables begin with an aspirate or ejective behave in a fashion parallel to those whose second syllables begin with a consonant cluster, both in the phonological processes which affect terminal a and when they undergo reduplication.

The one aspect of their position which is not completely clear is the nature of the second element of these "double consonants". Ejectives are always written with the raised comma, and the aspirates are always written with the raised inverted comma. Since the raised comma is also used to represent the glottal stop, and since the ejectives are always referred to as glottalized consonants, they surely considered the ejectives to be sequences of obstruent plus glottal stop. The case of the aspirates is not at all obvious, however. The authors do not comment upon the proposed second element of these sequences.

Matthews has also chosen to represent the aspirates and ejectives as consonant clusters, but with obvious differences. In his earlier work the aspirates are written as sequences of stop plus x̲, while the ejectives (including the "ejective spirants") are all represented as geminate obstruents. His reasons for the latter choice are briefly summarized as follows:

> 3.3. The reasons for phonemicizing the glottalized consonants as geminates is because they fill out the table of possible consonant clusters; and they occur in the same positions, and as frequently, as do other clusters. (Matthews 1955:58)

It would appear that he used similar reasoning in representing the aspirates as sequences of stop plus x̲; this choice also fills in "blanks" in the table of consonant clusters. In his later, comparative work, however, Matthews writes the aspirates as sequences of stop plus h̲, and the ejectives as sequences of obstruent plus glottal stop. Although the reasons for this change are not made explicit, it is presumably necessitated by diachronic considerations. (Matthews 1958, 1970)

Matthews' original decision to represent the ejectives as geminates was followed by Levin (1964) in his grammar of Assiniboine. In his recent paper on Assiniboine phonology, which supports an analysis of aspirates and ejectives as unitary segments, Hollow describes the geminate hypothesis as follows:

> By treating glottalized sounds in this way two significant facts about Assiniboine phonology are obscured; it is no longer possible to state the general morpheme structure conditions that spirant consonants do not cluster with each other, nor that /t/ and /č/ do not occur as the first element of clusters. (Hollow 1970:296)

Although, as indicated above, we do not accept the second of these two constraints, the first one is certainly well taken. Permitting geminate spirant sequences while prohibiting all other spirant sequences would result in a morpheme structure condition that was both complex and unnatural.

It is our contention that a grammar which derives the ejectives from underlying sequences of obstruent plus glottal stop is the most adequate, in that it captures more significant generalizations about Dakota phonological structure and is, in toto, more economical. As Hollow has suggested, by rejecting the geminate hypothesis we have no difficulty in formalizing the morpheme structure condition prohibiting spirant sequences. Morpheme structure conditions specifying the possible constituents of consonant clusters, and the possible terminations of a syllable, are also simplified if we do not treat ejectives as unitary consonants. We are essentially in agreement with Boas and Deloria regarding the significance of the canonical form of verb stems; their behavior is certainly more economically explained within the present hypothesis. The fact that all ejectives are of very infrequent occurrence, noted by Matthews, would also lend support to the claim that they are derived from underlying clusters.

Hollow has made the contrary claim that treating ejectives as underlying clusters is less economical than treating them as unitary segments:

> ... such an analysis is uneconomical since it requires that an additional column be added to the distinctive feature matrix for each morpheme containing a glottalized segment. In the analysis presented here it is necessary to add only a single feature, [+ ejection], to each such morpheme. (Hollow 1970:296-297)

Two facts, however, seem adequate to counter this argument. First, as noted previously, the feature ejective is not properly available to continuants, at least not in the Chomsky-Halle framework accepted here. This implies, at the least, that the Dakota "ejective spirants" cannot be systematically represented as unitary segments with the distinguishing feature [+ ejective]; at most, it implies that "ejective continuants" must be universally derived from non-unitary underlying sources. Second, the very infrequent occurrence of the ejectives would in fact add very few columns to the lexicon; it is our feeling that the greater elegance and simplicity of the total grammar more than offsets the small lack of economy in the lexicon that the cluster analysis engenders, especially in light of the fact that, with the cluster analysis, we can write a morpheme structure condition specifying all underlying segments as minus for the feature ejective. We note also that the cluster analysis requires an additional phonological rule, to "merge" the two elements of the cluster. Such a rule appears to be quite natural, however, and we do not consider it to be a very significant addition to the over-all complexity of the grammar.

Hollow also makes the following statement:

> As long as it is understood that his [Levin's - RTC] writing of glottalized stops and spirants is merely a notational device, and it is further understood that the notation implies that no morpheme boundary may intervene between the individual consonants, the difference between the two writing systems is a matter of taste. (Hollow 1970:296)

The assertion that ejectives do not occur across morpheme boundaries, however, may not be completely correct. It is certainly the case that ejectives do <u>not</u> result when identical obstruents meet at morpheme boundaries, which again militates against the ejectives being underlying geminates. Of more interest for our analysis, however, is the behavior of obstruent plus glottal stop sequences with intervening morpheme boundary. The difficulty here is that morphemes with final obstruents are nearly always stems, and the presence of a strong phonological boundary between stems in compounds serves to block many phonological rules, including our suggested "glottalization" rule. The lack of suffixes with initial glottal stop also precludes ejectives across a morpheme boundary.

There is one verbal prefix, however, which appears to have a final obstruent: this is /ųk-/ "first person plural". Although this prefix is in many respects peculiar, presumably because of its unique canonical shape, its behavior with certain verb stems is most interesting:

/ʔį́/	"to wear on the shoulders"	/ʔųk̓į́pi/[1]	"we wore them"
/ʔų́/	"to be, to use"	/ʔųk̓ų́pi/	"we used it"
/ʔó/	"to shoot"	/ʔųk̓ópi/	"we shot it"
/ʔí/	"to go (perfective)"	/ʔųkípi/	"we went"
/ʔú/	"to come (durative)"	/ʔųkúpi/	"we were coming"

We observe first that no Dakota word may begin with a vowel after pause; words with an initial vowel are provided with a weak, epenthetic glottal stop in this environment, much as in English. The interesting point, of course, is the behavior of the k in these forms. Boas and Deloria suggested that an initial nasalized vowel causes glottalization of the prefix-final k; before an oral vowel the k is medial. (Boas and Deloria 1941: 77) Although this hypothesis does in fact account for the overwhelming majority of the cases where /ųk-/ appears before a vowel, it does not seem too plausible. The form that the indicated phonological rule would have to take is most peculiar; given the authors' own decision to treat k as a "double consonant", there seems to be no reasonable explanation for the phenomenon that such a rule purports to capture. It is also quite clear that the overwhelming majority of the vowels which appear after /ųk-/ are prefixes, rather than stem-initial; prefixes of phonetic shape /a-/, /o-/, and /i-/ are extremely productive. If we assume that the underlying forms of these prefixes are the same as their phonetic forms, then we should not be surprised that they never "glottalize" the preceding

[1] The pluralizer /-pi/ plays no role in this discussion.

prefix-final k. The only prefix with an initial nasalized vowel is /ųk-/; since it cannot occur in sequence with itself, we are prevented from testing the Boas-Deloria hypothesis in that way.

It appears that there is sufficient evidence from the stems which are apparently vowel-initial, however, to justify a more logical and insightful hypothesis. Although four of the forms in the list on the preceding page are accounted for under the Boas-Deloria rule, one clearly is not: the first person plural form of /ʔó/ "to shoot" ought to be */ʔų́kópi/, rather than the indicated /ʔųk'ópi/. A counter-example of the opposite type, noted by Boas and Deloria, is provided by the stem /ʔųspé/ "to know how to do something"; its first person plural form is /ʔųkų́spepi/, rather than the predicted */ʔųk'ų́spepi/. If we assume the existence of initial organic glottal stops in some of these stems, but initial epenthetic glottal stops in others, and if we further assume that our proposed "glottalization" rule applies across the boundary in forms like underlying #ųk + STEM#, then both types of exceptions are obviated. Stems with underlying initial vowel would be: +i+ "to go (perfective)", +u+ "to come (durative)", and +ųspe+ "to know how to do something". Stems with underlying initial glottal stop would be: +ʔį+ "to wear on the shoulders", +ʔų+ "to be, use", and +ʔo+ "to shoot". Our claim, then, is that the behavior of the prefix /ųk-/ before stems with a presumed initial glottal stop provides strong supportive evidence for the contention that ejective obstruents are derived from underlying sequences of obstruent plus glottal stop.

It is also our contention that the better grammar of Dakota will derive the aspirate stops from underlying consonant clusters. Our arguments here, although admittedly weaker, essentially parallel those offered in support of our treatment of the ejectives. We again note that deriving aspirates from underlying consonant sequences will simplify the morpheme structure conditions specifying the potential elements of consonant clusters, and the permissible terminations of syllables, since the aspirates are not found in consonant clusters or in morpheme-final position. Unlike the situation with the ejectives, however, we are unable to present any "morphophonemic" evidence in support of this hypothesis; the aspirates are apparently all intramorphemic. Inspection of verb stems with initial h or x and the prefix /ųk-/ is unrevealing, as the k is here subject to a rule which deletes it before any consonant except ʔ.

This latter observation is interesting, however, in that it may assist us in making a principled choice of second element for the clusters which underlie the aspirates. The choice seems limited to h and x; as an assimilatory rule of "aspiration", similar in effect to our proposed rule of "glottalization", will be needed to produce the aspiration of the cluster-initial stop, it would seem that only these two segments would plausibly fit such a rule. Table 1 shows the high order of similarity between phonetic h and ʔ, in terms of distinctive feature specifications; granting the parallel structure of our proposed assimilation rules, if the second element of the clusters underlying the aspirates were in fact h, then it seems that the two rules would have collapsed into a single rule schema. That this is not the case is shown by the behavior of the prefix /ɣk-/ before stem-initial h. If the second element of these underlying clusters were x, however, then the failure of the two rules to collapse would not be noteworthy, given the phonetic dissimilarity of x and ʔ. It is clear that this type of argument is highly dependent on questions of rule interaction; we offer it here as merely suggestive, without further justification.

Another observation of interest, previously mentioned, is the lack of aspirate spirants. If the second element of the clusters which underlie the aspirates were h, the grammar would require a morpheme structure condition prohibiting spirant plus h sequences, but permitting stop plus h sequences. This constraint would prove to be somewhat complex; the existence of spirant plus w sequences rules out the simple solution of a constraint against clusters whose elements are both [+ continuant]. If the second element of these clusters were x, however, the lack of aspirate spirants would be explicable in terms of the constraint against spirant sequences, which must be incorporated into the grammar in any case. Clusters with h as second element would then be ruled out entirely, by a far more general morpheme structure condition than that suggested above. Assuming that the second element is x will complicate the constraints dealing with clusters whose initial segments are t and č; as indicated previously, however, it is our belief that those constraints are complex in any case.

underlying cluster defined by the intersection of column and row. Each blank in the table represents a systematic cluster which does not occur; each of these nonexistent clusters must be prohibited by some morpheme structure condition.

2.3 The Systematic Representation of the Phonetic Affricates

In the two preceding sections of this chapter we have claimed that Dakota phonetic representations contain three palato-alveolar affricates, <u>č</u>, <u>č'</u>, and <u>c̓</u>, and that the aspirate and ejective members of this set are derived from the underlying sequences <u>čx</u> and <u>čʔ</u>, respectively. A number of verb stems, however, exhibit alternation between an initial velar stop and a palato-alveolar affricate:

/káγa/	"to make"	/kóza/	"to wave to"
/yakáγa/	"you made it"	/yakóza/	"you waved to him"
/ničáγa/	"he made you"	/ničóza/	"he waved to you"
/k'uwá/	"to chase"	/k'uté/	"to shoot at"
/yak'úwa/	"you chased him"	/yak'úte/	"you shot at him"
/nič'úwa/	"he chased you"	/nič'úte/	"he shot at you"
/k̓ú/	"to give"	/k̓į́/	"to carry"
/yak̓ú/	"you gave it to him"	/yak̓į́/	"you carried it"
/nič̓ú/	"he gave it to you"	/nič̓į́/	"he carried you"

/kté/	"to kill"	/waksá/	"to cut"
/yakté/	"you killed him"	/wayáksa/	"you cut him"
/nikté/	"he killed you"	/waníksa/	"he cut you"

Bare stems show initial velar stops, as do the stems with prefixes containing <u>a</u>. By prefixing the second person stative marker /ni-/ to these stems we have placed a front vowel before the stem-initial velar stops, triggering a palatalization process; the velar stop assimilates its backness to that of the preceding vowel. The last two examples show, however, that this palatalization is prevented when the velar stop is followed by a second consonant.

Palatalization of velar stops is by no means limited to stems. It is, rather, a quite general process in the language. The following forms, for example, show palatalization of <u>k</u> in a verbal prefix: the verb forms in the left-hand column are constructed with the instrumental prefix /ka-/ "to cause an action by striking, or sudden application of force", while the right-hand column contains derived instrumental nouns.

/kahį́ta/	"to sweep"	/ʔičáhįte/	"a broom"
/kabú/	"to beat a drum"	/ʔičábu/	"a drum stick"
/kašká/	"to tie, bind"	/ʔičáške/	"a sash"
/kat̓á/	"to kill by striking"	/ʔičát̓e/	"a club"
/kaką́/	"to cut notches"	/ʔičáką/	"an adze"
/kak̓óɣa/	"to scrape off"	/ʔičák̓oɣe/	"a scraper"

It thus appears that the most economical choice of second element for the clusters underlying the aspirates is x, as originally suggested by Matthews; lacking the kind of evidence provided by surface allomorphy, economy and formal elegance become essentially our sole criteria of choice. The complications that arise from this analysis are basically resultant from our primary decision to treat aspirates as underlying clusters, rather than from our choice of x as second element. Most notable of these complications is the high frequency of occurrence characteristic of the aspirates, resulting in some loss of economy in the lexicon.

One further generalization about Dakota phonological structure supports our view that both the aspirate and ejective obstruents are phonetic realizations of underlying consonant clusters. Hollow has suggested (personal communication) that Dakota possesses a constraint limiting the number of consonant clusters in a single morpheme to one, the interesting point being that both aspirates and ejectives are treated as though they were clusters. Although this constraint would be very powerful support for our analysis, the number of forms in Teton which are apparently exceptions to the generalization is extremely large. Boas and Deloria (1941: 27) indicate that the majority of these are probably compounds; the difficulty here lies in demonstrating that they are synchronically compounds, rather than old, "fossilized" compounds. It is our feeling that the latter is most probably the case for many of these forms, and we therefore do not incorporate Hollow's proposed constraint into our synchronic description. It is almost certainly true, however, that such a constraint did exist at some relatively recent time in the history of the language; barring any subsequent restructuring of the lexical entries for morphemes containing aspirates or ejectives, an assumption which appears not too unlikely, the suggested constraint still constitutes evidence in favor of the underlying cluster analysis. (We note at this time that a fairly high proportion of the synchronic exceptions contain the segment <u>č'</u>; the relevance of this observation will become apparent in the following section.)

Table 3. Underlying Intramorpheme Consonant Clusters

		SECOND ELEMENT											
		p	t	č	k	s	š	x	l	n	m	w	ʔ
FIRST ELEMENT	p	-	pt	pč	-	ps	pš	p'	bl	mn	-	-	p̓
	t	-	-	-	tk	-	-	t'	-	-	-	-	t̓
	č	-	-	-	-	-	-	č'	-	-	-	-	č̓
	k	kp	kt	kč	-	ks	kš	k'	gl	gn	gm	gw	k̓
	s	sp	st	sč	sk	-	-	-	sl	sn	sm	sw	sʔ
	š	šp	št	-	šk	-	-	-	šl	šn	šm	šw	šʔ
	x	xp	xt	xč	-	-	-	-	xl	xn	xm	xw	xʔ

Table 3 summarizes our arguments to this point regarding the nature and number of underlying intramorphemic consonant clusters. Each entry in the table represents the phonetic realization of the

/kaxápa/	"to drive along"	/ʔičáxape/	"a whip, goad"
/kalú/	"to fan"	/ʔičálu/	"a fan"

The phenomenon of palatalization implies that some č are derived from underlying k, some č' from underlying kx, and some č̓ from underlying kʔ. Many of the affricates in phonetic representations, however, clearly cannot be derived in this way:

/č'ą́/	"tree, wood"	/načá/	"war chief"
/č'ú/	"dew"	/ʔasčú/	"to flirt"
/č'éɣa/	"kettle"	/wikčémna/	"ten"
/č'ok̓į́/	"to roast"	/waxčá/	"flower"

Each of these forms contains an affricate which is not in the appropriate environment for the velar palatalization process; indeed, stem-initial č' is extremely common.

Examination of bisyllabic stems seems to indicate that the rule producing the velar palatalization phenomenon must apply within morpheme boundaries. The number of velar stops in morpheme-internal palatalizing environments is exceptionally small, while the affricates are very common in such environments:

/šíča/	"bad"	/t'éča/	"new"
/zičá/	"squirrel"	/-bléča/	"to shatter"
/p'íča/	"possible"	/hečá/	"vulture"
/žį́ča/	"to snort"	/-sléča/	"to split"

In fact, the ejective *č̓* occurs only in palatalizing environments; the one possible case of intramorphemic *č̓* is in the word /šič̓é/ "a woman's brother-in-law". Similarly, the number of intervocalic occurrences of the affricates within morpheme boundaries, where the preceding vowel is not a front vowel, is also exceptionally small; the form /načá/ "war chief", from the list on the preceding page, is one of these few exceptions.

Despite these distributional facts, however, we argue here that the velar palatalization rule does *not* apply within morpheme boundaries. We claim instead that addition of the velar palatalization rule to some pre-Dakota grammar resulted in a restructuring of the lexical entries for all of those morphemes whose every surface occurrence would have been subject to the rule. It is thus our contention that the velar palatalization rule *did* at one time apply within morpheme boundaries, but that since the rule would have affected every surface representation of morphemes with internal palatalizing environments, the lexical entries for all such morphemes were restructured. Synchronically, then, we find only morphemes with underlying affricates in internal palatalizing environments; the velar palatalization rule does not now apply within morpheme boundaries due to the lack of appropriate input. Indeed, we suggest below that there may be reasons for assuming that the velar palatalization rule *cannot* now apply within morpheme boundaries.

Before examining the rather meager empirical evidence which supports this position, let us return briefly to the question of abstractness in underlying lexical representations. The primary metatheoretical argument against highly abstract lexical representations comes from assumptions about language acquisition; such representations are simply presumed to be difficult to learn. Lexical restructuring is normally accomplished whenever the resulting grammar is simplified; i.e., whenever the number or complexity of rules required to produce appropriate phonetic representations is lessened. However, Kiparsky (1968) has shown that there is a strong tendency for morphemes which are always subject to some phonological rule to be diachronically restructured, even in cases where the grammar needed to accommodate the restructured forms is somewhat more complex. Although Kiparsky's conclusions are based on the study of neutralization rules, for which this tendency toward restructuring should be especially strong, there seems to be no *a priori* reason to assume that the basic effect is limited to rules of that type. What is being claimed here is simply that abstract lexical representations which are not needed to account for any surface allomorphy may be sufficiently difficult to acquire that they are "discarded" through lexical restructuring, even at the cost of a slight increase in the complexity of the resulting grammar. It has been assumed for some time that children create optimal grammars; the present claim simply implies that, in some circumstances, phonological components with "complex" rules and "concrete" lexical representations may be "more optimal" than phonological components with "simple" rules and "abstract" lexical representations.

Consider now the following group of inflected verb themes, noting the effect of the "infixed" agreement marker:

/ʔičázo/	"to owe"	/ʔiwákazo/	"I owe him"
/ʔičáɣo/	"to draw a line"	/ʔiwákaɣo/	"I draw a line"
/ʔičáhi/	"to stir up"	/ʔiwákahi/	"I stir it up"
/ʔičáxli/	"to step in mud"	/ʔiwákaxli/	"I step in mud"
/ʔičáxmų/	"to make buzz"	/ʔiwákaxmų/	"I make it buzz"

The forms in the left-hand column, with underlying representations of #i+ka+STEM#, have clearly undergone the rule of velar palatalization. The forms of the right-hand column, with underlying representations of #i+wa+ka+STEM#, are not subject to this rule, and the underlying k appears in the phonetic representation. Now consider the following:

/ʔičáɣa/	"to grow, spring up"	/ʔimáčaɣa/	"I grew up"
/ʔičú/	"to take"	/ʔiwáču/	"I took it"

In these verb forms no k ever appears in a phonetic representation, even when the environment is such as to prevent application of the velar palatalization rule. We are thus forced to assume that these forms contain underlying affricates. The "infixing" of the agreement markers, however, reveals that both of these themes are, in some way, morphologically complex; the interesting point is that the only logical candidates for the verb stems contained in these themes show underlying k. The theme /ʔičú/ must be derived from the stem /k̓ú/ "to give", with loss of ejection in the initial stop. (This loss of ejection, apparently idiosyncratic to this stem, is also seen in forms more obviously derived from it; e. g., in the possessive form /kičú/ "to give one his own".) The theme /ʔičáɣa/ is derived from the stem /káɣa/ "to do, make". In each of the derived themes we note a shift in the meaning of the stem; we also note that, although the stem /káɣa/ is semantically active, the derived theme /ʔičáɣa/ is stative.

Although the precise diachronic sequence of events here is far from obvious, it does appear that these two verb themes provide strong evidence in support of our claim regarding lexical restructuring. Only such a restructuring can produce forms with synchronic underlying affricates from forms with underlying velar stops. The most obvious diachronic analysis suggests that, as a result of the semantic shifts, these two morphologically complex themes were reanalyzed as unitary morphemes. When the lexical restructuring of morphemes with internal palatalizing environments took place, these "new" morphemes were subjected to it also, even though they potentially could show surface allomorphy; perhaps Kiparsky's notion of paradigm coherence could be invoked to account for this phenomenon. (Cf. Kiparsky 1972) Whatever the correct diachronic explanation, however, the conclusion regarding a lexical restructuring seems inescapable.

Boas and Deloria (1941:14, 36) suggested that the behavior of some verb stems under reduplication supports morpheme-internal application of the velar palatalization process. They cited such forms as:

/šíča/	"bad"	reduplicated:	/šikšíča/
/t'éča/	"new"	reduplicated:	/t'ekt'éča/

Boas and Deloria assumed that palatalization of the first k has been blocked by the presence of the following consonant. A number of other forms confuse the issue here, though:

/sutá/	"hard"	reduplicated:	/suksúta/
/čónala/	"few"	reduplicated:	/čokčónala/
/líla/	"very"	reduplicated:	/liglíla/

It appears that, in fact, a rule which dissimilates coronals is in operation here; whether the first k of a reduplicated form like /šikšíča/ is the product of this dissimilation rule, or comes from an underlying k by blocking of the velar palatalization rule, is not clear. Forms such as the following, where coronals are not subject to dissimilation, argue conclusively in favor of the former explanation:

/p'íča/	"possible"	reduplicated:	/p'ilp'íča/
/ɣį́ča/	"to snivel"	reduplicated:	/ɣįlɣį́ča/
/k'áta/	"hot"	reduplicated:	/k'alk'áta/
/xóta/	"gray"	reduplicated:	/xolxóta/

If the latter of the two potential explanations were the correct one, then the reduplicated form of /p'íča/ should be */p'ikp'íča/, rather than the form indicated. It appears that non-continuant coronals, when final in a syllable, are dissimilated to *k* before coronals, but weakened to *l* before non-coronals.

In fact, these reduplicated forms strongly suggest that the lexical representations of stems like /šíča/ and /p'íča/ contain affricates, rather than velar stops. If they were to contain underlying velar stops, then a form like /p'ilp'íča/ would require the application of three phonological processes during its derivation: a velar palatalization process, a reduplication process, and a coronal weakening process. A form like /šikšíča/ would also require three such processes: velar palatalization, reduplication, and coronal dissimilation. Note that, in both cases, the processes would have to apply in the stated order, thus making the velar palatalization rule a relatively "deeper" rule than an abstract rule like reduplication. Yet it is precisely such "deeper" rules creating new segments which tend most strongly to restructure lexical entries, suggesting that this whole line of reasoning is egregious. If these two stems contain underlying affricates, however, then the resulting derivations for the reduplicated forms are greatly simplified. Only two rules need apply in either derivation, and since the reduplication rule must "feed" both the coronal weakening and coronal dissimilation rules, no extrinsic order need be imposed. Thus it appears that the phonology of reduplication supports our claim that the velar palatalization rule has restructured the lexical entries of those morphemes with internal palatalizing environments.

We also argue here for a synchronic process which palatalizes the segment t when it precedes a front vowel; as in the case of the velar palatalization rule, we claim that this dental palatalization process has also restructured some lexical entries. Unlike velar palatalization, however, dental palatalization is synchronically an optional process; it also accounts for no surface allomorphy other than the doublets produced by its optional application. In those morphemes which do not show such doublets, we claim that application of the rule has produced phonological restructuring. Unlike the velar palatalization rule, dental palatalization applies only to the medial t; the aspirate and ejective dental stops are never affected by it.

Much of our evidence for the existence of this rule in a synchronic Teton grammar stems from dialectal and idiolectal variation. There is very little regularity in this variation, though, so that it is not possible to generalize about it any further at this time; suffice it to say that forms which are always subject to the rule in eastern Teton dialects may not be in western dialects, and *vice versa*. Where one individual may always apply the rule to some morpheme, his neighbor may not. The rule is apparently obligatory for some forms, producing lexical restructuring, optional for some forms, producing surface doublets, and inapplicable for some forms, even though they apparently meet its structural description. Interestingly enough, the rule has apparently restructured many morphemes, through obligatory application, even though they do *not* meet its presumed structural description. In no case is it possible to determine, on purely formal grounds, which morphemes fall into which classes. While it is possible that some deeper generalization is being missed here, the presence of idiolectal variation and competing pronunciations seems to support the view presented. This rule seems to exhibit the earmarks of a recent addition to the grammar: irregular or idiosyncratic application, and numerous competing phonetic representations.

Dental palatalization always applies when the *t* is word-initial, followed by a front vowel. Our data shows a complete lack of *ti* sequences in word-initial position, and the Buechel dictionary lists no forms of this type. We do note the forms /čéka/ "to stagger", /čík̓ala/ "to be small", and /čístila/ "tiny", with no variation in the form of the initial segment. Patricia Shaw (personal communication) has recently recorded the form /tístina/ "tiny" in the Dakota dialect spoken in the vicinity of Brandon, Manitoba. Although this is probably a minor dialect of Santee, the form recorded is most revealing, in that it lends some credence to our claim that these forms originally possessed an underlying initial *t*. These three forms seem to be the only ones, however, which actually provided such input to the dental palatalization rule, indicating that *ti* and *te* sequences in word-initial position are not typically Dakota at all. The fact that two of these three forms are exceptions to the velar palatalization rule is interesting, as it raises the possibility that these forms are recent innovations or loans.

Let us return briefly to our earlier suggestion that the velar palatalization process cannot now apply within morpheme boundaries. In making that suggestion we were led by the notion that, since appropriate input within morpheme boundaries was eliminated by phonological restructuring, the formal structure of the rule itself could have been altered by the inclusion of a "triggering" morpheme boundary within its structural description. Such an alteration could be thought of as a "simplification" in the sense that the rule would more precisely delimit the kind of environment in which it actually could operate. Once such a change in the formal structure of the rule was accomplished, however, it could not then apply within morpheme boundaries, even if later changes created new input in that environment. If such forms as /čéka/ and /čik̔ala/ do constitute recent borrowings or innovations, as their unusual initial segment seems to suggest, then they may also constitute evidence that such a formal restructuring of the velar palatalization rule has indeed taken place. If we do not assume a formal restructuring of this type, then both forms must be marked as exceptions to the velar palatalization process.

Kiparsky (1973:4-9) has shown that there are neutralization rules in Finnish and Sanskrit that apply only in derived environments; i.e., they represent a type of global rule. It is tempting to suppose that the above-described development of the Dakota velar palatalization rule, if correct, might be one way in which such global rules are diachronically produced. Needless to say, this hypothesis would require testing in a number of other languages, especially languages with lengthy historical documentation.

Returning now to our examination of the dental palatalization process, we note an interesting example of exceptional application of the dental palatalization rule in the word /čónala/ "few". The presence of the competing pronunciation /tónala/, plus such closely related forms as /tóna/ "how many?", /tónak'eča/ "some, a few", and /tónakiya/ "how many times?", suggests that the initial *č* is the product of dental palatalization, even though the environment is not appropriate. Numerous other forms with initial *to* sequences never undergo this rule, *e.g.*, /tókša/ "presently", /tóhą/ "when?", /tók'iya/ "where?", and /tók'eške/ "how?".

The situation becomes somewhat more complex when the palatalizing *t* is the second element of a consonant cluster. That the rule does apply in this environment is revealed by the existence of such doublets as:

/pčéčela/	/ptéčela/	"short"
/čísčila/	/čístila/	"tiny"
/sčépąši/	/stépąši/	"woman's female cross-cousin"

In general, distributional patterns support the contention that it is normally the presence of a front vowel after the *t* which triggers the palatalization; *CčX* sequences, where *X* is a front vowel, are more frequent than *CtX* sequences, and conversely, *CtY* sequences, where *Y* is a back vowel, are more frequent than *CčY* sequences.

Some of the exceptions are probably explicable in terms of paradigmatic regularization. A possible example is afforded by the emphatic verbal suffix /-xča/, one of a group of verbal suffixes whose vowels undergo various apophonic alternations. The other allomorphs are /-xče/, /-xči/, and /-xčį/. Although we assume that the underlying form of this suffix was originally +xta+, the fact that three of the four allomorphs contained palatalizing environments could well have "caused" the dental palatalization rule to apply equally to all forms, thus restructuring the lexical representation to +xča+ and regularizing, or maintaining the regularity of, the paradigm. It is certainly the case that the "ablaut" phenomenon never triggers the palatalization rule in such a way as to promote allomorphy; either palatalization occurs throughout the paradigm, as is the case in the preceding example, or else the rule does not apply at all, in which case allomorphs with palatalizing environments become exceptions. Other stems seem to constitute true exceptions; e.g., /pté/ "cow bison" and /kté/ "to kill" never undergo palatalization under any circumstances. We observe, however, that the great majority of these exceptional forms contain an e rather than an i as the potentially triggering front vowel. Since i is the typically palatalizing vowel in all languages where this process is relevant, such an observation is, in a sense, predictable; indeed, if the converse were the case, we should suspect the correctness of our generalization.

In another exceptional example there is an apparent semantic connection between two stems which are distinguished by their susceptibility to dental palatalization. The stems are /stú/ "to be proud, think highly of oneself", and /sčú/ "to show off, attract attention, flirt, be coy".

There seem to be no other cases of this type of semantic link, if indeed this is such, nor is there any apparent semantic correlate to such alternate pronunciations as /čístila/ and /čísčila/, as previously discussed.

Comparative Siouan studies (Wolff 1950, Matthews 1958) have shown that all cases of the phonetic segments <u>č</u> and <u>č̓</u>, whether underlying affricates or underlying velar stops synchronically, have been diachronically produced by addition of the two palatalization rules to some pre-Dakota grammar. This fact accounts for some of the constraints on distribution of the affricates; <u>e.g.</u>, the fact that <u>č</u> may not occur in consonant clusters (except before <u>x</u> and <u>ʔ</u>) is due to the fact that neither of the palatalization rules can produce a <u>č</u> in that environment. Similarly, the restructuring of lexical entries after addition of these rules also resulted in the incorporation of two new morpheme structure conditions into the lexical component, one prohibiting <u>k</u> intervocalically after front vowels and one prohibiting <u>t</u> in initial position before front vowels (but note our above suggestion that such a constraint may have existed <u>before</u> addition of the dental palatalization rule).

The palatal aspirate, <u>č'</u>, is an altogether different matter, however. Although we have shown that some occurrences of this segment are produced from underlying <u>kx</u> by the velar palatalization process, casual inspection of the data reveals that the great majority are not. Comparative Siouan studies, as cited above, have shown that Dakota <u>č'</u> is historically derived from a unitary segment, Proto-Siouan <u>r̊</u>. We would thus suggest that, when the rule mapping *<u>r̊</u> into phonetic <u>č'</u> was added to a pre-Dakota grammar, lexical entries were restructured, through analogy with the other aspirates, to contain underlying čx sequences. Indeed, such a restructuring may have "fostered" the historically later addition of palatalization rules, which would have made the system of phonetic segments more symmetrical. Further restructuring of lexical entries would then have made the underlying phonological segments more symmetrical in organization, thus simplifying the over-all phonological system.

If we return briefly to our arguments supporting the treatment of the other aspirates as underlying consonant clusters, we see no clear indication that č' is in any way exceptional. It does not appear in consonant clusters, nor can it close a syllable. It is never produced across morpheme boundaries, but neither are the other aspirates. The one bit of equivocal behavior is that mentioned on page 51, in our brief discussion of Hollow's proposed constraint against morphemes with more than one consonant cluster, aspirate, or ejective. We noted at that point that a fairly high proportion of the synchronic exceptions contain a č', as exhibited by:

/č'axlí/	"charcoal, gunpowder"
/č'aksí/	"wolf"
/č'amní/	"to sprout"
/č'ąkpé/	"knee"
/č'ap'á/	"to stab"
/č'ąp'a/	"cherries"

/č'aské/ "to reach for by mistake"

Such forms are just what we would predict, knowing that <u>č'</u> is historically derived from a unitary segment, since prior to the addition of the rule producing this <u>č'</u> none of the cited forms would have been exceptional with respect to this constraint. Like other exceptions, however, some of these forms look very much like compounds; many are clearly compounds with the stem /č'ą́/ "wood, tree":

/č'ąglégle/	"scattered trees"
/č'ąglésˇka/	"a hoop"
/č'ąksá/	"a policeman's club"
/č'ąská/	"mulberry tree"

Nearly all of the exceptional forms with <u>č'</u> are nouns. The two verbs listed above are the only ones in our data, and both look like old compounds in that they "infix" agreement markers: /č'amáp'a/ "he stabbed me", /č'amáske/ "I reached for it by mistake". The latter verb can also prefix the agreement markers, though, indicating that some speakers may have "reinterpreted" it as a unitary morpheme. Our conclusion is that the many exceptions with <u>č'</u> are not now significantly distinct in their behavior from other exceptions to Hollow's proposed constraint, even though many may have been produced by lexical restructuring of forms which were not in themselves exceptional.

In summary, we have offered evidence to show that, despite certain complexities in terms of distribution and behavior, there is good reason to permit Dakota lexical representations with palato-alveolar affricates. Metatheoretical and empirically-based arguments both favor extensive lexical restructurings which have produced underlying affricates from velar and dental stops, as a result of the addition of palatalization rules, with visible synchronic effects, to the phonological component of a pre-Dakota grammar. We have shown that the grammar which admits underlying affricates is simpler, both in terms of ease of acquisition of lexical representations and in terms of the number of rules, rule complexities, and extrinsic orderings. Both the number and complexity of required morpheme structure conditions is increased with this analysis, but we believe that this situation reflects real complexities in the language. In short, we believe that the grammar resulting from this analysis of the systematic representation of phonetic affricates is more revealing and insightful than any other at hand.

2.4 The Systematic Representation of Intervocalic Voiced Spirants

Examination of the intramorphemic distribution of the voiced and voiceless spirants promptly reveals that they are in contrast only in initial position before a vowel. Elsewhere they are in complementary distribution: the voiced spirants do not occur in consonant clusters or final position, and the voiceless spirants do not occur between vowels. That these distributional patterns are at least in part produced by the operation of phonological rules is indicated by the existence of surface allomorphy; e. g., reduplication of certain verb stems with intervocalic voiced spirants reveals allomorphs with voiceless spirants.

/púza/	"dry"	reduplicated:	/puspúza/
/kíza/	"to creak, grate"	reduplicated:	/kiskíza/
/yúza/	"to catch, grasp"	reduplicated:	/yúsyuza/
/píža/	"wrinkled, deflated"	reduplicated:	/pišpíža/
/léža/	"to urinate"	reduplicated:	/léšleža/
/t̓áɣa/	"rough"	reduplicated:	/t̓axt̓áɣa/
/yuk̓éɣa/	"to scratch"	reduplicated:	/yuk̓éxk̓eɣa/

In general, it appears that allomorphs with voiceless spirants appear whenever a morphological process causes an otherwise voiced spirant to occupy morpheme-final position.

/púza/	"dry"	/pusyá/	"to dry something"
/káɣa/	"to make"	/kaxyá/	"made like, in the form of"
/máza/	"metal"	/masp'ép'e/	"barbed wire"
/máza/	"metal"	/masʔigmų́ke/	"a steel trap"
/máɣa/	"a field"	/maxkášla/	"to hoe a field"
/máɣa/	"a field"	/maxʔíčamna/	"a hoe"

Our problem here is to determine the appropriate value for the feature voice in the underlying representations of these morphemes.

Matthews has shown that all of the languages of the Mississippi

Valley subfamily of Siouan, at some point in their historical development, added a phonological rule which voiced spirants before unstressed vowels. Originally this rule applied only to the coronal spirants; it was later generalized in Dakota to apply to the velar spirant as well.

> The voicing distinction in MV can be traced back to the position of the accent in pre-MV, i.e., continuants became voiced when followed by an unaccented vowel, and this change also affected the velar reflexes of PSi x in Da. Later changes in the accentuation of the MV languages (there has been a general tendency to move the stress to the penultimate syllable of the stem) brought about the phonemicization of these voiced continuants... (Matthews 1970:98)

The statement regarding "phonemicization of these voiced continuants" suggests that Matthews is arguing in favor of lexical restructuring, wherein forms previously entered in the lexicon with voiceless spirants would later be entered with voiced spirants. Further on in his discussion, however, Matthews explicitly claims that allomorphy of the type exemplified above means that the proposed spirant voicing rule is still operating in Dakota:

> Rule I [the spirant voicing rule - RTC] was generalized in Da so that it applied to all continuants that preceded unaccented vowels. In fact, rule I still occurs as a synchronic rule in the phonology of Da: there are certain verb constructions that are signaled by the loss of an unaccented vowel, and if this vowel is preceded by an obstruent continuant, then when the vowel is lost the continuant is devoiced. (Matthews 1970:99)

In the remainder of this section we show that the synchronic facts are somewhat more complex and refractory than has previously been indicated, and that synchronic application of a spirant voicing rule, as suggested by Matthews, is inadequate.

We first note that, if a synchronic spirant voicing rule were to be triggered by the presence of a following unstressed vowel, single morphemes containing a sequence of vowel - voiceless spirant - stressed vowel should be permissible. In our data, however, such forms do not occur. We find no cases of intervocalic voiceless spirants in single morphemes, irrespective of the position of stress. If we follow Matthews in assuming that "later" rules shift the stress, then we have the problem of accounting for the following:

/máɣa/	"a field"	/maxt'áni/	"an old field"
/maɣá/	"waterfowl"	/maxč'ị́ča/	"duckling"

The presence of allomorphs with voiceless spirants would lead us to assume that the underlying spirants are voiceless in both forms, yet we must postulate some difference in their underlying representations to produce the distinct stress patterns. If we assume that the stress is distinct in the underlying forms, then the proposed spirant voicing rule would not work in both. Suppose we assume instead that the stress is on the first vowel in both underlying forms, and that their distinctness is due to a difference in canonical form. We might then have derivations like:

	#máx#	#máxa#
Spirant voicing	inapplicable	#máɣa#
Stress shift	inapplicable	#maɣá#

Epenthesis	#máxa#	inapplicable
Spirant voicing	#máɣa#	inapplicable
	/máɣa/ "a field"	/maɣá/ "waterfowl"

Such a solution requires that the proposed rule of stress shift must be ordered before epenthesis and after spirant voicing; epenthesis, however, must be allowed to apply before spirant voicing. It is just this type of extrinsic ordering paradox that has been most frequently used to motivate cyclical rule application. We see here no syntactic rationale for the existence of a cycle, however. Similarly, we cannot here argue for unordered rule application, since the proposed stress shift rule must not apply after the proposed epenthesis rule. In short, the whole derivation is completely ad hoc.

A far simpler analysis would assume a spirant voicing rule that simply applied between vowels, irrespective of stress placement. This would allow us to represent all intervocalic spirants as voiceless in the lexical representation of single morphemes. This analysis runs into a problem of another type, however, in that some means would have to be found to prevent application of the rule across morpheme boundaries. Intervocalic voiceless spirants are quite common when immediately preceded by a morpheme boundary, and no alternation ever occurs in such an environment. As noted in section 1.4 above, a fundamental convention of current phonological theory assumes that any phonological rule that can apply within morpheme boundaries can also apply across simple morpheme boundaries; i. e., no phonological rule is ranked by the formative (+) boundary. The suggested spirant voicing rule would violate this convention, and it appears that no appeal to rule interaction of any type could save it.

The best solution available seems to be one which assumes that intervocalic spirants within morpheme boundaries are all voiced in underlying representations, and that the surface allomorphs with voiceless spirants are produced by a phonological rule which devoices spirants before a morpheme boundary. Such an analysis violates no conventions of the metatheory, nor does it make any special appeal to complex rule interactions. Its only apparent disadvantage is that it is directly contrary to what we would predict from the diachronic situation.

Although we cannot utilize historical evidence either to support or refute our synchronic analysis, the historical picture is sufficiently interesting in its own right to warrant a brief digression. Recent comparative work has suggested that the Proto-Siouan consonants were fewer in number than those of the languages comprising the Mississippi Valley subfamily, of which Dakota is a member. This position has been summarized by Matthews as follows:

> Hans Wolff postulated the following PSi consonants: /p, t, k^y, k, q, s, x, h, w, L, L^y, m, n/. For the most part we will be discussing the reflexes of k^y, s, x, w, L, and L^y, for which we use the letters s, š, x, w, r, and ṙ, respectively. The use of these letters is in keeping with our belief that it makes good sense to postulate for PSi a voiceless strident obstruent and a voiced sonorant in each of the dental, palato-alveolar, and velar positions, and that PSi did not have a palatal or palato-alveolar stop. (Matthews 1970:98)

The expression "makes good sense" seems overly modest; in point of fact, Matthews has quite convincingly demonstrated the elegance and explanatory power of such a historical treatment. Unfortunately, the development of these Proto-Siouan continuants <u>within</u> the Mississippi Valley subfamily is not always clear:[1]

> The development of the coronal continuants in the MV subfamilies Da, CW, and Dh is in one sense quite straight-forward, i. e., the obstruents pretty much remained unchanged. On the other hand, the development of the sonorants appears to be somewhat chaotic. This is not to say that the correspondences are unknown, but rather that so many changes appear to have taken place that I have not been able to fathom the over-all regularities in these changes. (Matthews 1970:106)

(<u>Cf.</u> Wolff 1950, 1951; Matthews 1958, 1970 for more complete explication of diachronic models of the Siouan languages, and their dialects.)

Matthews has shown that voiced spirants in Dakota come from two distinct sources in Proto-Siouan. First, addition of the phonological rule voicing continuant obstruents before unstressed vowels produced intervocalic voiced spirants in all of the Mississippi Valley languages. Second, Matthews has shown that the sonorants and strident obstruents were neutralized in Proto-Siouan before stressed high vowels; <u>i. e.</u>, that a synchronic phonological rule of Proto-Siouan mapped underlying sonorants onto strident obstruents in that environment. As Proto-Siouan lacked voiced spirants, this rule must also have devoiced the underlying

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[1]The abbreviations used in this quotation are: MV = Mississippi Valley, Da = Dakota, CW = Chiwere-Winnebago, Dh = Dhegiha. Chiwere comprises the mutually intelligible Iowa, Oto, and Missouri; Dhegiha comprises Ponca-Omaha, Kansa, Osage, and Quapaw.

sonorants, so they would have appeared as surface voiceless spirants. In the Mississippi Valley languages, however, which added the rule voicing spirants before unstressed vowels intervocalically, the Proto-Siouan sonorants appear as surface voiced spirants before stressed high vowels; i.e., the presence of the voiced-voiceless contrast in the spirants presumably allowed generalization of the neutralization rule, so that it no longer devoiced the underlying sonorants in the process of mapping them onto strident obstruents. Later changes, perhaps in stress placement rules, brought about extensive restructuring of lexical entries, producing numerous underlying voiced spirants in Dakota. We claim explicitly that all spirants which appear intervocalically within morpheme boundaries were subject to this restructuring. A concomitant addition to the grammar was a rule devoicing spirants before morpheme boundaries, which still exists in synchronic Dakota grammars; the original rule voicing spirants before unstressed vowels was simultaneously lost.

Most morpheme-initial voiced spirants in Dakota occur before high stressed vowels, where they are presumably derived from earlier sonorants. There is a rather extensive group of exceptions to this generalization, however. If we were to assume that the original spirant voicing rule, before its ultimate loss, was generalized in such fashion that it was no longer sensitive to stress placement, but simply operated on any intervocalic spirant, then a number of the exceptional forms with morpheme-initial voiced spirants might be historically accounted for.

If we examine those exceptions more closely, it appears that a sizeable majority are stems which obligatorily take prefixes. The following are examples with the instrumental prefix /yu-/ "to cause by handling":

/yuzámni/	"to uncover"
/yuzą́/	"to separate, push aside"
/yuzé/	"to dip out, ladle out"
/yužá/	"to mix mush"
/yužáka/	"to pull open one's eye"
/yuɣá/	"to husk something"
/yuɣápa/	"to strip off something"
/yuɣáta/	"to stretch out the arm"

We note also the following:

/yusą́/	"to make whitish"
/yusápa/	"to blacken"
/yušá/	"to make red"
/yušíča/	"to spoil, ruin"

The fact that the stems in the first set of examples occur only with prefixes indicates that they could be historically derived from forms with initial voiceless spirants; since their initial spirants could only occur between vowels, these stems would have been subject to lexical restructuring. Such restructuring could not have affected stems like /sápa/ "black" or /šíča/ "bad", as they normally occur as free forms, without prefix.

Other exceptional stems might be explicable in the same fashion, if we assume that they became "more productive":

/žáta/	"forked"	/kažáta/	"to make forked by striking"

If we assume that this stem was originally one of those which require a prefix, but later came to be used as a free form, then its original spirant could have been voiceless; it would have been subject to the restructuring if it were still a bound form at that historical point.

2.5 Sound Symbolism

It has long been known that Dakota, like other Siouan languages, possesses sets of verb stems whose members are intimately related by sound symbolism; <u>i.e.</u>, by a direct, unmediated correspondence between meaning and sound. The following sets of stems clearly exhibit this effect:

/zí/	"yellow"	/-súza/	"bent"
/ží/	"golden"	/-šúža/	"badly bruised"
/γí/	"brown"	/-xúγa/	"fractured"
/sóta/	"hazy"	/-ptúza/	"bent"
/šóta/	"smoky"	/-ptúža/	"cracked in pieces"
/xóta/	"gray"	/-ptúγa/	"pieces broken off"

Matthews has characterized the effect in this way:

> What we see here exhibited is a rather direct correspondence between sound and meaning, i. e., the occurrence in a stem of a dental, palato-alveolar, or velar obstruent continuant corresponds to an aspect of the meaning of the stem which might be characterized as diminutive, normal, and augmentative, respectively. This sound symbolism is what might be called semi-productive in Da, i. e., many speakers are aware of it and will create new stems on analogy with existing stems and the sound symbolism. (Matthews 1970:102)

Matthews has suggested that this phenomenon should be incorporated into a grammar in the form of a semantic interpretation rule. Such a rule would predict the values of the semantic features <u>diminutive</u> and <u>augmentative</u> for any stem which participated in the symbolism, given the values of the phonological features <u>anterior</u> and <u>back</u> for its included spirants. Whether or not a particular stem participates in the sound symbolism must be indicated by a diacritic feature in its lexical entry.

We offer here the contrary hypothesis that sound symbolism of this type is best incorporated into a grammar in the form of a phonological rule; our argument is based partially on metatheoretical grounds, and partially upon the principle of parsimony. Matthews' interpretation of the phenomenon of sound symbolism presupposes a linguistic metatheory in which the base component is seen as being syntactic in nature; the semantic component is seen as being largely, if not completely, interpretive. In a semantically-based grammar, of the type presupposed here, all aspects of the meaning of a sentence are assumed to be present in its semantic representation, before any lexicalization or transformation has occurred. To derive values for semantic features from the values of phonological features in the lexical representation would thus seem to put the cart before the horse.

Matthews' treatment also seems to imply that there must be three separate lexical entries for each of the stem sets, the entries being distinguished solely by phonological representation. Our treatment, however, would allow a single lexical entry for each set, so that set members are viewed as "semantically conditioned allomorphs" of a single lexical formative. Our phonological rule, formalized here, looks almost exactly like Matthews' semantic interpretation rule, but in reverse:

$$\text{SOUND SYMBOLISM:} \quad \begin{bmatrix} 0 \\ +\ \text{cnt} \\ +\ \text{SS} \\ \alpha\ \text{DIM} \\ \beta\ \text{AUG} \end{bmatrix} \longrightarrow \begin{bmatrix} \alpha\ \text{ant} \\ \beta\ \text{bck} \end{bmatrix}$$

The feature SS is the diacritic feature needed to indicate whether or not a lexical formative participates in the sound symbolism; it must be present in the lexical entry. The values for the semantic features DIM and AUG (Matthews' diminutive and augmentative) will be present in the semantic representation, provided by rules of the base. The lexicon will contain, for each participating stem, the unmarked values for the phonological features anterior and back in each matrix column for spirants; we assume that this will mean that the symbolizing spirants will be represented as systematic s or z. SOUND SYMBOLISM will then apply to the resulting configuration, specifying the values of anterior and back as appropriate to the meaning. (As Matthews has pointed out, Dakota also possesses diminutive and augmentative suffixes; for those stems which do not participate in the symbolism the values of the semantic features DIM and AUG are mapped into the surface representation in this way.)

The precise degree of productivity of the SOUND SYMBOLISM rule is apparently an open question. That it is productive is indicated by the observations regarding the creation of new forms, cited above. On the other hand, many of the sets of forms related by the rule seem to show some semantic divergence; this suggests that SOUND SYMBOLISM may no longer be operating in those sets, and that there are now multiple lexical entries for such forms.

2.6 Nasal Consonants and Nasalized Vowels

It has usually been assumed that nasalized vowels are universally produced by assimilation rules; typically, a vowel becomes nasalized when it precedes a nasal consonant. Frequently the nasal consonant may then be elided, as in French or Portuguese, so that the derivation of the nasalized vowel becomes opaque. In their discussion of the feature nasal, Chomsky and Halle have this to say:

> Nasal vowels are, of course, quite common. In the best known cases, such as in the Romance and Slavic languages, however, the nasality of vowels is contextually determined and would not appear in the representation of items in the lexicon. (Chomsky and Halle 1968:316)

In Dakota, however, we apparently have no choice but that of allowing nasalized vowels to appear in lexical representations. There is no evidence to support the possibility of their being derived from distinct underlying sources; indeed, there are good reasons for denying the existence of such derivations.

First, we know of no situations where a nasalized vowel alternates with a sequence of a vowel and a nasal consonant, as in the Romance languages, nor do we know of any other alternations which might lead us to suspect that the phonetic nasalized vowels are derived through nasal assimilation of underlying oral vowels in all cases (although a _few_ nasal vowels _are_ so derived, as will be discussed shortly). Once again, we are confronted with the question of abstractness: in the absence of productive surface alternations, on what basis can we justify the absolute neutralization of an underlying imaginary representation? (_Cf._ in this respect Crothers 1971.)

Second, we note that there are no significant constraints on the distribution of nasalized vowels; they occur in the same environments as do the oral vowels, and are only slightly less frequent. Robert Hollow (personal communication) has suggested that there may be a constraint against more than one underlying nasal vowel per morpheme, but this constraint would have no apparent relevance to the problem at issue.

Third, if we make the usual assumption that nasal vowels are derived from underlying sequences of oral vowel and nasal consonant, by a rule of nasal assimilation, then we encounter great difficulties in writing the morpheme structure conditions which account for the permissible canonical shapes of stems. One such constraint states that, if a morpheme terminates in a consonant, then that consonant must be an obstruent. Morphemes may also end in nasal vowels, however:

/č'ą́/	"tree, wood"
/wą/	"indefinite article"
/šį́/	"fat meat, bacon"
/hį́/	"hair"
/ʔų́/	"to use"
/sų́/	"to braid"

If the underlying form of /č'ą́/ "tree, wood" were actually +čxan+, then the constraint against non-obstruent final consonants would be violated. We should have to formulate a constraint permitting morpheme-final obstruents and n, but prohibiting the other resonants, l and m; such a constraint appears rather strange.

A second morpheme structure condition limits the initial segments of consonant clusters within morpheme boundaries to voiceless obstruents. In general, however, nasal vowels may occur before consonants:

/č'ąté/	"heart"
/ʔą́pa/	"day"
/t'ą́ka/	"big"
/kų́za/	"to pretend"
/xmų́ɣa/	"to bewitch"

If the underlying forms of these stems contained n, then we would be admitting the morpheme-internal clusters nt, np, nk, nz, and nγ. Again, a constraint identifying voiceless obstruents and n, to the apparent exclusion of l and m, would be peculiar.

Our analysis of underlying consonant clusters has rejected the possibility of geminates within morpheme boundaries, yet nasal vowels may appear before nasal consonants intramorphemically:

/wąná/	"now"
/č'ą́na/	"regularly, normally"
/ʔųmá/	"the other one"

If the underlying form of /wąná/ were +wanna+, then we would have to admit the geminate nn. Similarly, if we were to assume that nasal vowels were derived from underlying sequences of an oral vowel plus m, then the form /ʔųmá/ would force us to admit the geminate mm. A constraint prohibiting all geminates except nasals in underlying representations would again be rather strange.

Another morpheme structure condition dealing with consonant clusters, the one prohibiting morpheme-internal three-consonant sequences, would also have to be restated. Note the following:

/č'ąkpé/	"knee"
/sįkpé/	"muskrat"
/hą́ska/	"long, tall"
/ʔųxčéla/	"cactus"

If the underlying forms of these words contained n, then we should have to admit the morpheme-internal clusters nkp, nsk, nxč, and others of the type nCC. We should have to permit three-consonant sequences beginning with n, while prohibiting all others.

In summary, we are forced to conclude that any phonological process which would derive all phonetically nasalized vowels from distinct underlying representations would be strictly *ad hoc*, would be lacking in non-prejudicial motivation, and would greatly complicate the morpheme structure conditions predicting potential canonical shapes. Like most of the other Siouan languages, Dakota provides good evidence for the existence of underlying nasal vowels.

As noted above, there *is* one phonological rule which nasalizes an underlying oral vowel. Some alternations which reveal this process are:

/yá/	"to go	/ʔųyą́pi/	"we went"
/slolyá/	"to know"	/slolʔų́yąpi/	"we know him"
/wąyą́ka/	"to see"	/wąbláka/	"I see him"
/niyą́/	"to revive one"	/niwáya/	"I revived him"
/naxʔų́yą/	"to notify one"	/naxʔų́waya/	"I notified him"

As we see here, the a of the syllable ya is frequently nasalized when there is a nasal segment in the preceding syllable. A few bisyllabic stems may show the same process, or a similar one, operating on the syllable wa:

/tųwą́/ "to look at"

/nųwą́/ "to swim"

Exceptions to this process are numerous; in particular, no verbal prefixes of appropriate shape (there are several) are ever affected. The process always seems to apply within morpheme boundaries, and in verbal suffixes, suggesting that the process is affected by the presence or absence of certain phonological boundaries. As the formalization of the rule in question is fairly complex, we defer discussion until Chapter 3, where we look further into the relevant morphological alternations.

In his recent article on Assiniboine phonology Hollow has shown that the contrast between oral and nasal vowels is preserved after nasal consonants. In Teton, however, we find that nasal vowels are infrequent after nasal consonants. A comparison of the Assiniboine forms cited by Hollow (1970:296, 298) with their Teton cognates is most interesting:

Assiniboine	Teton	Gloss
/yušná/	/yušlá/	"to pull out, make bare"
/yušną́/	/yušná/	"to drop"
/kikná/	/k'iglá/	"to go home"
/giknął́/	/kigná/	"to pet"

Assiniboine n corresponds to both l and n in Teton; the correspondence is n : l when the following vowel in Assiniboine is oral, and n : n when the following vowel in Assiniboine is nasal. Diachronically, such facts suggest that contemporary Teton forms with Cn sequences earlier contained nasal vowels after Cl; a phonological rule was later added to the grammar which mapped l into n before the nasal vowel. The nasality of the vowel was subsequently lost in most cases, perhaps because it was no longer required to preserve underlying contrasts.[2]

The postulated nasal assimilation rule is still operating in our synchronic grammar, although not necessarily in its original form. In terms of distribution, we note that l never occurs before a nasalized vowel. We also note the existence of a fair number of "morphophonemic" alternations involving l and n; in all such cases, the n appears whenever a morphological process causes an l to precede a nasalized vowel, as indicated in the following examples.

		/ʔį́skokeč'a/	"as large as"
/ká/	"that visible"	/kį́skokeč'a/	"as large as that"
/hé/	"that distant"	/hį́skokeč'a/	"as large as that"
/lé/	"this"	/nį́skokeč'a/	"as large as this"
/yá/	"he went"	/yį́kte/	"he will go"
/lá/	"you went"	/nį́kte/	"you will go"
/blá/	"I went"	/mnį́kte/	"I will go"
/glá/	"he went home"	/gnį́kte/	"he will go home"

[2] In a recent unpublished paper Jonathan Kaye has suggested that this type of loss, although leading to opaque derivations, is actually quite natural in that the underlying forms are recoverable. (Kaye 1973)

Since we later present evidence to motivate phonological rules that will map w into m before a nasal consonant, we might suspect that contemporary Cm sequences were earlier Cw sequences followed by nasal vowels, and that a historical process parallel to that described above mapped w into m, with subsequent loss of nasality in the triggering vowel. Although we have no supporting alternations, our suspicion is supported by the fact that there are no cases of a Cw sequence followed by a nasal vowel in our data; it must be admitted, however, that the rarity of all Cw sequences reduces the value of this generalization. We note also that w, unlike l, may appear before a nasal vowel in such forms as /wą́yąka/ "to see" and /wį́yą/ "woman"; thus we are prevented from formalizing a rule in such fashion as to nasalize both segments when they are followed by a nasal segment.

In point of fact, since the only one of these various hypothetical processes which is productive in Teton is the one mapping l into n before nasal vowels, we are once again obliged to argue in favor of lexical restructuring. We have no evidence for any surface alternations between w and m, except before nasal consonants. We also have no evidence to suggest that the kind of "vowel denasalization" hypothesized above is presently active; indeed, examination of relevant paradigms, such as that for the verb /yá/ "to go" presented on the preceding page, shows that the nasality of vowels is maintained after nasal assimilation of l. Thus we claim that underlying clusters of shape Cn and Cm must be permitted in lexical representations. The corollary to this claim is that lexical entries for some morphemes are different in Teton and Assiniboine: the merger of two earlier systematic phonemes into n in Assiniboine has produced one type of lexical restructuring, while nasal assimilation rules in Teton have produced lexical restructurings of a different type.

One further point is of interest here, and that is that lexical formatives in Dakota apparently never contain instances of a nasal consonant before the mid vowels e and o. That the vowels which are never preceded by nasal consonants are just those vowels which have no nasal homologues can hardly be coincidental, yet an appropriate explanation for this fact is not forthcoming. Compounding this fact with the observations made above, one is tempted to propose a situation in which all nasal consonants are derived from underlying sequences of non-nasal consonants followed by nasal vowels! Needless to say, such a situation could only be regarded as highly unnatural, and we do not intend to pursue the issue any further at this time. It is clear that this whole area of relationships between nasal consonants and nasal vowels is deserving of considerable additional investigation, however.

2.7 Canonical Form and Stress Placement

In this section we make a number of generalizations about the canonical shapes of morphemes, and about the position of primary stress in stems. We treat these phenomena together because there is an intimate relation between them; i. e., we argue that, in most cases, the position of primary stress in a stem is predictable from its underlying canonical form. In particular, we suggest that the vowel of an underlying monosyllabic stem always bears primary stress, and that in underlying bisyllabic (or longer) stems it is the second vowel which always bears primary stress.[3] The surface phonetic picture is often made more complex, however, by phonological processes which either shift primary stress from its underlying location or disturb the canonical form by means of vowel epenthesis.

We suggested on page 47 that Dakota possesses a rule which provides vowel-initial words after pause with an epenthetic initial glottal stop. Thus, at the level of phonetic representation, no word begins with a vowel after pause. We also suggested there, however, that some morphemes possess organic initial glottal stops. In general, it is difficult to show for a stem whether or not an initial glottal stop is organic or epenthetic; on the basis of lexical economy we shall assume that, in the absence of any evidence to the contrary, initial glottal stops are the product of the epenthesis rule, and that the great majority of the forms containing them are therefore vowel-initial in underlying representation.

Monosyllables in Dakota are always representable in terms of one of the following six canonical shapes:

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[3] Although not all of the forms in our data are analyzable, it is highly probable that all themes with more than two syllables in underlying representation are in fact compounds.

V	VC
CV	CVC
CCV	CCVC

We argue that monosyllabic stems may consist of any of these six syllable types; if the syllable is consonant-final, however, an epenthetic terminal vowel is added to the lexical representation, thus producing a phonetically bisyllabic form. In underlying bisyllabic stems it appears that only vowel-final syllables may occur. We thus predict that there are fifteen possible canonical shapes for underlying stems of two syllables or less, six monosyllabic shapes and nine bisyllabic shapes:

V, CV, CCV, VC, CVC, CCVC

VV, VCV, VCCV, CVV, CVCV, CVCCV, CCVV, CCVCV, CCVCCV

As discussed above, there was probably once a constraint against forms of shape CCVCCV; the present morphemes of this shape are most likely old compounds.

Our analysis thus predicts that there are two distinct types of phonetically bisyllabic stems: those with consonant-final, monosyllabic lexical representations, and those with vowel-final, bisyllabic lexical representations. As was noted above in section 2.2, much of the evidence in support of this analysis was originally recognized by Boas and Deloria; we largely follow their lead in arguing that these two stem types are distinguishable on the basis of stress pattern, manner of reduplication, and behavior of the final vowel. For example, if we confine our attention to phonetically bisyllabic stems with stress on the first vowel, we notice some interesting distributional facts:

/púza/	"dry"	/škáta/	"to play"
/sápa/	"black"	/bléza/	"clear"
/šíča/	"bad"	/glépa/	"to vomit"
/šóka/	"thick"	/gléɣa/	"spotted"
/xóta/	"gray"	/xlóka/	"hollow"
/káɣa/	"to make"	/k'áta/	"hot"
/ɣópa/	"to snore"	/k'úža/	"sick"
/žáta/	"forked"	/č'épa/	"fat"
/žį́ča/	"to snort"	/č'ápa/	"beaver"
/sáka/	"stiff"	/p'éta/	"fire"

In the great majority of cases the final vowel of such forms is <u>a</u>. We also observe that, with few exceptions, the second syllable begins with a single obstruent, either a medial stop or a voiced spirant. In contrast, examination of phonetically bisyllabic stems with stress on the second vowel reveals no such generalizations:

/napé/	"hand"	/bloká/	"male animal"
/pahá/	"hill"	/p'eží/	"grass"
/wazí/	"pine tree"	/p'ehą́/	"heron"

/xąté/	"cedar tree"	/c'ąkú/	"road"
/šiná/	"shawl"	/t'até/	"wind"
/hąpí/	"liquid"	/ʔištá/	"eye"
/zuyá/	"to go to war"	/zįtká/	"bird"
/slohą́/	"to crawl"	/sįkpé/	"muskrat"
/k'ąɣí/	"crow"	/mat'ó/	"bear"
/p'uté/	"upper lip"	/gnašká/	"frog"
/č'eží/	"tongue"	/blaská/	"flat"

The character of the final vowel in these forms is unpredictable, <u>a</u> being little more frequent than other vowels. The final syllable may begin with any single consonant, or with a consonant cluster.

If we assume that the phonetically bisyllabic forms with stress on the first vowel are monosyllabic and consonant-final in underlying representation, then the observed distributional phenomena are not difficult to account for: the final <u>a</u> is an epenthetic "theme" vowel, the uniform product of a phonological rule, while the single obstruent of the final syllable is predicted from a morpheme structure condition which permits only obstruents in morpheme-final position. Derivations would presumably look something like the following:

	#puz#		#škat#	
Stress placement	#púz#		#škát#	
Epenthesis	#púza#		#škáta#	
	/púza/	"dry"	/škáta/	"to play"

If the stress placement rule were to simply place primary stress on the <u>last</u> vowel of a stem, then the phonetically bisyllabic forms with final stress are also explicable, with such derivations as:

	#nape#	#txate#
Stress placement	#napé#	#txaté#
Epenthesis	inapplicable	inapplicable
Aspiration	inapplicable	#t'até#
	/napé/ "hand"	/t'até/ "wind"

The two main patterns of verb stem reduplication, as noted by Boas and Deloria, provide additional support for this analysis of underlying canonical shapes. Some phonetically bisyllabic stems seem to duplicate all but a final <u>a</u>:

/púza/	"dry"	reduplicated:	/puspúza/
/sápa/	"black"	reduplicated:	/sapsápa/
/šíča/	"bad"	reduplicated:	/šikšíča/
/gléɤa/	"spotted"	reduplicated:	/gleglé ɤa/
/xlóka/	"hollow"	reduplicated:	/xloxlóka/

(The last two forms of this list are explicable if we assume the existence of a rule which deletes the first of three consonants in sequence.) On the other hand, a much smaller number of phonetically bisyllabic stems reduplicate only their second syllable:

/slohą́/	"to crawl"	reduplicated:	/slohą́hą/
/blaská/	"flat"	reduplicated:	/blaskáska/
/patą́/	"to save"	reduplicated:	/patą́tą/
/ʔųspé/	"to know how"	reduplicated:	/ʔųspéspe/
/ʔilé/	"to burn"	reduplicated:	/ʔiléle/

Both of these patterns are explicable if we assume that reduplication copies the last syllable of the underlying representation of the stem. Derivations might look like the following:

	#sap#	#slohą#
Stress placement	#sáp#	#slohą́#
Reduplication	#sapsáp#	#slohą́hą#
Epenthesis	#sapsápa#	inapplicable

Thus we arrive at the phonetic representations /sapsápa/ and /slohą́hą/, respectively. The specific form of these phonological processes, and details of their interaction, are examined formally in the following chapter. The presentation above obviously ignores such questions as the stress pattern of reduplicated stems; these are also discussed later.

One phenomenon which this analysis of canonical shapes does not account for is the variance between lexical representations of noun and verb stems. Assuming the correctness of the line of reasoning given above, it appears that a very great majority of verb stems are monosyllabic in underlying representation. Noun stems, however, are both monosyllabic and bisyllabic in underlying representation, with none of the asymmetrical "preference" for one canonical type exhibited by verb stems. Since a number of those exceptional verbs which are bisyllabic in lexical representation are almost certainly "fossilized" compounds or polymorphemic constructions, it appears that this canonical asymmetry is the product of an old morpheme structure condition limiting verb stems to underlying monosyllables. As this old constraint is now violated by a number of "reinterpreted" forms, we assume that it is no longer operating as a synchronic process.

Assuming an old constraint against underlying bisyllabic verbs might also simplify treatment of reduplication. If the bisyllabic forms listed on the previous page were in fact old compounds, or stem plus affix constructions, in which the last syllable was the main verb stem, then reduplication would have been a rule that simply copied all of the stem, whatever its canonical shape.

We turn now to a slightly more detailed examination of stress patterns in Dakota. We have suggested above that the position of primary stress in a stem, assuming that there are no stems longer than two syllables, is determined by its canonical shape, stress being placed on the last underlying syllable. Other questions are raised by the stress patterns of inflected stems, however, which complicate the issue of formulating an appropriate stress placement rule. As an example, note the "movement" of primary stress in the following:

/-ksá/	"to cut, break off"
/waksá/	"he cut it"
/wakíksa/	"he cut his own"
/wakíčiksa/	"he cut it for him"
/wayéčiksa/	"you cut it for him"
/wamíyečiksa/	"you cut it for me"
/wawíč'ayečiksa/	"you cut it for them"
/wawáwič'ayečiksa/	"you cut (something) for them"

From an examination of numerous such paradigms, and various other inflected forms, it becomes obvious that Dakota possesses a constraint which prevents primary stress from falling "later" than the second syllable of a word. (The only exceptions are found in a very few trisyllabic interjections, such as /hųhųhé/ "alas!", where final stress occurs with prolongation of the final vowel.)

There are two basic ways in which we could account for this fact, each of which makes a distinct claim about the nature of stress. One way would assume that primary stress is essentially a property of lexical items: a stress placement rule would assign primary stress to the last underlying vowel of each stem in a word, and a later rule would shift that stress leftward, perhaps cyclically, so that it would never fall after the second syllable. A second way would assume that primary stress is essentially a property of words: a stress placement rule would simply assign stress to the second syllable of any string bracketed by word (#)

boundaries. Although the principle of parsimony would presumably militate for the latter analysis, we argue here that there are good empirical reasons for adopting the former analysis.

One such reason derives from the observation that suffixes play no role whatsoever in the location of primary stress. If a stress placement rule put stress on the second underlying vowel of a word, then a stem of canonical shape CCV, for instance, when followed by a typical CV suffix, should produce a word in which the suffix vowel bears primary stress; in fact, suffixes never exhibit stress under any circumstances. This fact is predicted if we assume that stress is placed on stem vowels, and then, if necessary, moved leftward to the second syllable.

A second reason derives from the treatment of exceptions. For example, the verb stem /hą́ska/ "long, tall" is an exceptional form in terms of stress no matter which of our proposed alternatives is chosen: both predict the stress pattern */hąská/. Treating stress as a property of stems, however, seems to facilitate the handling of exceptions: if we assume that the stressed vowel of such exceptions is marked [+ accent] in the lexicon, along with a rule feature [- stress placement], then the proposed rule moving stress leftward when prefixes are present would correctly apply to such forms as /wic'áyuhąska/ "he made them taller". If we assume, however, that primary stress is assigned to the second syllable of words, then how are we to mark /hą́ska/ as an exception? If we choose to mark it as exceptional in the lexicon, as above, then it appears that the grammar must be complicated in some fashion to allow the stress patterns of the forms with prefixes; i.e., the rule feature blocking the stress placement rule, needed to prevent */hą́ską́/, also prevents its application in forms where its output would be correct. If we add a rule to the grammar which moves stress, then the parsimony argument for the analysis treating stress as a word-level phenomenon is negated. To allow the word-level stress rule to apply to inflected forms, but not to the uninflected stem, would presumably require some complication in the theoretical machinery of rule features and their interpretation. On the other hand, if we do not use the lexicon to mark stems like /hą́ska/ as exceptional, then we must again complicate our theory in some undetermined fashion. That a stem-level stress rule, with a later stress movement rule, treats such exceptions in a fairly simple fashion thus argues in favor of that type of analysis.

Finally, we claim that the stress patterns of compounds are more simply explained if we assume that their underlying forms receive two primary stresses, one on each stem. A compound stress rule then weakens one of these primary stresses to secondary; e.g., /t'àpkápsičapi/ "they were playing ball", where we assume that the stress pattern at some earlier point in the derivation is like #txáp=ka+psíč+pi#, with the compound (=) boundary separating the stems +txap+ "ball" and +psič+ "to jump". Primary stress is moved leftward from the i of +psič+ to the second syllable of the word by the stress movement rule, and the primary stress of +txap+ is weakened to secondary by the compound stress rule. In comparison, a word-level stress rule would correctly place primary stress on the second vowel of the compound, but some additional rule would be required to account for the secondary stress of the first syllable.

In summary, we assume that primary stress in Dakota is a property of lexical items, and that the position of primary stress within any lexical item is determined by its underlying canonical form. The various rules needed to support this analysis are formalized in later portions of this work, where stress phenomena are examined in greater detail. Needless to say, the arguments presented at this point reveal various interactions between stress rules; these interactions, as well as others between stress rules and segmental rules, are also examined below.

2.8 Morpheme Structure Conditions: Sequential Redundancy

In the preceding sections of this chapter we have suggested a number of constraints on the structure of underlying phonological representations, constraints which we shall now formalize as morpheme structure conditions. Most of the suggested constraints are sequential in nature; in addition, we must formalize the various segmental redundancies which exist in Dakota lexical representations. Although the morpheme structure conditions are unordered, we have chosen to discuss them in two groups; those treating canonical forms, syllable shapes, and sequential constraints are formalized here, while those treating segmental redundancies are formalized in section 2.9. For ease of exposition and subsequent discussion, each MSC is numbered in order of appearance; again, this should not be interpreted as indicative of any extrinsic ordering. Although the formal statements are essentially self-explanatory, each MSC is accompanied by a brief prose statement of its effect.

We have accepted Stanley's suggested constraint on phonological metatheory, and assume that the canonical shapes of morphemes must be definable in terms of positive morpheme structure conditions. Our first MSC is thus a positive condition which defines possible canonical shapes:

$$\text{MSC 1.} \qquad \text{P(C)} \qquad +((\text{O})\ \ \text{C})\ \ \text{V} \begin{Bmatrix} + \\ \text{O}+ \\ ((\text{O})\ \ \text{C})\ \ \text{V}+ \end{Bmatrix}$$

$$\text{where } \underline{\text{O}} = \begin{bmatrix} -\text{ son} \\ -\text{ syl} \\ +\text{ con} \end{bmatrix} \qquad \underline{\text{C}} = \begin{bmatrix} -\text{ syl} \end{bmatrix} \qquad \underline{\text{V}} = \begin{bmatrix} +\text{ syl} \end{bmatrix}$$

This condition incorporates a number of the constraints which have been previously identified. It rules out the possibility of an intramorpheme three-consonant sequence; it ensures that the first element of an intramorpheme two-consonant sequence will be an obstruent; it prohibits bisyllabic morphemes with final consonants; it ensures that a final consonant of a monosyllabic morpheme will be an obstruent; and it prohibits morphemes with more than two syllables. In short, all constraints on the canonical shapes of lexical formatives should be captured by this one condition.

Our only significant deviation from the formalism suggested by Stanley occurs in the following if-then condition:

$$\text{MSC2.}\qquad \begin{array}{ll} \mathrm{I(C)} & \begin{bmatrix} -\ \text{son} \\ -\ \text{syl} \\ +\ \text{con} \end{bmatrix} \Big/ \begin{bmatrix} -\ \text{syl} \end{bmatrix} \\ & \quad\ \downarrow \\ \mathrm{T(C)} & \begin{bmatrix} -\ \text{voi} \end{bmatrix} \end{array}$$

The intent of this condition is to ensure that obstruents in consonant sequences are voiceless; in writing the condition we have used a "neighborhood convention" (Bach 1968) to collapse two "mirror image" statements into one. Thus the formalism of MSC2 is intended to schematize both of the rules which follow:

$$\text{A.}\quad \begin{array}{lll} \mathrm{I(C)} & \begin{bmatrix} -\ \text{son} \\ -\ \text{syl} \\ +\ \text{con} \end{bmatrix} & \begin{bmatrix} -\ \text{syl} \end{bmatrix} \\ & \qquad\downarrow & \\ \mathrm{T(C)} & \begin{bmatrix} -\ \text{voi} \end{bmatrix} & \begin{bmatrix} \quad \end{bmatrix} \end{array} \qquad \text{B.}\quad \begin{array}{lll} \mathrm{I(C)} & \begin{bmatrix} -\ \text{syl} \end{bmatrix} & \begin{bmatrix} -\ \text{son} \\ -\ \text{syl} \\ +\ \text{con} \end{bmatrix} \\ & \qquad\downarrow & \\ \mathrm{T(C)} & \begin{bmatrix} \quad \end{bmatrix} & \begin{bmatrix} -\ \text{voi} \end{bmatrix} \end{array}$$

The formalism of MSC2 explicitly claims that an obstruent "in the neighborhood of" a non-syllabic segment is always voiceless, irrespective of whether the non-syllabic precedes or follows it.

MSC 3.

$$\begin{array}{lcc} \text{I(C)} & \begin{bmatrix} -\text{syl} \end{bmatrix} & \begin{bmatrix} -\text{son} \\ -\text{syl} \\ +\text{con} \\ +\text{cnt} \end{bmatrix} \\ & \big\downarrow & \\ \text{T(C)} & \begin{bmatrix} -\text{cnt} \end{bmatrix} & \begin{bmatrix} \quad \end{bmatrix} \end{array}$$

This condition rejects all matrices which contain spirant sequences.

MSC 4.

$$\begin{array}{lcc} \text{I(C)} & \begin{bmatrix} -\text{syl} \\ +\text{cnt} \end{bmatrix} & + \\ & \big\downarrow & \\ \text{T(C)} & \begin{bmatrix} +\text{voi} \end{bmatrix} & \end{array}$$

This condition rejects all matrices with final voiceless spirants.

The following condition accepts only those matrices in which vowels are not followed by glottal stop and consonants are not followed by <u>h</u>.

MSC 5.

$$\begin{array}{lcc} \text{I(C)} & \begin{bmatrix} \alpha\,\text{syl} \end{bmatrix} & \begin{bmatrix} -\text{son} \\ -\text{syl} \\ -\text{con} \end{bmatrix} \\ & \big\downarrow & \\ \text{T(C)} & \begin{bmatrix} \quad \end{bmatrix} & \begin{bmatrix} \alpha\,\text{cnt} \end{bmatrix} \end{array}$$

The effect of the next condition is to ensure that any semivowel after a consonant is <u>w</u>; <u>Cy</u> sequences are prohibited.

MSC 6.

$$\begin{array}{lcc} \text{I(C)} & \begin{bmatrix} -\text{ syl} \end{bmatrix} & \begin{bmatrix} +\text{ son} \\ -\text{ syl} \\ -\text{ con} \end{bmatrix} \\ & \big\downarrow & \\ \text{T(C)} & \begin{bmatrix} \quad \end{bmatrix} & \begin{bmatrix} +\text{ bck} \end{bmatrix} \end{array}$$

MSC 7.

$$\begin{array}{lcc} \text{I(C)} & \begin{bmatrix} -\text{ syl} \\ -\text{ cnt} \end{bmatrix} & \begin{bmatrix} +\text{ son} \\ -\text{ syl} \\ -\text{ cor} \end{bmatrix} \\ & \big\downarrow & \\ \text{T(C)} & \begin{bmatrix} +\text{ bck} \end{bmatrix} & \begin{bmatrix} \quad \end{bmatrix} \end{array}$$

The effect of MSC7 is to ensure that *k* is the only stop which will appear before either *m* or *w*.

The next condition, MSC8, captures most of the constraints against *t* and *č* as initial elements of consonant clusters:

MSC 8.

$$\begin{array}{lcc} \text{I(C)} & \begin{bmatrix} -\text{ syl} \\ +\text{ cor} \\ -\text{ cnt} \end{bmatrix} & \begin{bmatrix} -\text{ syl} \\ +\text{ con} \end{bmatrix} \\ & \big\downarrow & \\ \text{T(C)} & \begin{bmatrix} \quad \end{bmatrix} & \begin{bmatrix} +\text{ bck} \end{bmatrix} \end{array}$$

This condition allows *t* and *č* to occur only before *ʔ*, and before the back consonants *k* and *x*. The prohibited *čk* sequence is now ruled out by a more general morpheme structure condition, MSC9, which also rejects *pk*, *kk*, and *xk*.

$$\text{MSC9.} \quad \begin{array}{lcc} \text{I(C)} & \begin{bmatrix} -\text{ syl} \\ \langle -\text{ cnt} \rangle \end{bmatrix} & \begin{bmatrix} -\text{ syl} \\ +\text{ con} \\ +\text{ bck} \\ -\text{ cnt} \end{bmatrix} \\ & \big\downarrow & \\ \text{T(C)} & \begin{bmatrix} +\text{ cor} \\ \langle +\text{ ant} \rangle \end{bmatrix} & \begin{bmatrix} \quad \end{bmatrix} \end{array}$$

This condition includes a co-occurrence constraint, as indicated by the presence of the angled brackets. The condition accepts only those matrices with coronal obstruents before *k*; in addition, if the obstruent is non-continuant it must also be anterior.

The next condition rejects matrices with *pp* sequences; non-back consonants after *p* must be coronal.

$$\text{MSC10.} \quad \begin{array}{lcc} \text{I(C)} & \begin{bmatrix} -\text{ syl} \\ -\text{ cor} \\ +\text{ ant} \end{bmatrix} & \begin{bmatrix} -\text{ syl} \\ +\text{ con} \\ -\text{ bck} \end{bmatrix} \\ & \big\downarrow & \\ \text{T(C)} & \begin{bmatrix} \quad \end{bmatrix} & \begin{bmatrix} +\text{ cor} \end{bmatrix} \end{array}$$

The following condition, MSC11, prohibits the sequence *šč*:

$$\text{MSC11.} \quad \begin{array}{lcc} \text{I(C)} & \begin{bmatrix} -\text{ syl} \\ +\text{ cor} \\ -\text{ ant} \\ +\text{ cnt} \end{bmatrix} & \begin{bmatrix} -\text{ syl} \\ +\text{ con} \\ +\text{ cor} \\ -\text{ cnt} \end{bmatrix} \\ & \big\downarrow & \\ \text{T(C)} & \begin{bmatrix} \quad \end{bmatrix} & \begin{bmatrix} +\text{ ant} \end{bmatrix} \end{array}$$

Our first eleven morpheme structure conditions thus determine the canonical shapes of potential morphemes in terms of syllable structure and consonant sequences; only the underlying consonant sequences of Table 3 will be accepted by these conditions.

We turn now to those sequential constraints involving sequences of consonants and vowels. As noted above, lexical formatives in Dakota never contain instances of a nasal consonant before the mid vowels *e* and *o*. The following condition captures this constraint:

$$\begin{array}{lll} \text{MSC12.} & \text{I(C)} & \begin{bmatrix} -\text{ syl} \end{bmatrix} \quad \begin{bmatrix} +\text{ syl} \\ -\text{ hgh} \\ -\text{ low} \end{bmatrix} \\ & & \qquad\quad\ \downarrow \\ & \text{T(C)} & \begin{bmatrix} -\text{ nas} \end{bmatrix} \quad \begin{bmatrix} \quad \end{bmatrix} \end{array}$$

We also observed in section 2.6 that the addition of a nasalization rule which mapped *l* into *n* before nasal vowels has restructured lexical entries; we now find no evidence for underlying sequences of *l* followed by a nasal vowel within morpheme boundaries. The following morpheme structure condition states this constraint:

$$\begin{array}{lll} \text{MSC13.} & \text{I(C)} & \begin{bmatrix} +\text{ son} \\ -\text{ syl} \\ +\text{ con} \end{bmatrix} \quad \begin{bmatrix} +\text{ syl} \\ +\text{ nas} \end{bmatrix} \\ & & \qquad\quad\ \downarrow \\ & \text{T(C)} & \begin{bmatrix} +\text{ nas} \end{bmatrix} \quad \begin{bmatrix} \quad \end{bmatrix} \end{array}$$

We note also that there is a constraint on possible semivowel plus vowel sequences: initial or intervocalic semivowels may not be followed by non-low vowels which match them in backness.

$$
\text{MSC14.}\qquad
\begin{array}{llll}
\text{I(C)} & \left\{\begin{array}{c} + \\ \left[+\ \text{syl}\right] \end{array}\right\} & \left[\begin{array}{l} +\ \text{son} \\ -\ \text{syl} \\ -\ \text{con} \end{array}\right] & \left[\begin{array}{l} +\ \text{syl} \\ -\ \text{low} \\ \alpha\ \text{bck} \end{array}\right] \\
 & & \downarrow & \\
\text{T(C)} & \left[\quad\right] & \left[-\alpha\ \text{bck}\right] & \left[\quad\right]
\end{array}
$$

This condition rejects matrices with such sequences as yi and wu, but permits Cwu sequences. Although the sequences ye and wo are common in phonetic representations, they apparently result from the operation of phonological processes on distinct underlying strings. (An important exception is the instrumental prefix /wo-/ "to cause by blowing, punching, shooting, or applying force from a distance".)

Finally, as we observed above in section 2.3, palatalization rules in Dakota have also restructured lexical entries in two ways: with few exceptions, there are no intervocalic velar stops after front vowels, and there are no cases of t before high front vowels in morpheme-initial or intervocalic positions. (We allow te sequences, to permit such forms as /č'ą̨té/ "heart" and /sį̨té/ "tail".) The following two morpheme structure conditions state these constraints:

$$
\text{MSC15.}\qquad
\begin{array}{llll}
\text{I(C)} & \left[\begin{array}{l} +\ \text{syl} \\ -\ \text{bck} \end{array}\right] & \left[\begin{array}{l} -\ \text{son} \\ -\ \text{syl} \\ +\ \text{con} \\ -\ \text{ant} \\ -\ \text{cnt} \end{array}\right] & \left[+\ \text{syl}\right] \\
 & & \downarrow & \\
\text{T(C)} & \left[\quad\right] & \left[+\ \text{cor}\right] & \left[\quad\right]
\end{array}
$$

MSC16. I(C) $\left\{\begin{matrix} + \\ \begin{bmatrix} +\ \text{syl} \end{bmatrix} \end{matrix}\right\} \begin{bmatrix} -\ \text{son} \\ -\ \text{syl} \\ +\ \text{con} \\ +\ \text{cor} \\ -\ \text{cnt} \end{bmatrix} \begin{bmatrix} +\ \text{syl} \\ +\ \text{hgh} \\ -\ \text{bck} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} \quad \end{bmatrix} \begin{bmatrix} -\ \text{ant} \end{bmatrix} \begin{bmatrix} \quad \end{bmatrix}$

The few exceptions to MSC15 can be more fully specified in the lexicon; note that "over-specification" of lexical entries can automatically block the operation of morpheme structure conditions, as the latter may not change feature values. (Stanley 1967) Thus we do not require devices like rule features for this purpose. If the k of /čiḱala/ "small" is entered in the lexicon as $\begin{bmatrix} -\ \text{coronal} \end{bmatrix}$, then MSC15 simply cannot apply to it.

2.9 Morpheme Structure Conditions: Segmental Redundancy

Table 4, on the following page, comprises a distinctive feature matrix for Dakota systematic phonemes; the numerous blanks in this table represent those feature values which are redundant. The if-then morpheme structure conditions which constitute the remainder of this section state the segmental redundancies of Dakota lexical representations; by selecting fully specified matrices from the universe of all possible matrices, they allow us to enter formatives in the lexicon in a highly "abbreviated", non-redundant fashion.

The first of these conditions selects only those matrices whose

Table 4. Dakota Systematic Phonemes

	a	ą	i	į	u	ų	e	o	w	y	l	m	n	p	t	s	z	č	š	ž	k	x	ɣ	h	ʔ
sonorant									+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-
syllabic	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
consonantal									-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-
coronal											+	-	+	-	+	+	+	+	+	+					
anterior														+	+	+	+	-	-	-					
low	+	+					-	-																	
high			+	+	+	+	-	-																	
back			-	-	+	+	-	+	+	-											+	+	+		
round																									
continuant															-	+	+	-	+	+	-	+	+	+	-
nasal	-	+	-	+	-	+					-	+	+												
lateral																									
delayed rel.																									
tense																									
ejective																									
h. s. p.																									
voice																-	+		-	+		-	+		

segments are valued minus for the features <u>ejective</u> and <u>heightened sub-glottal pressure</u>; Dakota lexical formatives contain no ejectives or aspirates. These segment-types are all produced by the operation of the phonological rules.

MSC17. I(C) $\begin{bmatrix} + \text{seg} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} - \text{ejc} \\ - \text{hsp} \end{bmatrix}$

The following condition states several redundancies for vowels; <u>viz.</u>, that vowels are always sonorant, non-continuant, and tense.

MSC18. I(C) $\begin{bmatrix} + \text{syl} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} + \text{son} \\ - \text{con} \\ + \text{tns} \end{bmatrix}$

The next condition selects only those matrices whose non-syllabic segments are also non-low and non-tense.

MSC19. I(C) $\begin{bmatrix} - \text{syl} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} - \text{low} \\ - \text{tns} \end{bmatrix}$

The following redundancy condition selects only those matrices whose sonorant segments are also voiced.

MSC20.

$$\begin{array}{ll} \text{I(C)} & \begin{bmatrix} +\ \text{son} \end{bmatrix} \\ & \quad\downarrow \\ \text{T(C)} & \begin{bmatrix} +\ \text{voi} \end{bmatrix} \end{array}$$

Redundancies in non-sonorant segments are captured by the following condition; only sonorant segments may be round, nasal, or lateral.

MSC21.

$$\begin{array}{ll} \text{I(C)} & \begin{bmatrix} -\ \text{son} \end{bmatrix} \\ & \quad\downarrow \\ \text{T(C)} & \begin{bmatrix} -\ \text{rnd} \\ -\ \text{nas} \\ -\ \text{lat} \end{bmatrix} \end{array}$$

The two following conditions state redundancies concerning consonantal segments; such segments are never round, but only such segments may be coronal, anterior, lateral, or with delayed release.

MSC22.

$$\begin{array}{ll} \text{I(C)} & \begin{bmatrix} +\ \text{con} \end{bmatrix} \\ & \quad\downarrow \\ \text{T(C)} & \begin{bmatrix} -\ \text{rnd} \end{bmatrix} \end{array}$$

MSC23.

$$\begin{array}{ll} \text{I(C)} & \begin{bmatrix} -\ \text{con} \end{bmatrix} \\ & \quad\downarrow \\ \text{T(C)} & \begin{bmatrix} -\ \text{cor} \\ -\ \text{ant} \\ -\ \text{lat} \\ -\ \text{dlr} \end{bmatrix} \end{array}$$

Next we have a series of conditions which capture redundant relationships between the features *coronal*, *anterior*, *back*, *high*, and *low*. Segments that are anterior, coronal, or both, may not be back; segments that are back may be neither coronal nor anterior. Similarly, if a segment is low, it may not be high, and *vice versa*. In addition, low segments are always back and non-round. Segments that are either anterior or back may not have a delayed release.

MSC24.

$$\begin{array}{ll} \text{I(C)} & \begin{bmatrix} +\ \text{cor} \end{bmatrix} \\ & \quad\downarrow \\ \text{T(C)} & \begin{bmatrix} -\ \text{bck} \end{bmatrix} \end{array}$$

MSC25.

$$\begin{array}{ll} \text{I(C)} & \begin{bmatrix} +\ \text{ant} \end{bmatrix} \\ & \quad\downarrow \\ \text{T(C)} & \begin{bmatrix} -\ \text{bck} \\ -\ \text{dlr} \end{bmatrix} \end{array}$$

MSC26.

$$\begin{array}{ll} \text{I(C)} & \begin{bmatrix} +\ \text{bck} \end{bmatrix} \\ & \quad\downarrow \\ \text{T(C)} & \begin{bmatrix} -\ \text{cor} \\ -\ \text{ant} \\ -\ \text{dlr} \end{bmatrix} \end{array}$$

MSC27.

$$\begin{array}{ll} \text{I(C)} & \begin{bmatrix} +\ \text{hgh} \end{bmatrix} \\ & \quad\downarrow \\ \text{T(C)} & \begin{bmatrix} -\ \text{low} \end{bmatrix} \end{array}$$

MSC28. I(C) $\begin{bmatrix} + \text{ low} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} - \text{ hgh} \\ + \text{ bck} \\ - \text{ rnd} \end{bmatrix}$

We also note that lexical matrices are accepted only if their consonantal segments have opposite values for the features anterior and high:

MSC29. I(C) $\begin{bmatrix} + \text{ con} \\ \alpha \text{ ant} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} -\alpha \text{ hgh} \end{bmatrix}$

The following condition accepts only those matrices in which sonorant, non-low segments have identical values for the features back and round; in other words, the roundness of voiced glides and vowels is predictable from their backness.

MSC30. I(C) $\begin{bmatrix} + \text{ son} \\ - \text{ low} \\ \alpha \text{ bck} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} \alpha \text{ rnd} \end{bmatrix}$

We also note that vowels and voiced glides must be continuant:

MSC31. I(C) $\begin{bmatrix} + \text{son} \\ - \text{con} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} + \text{cnt} \end{bmatrix}$

The following condition accepts just those matrices whose anterior, non-coronal segments are non-continuant; this prohibits bilabial spirants.

MSC32. I(C) $\begin{bmatrix} - \text{cor} \\ + \text{ant} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} - \text{cnt} \end{bmatrix}$

The remaining morpheme structure conditions state constraints that are slightly more specialized, in that the classes of segments affected by them are smaller. The first of these prohibits nasal vowels that are neither high nor low:

MSC33. I(C) $\begin{bmatrix} + \text{syl} \\ - \text{low} \\ - \text{hgh} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} - \text{nas} \end{bmatrix}$

The remaining redundancies in the voiced glide class are stated in the following condition, which ensures that voiced glides are high and non-nasal:

MSC34. I(C) $\begin{bmatrix} +\ \text{son} \\ -\ \text{syl} \\ -\ \text{con} \end{bmatrix}$

$\downarrow$

T(C) $\begin{bmatrix} +\ \text{hgh} \\ -\ \text{nas} \end{bmatrix}$

The following condition states the remaining redundancies in the resonant class; it selects only those matrices whose resonant segments are anterior and non-continuant, and whose values for the features nasal and lateral are opposite.

MSC35. I(C) $\begin{bmatrix} +\ \text{son} \\ -\ \text{syl} \\ +\ \text{con} \\ \alpha\ \text{nas} \end{bmatrix}$

$\downarrow$

T(C) $\begin{bmatrix} +\ \text{ant} \\ -\ \text{cnt} \\ -\alpha\ \text{lat} \end{bmatrix}$

The next condition prohibits voiced stops in lexical formatives; it selects only those matrices whose non-continuant obstruents are voiceless.

MSC36. I(C) $\begin{bmatrix} -\ \text{son} \\ -\ \text{syl} \\ +\ \text{con} \\ -\ \text{cnt} \end{bmatrix}$

$\downarrow$

T(C) $\begin{bmatrix} -\ \text{voi} \end{bmatrix}$

The following condition states that the values for the features continuant and delayed release must be opposite for all coronal, non-anterior segments.

MSC37. I(C) $\begin{bmatrix} + \text{ cor} \\ - \text{ ant} \\ \alpha \text{ cnt} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} -\alpha \text{ dlr} \end{bmatrix}$

Our final morpheme structure condition captures the remaining redundancies in the voiceless glide class:

MSC38. I(C) $\begin{bmatrix} - \text{ son} \\ - \text{ syl} \\ - \text{ con} \end{bmatrix}$

$$\downarrow$$

T(C) $\begin{bmatrix} - \text{ hgh} \\ - \text{ bck} \\ - \text{ voi} \end{bmatrix}$

In summary, redundancies in Teton Dakota lexical formatives are statable as thirty-eight morpheme structure conditions; one positive condition and thirty-seven if-then conditions. No constraint on the structure of lexical formatives seems to require a negative condition; we agree with Stanley that the <u>need</u> for negative conditions should be better demonstrated in a variety of languages before this device is added to linguistic metatheory.

3. Phonological Processes: The Verb

Formal explication of the phonological component of a Teton Dakota grammar commences here with an examination and analysis of the various phonological processes which operate within the verb complex. As is the case with all languages of the synthetic type, Dakota exhibits relatively intricate verbal morphology, due in large part to the effects of numerous concord and pronominal transformations. These syntactic rules all have the general effect of increasing the semantic content of verb nodes at the expense of their associated noun nodes; much of this increased semantic content is literalized as surface verb affixes, typically prefixes. Wallace Chafe has neatly summarized the operation of such transformational rules in his recent sketch of Onondaga, a typologically similar Iroquoian language:

> It is especially characteristic of post-semantic processes in Onondaga that they add units to the verb while very often subtracting them from elsewhere in the sentence. The structure of the verb is gradually augmented, while that of associated nouns is eroded. By the time surface structure is reached it is often the case that the only word left in a sentence is the verb. Such complete erosion of nouns does not always take place, however, and frequently enough is left of a noun that it becomes symbolized as a separate word. (Chafe 1970a:49)

Since phonological rules operate most commonly in regions of greater morphological complexity, the Dakota verb serves as our richest source of data for the formulation and testing of hypotheses regarding the structure, operation, and interaction of such rules.

The Dakota verb complex can be built around stems of two distinct types. Stative stems are those which define states or conditions; the nominal "subject" of a stative verb is a semantic patient, often represented in the verb by means of a pronominal agreement marker in stative case. Active stems, on the other hand, normally define activities; the nominal "subject" of an active verb is typically a semantic agent, often represented in the verb by means of a pronominal agreement marker in active case. Although the majority of verb stems are stative, a rich and highly productive network of derivational processes serves to vary the semantic specification of such stems, e.g., transitive verb themes are quite commonly derived from intransitive stative stems.

A significant point here is that these two stem types may behave differently with regard to regular phonological processes. An adequate theory of Dakota phonology must thus formally recognize, in some fashion, a distinction which is fundamentally semantic in nature. Although the phenomenon of sound symbolism, discussed above in section 2.5, seems to require a phonological rule with at least some limited access to relatively shallow semantic information, it is surely different in kind from the behavior at issue here. The sound symbolism rule maps meaning into sound directly, without syntactic mediation; stems participating in the symbolism are all equally susceptible to the operation of the rule. In the present instance, however, the different behavior of the two stem types results from differences in rule application; for example, initial velar stops in active stems are susceptible to the velar palatalization rule, whereas initial velar stops in stative stems are not, even when derivational processes have operated to secondarily "activize" the theme in which such a stem appears.

Similar problems continually appear in the course of our phonological analyses; there seem to be many situations in which meaning determines whether or not some phonological rule applies to a particular string. As an example, consider the following two forms:

/wánakixma/	"to deny, conceal"
/waánakixma/	"to hide one's things"

The different phonetic representations of these forms are the result of differential rule application; the first form has been subjected to a regular process which deletes the first of two vowels in a sequence, while the second form has not. Our analysis claims that the underlying morphological structure of these forms is identical, however, and that it is the meaning difference which has, in some way, determined the applicability of the vowel deletion rule. Boas and Deloria (1941) repeatedly suggested that, in such cases of differential applicability of regular phonological processes, it was the form that <u>did</u> undergo the rule which possessed a "special meaning".

Rather than offer a grammar in which phonological rules would have access to deep semantic structure, a move which would constitute an extremely serious weakening of linguistic metatheory, we argue here that such differences in rule applicability always reflect differences present in the phonological string. In particular, we claim that it is the phonological boundaries in a string which are responsible for such differences in behavior. If the representation which underlies the two forms on the previous page is something like #wa+a+na+ki+xma#, then our claim suggests that their different susceptibility to the vowel deletion process is due to the presence of different boundaries, with different strengths, between the morphemes +wa+ and +a+. The suggestion of Boas and Deloria, which is substantiated in our work, indicates that it is the first form, with "special meaning", which has the weaker boundary. Since the readjustment rules which determine the strength of intra-word phonological boundaries operate on information present in the surface syntactic structure, our claim directly implies that there are differences in the labeled bracketings of the example forms which reflect distinct derivational histories. We are thus arguing that the example forms are identical in terms of their constituent morphemes, but distinct in terms of their internal constituent structure; unfortunately, current knowledge of Dakota syntax is insufficient either to support or refute this argument.

3.1 A Profile of Verbal Morphology

All Dakota verbs contain at least one stem. Many such stems are free, and may be used without affixes; others are bound, and may only be used with a prefix of some type. Bound stems are typically stative, the required prefix normally being a derivational marker. Free stems are more commonly used with affixes than without, so that the verb is typically a complex form.

Prefixes and suffixes are functionally distinct: prefixes are the surface representations of inflectional and derivational categories, while most suffixes represent modal, performative, or other "higher predicate" functions, such as negation, quotation, declaration, interrogation, etc. Prefixes and suffixes also differ with respect to phonological processes: prefixes are relatively more "tightly bound" than are suffixes, both to the stem and to each other, and exhibit many more kinds of phonological alternation. There are various verbal enclitics, the distinction between suffixes and enclitics being somewhat arbitrary. There are no verbal proclitics, however, so that the notion "verbal prefix" constitutes, in some sense, a distinctive conceptual entity. No prefix ever occurs in other than a pre-stem environment.

In the style of presentation utilized by Stanley (1971), the Dakota verb complex can be schematically represented as follows:

#1-2-3-4-5-6-7-8-9-10-11-12-STEM-13-14-15-16-17-18-19#

Each of these nineteen numbered affix classes is defined in terms of permissible sequences, constraints on co-occurrence, and semantic relationships; the morphemes comprising a given affix class potentially occupy the same relative position within the verb complex, are semantically related in some fashion, and typically do not co-occur in the same construction. The twelve prefix classes are relatively well defined in that, with one exception, all of the verbal prefixes can be securely placed in one or another. The set of suffix classes is more tentative, however. In general, the verbal suffixes are simply less well known, especially in terms of semantic relationships, than are the prefixes, due in large part to their more infrequent occurrence.

In accordance with our discussion of phonological boundaries, presented above in section 1.4, we assume that each of the nineteen positions <u>between</u> the possible constituents of the verb complex could potentially be occupied by a phonological boundary of distinct hierarchical strength. It is highly unlikely, however, that nineteen distinct types of boundary are actually present; we thus face the problem of precisely delineating the number, positions, and relative strengths of the boundaries which are actually <u>required</u> for adequate phonological predictions. Of special value for our analysis of boundary phenomena are the six cases of homonymy between prefix classes; <u>e.g.</u>, prefixes of phonetic shape /wa-/ occur in Classes 1, 6, and 8. The fact that their phonological behavior is distinct in various environments indicates that either their underlying representations are distinct or they are accompanied by distinct phonological boundaries. We show below that there is no clear evidence which would serve to motivate systematic distinctness between any of the homonymous forms, and that the latter alternative is thus necessitated.

We now present brief summaries of each of the nineteen affix classes, in terms of both function and constituency; each of the affixes in a class is listed in its most frequent phonetic shape. Restrictions on class co-occurrence are noted when appropriate.

Class 1. This class contains a single prefix, of problematical syntactic and semantic function, whose usual phonetic representation is /wa- /. It is very frequent in nominals derived from verbs, and may thus serve a nominalizing function. In strictly verbal forms, as noted in the examples of page 120, it is the surface product of a transformation which deletes non-specific objects; e.g., /yuštą́/ "he finished it", as opposed to the form /wayúštą/ "he finished (something)".

Class 2. In this class are two nominalizing prefixes, which very often co-occur with the prefix of Class 1. The prefix /o- / usually marks derived abstract nouns; e.g., the verb /tųwą́/ "to look at" and the derived nominal /ʔotų́we/ "eyesight". The prefix /i- / usually marks derived instrumental nouns; e.g., the verb /kabú/ "to beat a drum" and the derived nominal /ʔičábu/ "a drumstick". The similarity of these prefixes to those of Class 4 indicates that the former are probably historically related to the latter.

Class 3. This class contains only the prefix /ųk- /, the marker of the first person plural. This is the only verbal prefix without a firmly fixed position, as it can also occur in the position of Class 8. Its position within the verb complex is not free, however, as it is always limited to one unique location within any particular context; suffice it to say that the transformations which determine its position within the verb complex are outside the scope of this study. We have previously noted the fact that this prefix is also unique in possessing a final consonant; all other prefixes are vowel-final.

Class 4. In this class are the three prefixes which Boas and Deloria called "locatives". As they indicated, the precise semantic and syntactic functions of these forms are often difficult to capture:

> While according to Riggs' Santee data the use of the locatives seems to be quite free, the Teton evidence shows that many of them are idiomatically restricted in usage. In fact the feeling for their original meaning and for the compound character of the verbal stem to which they are attached has often so completely disappeared that the compounds are treated like verbal stems. (Boas and Deloria 1941:39)

The prefix /a-/ indicates that the state or activity identified by the stem is ascribed to the surface of an object, and is thus similar in meaning to the English preposition on. With verbs of motion it indicates the idea of "bringing" or "taking" an object; e.g., /ʔú/ "to come" and /ʔaú/ "to bring something". The prefix /o-/ indicates that the state or activity identified by the stem is ascribed to a container or confined space of some sort, and is thus similar in meaning to the English preposition in. The prefix /i-/ is the one that is most frequently "idiomatically restricted" in the fashion indicated in the above quotation, so that its function is frequently obscure. It seems to indicate such ideas as against, toward, in contact with, by means of, on account of, etc. Unlike the other prefix classes, the members of this class may co-occur with one another; indeed, constructions with sequences of three locative prefixes are not at all uncommon. The similarity of these prefixes to those of Class 2 has been mentioned; their different phonological behavior suggests that, in some contexts at least, they may be accompanied by phonological boundaries of different strengths.

Class 5. Here we have the single prefix /k'i-/, which ascribes an activity or state to the middle or center of an object; e. g., /napsáka/ "to break something with the foot" and /k'inápsaka/ "to break something in the middle with the foot". This prefix often occurs with the instrumental prefixes of Classes 6 and 12.

Class 6. In this class are four instrumental prefixes, concord markers which are the products of transformations deleting underlying instrumental noun nodes. Their similarity to the prefixes of Class 12, both in terms of semantic and syntactic functions, coupled with the observation that they may not co-occur with any member of that class, leads us to suspect that some surface structure constraint may have split an earlier unitary class of instrumentals into the two synchronic classes. The prefix /wa-/ indicates that an activity is performed with an edged instrument, such as a knife or saw. The prefix /wo-/ indicates the use of a pointed instrument, an instrument that operates from a distance, such as a gun or bow, or the effects of punching, blowing, wind, or rain. The prefix /na-/ indicates that an activity is performed by the foot or leg. A second prefix of shape /na-/ indicates that an activity is performed by means of some "inner force"; this prefix is now completely non-productive, and occurs in very few forms.

Class 7. This class contains only the form /wič'a-/, the marker of third person, animate, plural objects. This prefix may represent an old object noun incorporation, as the noun stem meaning "human, person" is phonologically identical. We have no forms in which this prefix co-occurs with reflexive or reciprocal markers, Classes 10 and 11.

Class 8. This class contains the first person agreement markers. As noted above, the first person plural prefix /ųk-/ may occur in this position. The prefix /wa-/ marks the first person singular, active case. The prefix /ma-/ is the marker of first person singular, stative case.

Class 9. In this class are two second person agreement markers. The prefix /ya-/ represents the second person, active case, and the prefix /ni-/ represents the second person, stative case. Number in the second person is marked elsewhere in the verb complex. A third prefix in this class is /č'i-/, marking a first person singular subject acting on a second person object; historically this form is derived from a sequence of two prefixes, but the processes which collapsed them are no longer productive. The active case prefixes of Classes 8 and 9 may not co-occur with each other, nor with the reflexive prefix of Classes 10 and 11. The prefix /č'i-/ may not co-occur with any other prefix of Classes 8 or 9, nor with the reflexive.

Classes 10 and 11. The prefixes of these two classes are difficult to separate, as they interact with one another phonologically to a very great degree. In function, they all describe interrelationships between the subject and object of a transitive verb; possessive, reflexive, reciprocal, and benefactive relationships are all expressed by means of various combinations of prefixes drawn from these classes. The prefixes representing simple possessive and benefactive relationships are often homonymous, appearing phonetically as /ki- /; their phonological behavior is distinct, however, and they may co-occur in more complex constructions. The reciprocal /k'i- / often co-occurs with one of the /ki- / prefixes, although it is difficult to determine which one. The reflexive is marked by the form /ič̓i- /; there is very good evidence, however, that this is a sequence of an old possessive (or possibly third person) prefix of shape /i- /, which may appear in other constructions, and a prefix of shape /k̓i- /, which appears only with the preceding /i- /. Much of the difficulty encountered in sorting out these prefixes is due to the simple fact that the majority begin with a velar stop of some type, and all contain the vowel i. We are obviously confronted here with a problem of great complexity and interest, one which receives considerable attention in a section to follow.

Class 12. This class contains five instrumental prefixes similar to those of Class 6. The prefix /ka- / indicates that an activity is performed by means of a sudden application of force, or by sudden impact, as in the case of such instruments as a hammer or ax. The prefix /pa- / marks the use of pressure away from the body, *i.e.*, pushing. The prefix /pu- / also marks the use of pressure, but in an indefinite direction; it is nonproductive, and occurs in few forms. The prefix /ya- / indicates that an action is performed by means of the mouth or teeth. The prefix

/yu-/ indicates that the activity is performed by handling or manipulating, often with motion directed toward the body.

Class 13. In the first suffix class we have the continuative marker /-hą/, which is historically derived from a verb stem. This suffix indicates simple continuity or duration of an activity, as opposed to momentaneous, repeated, or habitual action; e.g., /t'aɣóša/ "he spat" and the continuative /t'aɣóšahą/ "he was continually spitting".

Class 14. This class contains the suffix /-pi/, which denotes plurality of one or more nouns within the scope of the verb stem to which it is affixed.

Class 15. In this class is the marker of the potential mood, the suffix /-kta/. This form is also derived historically from an old verb stem.

Class 16. This class contains the augmentative suffix /-xča/.

Class 17. This class contains the negative suffix /-šni/, which is probably derived historically from a sequence of two affixes /-š/ and /-ni/, both of which still occur as separate forms in Dakota. The former is an emphatic suffix now restricted to particle stems; the latter is a negative suffix, productive with particle stems but "fossilized" in verbs such as /ząní/ "well, healthy", derived from the stem /žą́/ "sick".

Class 18. This class contains a predicative marker /-e/, of uncertain syntactic and semantic function.

Class 19. This final affix class is characterized by suffixes whose vowel varies with the sex of the speaker, <u>o</u> for male speaking and <u>e</u> for female speaking. The imperative suffixes, /-o/ and /-e/, consist of the vowel alone. Two predicative suffixes, /-lo/ and /-le/, are used to mark rhetorical statements or statements of personal opinion; they always co-occur with the suffix of Class 18.

Two other suffixes are of uncertain class membership. These are the diminutive suffix /-la/, which seems to appear more freely than the augmentative suffix of Class 16, and the suffix /-ka/, a very frequent affix of uncertain function. It is probably a mild emphatic or adversative marker of some sort.

3.2 Prefix Vowel Deletion

Dakota exhibits a number of phonological processes which delete prefix vowels, thus altering the canonical shapes of the complex forms affected. The underlying forms are always recoverable, however, in that either some portion of the affected prefix remains in the phonetic representation, or some phonological "effect" of the deleted vowel is apparent. Thus the nominalizing and locative prefixes of Classes 2 and 4, for example, may be deleted only under rather special circumstances; since each consists of a single vowel, deletion in most environments would leave no surface evidence for their recovery. Furthermore, only prefixes in certain of the morphological classes are subject to vowel deletion processes; the instrumental prefixes of Classes 6 and 12, for example, never exhibit any type of vowel deletion, although their underlying shapes are similar to those of a number of prefixes which <u>do</u> undergo such changes.

In this section we concentrate upon those vowel deletion processes in which the affected vowel appears between consonants; such processes affect only prefixes in morphological classes near the verb stem, specifically the various pronominal concord markers of Classes 8 through 11. Deletion processes which operate on vowel sequences are dealt with in the section which follows.

The following brief paradigms show verb stems inflected for first and second person singular actors, or subjects. Note that the first person singular active marker appears as /wa-/, and that the second person active marker appears as /ya-/:

Stem	Gloss	First Person	Second Person
/kté/	"to kill"	/wakté/	/yakté/
/k'uté/	"to shoot at something"	/wak'úte/	/yak'úte/
/kų́/	"to give"	/wakų́/	/yakų́/
/lá/	"to ask for something"	/walá/	/yalá/
/hí/	"to arrive coming"	/wahí/	/yahí/
/niyá/	"to breathe"	/waníya/	/yaníya/
/t'í/	"to dwell"	/wat'í/	/yat'í/
/p'áta/	"to butcher"	/wap'áta/	/yap'áta/
/pšá/	"to sneeze"	/wapšá/	/yapšá/
/č'į́/	"to want"	/wač'į́/	/yač'į́/

Stem	Gloss	First Person	Second Person
/só/	"to cut into strips"	/wasó/	/yasó/

With preceding locative prefixes of Class 4 and instrumental prefixes of Class 6, the phonetic shapes of these first and second person agreement markers are the same:

Theme	Gloss	First Person	Second Person
/ʔap'á/	"to hit, strike"	/ʔawáp'a/	/ʔayáp'a/
/ʔok̔á/	"to dig a hole"	/ʔowák̔a/	/ʔoyák̔a/
/ʔixá/	"to laugh"	/ʔiwáxa/	/ʔiyáxa/
/naxtáka/	"to kick something"	/nawáxtaka/	/nayáxtaka/
/waksá/	"to cut something"	/wawáksa/	/wayáksa/
/wokpá/	"to shoot out"	/wowákpa/	/woyákpa/

With some of the prefixes of instrumental Class 12 these agreement markers are again the same:

Theme	Gloss	First Person	Second Person
/kaxpá/	"to knock down"	/wakáxpa/	/yakáxpa/
/kabléča/	"to shatter"	/wakábleča/	/yakábleča/
/pak̔éɣa/	"to scrape"	/wapák̔eɣa/	/yapák̔eɣa/
/pak̔óza/	"to rub smooth"	/wapák̔oza/	/yapák̔oza/
/pusképa/	"to empty out"	/wapúskepa/	/yapúskepa/
/pustáka/	"to squat down"	/wapústaka/	/yapústaka/

With the instrumental prefixes /ya-/ and /yu-/, the two remaining prefixes of Class 12, the paradigms with first and second person agreement markers look quite different, however:

Theme	Gloss	First Person	Second Person
/yaksá/	"to bite off a piece"	/blaksá/	/laksá/
/yažó/	"to play a flute"	/blažó/	/lažó/
/yaxtáka/	"to bite someone"	/blaxtáka/	/laxtáka/
/yatką́/	"to drink"	/blatką́/	/latką́/
/yušká/	"to untie something"	/blušká/	/lušká/
/yuxlá/	"to rattle something"	/bluxlá/	/luxlá/
/yuglá/	"to unroll something"	/bluglá/	/luglá/
/yuką́/	"to shake something off"	/bluką́/	/luką́/

Examination of the first person forms suggests that the expected first person prefix is in fact present, the *b* coming from the same underlying source as the more usual *w*. This implies that the vowel of the prefix has been deleted, and that the initial *y* of the instrumental prefixes has become an *l*. The following form indicates that stem-initial *y* may behave in the same fashion with regard to the first and second person agreement markers:

Stem	Gloss	First Person	Second Person
/yá/	"to be going"	/blá/	/lá/

Although unambiguous cases of stem-initial *y* are rare, the following form may be a second example:

Theme	Gloss	First Person	Second Person
/wąyą́ka/	"to see"	/wąbláka/	/wąláka/

(The inflected forms reveal that the second vowel of this theme is not nasal in the underlying representation; nasalization of the second vowel in the uninflected theme is produced by a rule of nasal assimilation, discussed above on page 86, and formalized below.)

In order to account for those first person forms which exhibit deletion of the prefix vowel we shall need to postulate three phonological rules, assuming that the underlying form of the prefix is something like *+wa+*. We shall need a rule of A-DELETION to remove the prefix vowel, a rule of LATERALIZATION to convert underlying *y* to *l*, and a third rule which will convert the underlying *w* into *b*. Our decision to treat the first person prefix as containing underlying *w* is motivated by the total absence of phonetic *b* other than as first element of consonant clusters; we thus assume that *b* is derived in all cases from distinct underlying segments, either *p*, as suggested above in section 2.2, or *w*, as in the present instance. Our decision to treat the instrumental prefixes and stems involved in the A-DELETION rule as containing an underlying initial *y* is motivated by consideration of such contrasting forms as /lá/ "to ask for something" and /yá/ "to be going", as well as /lak'óta/ "Dakota" and /yak'óka/ "to rattle with the teeth". Such contrasting forms would be difficult to account for if we were to assume that the initial underlying segment of the relevant prefixes and stems was l.

Our decision to treat the a of these first and second person agreement markers as organic, rather than epenthetic, has two basic types of support. One is that MSC1 does not permit lexical matrices without vowels. Although these prefixes are almost certainly produced by "spelling transformations", so that they do not in fact derive from lexical entries, it still seems to be a valid generalization that all Dakota morphemes have at least one organic vowel; the only clear exception is the emphatic suffix /-š/, which appears with particle stems. Second, there are environments in which the prefix vowel is deleted but leaves behind a "trace" of its existence in the form of some "effect" on a neighboring vowel; e.g., /kikté/ "to kill one's own" and its first person form /wékte/ "I kill my own". We show below that the underlying representation of the inflected form is something like #wa+ki+kte#: the a draws the stress to the i, the first k is deleted, and the a + i sequence "collapses" to e. We thus argue that the presence of a stressed e in such forms presupposes the existence of an a in the prefix; while it is quite possible for a vowel to be introduced into a string by an epenthesis rule, and later deleted by a deletion rule, it seems that any situation which required this treatment would be highly complex, as the resulting grammar would not be very parsimonious.

If we assume that the underlying form of the second person active prefix is something like +ya+, then application of A-DELETION will produce a consonant cluster with y as first element, just as it produces a cluster with w as first element in the case of the first person forms. Such clusters are not permitted in any environment; it would appear that, as cluster-initial w becomes b, so cluster-initial y is deleted. Since the environment triggering both of these processes is the same, and since their phonological function is the same, we can collapse the two rules into a single rule schema, GLIDE ASSIMILATION. Derivations of the first and second person forms exhibiting prefix vowel deletion would now proceed as follows:

	#wa+ya+ksa#	#ya+ya+ksa#
A-DELETION	#w +ya+ksa#	#y +ya+ksa#
LATERALIZATION	#w +la+ksa#	#y +la+ksa#
GLIDE ASSIMILATION	#b +la+ksa#	#∅ +la+ksa#
	/blaksá/	/laksá/

In order to arrive at an appropriate formalization for A-DELETION we must consider certain other lines of evidence.

We note first that A-DELETION is limited to the two prefixes currently under discussion; the other prefix of Class 8 which contains an a is the first person singular stative marker, /ma-/. The following brief paradigms show that this prefix, and the second person stative marker /ni-/, as well, is not affected by the vowel deletion:

Theme	Gloss	First Person	Second Person
/yaxtáka/	"to bite someone"	/mayáxtaka/	/niyáxtaka/
/yuškáa/	"to untie something"	/mayúška/	/niyúška/

Sequences like <u>way</u> and <u>yay</u> do not occur within morpheme boundaries, suggesting that lexical entries do not permit such sequences. (Historically, this could easily be the result of lexical restructuring following the addition of A-DELETION to the grammar; indeed, it would be difficult for any other situation to be possible.) This latter fact suggests that no phonological boundary is required to <u>trigger</u> the rule of A-DELETION, but rather that the rule is <u>ranked</u> by some boundary. That no prefix to the "left" of Class 8 ever undergoes A-DELETION is sufficient to show that the ranking boundary is considerably weaker than # in the hierarchy, particularly when we see that the other two prefixes of phonetic shape /wa-/ are not affected by this rule. In fact, an interesting demonstration is afforded by the fact of homonymy in prefixes of shape /wa-/ and /ya-/: there are three possible underlying structures with segmental shape #wa+ya+STEM#. They can be morphologically represented in the following ways:

a. (nonspecific object + instrumental "by mouth" + STEM)

b. (instrumental "by edge" + second person active + STEM)

c. (first person active + instrumental "by mouth" + STEM)

In conjunction with the stem /-ksá/, used in the preceding derivations, these structures result in the following phonetic representations:

a. /wayáksa/ "to bite a piece off of (something)"

b. /wayáksa/ "you (sng.) cut it"

c. /blaksá/ "I bit a piece off of it"

The first of these forms can be further inflected for first and second person actors, giving /wabláksa/ "I bit a piece off of (something)" and /waláksa/ "you (sng.) bit a piece off of (something)". If we assume that all affix classes to the "left" of Class 8 are associated with phonological boundaries of hierarchical strength equal to or greater than that of the boundary which ranks A-DELETION, then all of these derivations will proceed naturally.

Arguments and examples such as these indicate that, in order to account for all of the observed regularities in these paradigms, we must formalize the rule of A-DELETION as follows:

$$\text{A-DELETION:} \quad \text{a} \longrightarrow \emptyset \;/\; \begin{bmatrix} +\text{son} \\ -\text{syl} \\ -\text{con} \end{bmatrix} \_\_\,\text{y} \qquad \text{Rank: } *$$

We assume that all prefixes to the "left" of Class 8 are associated with a boundary of rank * or stronger. The GLIDE ASSIMILATION process can be formalized as follows:

$$\text{GLIDE ASSIMILATION:} \quad \begin{bmatrix} \text{w} \\ \text{y} \end{bmatrix} \longrightarrow \begin{bmatrix} \text{b} \\ \emptyset \end{bmatrix} \;/\; \_\_\,\text{C}$$

Since A-DELETION provides the only input to GLIDE ASSIMILATION, the latter requires no statement of rank. Derivations for /wayáksa/

"to bite a piece off of (something)" and /blaksá/ "I bit a piece off of it" would look like the following:

	#wa*ya+ksa#	#wa+ya+ksa#
A-DELETION	inapplicable	#w +ya+ksa#
LATERALIZATION	inapplicable	#w +la+ksa#
GLIDE ASSIMILATION	inapplicable	#b +la+ksa#
	/wayáksa/	/blaksá/

Other rules needed to derive such forms as these, including the rule of LATERALIZATION, are formalized below.

Although these rules "work" in the sense that they correctly predict phonetic representations from uniform underlying phonological shapes, we note that there are other forms which suggest that our analysis is too abstract. Forms in which a second person singular subject acts on a first person singular object are especially revealing:

/yaxtáka/	"to bite one"	/mayálaxtaka/	"you bit me"
/yuhá/	"to have"	/mayáluha/	"you have me"

Such forms seem to require the presence of <u>two</u> instances of the second person active prefix; <u>i. e.</u>, it appears that the underlying representation of a form like /mayálaxtaka/ is actually #ma+ya+ya+ya+xtaka#, where the first two /ya-/ prefixes are the second person active markers and the third /ya-/ is the instrumental prefix. Forms in which the benefactive prefix intervenes between the second person agreement marker and the instrumental prefix often exhibit the same phenomenon:

/yaxtáka/	"to bite one"
/kiyáxtaka/	"to bite one for someone"
/yakílaxtaka/	"you bit him for him"

Here we are led to assume that the underlying form of /yakílaxtaka/ is in fact something like #ya+ki+ya+ya+xtaka#; again, the first two /ya-/ prefixes represent the second person agreement marker, while the third is the instrumental prefix.

Occasionally this effect is also noted in the first person; *e.g.*, the verb /kiyúška/ "to untie, release one" has two first person forms, apparently in free variation, phonetically represented as /wakíyuška/ and /wakíbluška/. The second of these forms appears to be derived from underlying #wa+ki+wa+yu+ška#, with two occurrences of the *first* person agreement marker. It is only in such forms with "double" agreement markers that a prefix of Classes 8 and 9 may appear to the "right" of a prefix of Classes 10 and 11. All of these forms with "double" agreement markers have the additional peculiarity that they are the only forms with more than one active case marker; any other construction with more than one prefix in active case is rejected by the Dakota speaker as ill-formed, both syntactically and semantically.

In section 1.4 above we discussed, very briefly, the relationships between the abstractness of phonological representations and low-ranking phonological boundaries, citing recent work by Stanley. We repeat the crucial point of that citation:

> As his knowledge of the language grows, the child will learn rules of lower and lower rank, and will thus learn how to analyze some of these formerly indivisible units, but when he reaches a certain point, he might find it easier to simply memorize certain paradigms of morpheme combinations, than to incorporate rules of still lower rank; thus, perhaps the competence grammar of adults is not fully in terms of rules, but partially in terms of memorized paradigms. (Stanley 1971:29-30)

It appears that the only way in which we can reasonably account for the above constructions with "double" agreement markers is through an appeal to some such notion as Stanley's "paradigm memorization". Indeed, the very general constraint against forms with more than one prefix in active case strongly suggests that the Teton speaker does _not_ perceive more than one such prefix in a form like /mayálaxtaka/, indicating that the phonetic _l_ is not being derived from underlying +ya+ya+, but is instead a product of paradigmatic learning. The "redundant" use of the _maya_ sequence in these paradigms is explained by the principle of _paradigm coherence_ (_Cf._ Kiparsky 1972:206-213); if the _l_ of the inflected form is simply memorized as part of the inflectional paradigm, then use of the _maya_ phonetic string, the usual marker of second person subject acting on first person object, simply serves to _regularize_ these paradigms. Similarly, the phonetic sequence _yaki_ is the normal indicator of the second person benefactive construction, and regularization of paradigms would result in the very forms shown above if the phonetic _l_ were the result of paradigmatic learning, rather than derived by rule.

Further support for this claim of paradigm memorization is provided by some interesting diachronic evidence. We would expect that the indicator of first person singular subject acting on second person object would be the phonetic sequence wani; as noted previously, however, this particular construction does not occur, the relevant syntactic function being marked by the "portmanteau" prefix /č'i-/. Historically, this prefix is derived from Proto-Siouan */wa-/ "first person singular active" plus */yi-/ "second person stative", forms whose Dakota reflexes are the /wa-/ and /ni-/ prefixes mentioned here. (Matthews 1958:63, 67) Addition of the A-DELETION rule to a grammar of Proto-Siouan would have produced the sequence *wyi; Matthews (1958:31) has shown that the Dakota reflex of a *wy cluster is č'. Synchronically, however, a derivation of this type for the prefix /č'i-/ simply cannot be motivated in any realistic way. The A-DELETION rule drops a between a voiced glide and y; although the earlier *wayi would have been subject to this rule, forms such as the following reveal that Dakota wani is not.

Stem	Gloss	First Person	Second Person
/ní/	"to live"	/waní/	/yaní/
/niyá/	"to breathe"	/waníya/	/yaníya/

There is no independent evidence to suggest that the underlying form of Dakota /ni-/ might, in fact, be something like +yi+, nor is there any apparent motivation for a synchronic rule which would map underlying wy into phonetic č'. We must conclude that the prefix /č'i-/ is synchronically a unitary morpheme, and is learned as such by the native speaker.

Although paradigm memorization seems to have occurred universally in the second person paradigms listed above, the much less frequent use of "double" agreement markers in first person paradigms, coupled with the existence of such competing forms as /wakíyuška/ and /wakíbluška/ for "I released him", suggests that the phenomenon is not yet universal in the first person paradigms. This also suggests that it is basically the effects of the second sub-rule of GLIDE ASSIMILATION, deleting y in preconsonantal position, that are being memorized; A-DELETION and the first sub-rule of GLIDE ASSIMILATION are still required by those persons who have not memorized the first person paradigms.

The significant question that faces us here, of course, is that of why paradigm memorization has developed in these constructions. Stanley has suggested that the phenomenon develops when a phonological rule is restricted to a single short stretch of the phonological string by a weak ranking boundary. He has also suggested that such low-ranking rules are limited to morphological constructions which are semantically nonproductive. The present case, however, does not seem to entirely substantiate these suggestions. Inflection of verb stems for first and second person actors is obviously very productive semantically, thus indicating that the notion of semantic productivity is probably irrelevant. It is also not the case that the * boundary, which ranks the rules at issue, is a particularly low-ranking boundary in the over-all hierarchy; we show below that there are other phonological rules which are ranked by this boundary, and that those rules are both regular and productive. What is of significance here is the fact that both A-DELETION and GLIDE ASSIMILATION affect only the two prefixes discussed; they are not required in any other derivations in the language. We might then claim that it is the "functional load" of a rule which is relevant in these situations, and that when this factor of "utility" becomes sufficiently low, for any reason, then there is a rising probability that the rule will be "discarded" during the language learning process through memorization of its effect. Since A-DELETION and GLIDE ASSIMILATION "conspire" to eliminate the second person active agreement marker in the paradigms at issue (save for the "effect" of that prefix on the following y), and since the "functional load" of both rules is quite low, we claim that these second person paradigms are now being memorized, rather than derived by rule, and that the phenomenon is spreading to the first person paradigms as well.

Before we formalize the rule of LATERALIZATION, we must examine a second prefix vowel deletion process in which the rule plays a role. The following pairs of words show verb stems and their possessive forms. We see here that possession of the object of a verb by its subject is marked with a prefix of phonetic shape /ki-/:

Stem	Gloss	Possessive	Gloss
/kté/	"to kill"	/kikté/	"to kill one's own"
/k'uwá/	"to chase"	/kič'úwa/	"to chase one's own"
/k̓į́/	"to carry"	/kič̓į́/	"to carry one's own"
/č'į́/	"to want"	/kič'į́/	"to want one's own"
/só/	"to cut in strips"	/kisó/	"to cut one's own in strips"
/sų́/	"to braid"	/kisų́/	"to braid one's own"
/xló/	"to growl over"	/kixló/	"to growl over one's own"

This prefix also appears as /ki-/ with the locative prefixes of Class 4 and the instrumental prefixes of Class 6:

/ʔač'éya/	"to mourn, cry over"	possessive:	/ʔakíč'eya/
/ʔopémni/	"to wrap around"	possessive:	/ʔokípemni/
/woksá/	"to break by shooting"	possessive:	/wokíksa/
/waksá/	"to cut"	possessive:	/wakíksa/
/naksá/	"to break with the foot"	possessive:	/nakíksa/

With the prefixes of Class 12, however, the possessive marker appears without its vowel:

/kašká/	"to tie, bind"	possessive:	/glašká/
/kalá/	"to scatter"	possessive:	/glalá/
/yawá/	"to count"	possessive:	/glawá/
/yat̓á/	"to bite to death"	possessive:	/glat̓á/
/yužá/	"to stir"	possessive:	/glužá/

/yuglá/	"to unroll"	possessive:	/gluglá/
/pašpú/	"to loosen"	possessive:	/kpašpú/
/pagmų́/	"to twist"	possessive:	/kpagmų́/
/puspá/	"to seal, glue"	possessive:	/kpuspá/
/put'áka/	"to touch"	possessive:	/kput'áka/

Examination of the reflexive forms of verbs, a construction marking the coreferentiality of the subject and object, reveals a similar set of phenomena. With simple stems, and when appearing after the instrumental prefixes of Class 6, the reflexive marker appears as /iči-/:

/kté/	"to kill"	reflexive:	/ʔičíkte/
/k'uwá/	"to chase"	reflexive:	/ʔičíč'uwa/
/gnayą́/	"to deceive"	reflexive:	/ʔičígnayą/
/lá/	"to consider, say of"	reflexive:	/ʔičíla/
/waksá/	"to cut"	reflexive:	/waíčiksa/
/naxmá/	"to hide"	reflexive:	/naíčixma/
/nawáza/	"to scratch with the foot"	reflexive:	/naíčiwaza/

With the instrumental prefixes of Class 12, however, we find that the reflexive marker appears without its second vowel:

/patą́/	"to save, take care of"	reflexive:	/ʔikpátą/
/paptą́/	"to turn something over"	reflexive:	/ʔikpáptą/
/kašká/	"to tie, bind"	reflexive:	/ʔigláška/
/kaksá/	"to cut by striking"	reflexive:	/ʔigláksa/

/yažáta/	"to contradict one"	reflexive:	/ʔiglážata/
/yazų́ta/	"to praise one"	reflexive:	/ʔiglázųta/
/yužáža/	"to wash"	reflexive:	/ʔiglúžaža/
/yušká/	"to untie"	reflexive:	/ʔiglúška/

In many environments the benefactive prefix, as noted above, is homonymous with the possessive marker, appearing as phonetic /ki-/:

/kté/	"to kill"	benefactive:	/kikté/
/žó/	"to whistle"	benefactive:	/kižó/
/škáta/	"to play"	benefactive:	/kiškáta/
/ʔixʔą́/	"to cook"	benefactive:	/ʔikíxʔą/
/waksá/	"to cut"	benefactive:	/wakíksa/

With the instrumental prefixes of Class 12, however, the benefactive marker differs from the possessive in that it does <u>not</u> lose its vowel:

/pazó/	"to point to"	benefactive:	/kipázo/
/patą́/	"to keep, save"	benefactive:	/kipátą/
/pak'į́ta/	"to wipe off"	benefactive:	/kipák'įta/
/yamná/	"to acquire by talking"	benefactive:	/kiyámna/
/yužáža/	"to wash"	benefactive:	/kiyúžaža/
/yuγą́/	"to open"	benefactive:	/kiyúγą/
/yuhá/	"to have"	benefactive:	/kiyúha/

Similarly, the reciprocal marker /kič'i-/ does not lose its vowel before the instrumental prefixes of Class 12:

/yaxtáka/	"to bite someone"	reciprocal:	/kič'íyaxtakapi/
/yuhá/	"to have"	reciprocal:	/kič'íyuhapi/

Thus we see that, of the affixes of Classes 10 and 11, the possessive and reflexive markers lose their vowels before the instrumental prefixes of Class 12, but the benefactive and reciprocal markers do not. To account for these facts we motivate a second deletion rule, I-DELETION.

Although both A-DELETION and I-DELETION have the effect of removing prefix vowels from the phonological string, and operate in the same basic "region" of the verb complex, it appears that they must be synchronically treated as separate rules; no collapsing of these processes into a single rule schema seems possible. Both rules apply primarily before the prefixes of Class 12, but whereas I-DELETION applies before all of the prefixes of this class, A-DELETION applies only before the two which begin with y. The rules are also alike in that they apply before the very few stems which show initial y; it is quite possible that both rules originally applied only before the prefixes of Class 12, but were later generalized to apply also before the y-initial stems. We thus formalize I-DELETION as follows:

$$\text{I-DELETION:} \quad i \longrightarrow \emptyset \;/\; k(ʔ)\;\_\_\; \left\{ \begin{matrix} CV\% \\ y \end{matrix} \right\}$$

We assume that the prefixes of Class 12 are associated with a phonological boundary, symbolized as %, which will serve to trigger this rule. Since the underlying forms of the Class 5 "centralizing" prefix and the Class 11 "reciprocal" prefix are representable as +kxi+, failure of the I-DELETION process to apply to them is predicted from the presence of the underlying x.

Of considerably greater interest is the behavior of the benefactive prefix, whose underlying representation, like that of the possessive prefix, is apparently +ki+. Although the benefactive and possessive prefixes do behave differently in most constructions, there is no clear evidence to suggest that their underlying representations are distinct in any way; their distinctive behavior is always due to the failure of rules to apply to the benefactive form. There also seems to be no way in which we can appeal to boundaries or constituent structure to block the application of rules such as I-DELETION in the benefactive prefix, as we show below that this prefix is sequentially "closer" to the prefixes of Class 12 than is the possessive prefix. Hence we must argue that the benefactive prefix is an exception with regard to I-DELETION. Since it is also exceptional with regard to other regular rules, we conclude that some principle of "homonym avoidance" is at work here; if the possessive and benefactive prefixes were subject to the same phonological rules, then they would be homonymous in all constructions. We therefore claim that the benefactive prefix is distinguished from the possessive in that it is marked with a number of rule features, one of which is $\left[- \text{I-DELETION}\right]$.

Before the rule of LATERALIZATION can be applied in these derivations, the underlying ʔ must be removed from the reflexive marker. The rule that accomplishes this task is straight-forward:

$$\text{GLOTTAL DELETION:} \quad \text{ʔ} \longrightarrow \emptyset \;/\; C\_\_C$$

We can now formalize LATERALIZATION as follows:

$$\text{LATERALIZATION:} \quad \begin{bmatrix} y \\ k \end{bmatrix} \longrightarrow l \;/\; \begin{bmatrix} C \\ k \end{bmatrix}\_\_ \qquad \text{Rank: } =$$

The fact that LATERALIZATION converts both k and y to l accounts for the ambiguity of words like /glaksá/, which can mean either "to chop a piece off of one's own" or "to bite a piece off of one's own"; the former is derived from underlying #ki+ka%ksa#, while the latter comes from underlying #ki+ya%ksa#. Forms such as /ʔiglášpa/, meaning either "to break oneself loose" or "to bite oneself loose", show the same type of ambiguity, the former being derived from underlying #i+kʔi+ka%špa# and the latter from underlying #i+kʔi+ya%špa#. That LATERALIZATION is blocked by the compound (=) boundary can be seen in such forms as /sabyá/ "to blacken something", the causative of /sápa/ "to be black", in which the underlying representation is something like #sap=ya#.

Before going on to examine other rules needed in the derivation of possessive and reflexive forms, we note briefly the use of the possessive prefix with the verbs of motion. In these constructions the possessive has the specialized meaning of "returning":

/yá/	"to go (durative)"	/glá/	"to return going"
/ʔí/	"to go (perfective)"	/k'í/	"to return going"
/ʔú/	"to come (durative)"	/kú/	"to return coming"
/hí/	"to come (perfective)"	/glí/	"to return coming"

Only the first of these forms is regular, the others showing exceptional application of I-DELETION and idiosyncratic assimilations in the resulting strings. Since their behavior in these respects is unique, we contend that all of these forms, due to their specialized meanings and frequent use, have been reinterpreted as monomorphemic "stems". Thus we claim that their peculiar behavior is nonpredictable.

The stress patterns of all of the constructions discussed in this section are predictable if we assume that the rules of A-DELETION and I-DELETION apply before the rule of STRESS MOVEMENT. This latter rule moves stress "leftward" from the underlying position determined by the rule of STRESS PLACEMENT. We treat the STRESS PLACEMENT rule as a type of readjustment rule; it can be formulated more simply if we allow it to apply to a string before the # boundary is weakened to = within compounds. Since no phonological rule proper need apply before STRESS PLACEMENT, this decision seems to do no violence to the data. Accordingly, we formalize STRESS PLACEMENT as follows:

(R) STRESS PLACEMENT: $V \longrightarrow [1\ \text{acc}] \ / \ \underline{\quad} \left[C_0 \# \right]_{\text{STEM}}$

The label "STEM" on the bracket in this rule implies that only stems, whether noun stems, verb stems, or particle stems, may bear primary stress in underlying phonological representations; this label thus constitutes a convenient "abbreviation" for a set of "real" syntactic labels, since the different stem classes must be dominated by several different labeled nodes in the surface structure tree. The rule of STRESS MOVEMENT may now be formalized in the following way:

$$\text{STRESS MOVEMENT:}\quad \underset{1}{V}\ \underset{2}{C_0}\ \underset{3}{V}\ \underset{4}{C_0}\ \underset{5}{\begin{bmatrix} V \\ 1\ \text{acc} \end{bmatrix}} \longrightarrow 1\ 2 \begin{bmatrix} 3 \\ 1\ \text{acc} \end{bmatrix}\ 4 \begin{bmatrix} 5 \\ -\ \text{acc} \end{bmatrix}$$

That this rule must apply after the vowel deletion processes discussed here is shown by a form like /glawá/ "to count one's own", derived from underlying #ki+ya%wá#. If STRESS MOVEMENT shifted primary stress to the second syllable before I-DELETION applied, the resulting phonetic string would be the unacceptable */gláwa/.

Another rule required in the derivation of these forms is the rule of STOP VOICING, which will convert underlying k to phonetic g. As this rule is also required to convert underlying p to phonetic b (as discussed above in section 2. 2), we formalize this rule in such a way that it will voice all stops before voiced consonants:

$$\text{STOP VOICING:}\quad \begin{bmatrix} -\ \text{son} \\ -\ \text{syl} \\ +\ \text{con} \\ -\ \text{cnt} \end{bmatrix} \longrightarrow \begin{bmatrix} +\ \text{voi} \end{bmatrix} \Big/ \ \_\_ \begin{bmatrix} -\ \text{syl} \\ +\ \text{voi} \end{bmatrix}$$

Morpheme structure conditions ensure that only p and k are subject to this rule when it applies within morpheme boundaries; other phonological rules ensure that only p and k serve as input to STOP VOICING across morpheme boundaries.

The following derivations for /glašká/ "to tie one's own" and /kpagmų́/ "to twist one's own" exemplify the operation of these various phonological processes in the possessive construction:

	#ki+ka%šká#	#ki+pa%kmų́#
I-DELETION	#k +ka%šká#	#k +pa%kmų́#
LATERALIZATION	#k +la%šká#	inapplicable
STRESS MOVEMENT	inapplicable	inapplicable
STOP VOICING	#g +la%šká#	#k +pa%gmų́#
	/glašká/	/kpagmų́/

In order to derive the forms characteristic of the reflexive construction we require one further rule:

GLOTTAL EPENTHESIS: $\emptyset \longrightarrow ʔ \;/\; \left\{ \begin{matrix} \# \\ = \end{matrix} \right\} \_\_ V$

The following derivations for /ʔiglátą/ "to praise oneself" and /ʔikpátą/ "to take care of oneself" now proceed as follows:

	#i+kʔi+ya%tʂ́#	#i+kʔi+pa%tʂ́#
I-DELETION	#i+kʔ +ya%tʂ́#	#i+kʔ +pa%tʂ́#
GLOTTAL DELETION	#i+k +ya%tʂ́#	#i+k +pa%tʂ́#
LATERALIZATION	#i+k +la%tʂ́#	inapplicable
STRESS MOVEMENT	#i+k +lá%tʂ#	#i+k +pá%tʂ#
STOP VOICING	#i+g +lá%tʂ#	inapplicable
GLOTTAL EPENTHESIS	#ʔi+g +lá%tʂ#	#ʔi+k +pá%tʂ#
	/ʔiglátʂ/	/ʔikpátʂ/

The I-DELETION rule must clearly precede all other phonological rules in these derivations, other than A-DELETION, which seems to be equally "deep". GLOTTAL DELETION must precede LATERALIZATION, in order to provide the appropriate environment for the latter rule in the reflexive forms. Similarly, LATERALIZATION must be allowed to apply before GLIDE ASSIMILATION, as otherwise the latter rule would deprive the former of appropriate input by deleting y before y; the first y is needed to trigger the LATERALIZATION process. STRESS MOVEMENT, STOP VOICING, and GLOTTAL EPENTHESIS are mutually unordered, although STRESS MOVEMENT must follow A-DELETION and I-DELETION, and STOP VOICING must follow LATERALIZATION (since in the k+k sequence the second k must be converted to l in order to trigger STOP VOICING). Other aspects of the interactions of these rules are more fully discussed below.

3.3 Processes Affecting Vowel Sequences

Dakota permits no diphthongs, and there are strong tendencies toward the elimination of vowel sequences. When morphological composition results in a situation where two or more vowels are in contact, phonological processes will frequently delete one of the vowels, "collapse" two vowels into a single vowel, or insert an epenthetic glide. In some environments a vowel sequence will remain unmodified, although in such cases each vowel is clearly and distinctly articulated; there is no tendency to produce complex syllable nuclei. We note at the outset that the phonological phenomena surrounding vowel sequences are extremely complex and poorly understood; our analysis must be regarded as merely an initial approximation to an adequate grammar, to be expanded and refined as our knowledge and insight into the intricacies of these processes increases.

Vowel deletion processes are quite common, and their effects are observed in a number of morphological environments where vowel sequences are produced. For example, the prefix of Class 1 most frequently appears with phonetic shape /wa-/. In the following derived nouns, however, we see that this prefix loses its vowel when appearing before prefixes of Class 2:

/káɣa/	"to make, cause to be"
/wókaɣe/	"a creation"

/kté/	"to kill"
/wókte/	"a slaughter, massacre"
/č'ap'á/	"to stab"
/wíč'ap'e/	"a fork"
/natáka/	"to bar a door"
/wínataka/	"a lock"

If we assume that the underlying form of the instrumental noun /wínataka/ is something like #wa+i+na+taka#, then a vowel deletion rule is required to remove the first vowel of the sequence. We see that this rule, unlike the two vowel deletion rules of the preceding section, must apply <u>after</u> the rule of STRESS MOVEMENT, in order to produce primary stress on the initial syllable of the phonetic representation.

Glide epenthesis processes are not as frequent as those deleting vowels. As an example of a glide epenthesis process we cite the behavior of certain sequences of the locative prefixes of Class 4:

/kašká/	"to tie, bind"
/ʔakáška/	"to tie upon"
/ʔiyákaška/	"to tie one thing to another"
/hą́/	"to be standing"
/ʔahą́/	"to be standing on something"
/ʔiyáhą/	"to climb a hill and stand"

/-p'á/ "to hit, strike"

/ʔap'á/ "to strike something"

/ʔiyáp'a/ "to strike against something"

/č'óza/ "to be warm"

/ʔoč'óza/ "to be warm inside"

/ʔiyóč'oza/ "to be warm in something, as a coat"

/kalá/ "to scatter something"

/ʔokála/ "to scatter into"

/ʔiyókala/ "to empty into"

/-hą́/ "to boil"

/ʔohą́/ "to boil in a container, cook"

/ʔiyóhą/ "to boil one thing with another"

If we assume that the underlying representation of /ʔiyóhą/ is something like #i+o+ha#, then a phonological rule to insert the epenthetic y must be incorporated into the grammar.

The "collapsing" of vowels is also less frequent than vowel deletion. It most frequently occurs in derived environments, where a vowel sequence has been created by deletion of an intervening consonant. As an example of this phenomenon, note the following:

/waksá/ "to cut"

/wayáksa/ "you (sng.) cut it"

/wakíksa/ "to cut one's own"

/wayéksa/ "you (sng.) cut your own"

Assuming that the underlying representation of the last form is something like #wa+ya+ki+ksa#, we require a rule to delete the first k and a rule to subsequently "collapse" the resulting a + i sequence into e.

In some environments vowel sequences are unaffected by any of these processes; e.g., some of the sequences of prefixes from Class 4 appear as phonetic vowel sequences:

/ʔixpéya/ "to throw away, discard"

/ʔóixpeya/ "to throw into"

/ʔixáxa/ "to laugh at"

/ʔóixaxa/ "to scorn, ridicule"

/ʔiyákaška/ "to tie one thing to another"

/ʔóiyakaška/ "to tie one thing into another"

If the last form has an underlying representation like #o+i+a+ka+ška#, then the glide epenthesis rule, as noted above, must apply to the i + a sequence; it may not affect the o + i sequence, however.

As the "vowel collapsing" phenomenon can be more readily dealt with in conjunction with those processes which delete consonants, we defer discussion of it until a later time. The remainder of this section is given to developing arguments for specific formalizations of vowel deletion and glide epenthesis rules; we show that the facts require several discrete deletion rules and two separate epenthesis rules for adequate treatment. Since these various rules all exhibit "mutual bleeding" relationships, in that each can potentially remove input from the others, we are confronted with the problems of determining the factor or factors responsible for differential application and interaction. Although we concentrate our attention on prefix sequences, the behavior of some suffixes is also treated here.

We begin by formalizing a rule which deletes the vowel of the first and second person stative agreement markers when they appear before a second prefix vowel. As previously observed, the first person stative prefix normally appears as phonetic /ma-/ and the second person stative prefix as phonetic /ni-/:

Theme	Gloss	First Person	Second Person
/waksá/	"to cut"	/wamáksa/	/waníksa/
/yaxtáka/	"to bite one"	/mayáxtaka/	/niyáxtaka/
/ʔap'á/	"to strike, hit"	/ʔamáp'a/	/ʔaníp'a/
/k'uté/	"to shoot at"	/mak'úte/	/nič'úte/
/kté/	"to kill"	/makté/	/nikté/
/č'uwíta/	"to feel cold"	/mač'úwita/	/nič'úwita/
/šíča/	"to be bad"	/mašíča/	/nišíča/

With the reflexive construction, however, these prefixes appear without their vowels:

Theme	Gloss		
/waíčiksa/	"to cut oneself"	/wamíčiksa/	/waníčiksa/
/ʔigláxtaka/	"to bite oneself"	/migláxtaka/	/nigláxtaka/
/ʔaíčip'a/	"to hit oneself"	/ʔamíčip'a/	/ʔaníčip'a/
/ʔičíkte/	"to kill oneself"	/mičíkte/	/ničíkte/

The stress patterns of these forms reveal that the process which deletes the prefix vowel, like A-DELETION and I-DELETION, must precede the rule of STRESS MOVEMENT; if the underlying representation of /mičíkte/ is like #ma+i+kʔi+kte#, then application of STRESS MOVEMENT before the vowel deletion rule would result in the unacceptable */míčikte/. The vowel deletion rule exemplified by the forms on pages 155 and 156 (top), however, must be applied after STRESS MOVEMENT; if the underlying form of /wókte/ "a massacre" is something like #wa+o+kte#, then application of the appropriate vowel deletion rule before STRESS MOVEMENT would result in the unacceptable form */wokté/. Thus we see that different patterns of rule interaction argue in favor of two distinct vowel deletion rules.

The rule at issue here, which we term SYNCOPE, operates only upon the vowels of the stative agreement markers occupying prefix Classes 8 and 9, and only when the second vowel of the sequence is itself in a prefix. Although there are some exceptions, it is generally true that vowel deletion rules are not triggered by stem-initial vowels, other than in compounds. SYNCOPE can thus be formalized as follows:

$$\text{SYNCOPE:} \quad V \longrightarrow \emptyset \Big/ \begin{bmatrix} + \text{son} \\ + \text{con} \end{bmatrix} \_\_ V \qquad \text{Rank: } \%$$

Recall that the boundary % is associated with the instrumental prefixes of Class 12, and thus appears to the immediate "left" of the stem whenever a prefix of that class is present in the string. If we assume that this boundary is the weakest which may occupy this position, then the fact that SYNCOPE is never triggered by stem-initial vowels implies that the rule is ranked by %. Since the * boundary may also occupy the position to the immediate "left" of the stem, our assumption predicts that this boundary is equal to or greater than % in terms of hierarchical strength, and that the SYNCOPE rule must therefore be blocked by it. As we have previously suggested that the * boundary is the weakest of the boundaries occupying the position to the immediate "left" of Class 8, we predict that SYNCOPE may not apply in any prefix of Classes 1 through 7; forms such as /naičiwaza/ "to scratch oneself with the foot", derived from underlying #na*i+kʔi+waza#, support this prediction.

The rule must specify that the consonant preceding the deleted vowel is $[+\text{consonantal}]$ in order to prevent vowel deletion in the active prefixes /wa-/ and /ya-/; although these prefixes may not co-occur with the reflexive construction, we show below that there are other environments in which the active markers may precede a prefix vowel, and that SYNCOPE never applies in such situations. Similarly, the rule must specify that the consonant preceding the deleted vowel is $[+\text{sonorant}]$ in order to prevent vowel deletion in the possessive prefix /ki- /, which can also occur in sequence with a prefix vowel. In order to maximize simplicity we have formalized the rule in such a fashion that it will operate before any prefix vowel; in actuality, however, the only vowel which can occupy the correct environment for this rule is i. This is simply due to the fact that the prefixes of Classes 10 and 11, which are the only potential sources for the "triggering" vowel of the sequence, contain only the vowel i. As noted above, SYNCOPE must be applied before STRESS MOVEMENT; other interactions involving this rule are dealt with later.

To account for the forms presented on pages 155 and 156 (top) we motivate a second vowel deletion rule, termed A-DROP, which removes the a of the prefix in Class 1 before a following vowel. Unfortunately, our formalization of this rule is quite ad hoc, as the behavior of the vowel in question proves extremely refractory under analysis. In some environments the presence or absence of this prefix vowel is completely predictable, while in others it appears that A-DROP is optional, with resulting free variation between phonetic representations. In still other environments the behavior of the vowel is simply unpredictable; as has been noted above, it appears that A-DROP is sensitive to distinctions in the surface syntactic structure that are not at all transparent. In many cases there are subtle differences in meaning between contracted and uncontracted forms, which also indicates the existence of surface structure differences.

The fact that A-DROP applies only to the vowel of the single prefix in Class 1 indicates that it should probably be regarded as a minor rule; we do not treat it so, however, as our formalization requires the setting up of a unique triggering boundary. This boundary, which must separate the vowels of the sequence to be eliminated by A-DROP, thus serves the dual function of acting as a "diacritic" for the rule and serving to trigger the rule in appropriate environments. The _ad hoc_ nature of this arrangement is compounded by our inability to rigorously define the factors which are responsible for the placement of this boundary; once again, we can only plead ignorance of the fine points of surface constituent structure.

We assume that the prefix of Class 1 is associated with two types of phonological boundary, symbolized as ¢ and $, of which the latter is hierarchically stronger. The rule of A-DROP is triggered by the ¢ boundary, but does not apply across the $ boundary. Some precedent for this type of boundary assignment is supplied by Stanley:

> In certain cases, different instances of the same affix morpheme will fall into different affix classes, depending on the stem. Thus, the past tense "d" for the verb "weep" falls in a class associated with a weaker boundary than does the past tense "d" for the verb "peep", since we have more collapsing in "wept" than in "peeped." (Stanley 1971:28)

We would claim that our usage of this device is less _ad hoc_ than that of Stanley's English example, however, in that we assume that the readjustment rules responsible for placing the two boundaries in question do so on the basis of information contained in the surface syntactic structure, rather than through information about individual lexical items. The latter argument, which seems to represent Stanley's position, implies that the speaker of the language must individually learn the effect of particular lexical items with regard to particular affixes. While this may be true in some cases, perhaps in the English example cited by Stanley, it does not seem to be true for our Dakota problem; whatever it is that determines the assignment of these boundaries, information about specific lexical items is surely not relevant. The A-DROP rule applies most frequently when the second vowel of the sequence represents one of the prefixes of Class 2 or Class 4, and it is thus rather unlikely that any lexical properties of the stem would "leak leftward" in such fashion as to play a role in the assignment of the triggering boundary.

The basic generalization about A-DROP was made by Boas and Deloria (1941:6-8), who suggested that the vowel of the Class 1 prefix is always deleted in derived nouns, but is deleted in verbs only when there is a "special meaning" attached to the construction. There are many exceptions to this generalization, however, and it appears to be an oversimplification of a complex set of phenomena. One slight refinement improves the generalization considerably: A-DROP applies whenever the Class 1 /wa-/ prefix is affixed to a string which is already dominated by a noun node of some type. In other words, A-DROP always applies when the /wa-/ marker is prefixed to a noun, but it may or may not apply if the /wa-/ marker itself performs a nominalizing function. For example, A-DROP always applies in the few cases where the /wa-/ prefix precedes a vowel-initial noun stem:

/ʔitká/	"seed, egg, capsule"	/wítka/	"an egg"
/ʔik'ą́/	"tying strings"	/wík'ą/	"a rope"

Similarly, A-DROP always applies when the second vowel of the sequence represents one of the nominalizing prefixes of Class 2. With the prefix +o+, the marker of derived abstract nouns, A-DROP applies to produce the initial syllable <u>wó</u>, as shown by the following words:

/wašté/	"good"	/wówašte/	"goodness"
/naxʔų́/	"to hear"	/wónaxʔų/	"information"
/ʔináxni/	"to hurry"	/wóinaxni/	"haste"
/kakíža/	"to suffer"	/wókakiže/	"suffering"
/patą́/	"to save"	/wópatą/	"saving"

Before the prefix +i+, the marker of derived instrumental nouns, A-DROP applies to produce the initial syllable <u>wí</u>:

/kasléča/	"to split"	/wíčasleče/	"a wedge"
/kį́/	"to carry"	/wíčį/	"a pack-strap"
/pažúžu/	"to erase"	/wípažužu/	"an eraser"
/yatką́/	"to drink"	/wíyatke/	"a cup"
/yuskíča/	"to wring out"	/wíyuskiče/ →	"a wringer"

Stress on the initial syllable of these forms indicates, of course, that A-DROP must apply after STRESS MOVEMENT.

Some constructions in which there is apparent optionality of application for A-DROP can probably be accounted for in terms of this refinement of the Boas-Deloria generalization. For example, the underlying form #wa+a+ka+xpa# has three surface representations, depending upon the function of the prefix /wa-/ and the constituent structure of the form:

/ʔakáxpa/	"to cover something"	/waákaxpa/	"to cover"
/ʔakáxpa/	"to cover something"	/waákaxpe/	"a covering"
/ʔakáxpe/	"a cover"	/wákaxpe/	"a cover"

The three forms on the right are explicable if we assume that, in each case, the prefix /wa-/ is affixed to the form on the left. Better underlying representations for the derived forms might then look like the following:

$$\left[_V \#wa \ \left[_V \$a{+}ka\%xpa\right]_V\right]_V$$

$$\left[_N \#wa \ \left[_V \$a{+}ka\%xpa\right]_V\right]_N$$

$$\left[_N \#wa \ \left[_N ¢a{+}ka\%xpa\right]_N\right]_N$$

If we assume the existence of a readjustment rule which weakens the # boundary after /wa-/ to ¢ in a noun, but $ in a verb, then A-DROP will apply correctly in the forms given. The two nouns have slightly different meanings, indicating that some distinction between them in terms of surface constituent structure is highly likely. The form /waákaxpe/ seems to be less specific than /wákaxpe/; the former means something like "a covering for it", while the latter means something like "its (usual) covering". Other forms that might be handled in the same way are:

/ʔawą́yąka/	"to watch over"	/waáwąyąka/	"to watch over"
/ʔawą́yąka/	"to watch over"	/waáwąyąke/	"a watchman"
?		/wáwąyąke/	"a policeman"

In this case, though, the expected nominal form */ʔawą́yąke/ "a watchman, overseer" does not occur in our data.

The generalization regarding nouns gives us no insight into the behavior of verbs, however. It is clear that our suggested triggering boundary does appear in verbs, and rather more frequently than the "special meaning" hypothesis of Boas and Deloria would indicate. In all fairness, it must be noted that Boas and Deloria did remark on the "irregular" behavior of verbs with the /o-/ prefix of Class 4:

> The prefix wa- designates an indefinite object and is used with transitive verbs, corresponding to the English intransitive forms of verbs that are ordinarily transitive. ... When the verb begins with a vowel idiomatic use requires sometimes contracted, sometimes uncontracted forms. Verbs with initial a or i contract only when they have a special meaning. Verbs with initial o behave much more irregularly. The contracted forms are in meaning firmer units than those not contracted. They express a habitual occupation and are for this reason often more specific than the uncontracted forms. (Boas and Deloria 1941:52)

As examples of the distinction between contracted and uncontracted forms, we offer the following:

/waóčʼį/	"to beg for things"	/wóčʼį/	"to be a beggar"

/waóhą/	"to cook things"	/wóhą/	"to cook"
/waágli/	"to bring things home"	/wágli/	"to bring game"
/waák'ita/	"to look about for"	/wák'ita/	"to look around"
/waíxpeya/	"to discard things"	/wíxpeya/	"to give away"
/waíyųɣa/	"to inquire, ask"	/wíyųɣa/	"to question"
/waíyap'e/	"to lie in wait"	/wíyap'e/	"to ambush"

In general, it does seem to be the case that uncontracted forms have more "generalized" meanings and contracted forms have more "specialized" meanings. With the prefix /o-/, however, the contracted forms are much more frequent than the uncontracted ones, and the readjustment rule assigning the ¢ boundary must account for this in some way.

It is at just this point, of course, that analysis breaks down. We are unable to actually formulate an appropriate readjustment rule for the verbal forms. As previously suggested, we assume that this rule is sensitive to distinctions in surface constituent structure, but are unable to offer any concrete suggestions as to what those distinctions might be. We offer the following formalization for the rule of A-DROP itself:

$$\text{A-DROP:} \quad a \longrightarrow \emptyset \;/\; \_\_\_\,\text{¢}V$$

With our inability to formulate specific principles for the assignment of the ¢ and $ boundaries, the A-DROP rule is circular; the rule applies just when the ¢ boundary is present, but we assume that the boundary is present, in verbs at least, just when A-DROP applies. It is to be hoped that more detailed investigations of the behavior of the /wa- / prefix in verbal forms will shed more light on these problems.

A third rule deleting the first of two vowels in sequence is also required to account for the behavior of certain prefixes. This rule, which we call EQUI-VOWEL DELETION, applies only when the vowels in sequence are identical. Like A-DROP, its application must follow that of STRESS MOVEMENT; this order, coupled with the relatively low rank of the rule, has the consequence that the second vowel of the sequence usually bears primary stress, and application of the rule thus tends to produce words with the primary stress on the initial syllable. As mentioned previously, sequences of the prefixes in Classes 2 and 4, each consisting of a single vowel, are normally not subject to vowel deletion processes. This is obviously due to the fact that, all else being equal, the underlying representation of a string in which such a deletion had taken place would not be recoverable. Stress on the initial syllable of a word, however, is a "marked" pattern in all but those few words consisting of a single stem; such a "marked" pattern allows recoverability after the application of a deletion rule <u>just</u> in the case where the vowels of the affected sequence are the same. That EQUI-VOWEL DELETION does apply in such sequences is indicated by the following forms:

/ʔákablaya/	"to spread out over"
/ʔákatį/	"to straighten out on"
/ʔákič'izuya/	"to make war on one another"

/ʔástoya/	"to smooth down upon"
/ʔíyuxmį/	"to be distorted"
/ʔíyotaka/	"to sit down"
/ʔíwoɣaɣa/	"a rifle"
/ʔínatą/	"to press upon with the foot"
/ʔónataka/	"to lock up in"
/ʔókaɣa/	"to float in"
/ʔógmuza/	"to be shut in"

If the first vowel of the sequence is from prefix Class 2, however, the rule of EQUI-VOWEL DELETION is blocked:

/ʔognáka/	"to place in"	/ʔoógnake/	"a holder"
/ʔohą́/	"to boil in"	/ʔoóhe/	"a boiling"
/ʔohíya/	"to win"	/ʔoóhiye/	"victory"
/ʔokšú/	"to load"	/ʔoókšu/	"a load"
/ʔoyáka/	"to tell, relate"	/ʔoóyake/	"a narrative"

The form /ʔíwoɣaɣa/ "a rifle" is apparently an exception to this generalization.

The rule can be formalized in the following fashion:

EQUI-VOWEL DELETION: $V_\alpha \longrightarrow \emptyset \;/\; \overset{\rightarrow}{\_\_\,V_\alpha}$ Rank: %

Since the rule never applies when the second vowel of the sequence is in a stem, we can safely assume that % is its appropriate ranking boundary.

Although in our discussion here we have utilized this rule only to collapse sequences of identical prefixes from Class 4, constructions which are rare at best, we show below that EQUI-VOWEL DELETION is a crucial rule in other derivations.

We conclude our discussion of vowel deletion processes by formulating a minor rule to account for the idiosyncratic behavior of the vowel in the suffix /-pi/, a general pluralizer. This vowel is always deleted before a following vowel, the suffixes of Classes 18 and 19 providing appropriate environments. The rule is as follows:

$$\text{(M) I-DROP:} \quad i \longrightarrow \emptyset \;/\; p \_\_ V$$

We assume that the suffix /-pi/ is marked with a rule feature [+ I-DROP] which triggers this minor rule. Examples of its effect are:

/mak̓úwo/	"give it to me (imperative singular)"
/mak̓úpo/	"give it to me (imperative plural)"
/kaškáyo/	"tie it (imperative singular)"
/kaškápo/	"tie it (imperative plural)"
/lé nážįye/	"he is standing here"
/lé nážįpe/	"they are standing here"

We assume that the underlying form of /kaškápo/ is something like #ka%šká+pi+o#, and that the minor rule deletes the i. Although the behavior of this vowel is completely predictable, it is also unique; thus our use of the minor rule apparatus.

Examination of the following forms reveals the operation of a rule which inserts an epenthetic y in certain sequences of prefix vowels:

/ʔalí/	"to climb up"	/ʔiyáli/	"to climb up on"
/ʔakíp'e/	"to wait for"	/ʔiyákip'e/	"to wait for"
/ʔaópemni/	"to roll up in"	/ʔiyáopemni/	"to enshroud"
/ʔonáp'a/	"to flee to"	/ʔiyónap'a/	"to shelter in"
/ʔokátą/	"to drive in"	/ʔiyókatą/	"to nail up"
/ʔoyáza/	"to string, as beads"	/ʔiyóyaza/	"to string"

The vowel sequences in these forms represent sequences of Class 4 prefixes. In the following forms we see that nominal derivations with the prefix /i-/ from Class 2 may also undergo this epenthesis rule:

/kaptá/	"to bail out"
/ʔokápta/	"to dip out into"
/ʔiyókapte/	"a dipper, ladle"
/ʔokáška/	"to tie into"
/ʔiyókaške/	"something to tie with"
/ʔopúskiča/	"to press down in"
/ʔiyópuskiče/	"a ramrod"

/ʔ óštą/	"to insert"
/ʔ iyóštą/	"a cork, stopper"

Other sequences of prefixes from Classes 2 and 4 do not undergo this glide epenthesis rule:

/č'ap'á/	"to stab"
/ʔ ič'áp'a/	"to stab into"
/ʔ aíč'ap'a/	"to stab one thing on another"
/káγa/	"to make, cause to be"
/ʔ ičáγa/	"to grow, spring up"
/ʔ aíčaγa/	"to grow on, produce"
/póγą/	"to blow"
/ʔ ipóγą/	"to exhale"
/ʔ aípoγą/	"to exhale upon"
/k'áta/	"to be hot"
/ʔ ok'áta/	"to be hot inside"
/ʔ aók'ata/	"to be hot on something"
/pemní/	"twisted"
/ʔ opémni/	"to wrap in"
/ʔ aópemni/	"to roll up in"

/xaxá/	"to laugh"
/ʔixáxa/	"to laugh at"
/ʔóixaxa/	"to scorn, ridicule"
/ʔixpéya/	"to throw away, discard"
/ʔóixpeya/	"to throw into"
/glé/	"to put, place"
/ʔaglé/	"to place on"
/ʔóagle/	"a place of holding or resting something"
/ʔiyá/	"to talk"
/ʔáiya/	"to talk about, speak evil of"
/ʔóaiye/	"slander"
/ʔakáxpa/	"to cover something"
/ʔóakaxpe/	"a cover for something"

These examples exhaust the possible combinations of distinct prefixes from Classes 2 and 4. We see that the rule which inserts y into the phonetic string does so only after i and before a back vowel. The rule of Y-EPENTHESIS can thus be formulated as follows:

$$\text{Y-EPENTHESIS:} \quad \emptyset \longrightarrow y \Big/ \; i\,\_\_ \begin{bmatrix} V \\ +\,\text{bck} \end{bmatrix} \qquad \text{Rank: } \%$$

Here again we have a rule which does not apply across any boundary which may appear to the immediate "left" of the stem; as the % boundary seems to be the weakest boundary to occupy this position, we assume that it is the appropriate ranking boundary. In actuality, the effect of the rule is restricted to just the environments exemplified above.

A second glide epenthesis rule is required to predict the behavior of the suffixes in Classes 18 and 19. As these suffixes are but weakly attached to the verb complex, we assume that the epenthesis rule which inserts a glide before them in some environments is triggered by a fairly strong boundary, symbolized ≠. This rule, which we call GLIDE EPENTHESIS, is distinctly different from the Y-EPENTHESIS rule in that it inserts an appropriate semivowel between any two vowels separated by the ≠ boundary. Examples of the operation of this rule are provided by:

/híye ló/	"he has come here (male speaking)"
/ʔap'éye lé/	"he is waiting (female speaking)"
/ʔúwe ló/	"he is coming (male speaking)"
/maɣážu wé/	"it is raining (female speaking)"

(We write these forms as two words to conventionally emphasize the enclitic nature of the predicative suffixes; their primary stress is produced by a rule which secondarily stresses any Class 18 or 19 affix in sentence-final position.) We assume that the form which underlies /híye ló/ is something like #hí≠e+lo#, and that GLIDE EPENTHESIS is the source of the phonetic y. Similarly, we assume that the form which underlies /ʔúwe ló/ is something like #ú≠e+lo#, and that the phonetic w is also epenthetic. Our claim that the affix of Class 18 has no semivowel in its underlying representation is supported by two arguments. First, this suffix triggers the minor rule I-DROP, as seen in the form /hípe ló/ "they have come here (male speaking)", where the underlying representation must be like #hí+pi≠e+lo#. If the underlying representation were like #hí+pi≠ye+lo#, it would be difficult to derive the phonetic form in any natural fashion. Second, this suffix also triggers another vowel deletion rule, discussed below, which removes some phonetic _e_; _e.g._, in the form /ʔúkte ló/ "he will come (male speaking)" the underlying representation is presumably something like #ú+kta≠e+lo#, where the underlying _a_ is converted to _e_ by a regular ablaut rule and the resulting _e_ is then deleted. Again, were we to assume that the underlying representation of this form is something like #ú+kta≠ye+lo#, the phonetic representation would prove difficult to derive. We note also that the grammar resulting from this choice of underlying form is no more complex than any resulting from the opposite choice, as some rule to account for the _y_∼_w_ alternation is required in any case.

By using an alpha convention with this rule, we are able to insert the glide and specify its roundness and backness simultaneously:

$$\text{GLIDE EPENTHESIS:}\quad \emptyset \longrightarrow \begin{bmatrix} +\text{son} \\ -\text{syl} \\ -\text{con} \\ \alpha\,\text{bck} \\ \alpha\,\text{rnd} \end{bmatrix} \Big/ \begin{bmatrix} \text{V} \\ \alpha\,\text{rnd} \end{bmatrix} \_\_ \neq \text{V}$$

Thus we predict correctly that rounded vowels (_u_, _ʉ_, and _o_) are followed by w in the epenthesis environment, and the unrounded vowels (i, ɨ, e, a, and ạ) are followed by y. The rule must be ordered after the minor rule I-DROP, and after the ablaut and e-deletion rules, which are discussed and formalized at a later point.

In summary, sections 3.2 and 3.3 have developed a number of rules required to account for vowel deletion phenomena, particularly vowel deletion in prefixes. Although these rules do not exhaustively account for vowel deletion processes, they do represent the most common and transparent processes of the type. Other vowel deletion processes, motivated in later sections, tend to be more "specialized" and complex; they are also of considerably greater interest from the standpoint of phonological theory. The other rules developed here are largely word-level rules of very general application, which will figure in the majority of the derivations to be presented in subsequent sections of this work.

We have also developed, at least tentatively, a series of seven phonological boundaries; in order of ascending hierarchical strength they are symbolized as +, %, *, ¢, $, ≠, and #. Their positions within the verbal complex can be represented as follows:

$$\#1¢2\left\{\begin{matrix} ¢ \\ \$ \end{matrix}\right\}4+5+6+7*8+9+10+11+12\%\mathrm{STEM}+13+14+15+16+17\neq 18+19\#$$

(Although the compound boundary, symbolized as =, has been mentioned here, we defer discussion of its function and hierarchical strength until a later time.) Recall that the theory of boundary placement adopted here assumes the existence of affix "classes" whose constituent members all determine the same phonological boundary; e.g., our grammar thus far assumes that the prefixes of (morphological) Classes 4, 5, 6, and 7 all determine the following boundary *. In sequence with one another these affixes are separated only by the formative boundary, but the last affix of such a sequence must be followed by the * boundary. (In the case of suffix classes, of course, it is the preceding boundary which is so determined.) The readjustment rules would thus take a construction like #6#8#10#STEM#18# and weaken the internal # boundaries to form the modified representation of #6*8+10%STEM≠18#; the phonological rules proper would then apply to derive the surface phonetic representation.

3.4 A Preliminary Formulation of Velar Palatalization

In section 2.3 above we offered a body of data motivating a rule of velar palatalization. This data showed that, in many environments, an intervocalic velar stop is palatalized to an alveo-palatal affricate when the preceding vowel is non-back. We now present additional data on this process, and develop a tentative formalization of the VELAR PALATALIZATION rule; we also develop here several other rules that are relevant to the formalization of VELAR PALATALIZATION, and discuss their interactions.

The data presented in section 2.3 showed the application of VELAR PALATALIZATION in active transitive verbs. The process is ubiquitous in such forms, as exemplified by the following brief paradigm:

/k'uwá/	"to chase"
/č'ič'úwa/	"I chased you (sng.)"
/nič'úwa/	"he chased you (sng.)"
/ʔič'úwa/	"something to hunt with"
/kič'úwa/	"to chase one's own"
/ʔič̓íč'uwa/	"to chase oneself"
/kič'íč'uwapi/	"they chased each other"
/kíčič'uwa/	"he chased it for him"

It thus appears that most of the i-final verb prefixes will trigger the palatalization of a stem-initial velar stop, provided that it is followed by a vowel. The single exception to this generalization is the benefactive prefix /ki-/:

/kik'úwa/	"he chased it for him"
/kik'úte/	"he shot at it for him"
/kikáɣa/	"he made it for him"
/ʔokí̓ka/	"he dug (a hole) for him"

The forms /kíčič'uwa/ and /kik'úwa/ represent two distinct types of benefactive constructions, the first of which triggers palatalization, while the second does not. Of great interest, however, is the fact that the constructions of the second type do exhibit palatalization of a velar stop at the beginning of the stem if the benefactive /ki-/ prefix has itself been palatalized:

/kik'úwa/	"he chased it for him"
/wakík'uwa/	"I chased it for him"
/makík'uwa/	"he chased it for me"
/nič́ič'uwa/	"he chased it for you (sng.)"
/č'ič́ič'uwa/	"I chased it for you (sng.)"

Although the various possessive and benefactive constructions are examined in greater detail in the following section, it is clear from the cited forms that VELAR PALATALIZATION is a rule which "propagates rightward" in some fashion.

Other data reveals that the only stems which are subject to palatalization of initial velar stops are active verb stems. Stative verb stems never undergo VELAR PALATALIZATION:

/k'áta/	"to be warm"	/nik'áta/	"you are warm"
/k'úža/	"to be ill"	/nik'úža/	"you are ill"
/kį́za/	"to be squeaking"	/nikį́za/	"you are squeaking"

Such stems do not palatalize even when actively derived, nor do they exhibit the "rightward propagation" effect shown above:

/kį́za/	"to be squeaking"
/nanikį́za/	"he makes you squeak by kicking"
/k'áta/	"to be warm"
/naíčik'ata/	"to warm oneself by stamping, or running"
/-k̓éɣa/	"to be scratched"
/naíčik̓eɣa/	"to scratch oneself with the foot"

Although noun stems rarely occur in palatalizing environments, the few known cases show that they are also not subject to VELAR PALATALIZATION:

/k'ą́/	"string, sinew, vein, nerve"
/ʔik'ą́/	"tying strings"
/wík'ą/	"rope"
/k'ų́ši/	"grandmother"
/nik'ų́ši/	"your grandmother"

Numerous examples of locative adverbials reveal that particle stems are not subject to the palatalization process, either:

/k'iyéla/	"near"
/ʔik'íyela/	"near to"
/k'ap'éya/	"exceeding"
/ʔik'áp'eya/	"exceeding by"

Boas and Deloria (1941:14) claimed that active intransitive verb stems also do not palatalize, thus casting doubt on their earlier claim that it is the active-stative dichotomy in verbs which determines the applicability of the palatalization rule. The only example which they cited, however, is the compound /č'ap'éku/ "to come back from stabbing", derived from the stems /č'ap'á/ "to stab" and /kú/ "to return coming (durative)". The e is here derived from underlying a by an ablaut rule; it is normally the case that e derived by ablaut does not trigger velar palatalization (although a very interesting exception to this generalization is discussed below). A more instructive example is afforded by the compound /gličú/ "to return coming (inceptive)", derived from the stems /glí/ "to return coming (perfective)" and /kú/ "to return coming (durative)". In this form we see that VELAR PALATALIZATION applies to an active intransitive stem; as noted previously, however, the verbs of motion behave exceptionally in some ways, so that the example is not totally unambiguous. We are again hampered by a great paucity of examples, since active intransitive stems do not normally occur in palatalizing environments. In the absence of clear examples to the contrary, however, it seems best to assume that all active verbs are subject to the rule. Thus we argue that active stems are all subject to VELAR PALATALIZATION, while stative stems, noun stems, and particle stems are not.

Thus far our examples of the effect of VELAR PALATALIZATION have contained only i as the triggering vowel. Forms containing demonstrative particles reveal that underlying e also triggers the rule:

/kák'el/	"that way"
/héč'el/	"that way"
/léč'el/	"this way"
/kák'iya/	"over there somewhere"
/héč'iya/	"over there"
/léč'iya/	"over here"

These forms also suggest that particle suffixes (or compounds) provide appropriate input to the palatalization rule.

Before proceeding further, it must be made clear that VELAR PALATALIZATION is a rule of bewildering complexity; we cannot even safely assume that there is only one rule involved. Although many of the complicating factors are discussed in later sections of this work, we note at this point that our final analysis does not adequately handle the palatalization phenomenon. Many exceptional forms and apparent counterexamples to our generalizations can be found in the Buechel dictionary; once again, whether or not a form exceptionally undergoes VELAR PALATALIZATION seems correlated with slight differences in meaning, presumably a reflection of differences in surface syntactic structure. The rule also exhibits global application in some environments: as noted previously, the rule is not triggered in most environments by an e derived from underlying a, but there is one environment where the rule is triggered only by such a vowel. The rule also interacts with the reduplication rule in an interesting fashion: if VELAR PALATALIZATION appropriately applies to the first "stem" of a reduplicated form, then it also applies to the second, irrespective of whether or not its structural index is met by the second environment.

For the present, we offer the following tentative formalization of the VELAR PALATALIZATION rule:

$$\text{VELAR PALATALIZATION:}\quad \begin{bmatrix} -\ \text{son} \\ -\ \text{syl} \\ +\ \text{con} \\ +\ \text{bck} \\ -\ \text{cnt} \end{bmatrix} \longrightarrow \begin{bmatrix} +\ \text{cor} \\ -\ \text{bck} \\ +\ \text{dlr} \\ +\ \text{VPT} \end{bmatrix} \Big/ \begin{bmatrix} \text{V} \\ -\ \text{bck} \end{bmatrix} \_\_ \text{V}$$

Rank: @

To account for the "rightward propagation" phenomenon we admit the ad hoc device of letting the rule change the value of a rule feature; we assume that the benefactive prefix is marked with a rule feature [- velar palatalization trigger] (abbreviated to VPT in the statement of the rule), and that application of VELAR PALATALIZATION changes the value of this feature. Thus the benefactive prefix cannot trigger the rule unless it has first been affected by it; this device obviously must permit iterative application of the VELAR PALATALIZATION rule. Indeed, it is difficult to imagine how this particular phenomenon could be handled without permitting the rule to apply iteratively.

Similarly, the ranking boundary @ is a device to block application of VELAR PALATALIZATION before all but active verb stems. It is assumed that a readjustment rule places this boundary before all stative verb stems, noun stems, and particle stems, and that it places the usual # boundary before all active verb stems. The # boundary is then subject to later "weakening" rules, while the @ boundary is not. We must then also assume that most of the "weakened" versions of the # boundary are hierarchically weaker than the @ boundary, since most of the former do not block VELAR PALATALIZATION.

Since our rule must apply to all velar stops in the appropriate phonological environments, irrespective of whether they are medial, aspirate, or ejective, VELAR PALATALIZATION must be ordered after the rules which are responsible for producing the aspirate and ejective stops from underlying consonant sequences. These rules can be formalized as follows:

$$\text{EJECTION:}\quad \begin{array}{cc} \begin{bmatrix} -\text{ son} \\ -\text{ syl} \\ +\text{ con} \\ -\text{ cnt} \end{bmatrix} & ʔ \\ 1 & 2 \end{array} \longrightarrow \begin{bmatrix} 1 \\ +\text{ ejc} \end{bmatrix} \quad \emptyset \qquad \text{Rank: } =$$

$$\text{ASPIRATION:}\quad \begin{array}{cc} \begin{bmatrix} -\text{ son} \\ -\text{ syl} \\ +\text{ con} \end{bmatrix} & \text{x} \\ 1 & 2 \end{array} \longrightarrow \begin{bmatrix} 1 \\ +\text{ hsp} \end{bmatrix} \quad \emptyset \qquad \text{Rank: } \%$$

The rank of % given to ASPIRATION prevents it from forming aspirates across stem boundaries; as noted above, stem-initial <u>x</u> is deleted after the first person plural prefix /ų̨k-/ by a phonological rule, whereas stem-initial ʔ forms ejective k̓ after this prefix. We have already cited such forms as /ʔų̨k̓ópi/ "we shot it", derived from underlying #uk%ʔo+pi#, in support of our contention that ejectives are derived from underlying consonant sequences. Additional support is provided by the interesting form /wéč̓ų̨/ "I used my own", presumably derived from underlying #wa+ki+ki%ʔų̨#, where the two /ki-/ prefixes are possessives. The ejective must come from the "overapplication" of I-DELETION to the second /ki-/ prefix, followed by EJECTION and VELAR PALATALIZATION. That the stem /ʔų̨́/ "to use" contains an organic glottal stop is indicated by the form /ʔų̨k̓ų̨́pi/ "we used it". Such forms are discussed in more detail in the following section.

The rule which deletes the k of the prefix /ų̨k-/ must be formalized as a minor rule, since k does not delete before a consonant in any other environment. Only the k of this specific morpheme is deleted in this fashion. We thus claim that the prefix /ų̨k-/ is marked with a rule feature $\left[+\text{ K-DROP}\right]$, and formalize the deletion rule as follows:

(M) K-DROP: $\quad k \longrightarrow \emptyset \;/\; \_\_\, C$

The behavior of the final k in this prefix is thus treated as being completely idiosyncratic. The minor rule K-DROP must be ordered after the rule of EJECTION to correctly derive the forms cited above.

Derivations with reflexive constructions are most revealing with regard to the interaction of VELAR PALATALIZATION with other rules.

In the following derivations of /mič̓íč'uwa/ "I chased myself" and /migláxtaka/ "I bit myself" we observe that VELAR PALATALIZATION must follow I-DELETION and GLOTTAL DELETION, since EJECTION must follow GLOTTAL DELETION but precede VELAR PALATALIZATION:

	#ma+i+kʔi%kxuwá#	#ma+i+kʔi+ya%xtáka#
I-DELETION	inapplicable	#ma+i+kʔ +ya%xtáka#
SYNCOPE	#m +i+kʔi%kxuwá#	#m +i+kʔ +ya%xtáka#
STRESS MOVEMENT	#m +i+kʔí%kxuwa#	#m +i+kʔ +yá%xtaka#
GLOTTAL DELETION	inapplicable	#m +i+k +yá%xtaka#
EJECTION	#m +i+k̓ í%kxuwa#	inapplicable
ASPIRATION	#m +i+k̓ í%k'uwa#	inapplicable
VELAR PALATALIZATION	#m +i+č̓ í%č'uwa#	inapplicable
LATERALIZATION	inapplicable	#m +i+k +lá%xtaka#
STOP VOICING	inapplicable	#m +i+g +lá%xtaka#
	/mič̓íč'uwa/	/migláxtaka/

Other orderings in this derivational sequence are strictly tentative, and are further elaborated in the following section.

3.5 Possessives and Benefactives

We turn now to a more thorough analysis of the phonological behavior of the possessive and benefactive prefixes, both of which have the underlying representation +ki+. The various constructions which contain one or more instances of these prefixes are especially revealing, both substantively and theoretically. It is in such constructions that we have our clearest empirical support for certain rule interactions, particularly the existence of a rule cycle. We note also that one of the rules needed to account for some of these forms is apparently global, in that it applies only in a particular type of derived environment; of theoretical interest is the fact that Kiparsky's (1973) suggested constraints on the global application of phonological rules do not correctly predict the behavior of this rule.

Simple possessive forms, when not inflected for person or number, show the prefix /ki-/ before the verb stem; since the possessive /ki-/ is subject to I-DELETION, it also appears as /k-/ or /g-/ in many forms. When such forms are inflected for person and number, however, the form of the possessive prefix may be obscured:

/wékte/	"I killed my own"
/yékte/	"you (sng.) killed your own"
/ikté/	"he killed his own"
/ʔųkíktepi/	"we killed our own"
/yéktepi/	"you (pl.) killed your own"
/kiktépi/	"they killed their own"

When following /wa-/ "first person singular active" or /ya-/ "second person active" the possessive /ki-/ seems to "disappear", its presence in the phonological string being preserved in the change of a to e, and in the position of primary stress. If the underlying form of /wékte/ is something like #wa+ki%ktè#, which seems to be the only logical choice, then it appears that two phonological rules are required to produce the correct phonetic representation, one to delete the intervocalic k and one to "collapse" the resulting a + i sequence to phonetic e.

It might be argued that the process which maps underlying aki into phonetic e is unitary, since only the possessive prefix is subject to the suggested rule deleting k, and since, with few exceptions, the contraction of a + i to phonetic e occurs only where an intervening k has been deleted. We show below, however, that the k-deletion and vowel contraction processes interact differently with other phonological rules; the process deleting k must be permitted to occur before the application of SYNCOPE, and the process contracting the vowels can provide the correct stress pattern only if it occurs after STRESS MOVEMENT. Since SYNCOPE must apply before STRESS MOVEMENT, we see that the k-deletion and vowel contraction processes are separated by at least two other rules.

A brief digression at this point also reveals evidence for treating the "vowel collapse" phenomenon independently. Note the following:

/wókpą/	"to grind fine"	/wablúkpą/	"I ground it"
/wóksa/	"to cut things"	/wablúksa/	"I cut them"
/wópta/	"to cut skin into shape"	/wablúpta/	"I cut it"

/wóšpi/ "to pick berries" /wablúšpi/ "I pick them"

The underlying form of /wókpą̧/ thus appears to be #wa+yu+kpą̧#, with the phonetic wo sequence being a contraction. Again it appears that two phonological rules are required, one to delete the intervocalic y and one to collapse the a + u sequence into phonetic o. The two vowel sequences that are subject to this "collapsing" phenomenon, a + i and a + u, are quite obviously parallel; since they behave in the same way in rule interactions, there is nothing to prevent the formulation of a single phonological rule to cover both cases. The k-deletion and y-deletion processes, however, are quite distinct, and cannot be merged into a single rule schema.

The Y-DELETION rule can be formulated as follows, using the same convention of two possible boundaries after the Class 1 prefix that was used in formulating A-DROP:

Y-DELETION: $y \longrightarrow \emptyset \,/\, ¢\_\_u$

The Y-DELETION rule behaves almost exactly like A-DROP, in that its application marks a "special meaning" for the construction which undergoes it. (Cf. Boas and Deloria 1941:9) Just as in the case of A-DROP, we assume that the Class 1 prefix /wa-/ in verbs is separated from what follows by the \$ boundary, and it is only in certain forms, presumably definable in terms of minor differences in surface syntactic structure, that the # boundary is weakened to ¢ in this environment.

The K-DELETION rule, however, can be formalized as follows:

$$\text{K-DELETION:} \quad k \longrightarrow \emptyset \Big/ \begin{bmatrix} V \\ -\text{nas} \end{bmatrix} \_\_ i \qquad \text{Rank: } \%$$

The ranking boundary % limits this rule, once again, to the group of prefixes immediately preceding the stem. The deleted k can be preceded by either a or i, but not by u, as the final k of the prefix /ųk-/ may not be deleted by this rule. Just as the benefactive prefix /ki-/ cannot undergo I-DELETION, so it is also exceptional with regard to K-DELETION, as shown by the following:

/kikté/	"to kill for one"
/wakíkte/	"I killed it for him"
/yakíkte/	"you (sng.) killed it for him"
/kikté/	"he killed it for him"
/ʔųkíkte/	"we killed it for him"
/yakíktepi/	"you (pl.) killed it for him"
/kiktépi/	"they killed it for him"

Comparison of these forms with the possessive forms of page 188 shows a lack of homonymy in the first person singular and second person, but homonymy elsewhere. The possessive and benefactive paradigms are thus partially disambiguated by the failure of the benefactive prefix to undergo K-DELETION.

Although the disparate structure and effects of the Y-DELETION and K-DELETION rules prevents their schematization, the "vowel collapsing" processes can be formulated as follows:

$$\text{SYNERESIS:} \qquad \begin{matrix} a & \begin{bmatrix} \text{V} \\ +\ \text{hgh} \\ -\ \text{nas} \end{bmatrix} \\ 1 & 2 \end{matrix} \longrightarrow \emptyset \quad \begin{bmatrix} 2 \\ -\ \text{hgh} \end{bmatrix}$$

This rule is of considerable interest, as it seemingly requires global access to "derivational history"; with few exceptions, SYNERESIS applies only to vowel sequences "created" by the deletion of an intervening consonant. The only examples of SYNERESIS applying to <u>a</u> + <u>u</u> sequences in our data are those noted above, where the vowel sequence is the product of prior application of Y-DELETION. Although the majority of examples of SYNERESIS applying to <u>a</u> + <u>i</u> sequences are in environments "created" by the prior application of K-DELETION, certain exceptions are at present inexplicable. These all seem to reveal that the prefix /a-/ of Class 4 "collapses" with the stem /ʔí/ "to go (perfective)" in some constructions; the form /ʔaí/ "to go (perfective) taking something" shows that this phenomenon does not always occur, however. In general, it appears that the "collapsing" process only operates in certain compounds:

/ʔahít'i/	"to come and make camp"
/ʔak'ít'i/	"to go back and make camp"
/ʔét'i/	"to go there and make camp"

The underlying representations of the first two of these forms should be #a+hi+txi# and #a+kxi+txi#, respectively, from the stems /hí/ "to come (perfective)", /k'í/ "to return going (perfective)", and /t'í/ "to dwell". By analogy with these constructions the third form should have the underlying representation #a+i+txi#, and SYNERESIS must be responsible for the e of the phonetic representation.

However these constructions with the stem /ʔí/ are ultimately explained, it is clear that the basic generalization regarding the "global" nature of SYNERESIS is accurate. Sequences of a + i are extremely numerous, as shown by the following forms with multiple prefixes from Class 4:

/ʔaíč'amna/	"to storm upon"
/ʔaíč'ap'a/	"to stab one thing on another"
/ʔaíxpeya/	"to throw down upon"
/ʔaípoɣą/	"to blow upon"
/ʔaíyokpaza/	"to be darkened"

Other forms show that the prefix /a-/ of Class 4 does not "collapse" with the i of the reflexive construction:

/ʔaíčip'a/	"to hit oneself"
/ʔaíčibleza/	"to understand something about oneself"
/ʔaíčiktašni/	"to neglect oneself"
/ʔaíglaxpa/	"to cover oneself"

/ʔaíglaštą/ "to spill something on oneself"

/ʔaíkpoɣą/ "to blow upon oneself"

Due to the lack of prefixes with initial u, we have only two forms containing the a + u sequence, both with the prefix /a-/ of Class 4 and the stem /ʔú/ "to come (durative)":

/ʔaú/ "to come (durative) bringing something"

/ʔaú/ "to come out on, as resin on trees"

Although two examples are hardly conclusive on this point, the fact that there seem to be no obvious counterexamples supports the over-all contention regarding global application.

On page 64 above we made brief reference to Kiparsky's recent work on neutralization rules. Utilizing data from Finnish and Sanskrit, he has offered the following constraint:

> Non-automatic neutralization processes apply only to derived forms. (Kiparsky 1973:10)

The concept of a "derived form" is defined as follows:

> I will refer to an input which is created either by combining morphemes through derivation or inflection, ... or by applying a phonological rule, ... as a derived input. (Kiparsky 1973:4)

The SYNERESIS rule is clearly a neutralization rule, since it neutralizes underlying ai and underlying e, and underlying au and underlying o. It is also non-automatic, as the sequences ai and au occur in the output of the rule. If this is the case, though, then we see that Kiparsky's suggested constraint on global rule application makes a faulty prediction;

forms such as /ʔaíxpeya/ "to throw down upon", /ʔaíglaxpa/ "to cover oneself", and /ʔaú/ "to come out on" contain derived vowel sequences, and should thus be subject to SYNERESIS. The rule does not, however, apply in those environments where a vowel sequence has been "created" by morphological processes. It applies only in the second of Kiparsky's types of derived environments, that in which a vowel sequence has been "created" by the prior application of some phonological rule. This suggests that the entire notion of "derived environment" needs some refinement; in particular, it appears that the two types of "derived environment" recognized by Kiparsky are actually quite distinct in the way they affect neutralization rules. Another example of a problem with the Kiparsky constraint is presented below, when we look further at the VELAR PALATALIZATION rule.

The following derivations for /wékte/ "I killed my own" and /wagláška/ "I tied my own" reveal some rule interactions:

	#wa+ki%kté#	#wa+ki+ka%šká#
I-DELETION	inapplicable	#wa+k +ka%šká#
K-DELETION	#wa+ i%kté#	inapplicable
STRESS MOVEMENT	#wa+ í%kte#	#wa+k +ká%ška#
SYNERESIS	#w + é%kte#	inapplicable
LATERALIZATION	inapplicable	#wa+k +lá%ška#
STOP VOICING	inapplicable	#wa+g +lá%ška#
	/wékte/	/wagláška/

It is apparent that the phonetic form /wagláška/ will be produced only if I-DELETION precedes K-DELETION; if the opposite order were the case, then the unacceptable form */wéčaška/ would be the result.

As noted in the preceding section, Dakota possesses at least two distinct types of benefactive construction. In the grammar of Boas and Deloria (1941:86-87) these were called the "first dative" and "second dative" constructions, there being a distinct difference in meaning between the two types.

> The possession of the object by the subject, and the indirect objects to, on behalf of, instead of, in place of, are expressed by the prefixes ki and kici. The latter may be by origin a doubled ki, the second k being transformed after i into a c. The form ki- (1st dative) implies action referring to an object belonging to a person different from the subject but without sanction or permission of the owner, for instance, "I take his own without his permission," in other words, an action that reflects in some way upon his interest but performed on the initiative of the subject. The form kici- (2d dative) expresses an action done with permission of the owner of an object, an action done on his initiative or in his place. ... The use of these forms is very irregular. (Boas and Deloria 1941:86-87)

There is good reason to suspect that a part of the apparent irregularity cited by the authors is the result of our faulty understanding of the semantics of benefactive constructions. There are certainly a number of possibilities regarding possession of the direct object of such forms; in English, for example, the sentence "John cut the meat for Sam," is quite ambiguous with regard to the meat's ownership. It seems highly likely that benefactive constructions in Dakota, with their various prefix configurations, are less ambiguous in this respect.

The following paradigm for the verb /k'uwá/ "to chase" shows the two types of benefactive defined by Boas and Deloria, inflected for different combinations of person and number.

First Dative	Second Dative	Gloss
/wakík'uwa/	/wéčič'uwa/	"I chased it for him"
/yakík'uwa/	/yéčič'uwa/	"you (sng.) chased it for him"
/kik'úwa/	/kíčič'uwa/	"he chased it for him"
/ʔųkík'uwapi/	/ʔųkíčič'uwapi/	"we chased it for him"
/č'ičíč'uwa/	/č'íčič'uwa/	"I chased it for you (sng.)"
/mayákik'uwa/	/miyéčič'uwa/	"you (sng.) chased it for me"
/makík'uwa/	/míčič'uwa/	"he chased it for me"
/ničíč'uwa/	/níčič'uwa/	"he chased it for you (sng.)"
/ʔųníčič'uwapi/	/ʔųníčič'uwapi/	"we chased it for you"

The "first dative" consists of simple benefactive forms with the benefactive prefix /ki-/; these forms are all explicable with the rules that we have already developed. The second dative forms, however, are rather more complex, as evidenced by the larger number of segments in their phonetic representations, as well as the varying stress patterns.

Were it not for the initial stress, the third person form /kíčič'uwa/ "he chased it for him" would seem to substantiate the suggestion of Boas and Deloria that the <u>kiči</u> sequence represents a "doubled <u>ki</u>", with subsequent application of VELAR PALATALIZATION. That this form does contain two prefixes with underlying shape +ki+ is obvious; the question is simply one of determining which of the homonymous prefixes of this shape is represented by each. We have thus far implied, however, that initial stress in constructions with prefixes is always the product of some deletion rule which applies after STRESS MOVEMENT; if this generalization is to be maintained, we must motivate an additional syllable for the underlying representation, located between the two apparent +ki+ prefixes. Since only the possessive /ki-/ prefix is subject to K-DELETION, the fact that a "contraction" of the first two underlying syllables of the first person form /wéčič'uwa/ has been produced by this rule indicates that the leftmost +ki+ must be the possessive prefix. Similarly, a form like /wéčiyatką/ "I drank it for him" reveals that the rightmost +ki+ must be the benefactive prefix, since it has not undergone I-DELETION before the instrumental prefix /ya-/. We suggest now that the additional syllable of the underlying form for the third person is the prefix /i-/ of Class 10, an old possessive prefix which is probably non-productive synchronically. We have implied that it is this prefix which is bound to the underlying reflexive +kʔi+ to form the distinctive /ič̓i-/ construction; we show later that such a prefix is also required to account for certain possessive forms in noun paradigms. If we then assume that the underlying form of /kíčič'uwa/ is something like #ki+i+ki%kxuwá#, we are able to account for its initial stress. The form /miyéčič'uwa/ "you (sng.) chased it for me" supports our claim that a prefix +i+ is present in these forms, since here its location is different; the underlying form of this word appears to be something like #ma+i+ya+ki+ki%kxuwá#. The pronominal object agreement marker is followed by the +i+ possessive prefix and the pronominal subject agreement marker is followed by the +ki+ possessive prefix. Derivations for /kíčič'uwa/ and /miyéčič'uwa/ reveal a certain difficulty, however.

	#ki+i+ki%kxuwá#	#ma+i+ya+ki+ki%kxuwá#
K-DELETION	inapplicable	#ma+i+ya+ i+ki%kxuwá#
SYNCOPE	inapplicable	#m +i+ya+ i+ki%kxuwá#
STRESS MOVEMENT	#ki+í+ki%kxuwa#	#m +i+yá+ i+ki%kxuwa#
EQUI-VOWEL DELETION	#k +í+ki%kxuwa#	inapplicable
ASPIRATION	#k +í+ki%k'uwa#	#m +i+yá+ i+ki%k'uwa#
VELAR PALATALIZATION	#k +í+či%č'uwa#	#m +i+yá+ i+či%č'uwa#
SYNERESIS	inapplicable	?
	/kíčič'uwa/	?

Application of SYNERESIS in the derivation of /miyéčič'uwa/ is obviously necessary, yet with the rule sequence adopted would have the effect of deleting the vowel which carries primary stress. If SYNERESIS were to apply <u>before</u> STRESS MOVEMENT, the correct form would be produced. Our derivation of the form /wékte/ on page 195, however, clearly reveals that such an ordering would frequently yield inappropriate forms. That this is not an idiosyncrasy of the form in question is revealed by other derivations, such as those for /ʔųkíčič'uwapi/ "we chased it for him" and /ʔųníčič'uwapi/ "we chased it for you", where the "problem" rule is EQUI-VOWEL DELETION, rather than SYNERESIS:

	#y̧k+ki+i+ki%kxuwá+pi#
STRESS MOVEMENT	#y̧k+kí+i+ki%kxuwa+pi#
EQUI-VOWEL DELETION	?

	#y̧k+ni+ki+i+ki%kxuwá+pi#
K-DELETION	#y̧k+ni+ i+i+ki%kxuwá+pi#
SYNCOPE	#y̧k+n + i+i+ki%kxuwá+pi#
STRESS MOVEMENT	#y̧k+n + í+i+ki%kxuwa+pi#
EQUI-VOWEL DELETION	?

Both of these forms could be easily derived if we were to permit EQUI-VOWEL DELETION to apply <u>before</u> STRESS MOVEMENT; evidence presented in section 3. 3, however, showed that the order adopted here is essential for the production of forms with initial stress. Our derivation of the form /kíčič'uwa/ on page 199 also shows the need for this order. Thus we are faced with an apparent ordering paradox.

There are various simple ways in which one or two of the problem derivations above might be "corrected", but apparently no simple way exists to account for all three. For example, the second of the derivations on this page will proceed correctly if we allow multiple applications of SYNCOPE, since the immediate output of that rule in this form still meets its structural index. This would not account for the first two problem derivations, however. Similarly, both of the forms on this page could be derived without difficulty if we simply assumed that the prefix +i+ is not present in their underlying representations, thus making application of EQUI-VOWEL DELETION unnecessary. Such a "solution" would not account for the first of these problem derivations, however.

That both of these suggestions are incorrect is evidenced by the derivation for the form /níčič'uwa/ "he chased it for you (sng.)":

	#ni+ki+i+ki%kxuwá#
K-DELETION	#ni+ i+i+ki%kxuwá#
SYNCOPE	#n + i+i+ki%kxuwá#
STRESS MOVEMENT	#n + i+í+ki%kxuwa#
EQUI-VOWEL DELETION	#n + +í+ki%kxuwa#
ASPIRATION	#n + +í+ki%k'uwa#
VELAR PALATALIZATION	#n + +í+či%č'uwa#
	/níčič'uwa/

Using the order of rule application adopted above, it is clear that the correct output is produced here only if we assume that the +i+ prefix is present in the underlying form, and if we do not allow multiple application of SYNCOPE. That SYNCOPE must apply in such forms is shown by the derivation of /míčič'uwa/ "he chased it for me":

	//ma+ki+i+ki%kxuwá//
K-DELETION	#ma+ i+i+ki%kxuwá#
SYNCOPE	#m + i+i+ki%kxuwá#
STRESS MOVEMENT	#m + í+i+ki%kxuwa#
EQUI-VOWEL DELETION	#m + +í+ki%kxuwa#
ASPIRATION	#m + +í+ki%k'uwa#
VELAR PALATALIZATION	#m + +í+či%č'uwa#
	/míčič'uwa/

If SYNCOPE did not remove the a of +ma+, then SYNERESIS would later produce the unacceptable string */méčič'uwa/.

The rule responsible for the difficulty in the three problem derivations above is clearly STRESS MOVEMENT. We have tacitly assumed that this rule is to be permitted multiple application, operating on its own immediate output until its structural index is no longer matched by the phonological string. What is required here is that SYNERESIS and EQUI-VOWEL DELETION be permitted to apply between applications of STRESS MOVEMENT; i.e., these three rules must all be allowed to apply cyclically. Note that the idea of a rule shifting the position of primary stress from an "underlying" location does not itself appear to be at fault. If we try to rectify the difficulty by abandoning our rules of STRESS PLACEMENT and STRESS MOVEMENT for an analysis which utilizes a word-level rule to place primary stress, we quickly find ourselves in the same dilemma; any rule predicting the location of primary stress must interact with the vowel deletion rules in exactly the same fashion proposed for STRESS MOVEMENT. Indeed, since a word-level stress rule could not participate in a rule cycle, the present ordering paradox argues strongly against such an analysis.

That a rule cycle including STRESS MOVEMENT, SYNERESIS, and EQUI-VOWEL DELETION does eliminate the difficulty encountered in the three problem derivations is shown by the following:

	#ma+i+ya+ki+ki%kxuwá#
K-DELETION	#ma+i+ya+ i+ki%kxuwá#
SYNCOPE	#m +i+ya+ i+ki%kxuwá#
STRESS MOVEMENT (1)	+ki%kxúwa#
STRESS MOVEMENT (2)	+ i+kí%kxuwa#
STRESS MOVEMENT (3)	+ya+ í+ki%kxuwa#
SYNERESIS (3)	+y + é+ki%kxuwa#
ASPIRATION	#m +i+y + é+ki%k'uwa#
VELAR PALATALIZATION	#m +i+y + é+či%č'uwa#
	/miyéčič'uwa/

	#y̨k+ki+i+ki%kxuwá+pi#
STRESS MOVEMENT (1)	+ki%kx̄úwa+pi#
STRESS MOVEMENT (2)	+i+kí%kxuwa+pi#
STRESS MOVEMENT (3)	+ki+í+ki%kxuwa+pi#
EQUI-VOWEL DELETION (3)	+k +í+ki%kxuwa+pi#

(M) K-DROP	#y̨ +k +í+ki%kxuwa+pi#
ASPIRATION	#y̨ +k +í+ki%k'uwa+pi#
VELAR PALATALIZATION	#y̨ +k +í+či%č'uwa+pi#
GLOTTAL EPENTHESIS	#ʔy̨+k +í+či%č'uwa+pi#
	/ʔy̨kíčič'uwapi/
	#y̨k+ni+ki+i+ki%kxuwá+pi#
K-DELETION	#y̨k+ni+ i+i+ki%kxuwá+pi#
SYNCOPE	#y̨k+n + i+i+ki%kxuwá+pi#
STRESS MOVEMENT (1)	+ki%kxúwa+pi#
STRESS MOVEMENT (2)	+i+kí%kxuwa+pi#
STRESS MOVEMENT (3)	+ í+i+ki%kxuwa+pi#
EQUI-VOWEL DELETION (3)	+ í+ki%kxuwa+pi#
(M) K-DROP	#y̨ +n + í+ki%kxuwa+pi#
ASPIRATION	#y̨ +n + í+ki%k'uwa+pi#
VELAR PALATALIZATION	#y̨ +n + í+či%č'uwa+pi#
GLOTTAL EPENTHESIS	#ʔy̨+n + í+či%č'uwa+pi#
	/ʔy̨níčič'uwapi/

The following derivation of /wéčič'uwa/ "I chased it for him" shows that cyclical application of rules will also produce the forms with initial stress correctly:

	#wa+ki+i+ki%kxuwá#
K-DELETION	#wa+ i+i+ki%kxuwá#

SYNCOPE	inapplicable
STRESS MOVEMENT (1)	+ki%kxúwa#
STRESS MOVEMENT (2)	+i+kí%kxuwa#
STRESS MOVEMENT (3)	+ i+í+ki%kxuwa#
EQUI-VOWEL DELETION (3)	+ +í+ki%kxuwa#
STRESS MOVEMENT (4)	inapplicable
SYNERESIS (4)	#w + +é+ki%kxuwa#
ASPIRATION	#w + +é+ki%k'uwa#
VELAR PALATALIZATION	#w + +é+či%č'uwa#
	/wéčič'uwa/

Inspection of the derivations presented above reveals, however, that the over-all order of application adopted is not the only one which will yield appropriate phonetic representations. Although the cycle must be retained in the form presented, VELAR PALATALIZATION and the rules needed to provide correct input for it can be ordered before STRESS MOVEMENT, and hence before the cycle. The following derivation of /níčič'uwa/ "he chased it for you (sng.)" shows the effect of such a revised ordering:

	#ni+ki+i+ki%kxuwá#
K-DELETION	#ni+ i+i+ki%kxuwá#
SYNCOPE	#n + i+i+ki%kxuwá#
ASPIRATION	#n + i+i+ki%k'uwá#
VELAR PALATALIZATION	#n + i+i+či%č'uwá#

STRESS MOVEMENT (1) +či%č'úwa#

STRESS MOVEMENT (2) +i+čí%č'uwa#

STRESS MOVEMENT (3) + i+í+či%č'uwa#

EQUI-VOWEL DELETION (3) + +í+či%č'uwa#

STRESS MOVEMENT (4) inapplicable

/níčič'uwa/

Such an ordering ensures that the only front vowel which will trigger the VELAR PALATALIZATION rule is i, at least in verb constructions; the significance of this fact is discussed below. For the moment we assume, at least tentatively, that this revised ordering is preferable.

What is apparently a third possessive-benefactive construction can be seen in forms with the instrumental prefix /ka-/ of Class 12:

/kaksá/	"to cut"
/kíčaksa/	"he cut his"
/wéčaksa/	"I cut his"
/č'íčaksa/	"I cut yours"
/miyéčaksa/	"you cut mine"

These forms apparently replace the "first dative" forms of Boas and Deloria; their phonetic representations immediately suggest an underlying sequence of the two possessive prefixes +ki+ and +i+. Such an underlying sequence would account for the failure of I-DELETION to apply, and would explain the initial stress of /kíčaksa/. One might even suggest a rationale for the "substitution" of these forms for the simple benefactives: it appears to be the case that the instrumental /ka- / is always palatalized when it follows an i. A simple first person form of /kaksa/, inflected with the benefactive /ki- / prefix, would have the phonetic representation */wakíkaksa/, since the benefactive prefix does not trigger VELAR PALATALIZATION; this form would thus be an exception to the generalization that /ka- / is always palatalized after i. We might thus imagine a "surface structure constraint" of some type, whose effect is to avoid environments with unpalatalized k after front vowels.

The following derivations for /waglákṡa/ "I cut my own" and /wéčaksa/ "I cut his" show the differences produced by the presence of the +i+ prefix:

	#wa+ki+ka%ksá#	#wa+ki+i+ka%ksá#
I-DELETION	#wa+k +ka%ksá#	inapplicable
K-DELETION	inapplicable	#wa+ i+i+ka%ksá#
VELAR PALATALIZATION	inapplicable	#wa+ i+i+ča%ksá#
STRESS MOVEMENT (1)	inapplicable	inapplicable
STRESS MOVEMENT (2)	inapplicable	+i+čá%ksa#
STRESS MOVEMENT (3)	#wa+k +ká%ksa#	+ i+í+ča%ksa#
EQUI-VOWEL DELETION (3)	inapplicable	+ +í+ča%ksa#
STRESS MOVEMENT (4)	inapplicable	inapplicable
SYNERESIS (4)	inapplicable	#w + +é+ča%ksa#
LATERALIZATION	#wa+k +lá%ksa#	inapplicable

STOP VOICING	//wa+g +lá%ksa//	inapplicable
	/wagláksa/	/wéčaksa/

The "second dative" forms of verbs with the /ka-/ prefix are regular, the first person form of /kaksá/ being /wéčíčaksa/.

The following forms reveal that the reciprocal construction consists of a sequence of two prefixes, the /ki-/ possessive and a prefix +kxi+:

/k'uwá/	"to chase"
/ʔų́kič'ič'uwapi/	"we chased each other"
/yéč'ič'uwapi/	"you chased each other"
/kič'íč'uwapi/	"They chased each other"

That the prefix +kxi+, with meaning "mutual contact, effect", has not undergone lexical restructuring to +čxi+ is indicated by the fact that it appears as /k'i-/ in a number of forms:

/k'iįyą́ka/	"to race"
/k'ikšą́/	"to wrestle"
/k'ipážį/	"to oppose"

Derivations for these reciprocal forms proceed in straight-forward fashion, with no problems of interaction.

The various constructions presented in this section suggest that the prefix Classes 10 and 11 are constituted as follows: Class 10 contains the two possessives, +ki+ and +i+, while Class 11 contains the benefactive +ki+, the reflexive +kʔi+, and the reciprocal +kxi+. The reflexive prefix obligatorily follows Class 10 +i+, and the reciprocal prefix normally follows Class 10 +ki+. The distinction in meaning between the two prefixes of Class 10 is obscure, and it may be that, as previously suggested, the prefix +i+ is no longer productive in any way.

3.6 Stem Formation and Ablaut

Section 2.7 presented evidence in support of the view that Dakota permits underlying consonant-final stems, and that a phonological rule provides an epenthetic final a in the majority of environments occupied by such stems. Section 3.3 suggested that an ablaut rule converts a into e in a number of stem-final and post-stem environments. We suggest here that these two rules interact in a significant way; specifically, that the rule providing the epenthetic stem-final vowel feeds the ablaut rule, in that the majority of the vowels which undergo the ablaut process are "created" by the epenthesis rule. The ablaut rule is not global, however, for some epenthetic a's do not undergo it, while some organic a's do. Two generalizations are apparent, however:

a. The great majority of epenthetic a's do undergo ablaut in appropriate environments.

b. The great majority of organic a's do not undergo ablaut.

The basic problem here stems from the simple fact that it is not possible to define which stem-final a's, whether organic or epenthetic, are subject to the ablaut rule and which are not; no phonological, syntactic, or semantic criteria are available for such definition. There appear to be two ways in which we can account for this situation: we can assume that all lexical entries which are either consonant-final or a-final are marked with an appropriately valued rule feature, $\left[\pm \text{ ablaut}\right]$, or we can assume that the ablaut rule is global, with lexically-marked exceptions. The former solution assigns all appropriate stems to one of two morphological classes on a strictly ad hoc basis, ignoring the generalizations listed above. The second solution assumes that these generalizations are significant, and that the ablaut rule "knows" which stem-final a's are epenthetic and which are organic.

Matthews (personal communication) has suggested an excellent historical explanation for the Siouan ablaut phenomenon. In his view, Proto-Siouan had stems which were consonant-final and a stem-forming epenthesis rule, just as we have concluded for our synchronic Dakota grammar. Matthews suggests that the ablaut process in Proto-Siouan applied only to the epenthetic stem-forming vowel, but that the process has "spread" during the diachronic development of the various languages to stems with organic final vowels. Similarly, the process was "lost" by stems which originally were subject to it. This explanation would account for the fact that cognate verb stems in different Siouan languages may or may not show the same susceptibility to the ablaut process.

This diachronic argument strongly suggests that the second of our proposed solutions to the ablaut problem is the correct one. If the ablaut process were purely global in Proto-Siouan, and applied only to the epenthetic vowels, then we need only claim that this global behavior has come down intact to our synchronic Dakota grammar. Although large numbers of exceptions have accumulated in the intervening period, this should not by any means be interpreted as negating the over-all nature of the global power of the rule. Needless to say, this global solution is also preferable on the grounds of parsimony; although both suggested solutions must mark a very large number of exceptions, the number of exceptions required by the "global rule" solution must be fewer in number than the "morphological" solution requires, since the latter basically treats <u>all</u> appropriate stems as exceptions.

Thus we claim that the ablaut process in Dakota, which we formalize below as ABLAUT, is global, applying "only" to epenthetic <u>a</u> produced by the rule of STEM FORMATION. The numerous exceptions will be marked in the lexicon with a rule feature; consonant-final stems which do <u>not</u> undergo ABLAUT will be marked $\left[-\text{ ablaut}\right]$, while stems with organic final <u>a</u> that <u>do</u> undergo ABLAUT will be marked $\left[+\text{ ablaut}\right]$. This solution also has the interesting property of satisfying Kiparsky's constraint limiting those neutralization processes that are non-automatic to "derived environments", but again only if we distinguish between "created" environments and those derived from morphological composition.

An even knottier problem is encountered when we try to define the environments in which ABLAUT operates. Numerous verbal suffixes trigger the process, while others do not. Several enclitic particles trigger the process, but others do not. Verb stems are subject to ABLAUT, while noun and particle stems, with exceptions, are not. Nouns derived from verbs with final "ablaut" vowels *do* exhibit the process, however. Verbs with final "ablaut" vowels always exhibit the process in sentence-final position. In short, our characterization of the ABLAUT rule is highly imperfect. We are forced to adopt a second rule feature, [+ ablaut trigger], to mark the suffixes and enclitics which trigger the rule. The rule is also complicated by the fact that two morphemes convert the "ablaut" *a* to *į*, rather than to *e*. These morphemes are the enclitic conjunction /ną/ and the suffix /-kta/, marker of the potential mood; while the former presumably affects the "ablaut" *a* through some type of nasal assimilation, we know of no independent evidence to suggest that the latter morpheme contains any nasal segment.

The STEM FORMATION rule also presents certain difficulties. It applies only in stems that are consonant-final, having no effect on consonant-final affixes such as /-š/ "emphatic" or /ųk-/ "first person plural". We thus assume that the rule has access to the labels on the brackets of the surface syntactic structure, applying only *within* those brackets which we have conveniently abbreviated with the "cover label" STEM in our earlier treatment of the STRESS PLACEMENT rule. STEM FORMATION must also utilize a triggering boundary; since the rule does not apply to the first stem of a compound, we claim that it is not triggered by this boundary, but that it is triggered by each of the other boundaries occurring in post-stem environments. We thus formalize STEM FORMATION as follows:

$$\text{STEM FORMATION:} \quad \emptyset \longrightarrow a \;/\; C\_\_ \left.\begin{array}{c} + \\ \neq \\ - \\ \# \end{array}\right]_{\text{STEM}}$$

The rule must precede ABLAUT in order to provide appropriate input for it, and must follow STRESS PLACEMENT, to ensure that underlying consonant-final stems appear with initial stress in their uninflected forms. Since the first part of a reduplicated verb never undergoes STEM FORMATION, we assume that the latter must also follow REDUPLICATION.

The ABLAUT rule can now be formulated in the following fashion, with the liberal use of ad hoc devices:

$$\text{ABLAUT:} \quad a \longrightarrow \begin{bmatrix} e \\ \\ \text{į} \end{bmatrix} \Big/ \_\_\,]_{\text{VERB}} \left[\begin{array}{c} \begin{Bmatrix} \begin{bmatrix} X \\ +\text{ABT} \end{bmatrix} \\ \#\# \\ = \\ +\,]_{\text{NOUN}} \end{Bmatrix} \\ \begin{Bmatrix} \#n\text{ą} \\ +kta \end{Bmatrix} \end{array}\right]$$

CONDITION: $\underline{a}$ produced by STEM FORMATION.

The condition on the rule captures its global effect by limiting its input in the appropriate way; since ABLAUT is a non-automatic neutralization rule, it may be that some version of Kiparsky's constraint on global rules would eliminate the need for this condition. (Cf. Kiparsky 1973) The first part of the rule schema maps the epenthetic a of the verb stem into e when followed by any of the triggering suffixes or enclitics (those marked with the rule feature discussed above, abbreviated here as [+ ABT]), when in sentence-final position (indicated by the sentence-final ## boundary), when before the compound (=) boundary, or when appearing in a derived nominal. The second part of the schema maps the epenthetic a of the verb stem into į when it is followed by the suffix /-kta/ "potential mood" or the enclitic conjunction /ną/ "and"; we know of no way to capture this change other than to simply list the two morphemes which trigger it.

Boas and Deloria (1941:29) listed the following verbal suffixes as triggering the ABLAUT rule:

/-kta/	"potential mood"	+ ablaut
/-xča/	"augmentative"	+ ablaut
/-la/	"diminutive"	
/-šni/	"negative"	
/-ka/	"somewhat, rather"	+ ablaut
/-ya/	"adverbial"	+ ablaut
/-e/	"predicative"	

Although the authors did not recognize our Class 18 suffix as having the form /-e/, they did clearly indicate its effect on the ablaut vowel. The forms of this list which are marked on the right as + ablaut are forms which are themselves subject to the ablaut process; since none are subject to STEM FORMATION, they must be marked as exceptions. The suffixes /-pi/ "pluralizer" and /-hą/ "continuative", which immediately follow the stem, do not trigger ABLAUT, although the continuative suffix itself is subject to the rule. Similarly, the suffixes /-o/ and /-e/ "imperative" of Class 19, "furthest" from the stem, do not trigger ABLAUT; thus it appears that "closeness" to the stem is of no value as a criterion for defining the affixes which trigger the rule.

Boas and Deloria also listed a number of enclitics which trigger the rule, among which are:

/sʔa/	"regularly"	
/sʔe/	"as if, as though"	
/k̔éyaš/	"but"	
/séča/	"perhaps"	+ ablaut
/so/	"conversational interrogative"	

They also list the following; but as these all occur only after the predicative /-e/ of Class 19, there is no reason to assume that they are responsible for the ablaut effect.

/lak'a/ "evidently, apparently"

/šą́/ "but, nevertheless"

The following forms are also listed, but as they apparently occur only after nominals, there is again no reason to assume that they are responsible for the ablaut effect.

/kį/ "definite article"

/k̓ų/ "definite article, established context"

/kįhą́/ "when"

/k̓ųhą́/ "then"

An enclitic which does not trigger ABLAUT, but is itself subject to it, is the quotative /šk'á/.

As shown by the example of the continuative suffix /-hą/, which is subject to the ABLAUT rule, the ablaut process has spread to a number of forms with final ą. Other examples are:

/pehą́/ "to fold"

/yatką́/ "to drink"

/hįxtą́/ "to be porous"

We assume that all forms of this type are exceptions, and are marked in the lexicon with a positive rule feature.

Of no little interest is the fact that ABLAUT feeds two global rules; <u>i.e.</u>, two rules which affect only <u>e</u> produced by the ABLAUT rule. One of these was briefly mentioned on page 176 above; it deletes the Class 18 /-e/ suffix after the "ablaut" *e*. Although other vowel deletion rules in Dakota remove the *first* vowel of a sequence, we claim that this rule, which we term E-DELETION, deletes the *second* vowel. The first vowel of the sequence often carries primary stress; to delete this vowel would create difficulty in stress assignment. The following derivations for the forms /ʔap'éye šą́/ "he waited for him, but--" and /ʔap'éšą/ "he struck him, but--" reveal that organic *e* does not trigger E-DELETION:

	#a*pxé≠e#šą́#	#a*pxá≠e#šą́#
ABLAUT	inapplicable	#a*pxé≠e#šą́#
E-DELETION	inapplicable	#a*pxé≠ #šą́#
GLIDE EPENTHESIS	#a*pxé≠ye#šą́#	inapplicable
ASPIRATION	#a*p'é≠ye#šą́#	#a*p'é≠ #šą́#
GLOTTAL EPENTHESIS	#ʔa*p'é≠ye#šą́#	#ʔa*p'é≠ #šą́#
	/ʔap'éye šą́/	/ʔap'éšą/

(We do not attempt to account for the variable stress on the enclitic; in general, the stress patterns of enclitic particles are very poorly understood, and require additional research. For a short discussion of some of the syntactic and semantic complexities which surround this issue, *cf.* Boas and Deloria 1941:109-111.) We now formalize E-DELETION as follows:

E-DELETION: $e \longrightarrow \emptyset \,/\, e\#\_\_$

CONDITION: triggering <u>e</u> derived by ABLAUT.

Since the suffix /-e/ "imperative" of Class 19 does not trigger ABLAUT, we do not have to worry about E-DELETION inappropriately dropping that affix.

The second of these global rules brings us back to the phenomenon of velar palatalization once again. As observed in section 3.4, VELAR PALATALIZATION is blocked by the word-internal @ boundary. It is interesting to note, however, that there is one situation in which a velar palatalization process will operate across the stronger # boundary; in this case, it is only the <u>e</u> produced by ABLAUT which will trigger the effect. The phenomenon occurs whenever the definite articles /kį/ and /k̓ų/ follow a verb subjected to ABLAUT in a relative clause; <u>i. e.</u>, there is more involved here than simply the presence of a derived <u>e</u> before initial velar stops. Consider the following:

/p'ež́i kį/	"the grass"
/sįté kį/	"the tail"
/wé kį/	"the blood"

Innumerable examples of this type clearly reveal that the definite articles are not subject to palatalization processes after noun stems with final organic front vowels. Now consider the following:

/ʔičáɣe kį/	"the tool"
/wíyut'e kį/	"the measure"
/wíč'ap'e kį/	"the fork"

These instrumental nouns are derived from the verb stems /káɣa/ "to make", /-t'á/ "to measure, try, weigh", and /č'ap'á/ "to stab", respectively. In each case the final e of the nominal form has been produced by ABLAUT, but no palatalization occurs. In the following forms, however, where the definite article closes a relative clause, final e derived by ABLAUT does trigger a palatalization effect:

/wakáɣe čį hé/	"the one who made it"
/wíyut'e čį hé/	"the one who measures"
/wač'áp'e čį hé/	"the one who stabbed it"
/ʔoyáte t'epwíč'aye čų̂ hená/	"the people who were devoured"
/ʔixpéwaye čų̂ hé/	"that which I discarded"

(The demonstratives /hé/ and /hená/ are pronominalizations of the head noun.) This palatalization effect is not triggered by organic front vowels:

/hípi kį hená/	"the ones who came"
/t'okákàɣapi kų̂ hé/	"the one that was first made"
/wašté kį hé/	"the one who is good"

Although there may be other syntactic environments beside relative clauses which exhibit this palatalization phenomenon, our knowledge of

Dakota syntax is not adequate to characterize them.

Needless to say, it appears that the rule accounting for this particular palatalization phenomenon must be distinct from VELAR PALATALIZATION; the global application of this process, plus the difference in boundary relations, seems adequate to motivate a second palatalization rule. This rule, which we term RELATIVE PALATALIZATION, can apparently be formulated only with *ad hoc* conditions:

$$\text{RELATIVE PALATALIZATION:} \quad \begin{bmatrix} -\text{ son} \\ -\text{ syl} \\ +\text{ con} \\ +\text{ bck} \\ -\text{ cnt} \end{bmatrix} \longrightarrow \begin{bmatrix} +\text{ cor} \\ -\text{ bck} \\ +\text{ dlr} \end{bmatrix} \Big/ \text{e}\#\_\_\,\text{V}$$

CONDITIONS: $\underline{\text{e}}$ produced by ABLAUT.

environment a relative clause.

Once again we seem to have encountered a non-automatic neutralization rule which applies only in created environments, and not in environments derived through morphological composition. Thus it may be that some version of the Kiparsky constraint, as previously discussed, may allow us to dispense with the first condition on RELATIVE PALATALIZATION. With more complete knowledge of syntactic structure the second condition, if it is indeed accurate, could probably be stated directly in terms of labels on constituent brackets.

3.7 Reduplication

As we have observed above, the phonology of reduplicated verbs in Dakota is especially revealing in terms of the over-all phonological structure of the language, and it is often the case that phonological processes are most clearly exhibited in such forms. We cannot make the claim that the phonology of reduplication is well understood, however, since a number of problems prove to be quite refractory. In general, it seems to be the case that reduplicated forms behave very much like compounds, and many of the conclusions reached here anticipate the analysis of compound forms presented in Chapter 5. Reduplication in Dakota is of special theoretical interest, since a recent dissertation by Ronnie Wilbur (1973) has made use of data from Dakota in the construction of arguments regarding certain peculiarities in the phonology of reduplicated forms. These Dakota examples are discussed here in somewhat greater detail; one is shown to be irrelevant to the question at issue, that of "rule failure" in reduplicated forms, while a second example, dealing with the "overapplication" of phonological rules in reduplicated forms, is shown to give greater support to Wilbur's argument than is claimed.

Reduplication of a stative verbal stem in Dakota indexes the plurality of some associated inanimate noun; reduplication of an active verbal stem indexes distributive plurals, as well as some types of iterative activities. Since plurality of animate nouns is marked by the verbal suffix /-pi/, which closely follows the stem, Wilbur suggests that, in the absence of any evidence to the contrary, reduplication in Dakota should be regarded as a special case of "suffixing", thus making the noun plural markers morphologically parallel. Our contention that reduplication copies the last underlying syllable of a stem would tend to corroborate this view. We thus assume that the location of the copied material in a reduplicated form is represented in its underlying phonological string by an abstract suffix, symbolized as R, which immediately follows the stem to be reduplicated. This abstract suffix also serves the function of triggering the reduplication rule.

By ordering REDUPLICATION before STEM FORMATION we are able to predict that, in a form like /puspúza/ "dry", only the copy of the stem receives an epenthetic vowel. At the time when STEM FORMATION applies, the "original" stem will be followed by a boundary which does not trigger the rule. Such a condition can be accomplished in two ways: either we can order the REDUPLICATION rule before the readjustment rules which weaken the # boundary to a compound boundary between stems, or we can order the rule of REDUPLICATION with the phonological rules proper and assume that the readjustment rules weaken the # boundary between the verb stem and its abstract suffix R to a compound boundary. The former solution claims that REDUPLICATION is a morphological rule, while the latter claims that it is a phonological rule, at least in terms of its potential interactions. We return to this question below.

Verb stems with canonical shape CVC, being of one syllable in length, copy that syllable intact:

/sápa/	"black"	reduplicated:	/sapsápa/
/xápa/	"rustling, whispering"	reduplicated:	/xapxápa/
/sáka/	"stiff, hard"	reduplicated:	/saksáka/
/púza/	"dry"	reduplicated:	/puspúza/
/píža/	"wrinkled, deflated"	reduplicated:	/pišpíža/

Verb stems with canonical shape CCVC, although of one syllable also, exhibit a slightly different pattern:

/mnúɣa/	"crackling, crunching"	reduplicated:	/mnumnúɣa/
/bléza/	"clear"	reduplicated:	/blebléza/
/xlóka/	"to have holes"	reduplicated:	/xloxlóka/
/ksápa/	"wise"	reduplicated:	/ksaksápa/
/ptúza/	"bent over"	reduplicated:	/ptuptúza/

In these forms it would appear that the final consonant of the stem is not being copied by REDUPLICATION; the following, however, reveal an alternative explanation:

/t̓áɣa/	"rough"	reduplicated:	/t̓axt̓áɣa/
/k'áta/	"warm"	reduplicated:	/k'alk'áta/
/t'éča/	"new"	reduplicated:	/t'ekt'éča/
/p'íča/	"possible"	reduplicated:	/p'ilp'íča/

/-k̓éɣa/ "scratched" reduplicated: /-k̓exk̓éɣa/

These forms are also CCVC in terms of underlying canonical shape, their different reduplicated shapes being due to the fact that they contain either aspirate or ejective stops. All of these forms are explicable if we simply assume that Dakota permits no sequences of three consonants; inspection of large numbers of Dakota words reveals that, with few exceptions, this generalization is completely valid. What is required here is a phonological rule which deletes the first consonant of such a sequence; that this rule does not apply to the last five forms listed above indicates that it must apply after EJECTION and ASPIRATION. The rule can be formulated as follows:

CONSONANT DELETION: $C \longrightarrow \emptyset \; / \; \_\_CC$

If the underlying form of /ksápa/ "wise" is +ksap+, then its reduplicated form after the application of STEM FORMATION must have the representation #ksap=ksapa#, and CONSONANT DELETION applies to remove the first p. If the underlying form of /t̓áɣa/ "rough" is +tʔaɣ+, then its reduplicated form after the application of STEM FORMATION must have the representation #tʔaɣ=tʔaɣa#; EJECTION will apply to produce the representation #t̓aɣ=t̓aɣa#, and CONSONANT DELETION is then inapplicable. The CONSONANT DELETION rule applies in many compounds, often in such fashion as to lend strong support to this analysis. For example, in the word /šiglá/ "to become angry", a compound of

/šíča/ "bad" and /-glá/ "to consider one's own", we note the first person form /šilwágla/; in the uninflected form the final consonant of the underlying stem +šič+ "bad" has been removed by CONSONANT DELETION, whereas in the inflected form the structural description of the rule is not met, and the underlying č appears as phonetic l.

As noted on pages 60-61 above, the appearance of phonetic l for underlying t and č is due to a phonological rule which prevents coronal stops in syllable-final position. This rule, which we call CORONAL LAXING, can be formulated in the following fashion:

$$\text{CORONAL LAXING:}\qquad \begin{bmatrix} -\text{son}\\ -\text{syl}\\ +\text{con}\\ +\text{cor}\\ -\text{cnt}\end{bmatrix} \longrightarrow \begin{bmatrix}+\text{son}\\ +\text{lat}\\ +\text{voi}\end{bmatrix} \Big/ \_\_ \begin{Bmatrix} = \\ \# \end{Bmatrix}$$

Although the major function of CORONAL LAXING is to prevent consonant clusters with initial coronal stops, using the compound (=) and word (#) boundaries to trigger the rule allows us to account for such forms as /škàlʔómani/ "he goes about playing", from underlying #škat=o*mani#, and /tuktél/ "where?", from underlying #tukte+etu#. These forms are dealt with in greater detail below.

A second rule is required to account for the dissimilation of coronal stops to velar k before other coronal segments. This rule, called here CORONAL DISSIMILATION, can be formalized as follows:

CORONAL DISSIMILATION: $$\begin{bmatrix} -\text{ syl} \\ +\text{ con} \\ +\text{ cor} \\ -\text{ cnt} \end{bmatrix} \longrightarrow \begin{bmatrix} -\text{ son} \\ -\text{ cor} \\ -\text{ ant} \\ +\text{ bck} \end{bmatrix} \Big/ \_\_ \begin{bmatrix} +\text{ cor} \end{bmatrix}$$

The following examples illustrate the effects of CORONAL LAXING and CORONAL DISSIMILATION:

/xóta/	"gray"	reduplicated:	/xolxóta/
/k'áta/	"warm"	reduplicated:	/k'alk'áta/
/p'íča/	"possible"	reduplicated:	/p'ilp'íča/
/ɣį́ča/	"to snivel"	reduplicated:	/ɣįlɣį́ča/
/sóta/	"hazy"	reduplicated:	/soksóta/
/žáta/	"forked"	reduplicated:	/žagžáta/
/šíča/	"bad"	reduplicated:	/šikšíča/
/t'éča/	"new"	reduplicated:	/t'ekt'éča/

Note that CORONAL DISSIMILATION bleeds CORONAL LAXING, and must thus be ordered before it.

Although the great majority of the segments affected by CORONAL DISSIMILATION are stops, as indicated in the preceding examples, we have formulated the rule in such fashion as to allow it to apply to all non-continuant coronals. Thus the rule will also account for the following:

/líla/	"very"	reduplicated:	/liglíla/
/čónala/	"few"	reduplicated:	/čokčónala/

Although such forms exhibit an uncommon pattern of reduplication, their coronal l and n dissimilate to k just as the coronal stops do.

A third phonological rule, SPIRANT DEVOICING, is required to account for such forms as the following:

/púza/	"dry"	reduplicated:	/puspúza/
/píža/	"wrinkled, deflated"	reduplicated:	/pišpíža/
/-k̓éɣa/	"scratched"	reduplicated:	/-k̓exk̓éɣa/
/č'óza/	"warm, comfortable"	reduplicated:	/č'osč'óza/
/léža/	"to urinate"	reduplicated:	/léšleža/
/t̓áɣa/	"rough"	reduplicated:	/t̓axt̓áɣa/

We formulate this rule as follows:

SPIRANT DEVOICING: $$\begin{bmatrix} -\text{ son} \\ -\text{ syl} \\ +\text{ con} \\ +\text{ cnt} \end{bmatrix} \longrightarrow [-\text{ voi}] \;/\; \_\_ =$$

The major function of SPIRANT DEVOICING is to prevent consonant clusters with initial voiced spirants; as such clusters can only occur across the compound (=) boundary, we use that boundary to trigger the rule. Thus we are also able to account for such compounds as /masʔík'uše/ "a buckle", from underlying #maz=i@$\vec{k}$xuše#.

Vowel-final verb stems normally show a different pattern of reduplication, in which only the final syllable of the stem is copied:

/hą́ska/	"long, tall"	reduplicated:	/hą́skaska/

/blaská/	"flat"	reduplicated:	/blaskáska/
/wašté/	"good"	reduplicated:	/waštéšte/
/ʔųspé/	"to know how"	reduplicated:	/ʔųspéspe/
/č'ap'á/	"to stab"	reduplicated:	/č'ap'áp'a/
/manų́/	"to steal"	reduplicated:	/manų́nų/
/kįyą́/	"to fly"	reduplicated:	/kįyą́yą/
/č'éya/	"to cry"	reduplicated:	/č'éyaya/

Although some of these forms are old compounds, as evidenced by the "infixation" of agreement markers, most are clearly not analyzable as such in a synchronic grammar. Our REDUPLICATION rule must thus be able to copy the <u>last</u> underlying syllable of a stem; in the case of stems with canonical shapes V, CV, CCV, VC, CVC, and CCVC, this means that the underlying structure is copied intact. In the case of stems with canonical shapes VV, VCV, VCCV, CVV, CVCV, CVCCV, CCVV, CCVCV, and CCVCCV, however, the underlying structure is bisyllabic, and only the second syllable is copied by the rule.

Before proceeding to a formulation of the rule, however, we must note that the preceding generalization has a large number of exceptions. The exceptions are all of the same type, and reveal that there is a strong tendency to reduplicate some vowel-final stems as though they were typical consonant-final stems:

/sutá/	"hard"	reduplicated:	/suksúta/
/čónala/	"few"	reduplicated:	/čokčónala/

/yų́ka/ "to be reclining" reduplicated: /yųkyų́ka/

This tendency is also revealed by the fact that some stems have more than one permissible reduplicated form:

/yúza/	"to grasp"	reduplicated:	/yusyúza/
		or:	/yuzáza/
/nážį/	"to stand"	reduplicated:	/nášnažį/
		or:	/nážįžį/
/pútą/	"short and thick"	reduplicated:	/pulpútą/
		or:	/putą́tą/

In each case the exceptional form has a stem with the final vowel preceded by a single consonant, and we can conclude that the tendency is to treat all stems terminating in -CVC as though they were consonant-final.

Wilbur (1973:26) has suggested that Dakota exhibits a case of "rule failure" in reduplicated forms, i.e., a situation in which reduplicated forms do not undergo a phonological rule even though its structural description is properly met. We quote the argument in full, including the two examples:

> Our last example of the failure of a phonological rule to apply comes from Dakota. This involves the failure of reduplicated forms ending in /a/ to undergo a contraction rule which combines the particle /ye/ with the /a/ to produce /e/. This contraction rule is conditioned by a number of adverbial endings such as ṡa.
>
> ʾapʿá "to strike" ʾapʿé ṡa (< ʾapʿá ye ṡa) "he struck him, but"

Some reduplicated forms do not contract their final /a/ with /ye/. For example,

hą́ ska lo "it is long" hą́ ska ska ye ló "they are long"

The rule which has presumably failed here is our ABLAUT rule, although Wilbur's analysis of the ablaut phenomenon is obviously quite different from ours. Wilbur assumes that the ablaut phenomenon is simply the product of a "vowel contraction", and that the process only operates when the a undergoing the effect is followed by a particle /ye/, which we assume to be our Class 18 suffix /-e/. Irrespective of this difference, however, the argument offered by Wilbur is faulty, for the simple reason that the stem /hą́ska/ "long, tall" does not undergo ABLAUT under any circumstances, whether reduplicated or not. As we have shown above, this is a generalization which will hold for the majority of those stems which are terminated by vowels in their underlying representations. The failure of ABLAUT to apply to the reduplicated form /hą́skaska/ is thus not a "rule failure" in any way, since it is always the case that, if a stem is not subject to ABLAUT, then its reduplicated form is not either, and vice versa. Note the following:

/ʔap'á/	"to strike"	#a*pxá#
/ʔap'éšni/	"he didn't strike it"	#a*pxá+šni#
/ʔap'é šą/	"he struck him, but--"	#a*pxá≠e#šą#
/ʔap'élo/	"he struck him"	#a*pxá≠e+lo#

/hą́ska/	"long, tall"	//hą́ska//
/hą́skašni/	"not tall"	//hą́ska+šni//
/hą́skaye šą́/	"he is tall, but--"	#hą́ska≠e#šą́#
/hą́skaye ló/	"he is tall"	#hą́ska≠e+lo#

Our informants are agreed that, although /hą́skalo/ is acceptable for the last gloss, the form /hą́skaye ló/ is definitely preferred; the former simply results from an underlying form #hą́ska≠lo#, and not from any contraction.

Wilbur (1973:31-32) has built a good case, however, for the "overapplication" of VELAR PALATALIZATION in Dakota. Forms like the following indicate that VELAR PALATALIZATION may apply in reduplicated verbs even where its structural description is not met:

/káγa/	"to make"
/wič'ákičaxčax?iyèya/	"he made it for them quickly"
/kóza/	"to wave"
/napé kičóščoza/	"he waved his hand"

The only way in which "overapplication" can be avoided is by ordering VELAR PALATALIZATION before REDUPLICATION. Wilbur suggests, however, that this type of solution is incorrect, in that it treats reduplication as a phonological process rather than a morphological one. It is Wilbur's contention that reduplication rules in all languages should be regarded as morphological rules:

> Furthermore, the ordering of phonological rules before Reduplication raises a serious problem in that it claims that Reduplication can interact with phonological rules in the same manner that phonological rules can interact with other phonological rules. That is, it claims that a phonological rule can feed or bleed Reduplication, and that Reduplication can feed or bleed a phonological rule. There is no problem with the latter, with Reduplication feeding or bleeding a phonological rule. ... Essentially, Reduplication can bleed any type of phonological rule whose application is dependent on syllable structure, because Reduplication changes the syllable structure by adding at least one more syllable (to the extent that gemination is Reduplication, it too changes the structure of a word, if only to change a light syllable to a heavy one). There are, however, no cases that I know of where a phonological rule feeds or bleeds Reduplication. It is hard to imagine a hypothetical case where this might happen. The application of Reduplication is unaffected by phonological rules -- its applicability is determined by factors outside the phonological component. This is because Reduplication is basically a morphological process. (Wilbur 1973:64)

Wilbur supports this contention by arguing that rule ordering is not adequate to handle all of the cases of "rule failure" or "rule overapplication" that are known, and that appeals to rule ordering in the cases where such a device <u>will</u> handle the peculiarities are egregious.

We suggest that the evidence from Dakota supports Wilbur's contention. Although it appears that REDUPLICATION could be ordered after VELAR PALATALIZATION, so as to allow the derivation of /kič́osčoza/ in a Markovian fashion, the resulting grammar would look rather peculiar. The abstract suffix R would be maintained intact throughout a large portion of the derivation of a reduplicated form before being finally "spelled out"; this is because many other phonological rules must be ordered <u>before</u> VELAR PALATALIZATION. None of these other rules would interact with REDUPLICATION in any way, however.

In other words, our only motivation for ordering REDUPLICATION with the rules of the phonological component proper would be that of preserving, or rather providing, Markovian derivations for those reduplicated forms in which VELAR PALATALIZATION is applicable to the stem-initial stop. Such a motivation appears highly ad hoc, and we agree with Wilbur that a significant generalization is being missed by such treatment.

Wilbur's work has clearly shown that both "rule failure" and "rule overapplication" in reduplicated forms always has the effect of ensuring identity between the "original" and "copied" material; overapplication of VELAR PALATALIZATION in Dakota obviously has this effect. Wilbur incorporates this generalization into the metatheory of generative phonology by means of a universal Identity Constraint: "There is a tendency to preserve the identity of R_o and R_r in reduplicated forms." (Wilbur 1973:58) (The symbols R_o and R_r represent the "original" and "copied" material of the form, respectively.) Such a constraint is clearly not self-sufficient:

> It thus remains for each particular language to indicate in its grammar which of its phonological rules are subject to the Identity Constraint. Furthermore, there is no way that I know of to predict whether a rule which is subject to the Identity Constraint will fail to preserve the identity or will overapply to preserve the identity. That is, there seems to be no way to predict which type of "exceptional" behaviour is to be expected. This information must be incorporated into the grammar of each individual language for each phonological rule affected by the Identity Constraint. (Wilbur 1973:59)

In a later section of this work, we incorporate Wilbur's Identity Constraint as a global condition on the VELAR PALATALIZATION rule.

Accepting Wilbur's contention that "rule overapplication" is basically non-Markovian allows us to formalize REDUPLICATION as a morphological rule:

$$\text{REDUPLICATION:} \quad \begin{array}{ccccc} C_0 & V & C_0 & \# & R \\ 1 & 2 & 3 & 4 & 5 \end{array} \longrightarrow 1\ 2\ 3\ 4\ \emptyset\ 1\ 2\ 3$$

This rule simply copies the last syllable of any lexical item followed by the abstract suffix R; other morphological rules, applying before REDUPLICATION, ensure that this suffix occurs only after verb stems. As a morphological rule, REDUPLICATION applies before the readjustment rules that weaken various occurrences of the # boundary, and before the STRESS PLACEMENT rule. It is clear, however, that our current version of STRESS PLACEMENT cannot account for the stress patterns of reduplicated forms.

The majority of the forms cited as examples here have been reduplicated stative verbs, which normally show primary stress on the "copy" of the stem:

/púza/	"dry"	reduplicated:	/puspúza/
/sápa/	"black"	reduplicated:	/sapsápa/
/t'ó/	"blue"	reduplicated:	/t'ot'ó/

This stress pattern is correctly predicted by STRESS PLACEMENT if we assume that the reduplicated form is treated as a unitary "stem".

Active verbs, however, show <u>initial</u> stress when reduplicated:

/ɣópa/	"to snore"	reduplicated:	/ɣópɣopa/
/psíča/	"to jump"	reduplicated:	/psípsiča/
/p'áta/	"to butcher"	reduplicated:	/p'álp'ata/

Such forms are not common, as active verbs are much less frequently subjected to the reduplication process than are stative verbs. Boas and Deloria (1941:38) have shown, however, that there is a derivational process which forms active verbs from reduplicated stative verbs through the use of contrastive stress:

/xopxópa/	"to be good-looking"
/xópxopa/	"to pose, show off"
/blebléčahą/	"to be shattered to pieces"
/blébleča/	"to shake water off, as a wet dog"
/blebléza/	"to be sane"
/bléblezešni/	"to run about frantically"
/píza/	"to be squeaking"
/pispízala/	"prairie-dog"
/píspiza/	"to make squeaking noises"

Thus we see that the stress placement process must be sensitive to the semantic distinction between active and stative verbs.

The problem here, of course, is to formulate an appropriate device for producing this contrastive stress. Since the forms with primary stress on the second syllable are far more common than those with initial stress, it seems that the former should be regarded as the unmarked stress pattern, to be produced by a general rule of stress placement. The contrastive initial stress of the active forms is then marked, to be derived by some "special" rule or process. We show below that the proper placement of primary stress in compounds requires that both stems receive primary stress, with a later weakening of one stressed vowel to secondary stress by a compound stress rule. If we assume that the "original" and "copied" material in a reduplicated verb behave like independent stems, so that each part receives primary stress, the weakening rules that are independently motivated for compounds will correctly produce the unmarked forms with primary stress on the second syllable. If, on the other hand, we mark reduplicated active verbs as exceptional with regard to one of the weakening rules, so that they are not subject to that rule, then the hypothesis that reduplicated forms act like compounds will also allow us to predict the initial stress of the actives. We defer formalization of the various stress rules required for this analysis until Chapter 5, however, since the evidence from compound forms greatly simplifies the task.

The following derivations reveal the operations of the various rules formalized in this section:

	#čxoz#R#	#plaska#R#
REDUPLICATION	#čxoz#čxoz#	#plaska#ska#
Readjustment Rules	//čxoz=čxoz//	//plaska=ska//
Stress Rules	#čxoz=čxóz#	#plaská=ska#
STEM FORMATION	#čxoz=čxóza#	inapplicable
ASPIRATION	#č'oz=č'óza#	inapplicable
CONSONANT DELETION	inapplicable	inapplicable
SPIRANT DEVOICING	#č'os=č'óza#	inapplicable
CORONAL DISSIMILATION	inapplicable	inapplicable
CORONAL LAXING	inapplicable	inapplicable
STOP VOICING	inapplicable	#blaská=ska#
	/č'osč'óza/	/blaskáska/

	#sot#R#	#šič#R#
REDUPLICATION	#sot#sot#	#šič#šič#
Readjustment Rules	#sot=sot#	#šič=šič#
Stress Rules	#sot=sót#	#šič=šíč#
STEM FORMATION	#sot=sóta#	#šič=šíča#
SOUND SYMBOLISM	#xot=xóta#	inapplicable
CONSONANT DELETION	inapplicable	inapplicable
SPIRANT DEVOICING	inapplicable	inapplicable
CORONAL DISSIMILATION	inapplicable	#šik=šíča#
CORONAL LAXING	#xol=xóta#	inapplicable
	/xolxóta/	/šikšíča/

We see in these derivations that ASPIRATION (and EJECTION, as well) must be ordered before CONSONANT DELETION, and that the latter rule should be ordered before SPIRANT DEVOICING, CORONAL DISSIMILATION, and CORONAL LAXING in order to prevent "useless" application of rules. We have previously noted that CORONAL DISSIMILATION bleeds CORONAL LAXING; in addition, the derivation of /xolxóta/ reveals that the SOUND SYMBOLISM rule must properly specify the spirants of a stem before CORONAL DISSIMILATION applies, else we would arrive at the unacceptable */xokxóta/.

Before terminating our discussion of the reduplication process, we must note one additional case of the operation of Wilbur's Identity Constraint. The inceptive forms of motion verbs are formed by compounding the perfective and durative forms, in that order: thus, the form /gličú/ "to return coming (inceptive)" is a compound of /glí/ "to return coming (perfective)" and /kú/ "to return coming (durative)". The inceptive form /ʔiyáya/ "to go", however, is a compound of /ʔí/ "to go (perfective)" and the <u>reduplicated</u> form of /yá/ "to go (durative)". The point here is that the first person form of /ʔiyáya/ is the interesting /ʔiblábla/, and the second person form is /ʔilála/. While we have suggested that the occasional use of "double" agreement markers with such verbs represents a case of paradigm memorization, that explanation seems hardly adequate here. It would appear more likely that the Identity Constraint has produced irregular forms in which the "original" and "copied" material is once again identical; note that it has not done so by blocking or overapplying a phonological rule, however. Rather, the irregularity is traceable to a modification of the purported underlying phonological representation. Given the use of "double" agreement markers with such verbs, it is perhaps not too surprising that the identity constraint would have this effect; the end <u>result</u> is rather surprising, however, in that these forms are the only ones in which <u>both</u> of the "double" agreement markers are subjected to A-DELETION.

3.8 Nasal Assimilation

In section 2.6 above we offered brief arguments in support of two nasal assimilation processes affecting consonants, one mapping <u>l</u> into <u>n</u> before nasal vowels and one mapping <u>b</u> into <u>m</u> before <u>n</u>. The effects of these processes are shown in the following short paradigms of the motion verbs /yá/ "to go (durative)" and /glá/ "to return going (durative)", both of which are marked in the lexicon as being susceptible to ABLAUT.

Theme	Mood	First Person	Second Person
/yá/	indicative	/blá/	/lá/
/glá/	indicative	/waglá/	/yaglá/
/yį́kta/	potential	/mnį́kta/	/nį́kta/
/gnį́kta/	potential	/wagnį́kta/	/yagnį́kta/

The application of ABLAUT before the potential mood suffix /-kta/ has converted underlying a to nasal į, with the result that the expected l appears as phonetic n. In the first person form /mnį́kta/ we see that the nasalization has "spread" to the expected b, which appears as phonetic m. The rules which produce these effects can be formulated in the following fashion:

$$\text{L-NASALIZATION:} \quad l \longrightarrow n \;/\; \_\_ \begin{bmatrix} \text{V} \\ +\text{nas} \end{bmatrix} \qquad \text{Rank: } =$$

$$\text{B-NASALIZATION:} \quad b \longrightarrow m \;/\; \_\_\, n$$

Although these rules are obviously very similar in their operation, it appears that they should not be conflated into a single rule schema. The segments b and l do not constitute a very natural class, and the difference in the ranking boundaries would be difficult to reconcile. That the rule of L-NASALIZATION does not apply across the = boundary is indicated by a form like /slolʔų́yąpi/ "we know him", derived from underlying #slot=uk%ya+pi#, a causative compound. The B-NASALIZATION rule may apply across this boundary, however, as indicated by:

/nų́pa/ "two" reduplicated: /nų́mnųpa/

Similarly, the fact that L-NASALIZATION feeds B-NASALIZATION suggests that they should be maintained as separate rules.

The following derivations show the effects of these rules, as well as their interaction:

	#wa%yá+kta#	#ya%yá+kta#
ABLAUT	#wa%yį́+kta#	#ya%yį́+kta#
A-DELETION	#w %yį́+kta#	#y %yį́+kta#
LATERALIZATION	#w %lį́+kta#	#y %lį́+kta#
GLIDE ASSIMILATION	#b %lį́+kta#	#∅ %lį́+kta#
L-NASALIZATION	#b %nį́+kta#	#∅ %nį́+kta#
B-NASALIZATION	#m %nį́+kta#	inapplicable
	/mnį́kta/	/nį́kta/

Note that the order of GLIDE ASSIMILATION and L-NASALIZATION could be reversed, but that both of these rules must apply before B-NASALIZATION.

Boas and Deloria (1941:99-100) suggested that the following verbs are irregularly inflected:

Theme	Gloss	First Person	Second Person
/yąká/	"to sit"	/mąká/	/nąká/
/yųká/	"to recline"	/mųká/	/nųká/
/ʔiyų́ka/	"to go to bed"	/ʔimų́ka/	/ʔinų́ka/
/ʔiyų́ɣa/	"to ask, inquire"	/ʔimų́ɣa/	/ʔinų́ɣa/

The glosses of the last two forms strongly suggest that these are active verbs, and that the underlying representations of their inflected forms should contain the active agreement prefixes /wa-/ and /ya-/. Inspection of entries in the Buechel dictionary shows no forms with the <u>mn</u> sequence before nasal vowels other than į, thus suggesting the following rule:

$$\text{N-DELETION:} \quad n \longrightarrow \emptyset \;\Big/\; m\_\_ \begin{bmatrix} \text{V} \\ +\text{bck} \\ +\text{nas} \end{bmatrix} \qquad \text{Rank: } =$$

The rank of = for this rule will permit the reduplicated form /nų́mnųpa/ "two", cited on page 240.

Derivations for the verb forms listed on the preceding page will now proceed naturally, as shown by the following:

	#wa%yąká#	#ya%yąká#
A-DELETION	#w %yąká#	#y %yąká#
LATERALIZATION	#w %ląká#	#y %ląká#
GLIDE ASSIMILATION	#b %ląká#	#∅ %ląká#
L-NASALIZATION	#b %nąká#	#∅ %nąká#
B-NASALIZATION	#m %nąká#	inapplicable
N-DELETION	#m % ąká#	inapplicable
	/mąká/	/nąká/

	#i*wa%yųka#	#i*ya%yųka#
A-DELETION	#i*w %yųka#	#i*y %yųka#
LATERALIZATION	#i*w %lųka#	#i*y %lųka#
GLIDE ASSIMILATION	#i*b %lųka#	#i*∅ %lųka#
L-NASALIZATION	#i*b %nųka#	#i*∅ %nųka#
B-NASALIZATION	#i*m %nųka#	inapplicable

N-DELETION	#i*m % ųka#	inapplicable
GLOTTAL EPENTHESIS	#ʔi*m % ųka#	#ʔi*∅ %nųka#
	/ʔimų́ka/	/ʔinų́ka/

Such derivations indicate that N-DELETION must follow B-NASALIZATION, as the latter feeds the former. An exception to the rule of N-DELETION is the irregular verb /ʔį́yąka/ "to run", whose first person form is /waimną́ka/. We have no explanation for this irregularity.

We also noted in section 2.6 that Dakota possesses a rule which nasalizes the a of the syllable ya after a syllable containing a nasal segment. The effect is shown in the following:

Theme	Gloss	First Person	Second Person
/niyą́/	"to revive one"	/niwáya/	/niyáya/
/naxʔų́yą/	"to notify one"	/naxʔų́waya/	/naxʔų́yaya/

The pattern of inflection reveals that the ya of the theme which is being nasalized is the causative verb /-yá/; in the second person forms, however, we note that the active agreement marker /ya-/ is not subject to the rule. This seems to represent a basic generalization: verbal prefixes are not subject to this type of nasalization. Thus the following:

/káɣa/	"to make"	/ʔųyákaɣapi/	"you made us"
/yaxtáka/	"to bite one"	/ʔųyáxtakapi/	"we bit him"

In the first example we see that, once again, the active second person agreement marker /ya-/ is not subject to the rule. In the second example we see that the instrumental prefix /ya-/ is not subject to it either.

In general, it seems to be the case that *ya* when the first syllable of a verb stem, including the causative /-yá/, is subject to the rule:

/yá/	"to go (durative"	/ʔų́yąpi/	"we are going"
/wąyą́ka/	"to see"	/wąbláka/	"I see him"
/slolyá/	"to know"	/slolʔų́yąpi/	"we know him"

The adverbial suffix /-ya/ is also subject to this rule:

/naxʔų́/	"to hear"	/naxʔų́yą/	"hearing"
/máni/	"to walk"	/mániyą/	"walking"
/xmų́/	"to hum, buzz"	/xmų́yą/	"humming"

The rule has numerous apparent irregularities in its application, however. The subordinate verb /-yá/, perhaps identical with the causative, which means "to have for a relative" is a good case in point. Normally, this verb is not subject to the nasalization rule, as shown by its compounds with the following kinship terms:

/k'ų́/	"mother-in-law"
/k'ųyá/	"to have one for a mother-in-law"
/t'ųžą́/	"a man's niece"
/t'ųžą́ya/	"to have one for a niece"

/sčepą́/	"a woman's sister-in-law"
/sčepą́ya/	"to have for a sister-in-law"
/tąhą́/	"a man's brother-in-law"
/tąhą́ya/	"to have for a brother-in-law"

The following, however, constitutes an exception:

/t'ųką́/	"father-in-law"
/t'ųką́yą/	"to have for a father-in-law"

Many exceptions apparently result, once again, from some type of homonym avoidance:

/niyą́/	"to revive one"
/niyá/	"to breathe"
/xmų́yą/	"humming"
/xmųyá/	"to make something hum"
/k'ųyą́/	"promptly"
/k'ųyá/	"to have for a mother-in-law"

(Boas and Deloria also list the pair /naxʔų́yą/ "hear<u>in</u>g" and /naxʔų́ya/ "to notify" as an example of this phenomenon, but our data shows the form /naxʔų́yą/ for each of these glosses.)

The following forms reveal that the presence of <u>m</u> in the syllable preceding the nasalization target is not sufficient to trigger the rule:

/slolyá/	"to know"
/slolʔų́yąpi/	"they know us"
/slolníyąpi/	"they know you"
/slolmáyapi/	"they know me"

The rule is only triggered by a nasalized vowel or n in the preceding syllable; that the effect with n is not limited to the syllable ni is shown by the following.

/mnayą́/	"to collect, gather together"
/mnawáya/	"I collected them together"

Boas and Deloria (1941:6) suggested that this nasalization rule may also affect the syllable wa after a nasalized vowel, but all of their examples show the "effect" within morpheme boundaries, as in /tųwą́/ "to look" and /nųwą́/ "to swim". We know of no productive cases where this rule has applied to the syllable wa, however.

The question of whether or not this process applies within morpheme boundaries is an interesting one. Since it is clearly a neutralization rule that is involved, Kiparsky's (1973) constraint on such rules predicts that it does not. It is certainly the case, however, that appropriate morpheme-internal environments do show nasalized vowels in the syllables wa and ya:

/tųwą́/	"to look"
/nųwą́/	"to swim"

/kį́yą̨/	"to fly"
/wį́yą̨/	"woman"
/ʔį́yą̨/	"a stone"

Nasalization in these forms is nonproductive, in that it is invariant in all environments. It appears that we must make the same assumption to account for these distributional facts that we made to account for the intramorphemic distribution of the palato-alveolar affricates: that the rule once applied within morpheme boundaries, but in doing so restructured the lexical entries for each morpheme involved. We now claim that the rule does not apply within morpheme boundaries for lack of appropriate input. In this way the Kiparsky constraint is met, and the nasalization rule applies only in environments derived through morphological composition. We must also claim that, whereas the rule originally affected both wa and ya, it now affects the latter only.

We are at present unable to account for the exceptions to the nasalization process in any revealing way; the fact that a suffix is subject to the rule with some stems but not with others, and that a stem may trigger the rule with one suffix but not another, seems to preclude the use of rule features in lexical entries. We simply formulate the rule as follows, realizing that the formalization is ad hoc:

$$\text{NASAL ASSIMILATION:} \quad a \longrightarrow \begin{bmatrix} + \text{nas} \end{bmatrix} \Big/ \left\{ \begin{matrix} \begin{bmatrix} \text{V} \\ + \text{nas} \end{bmatrix} \\ \text{nV} \end{matrix} \right\} \text{y}\_\_$$

CONDITION: does not apply in prefixes.

There seems to be no simple way in which the condition can be formally captured, even with the use of triggering or blocking boundaries. It is apparent that some deeper regularity is being missed here; we can only claim that that regularity is obscure.

NASAL ASSIMILATION does not seem to interact with any other phonological rule; it does not need to be ordered prior to any other rule, nor does it need to follow any other rule. This suggests that it is a "late" rule, perhaps similar to such other assimilation rules as STOP VOICING and GLOTTAL EPENTHESIS.

3.9 Summary

The thirty-six rules formulated and discussed in this chapter allow us to correctly predict the surface phonetic representations of the great majority of verbal constructions. The assumptions made about underlying phonological representations have been fairly conservative; we have seen no motivation for any absolute neutralization, for example. We <u>have</u> seen an apparent need for fairly complex rule interactions, however, including a short rule cycle. In general, this analysis seems to show that Dakota has relatively shallow phonology, the difference between underlying abstract representations and surface phonetic representations being less than profound. The most complex rule interactions are required to account for prefix phonology; with the exception of a few "special" rules, suffixes exhibit little in the way of phonological complexity. The weakest part of the analysis is certainly the treatment of stress; although the basic ideas of a STRESS PLACEMENT rule and a later STRESS MOVEMENT rule appear to be correct, our formulation of STRESS PLACEMENT seems less than adequate. We return to this problem in Chapter 5.

4. Phonological Processes: Nouns and Particles

We turn now to an examination of those phonological processes that are characteristic of words built on noun or particle stems. Such words are normally much less complex than verbal constructions in Dakota, due to the general paucity of inflectional and derivational processes which affect noun or particle stems. The relatively simple morphology of these forms is mirrored in their simple phonology; with the exception of nouns derived from verb stems, treated to some extent in the preceding chapter, the process of mapping the underlying lexical representation of a noun or particle into its phonetic representation is almost trivial, with few rules applying in any one derivation. It is also the case that, by and large, nouns and particles are subject to a simple subset of the rules that we have already motivated for verbs; membership in this subset seems to be determined by whether or not appropriate environments for the application of the rule are found in noun and particle constructions.

Rules such as STRESS MOVEMENT, for example, apply in nouns and particles just as they do in verbs. The ABLAUT rule, on the other hand, seems to be restricted to verbs; the CCVC stem /p'éta/ "fire" never appears as phonetic * /p'éte/, although its epenthetic final <u>a</u> should make it subject to the rule. Presumably, this stem cannot appear in any environment that would trigger the rule.

This chapter is thus concerned not so much with "special" phonological rules affecting noun and particle derivations as it is with the behavior of individual construction types. Certain of these prove both revealing and interesting in regard to general phonological processes; we cite especially the behavior of possessed noun stems, the independent personal pronouns, demonstrative constructions, and various types of adverbials.

4.1 Possessives

Although we have noted above that Dakota marks some types of possession by means of verbal prefixes, there is also a fairly rich inflectional machinery for directly marking possessed nouns. Like many languages, Dakota clearly distinguishes between alienable and inalienable possession; nouns in the latter category are typically limited to names of body parts and kin terms. Possessive prefixes indicating person are identical to the stative agreement prefixes of verbs. With inalienable nouns these prefixes are either affixed directly to the stem, or sequenced with the old possessive prefix /i-/. With alienable nouns the personal prefixes appear in sequence with a possessive prefix /t'a-/, with or without intervening /i-/. In addition, kin terms take a third person possessive suffix, appearing as /-ku/ or /-tku/; other inalienable nouns have no third person possessive forms, and only the /t'a-/ prefix marks third person possession in alienable nouns. The /i- / prefix never appears in third person forms.

The names for parts of the body are all inalienable nouns. Second person possessed forms all appear with the prefix /ni- /:

/t'ąč'ą́/	"body"	/nit'ą́č'ą/	"your body"
/č'ąté/	"heart"	/nič'ą́te/	"your heart"
/sí/	"foot"	/nisí/	"your foot"
/ʔité/	"face"	/niíte/	"your face"

First person possessed forms usually appear with the prefix /ma- /:

/ʔišpá/	"elbow"	/maíšpa/	"my elbow"
/p'asú/	"nose"	/map'ásu/	"my nose"
/č'aɣú/	"lungs"	/mač'áɣu/	"my lungs"
/sič'ą́/	"thigh"	/masíč'ą/	"my thigh"
/ʔųzé/	"buttocks"	/maų́ze/	"my buttocks"

Other forms, however, appear with the apparent prefix /mi- /:

/ʔistó/	"arm"	/miísto/	"my arm"
/t'ąč'ą́/	"body"	/mit'ą́č'ą/	"my body"
/č'ąté/	"heart"	/mič'ą́te/	"my heart"
/nų́ɣe/	"ear"	/minų́ɣe/	"my ear"

A few nouns may appear with either of these inflections:

/ʔí/	"mouth"	/maí/	/mií/	"my mouth"
/ʔité/	"face"	/maíte/	/miíte/	"my face"
/hó/	"voice"	/mahó/	/mihó/	"my voice"
/sí/	"foot"	/masí/	/misí/	"my foot"

Boas and Deloria (1941:128-129) presented very complete tables of such forms, and suggested that whether a noun appeared with /ma-/ or /mi-/ was dependent upon whether or not the body part was thought of as subject to volition. Body parts under the volitional control of the possessor are marked with /mi-/, while other body parts are marked with /ma-/. Examination of the authors' tables suggests that this generalization is probably correct. Additional support is provided by the fact that when body parts are personified, as in certain traditional folklore, they always appear with the /mi-/ prefix:

/ʔųzé/	"buttocks"
/maų́ze/	"my buttocks"
/mìųze, lená ʔawą́mičiyaka yó/	"my buttocks! Watch these for me!"

(The latter quotation from a trickster myth is cited in Boas and Deloria 1941:129.)

Our analysis assumes that the underlying representations of the first and second person possessive markers is /ma-/ and /ni-/, respectively, and that the "volitional" function is marked by the prefix /i-/. Derivations proceed as follows:

	//ma+i@čxąté//	//ni+i@čxąté//
SYNCOPE	//m +i@čxąté//	//n +i@čxąté//
ASPIRATION	#m +i@č'ąté#	#n +i@č'ąté#
STRESS MOVEMENT	#m +i@č'ą́te#	#n +i@č'ą́te#
	/mič'ą́te/	/nič'ą́te/

Assuming that SYNCOPE and EQUI-VOWEL DELETION are ranked by the @ boundary, just as they are ranked by the % boundary, allows the derivation of forms like /miísto/ "my arm" without deletion of the stem-initial vowel. That the analysis with underlying +i+ is correct gains support from the fact that the first person plural possessive appears as either /y̨-/ or /y̨kí-/ with inalienable nouns; the latter form can occur only if the i is present in the underlying representation.

First and second person possessives of kin terms behave just like those of body parts, except that the /i-/ prefix is obligatorily present in all forms. Derivations proceed just as the ones given above. Of no little interest, however, is the behavior of the third person possessive suffix which appears with these forms. The problem of choosing an underlying, systematic representation for this affix proves completely refractory. With many forms it appears as /-ku/, occasionally palatalized to /-ču/, while with many other forms it appears as /-tku/. The basic fact is that /-tku/ may appear only after high front vowels; /-ku/ may occur in most environments, but is less frequent after high front vowels. A deeper generalization emerges from closer inspection of the kin terms themselves; many kin terms are formed from others through the addition of an old, non-productive suffix /-ši/. The following pairs demonstrate the use of this suffix:

/t'ąké/	"a man's elder sister"
/t'ąkší/	"a man's younger sister"
/t'ųką́/	"father-in-law"
/t'ųką́šila/	"grandfather"
/šičé/	"woman's brother-in-law"
/šičéši/	"woman's male cross-cousin"
/t'ąhą́/	"man's brother-in-law"
/t'ąhą́ši/	"man's male cross-cousin"
/sčep'ą́/	"woman's sister-in-law"
/sčep'ą́ši/	"woman's female cross-cousin"
/hąká/	"man's sister-in-law"
/hąkáši/	"man's female cross-cousin"

The deeper generalization that emerges is simply that this suffix /-ši/ is followed only by the possessive suffix /-tku/. In fact, it would appear that /-tku/ appears <u>only</u> after forms with the suffix /-ši/, and /-ku/ appears elsewhere. The only apparent exceptions are the irregular /č'įhį́-tku/ "his son" and /č'ųwį́tku/ "his daughter"; the first person possessive forms with these stems, however, are /mič'į́kši/ and /mič'ų́kši/, respectively, thus showing that the suffix /-ši/ is present here. That the form /-tku/ appears with these stems even though the suffix /-ši/ may not is good evidence in favor of a morphological solution to this problem. We thus assume that the shape of the third person suffix is morphologically determined, /-tku/ after the suffix /-ši/ and /-ku/ elsewhere.

The effect of VELAR PALATALIZATION on the /-ku/ form of the suffix is also of interest. Stems ending in high front vowels always palatalize this suffix:

/t'ųwį́ču/	"father's sister"
/t'awíču/	"wife"

Stems ending in e, however, do not trigger the palatalization process:

/č'iyéku/	"his elder brother"
/t'ąkéku/	"his elder sister"
/č'uwéku/	"her elder sister"

An exception, however, is the following:

/šič̓éču/	"her brother-in-law"

These forms represent some of the apparent irregularities in the application of VELAR PALATALIZATION which we are unable to account for.

The prefix /t'a-/, marking alienable possession, is subject to the rule of A-DROP; like the verb prefix /wa-/ of Class 1, this prefix may or may not lose its a, depending on the "closeness" of the possession:

/t'aóųye/	"his temporary residence"
/t'óųye/	"his permanent residence"
/t'aų́xnaɣe/	"his fireplace"
/t'ų́xnaɣe/	"his home fireplace"

As in the case of our earlier analysis, we assume that fine distinctions in the surface syntactic structure are responsible for the placement of two distinct boundaries in such forms, ¢ in the forms which contract by A-DROP, and $ in the forms which do not.

4.2 Pronouns

Independent personal pronouns in Dakota, as distinct from the pronominal agreement markers prefixed to the verb, again support the notion that there is an underlying prefix +i+ that can appear with the stative markers /ma-/ and /ni-/. In this case, though, the +i+ prefix may be an old third person marker. (Boas and Deloria 1941:78) The most frequent forms of the independent personal pronouns are:

/miyé/	"I"
/niyé/	"you (sng.)"
/ʔiyé/	"he, she, it"

/ʔųkíyepi/	"we"
/niyépi/	"you (pl.)"
/ʔiyépi/	"they"

The stem in these forms appears to be the defective verb /ʔé/ "to be", which otherwise occurs only in the third person:

/Joe ʔéšni/ "It wasn't Joe."

If we assume that GLIDE EPENTHESIS applies exceptionally with this stem, then derivations might proceed as follows:

	#ma+i+é#	#ųk+i+é+pi#
SYNCOPE	#m +i+é#	inapplicable
STRESS MOVEMENT	inapplicable	#ųk+í+e+pi#
GLIDE EPENTHESIS (?)	#m +i+yé#	#ųk+í+ye+pi#
GLOTTAL EPENTHESIS	inapplicable	#ʔųk+í+ye+pi#
	/miyé/	/ʔųkíyepi/

The third person form /ʔiyé/ does indeed suggest that the +i+ prefix here may represent an old third person; whether this is the same morpheme as our "possessive" +i+ remains to be seen.

4.3 Demonstratives

Dakota possesses four demonstrative particles, which may appear as independent forms or with any of a large set of temporal and locative suffixes. The citation forms of the demonstratives are:

/ʔé/	"general demonstrative"
/lé/	"this"
/hé/	"that near you"
/ká/	"that yonder"

Inspection of the various types of constructions in which these particles occur with suffixes reveals an interesting fact, noted by Boas and Deloria (1941:116): a series of constructions terminating in l is precisely paralleled by a series of forms terminating in tu:

/leh̨ą́l/	"during this time"	/leh̨ą́tu/	"it is just now"
/heh̨ą́l/	"during that time"	/heh̨ą́tu/	"it was just then"
/kah̨ą́l/	"during that time"	/kah̨ą́tu/	"it was just then"
/léč'el/	"like this"	/léč'etu/	"it is like this"
/héč'el/	"like that"	/héč'etu/	"it is like that"
/kák'el/	"like that"	/kák'etu/	"it is like that"
/lél/	"here"	/létu/	"it is here"
/hél/	"there"	/hétu/	"it is there"
/kál/	"there"	/kátu/	"it is there"

Other particles reveal the same pattern:

/tukté/	"which?"
/tuktél/	"where?, somewhere"
/tuktétu/	"where is it?, it is somewhere"
/tók'el/	"how?, in what way?"
/tók'etu/	"how is it?, as it is"

The forms which terminate in l are always adverbial; the forms which terminate in tu are always predicational, or verbal.

These observations suggest a rule which deletes the final u of the predicational form when it functions adverbially; i. e., we assume that the adverbial forms are derived from the predicational forms. Once the final vowel has been dropped from such forms, CORONAL LAXING will apply to produce the final l of the phonetic representation. The rule needed to delete the final vowel is formalized as follows:

$$\text{FINAL U-DELETION:} \quad u \longrightarrow \emptyset \;/\; \_\_\#\,]_{\text{ADV}}$$

The claim that no adverbial form ends in u is correct, but in point of fact the suffix /-tu/ is the only possible source for this vowel. Since no adverbial "stem" or suffix ends in u, we can formulate the rule as a regular phonological process, rather than a morphological peculiarity of the suffix involved.

Derivations for these forms would proceed as follows:

	$[\#hé+kxe+tu\#]_{ADV}$	$[\#ká+kxe+tu\#]_{V}$
ASPIRATION	$[\#hé+k'e+tu\#]_{ADV}$	$[\#ká+k'e+tu\#]_{V}$
FINAL U-DELETION	#hé+k'e+t #	inapplicable
VELAR PALATALIZATION	#hé+č'e+t #	inapplicable
CORONAL LAXING	#hé+č'e+l #	inapplicable
	/héč'el/	/kák'etu/

In terms of interaction, FINAL U-DELETION must precede CORONAL LAXING, since the latter is fed by the former, and must also precede the rules of the cycle, since it requires information from a labeled bracket.

The suffix /-tu/ also occurs with some noun stems, always after the defective verb /ʔé/, to indicate units of time. Examples are:

/ʔą́pa/	"daytime"
/ʔąpétu/	"a day"
/waní/	"winter-time"
/waníyetu/	"winter"
/xtá-/	"evening"
/xtáyetu/	"the evening"
/ptą́/	"autumn-time"
/ptą́yetu/	"autumn"

Here again, as on page 258 above, we see that GLIDE EPENTHESIS applies exceptionally in derivations with the stem /ʔé/, so that derivations for /ʔąpétu/ "a day" and /waníyetu/ "winter" might look like the following:

	#ąp+e+tu#	#wani+e+tu#
GLIDE EPENTHESIS	inapplicable	#wani+ye+tu#
GLOTTAL EPENTHESIS	#ʔąp+e+tu#	inapplicable
Stress Rules	#ʔąp+é+tu#	#waní+ye+tu#
	/ʔąpétu/	/waníyetu/

The stress rules needed to account for these forms are regular, and are discussed in the following chapter.

Although we have barely scratched the surface of noun and particle constructions in these few pages, it is hoped that the examples have sufficiently indicated that, by and large, the phonology of nouns and particles is virtually identical to that of verbs. Just as verbal suffixes require few phonological rules for their explication, so the fact that most inflectional processes operating on noun and particle stems result in suffixing, rather than prefixing, helps to explain why the phonology of nouns and particles is of less interest than that of verbs.

5. Phonological Processes: Compounds

Compound words are those which contain more than one stem; they are of special interest in Dakota because of the light they shed on various phonological processes, particularly those dealing with stress. Certain vowel deletion phenomena are also especially prominent in compounds, and evidence from such forms is essential for appropriate formalization of the rules involved. We must note at the outset, however, that the syntactic and phonological characteristics of many types of compounds are poorly understood, and that our investigations in this area have been limited to just a few of the basic types of compound words. Casual inspection of other types of compounds has suggested, though, that the phonological treatment presented here will account for the great majority of compound forms.

Compound structures in Dakota fall into two broad categories: those entered directly in the lexicon as single lexical items, and those produced by the operation of transformational rules. Compounds of the former category behave much like individual stems, and although they exhibit a number of interesting phonological properties, we do not deal with them here in any real detail. The compounds of the second category can again be divided into a number of distinct types, with each type the product of some specific transformational process. Our work on compounds has been concentrated on two of these types: the compound verbs produced by a transformation similar to English *Predicate Raising* (McCawley 1968), and the noun-verb compounds produced by a transformation of *Object Noun Incorporation*. The former transformation moves the verb from an embedded S into a higher S, adjoining it to the left of the verb in the higher S. The following are compounds which could be produced by this process:

/yèší/	"he ordered him to go"	
	/yá/	"to go (durative)"
	/-ší/	"to order, command"
/sàbyá/	"he blackened it"	
	/sápa/	"black"
	/-yá/	"to cause"
/t̓èkų́za/	"he pretends to be dead"	
	/t̓á/	"dead"
	/kų́za/	"to pretend"

The following compounds could be produced by *Object Noun Incorporation*:

/hòk'úwa/	"to fish, go fishing"	
	/hó-/	"fish"
	/k'uwá/	"to chase, hunt"
/ptèkté/	"to kill buffalo"	
	/pté/	"buffalo"

	/kté/	"to kill"
/ʔiktómikàɣa/	"to play the fool"	
	/ʔiktómi/	"the Trickster"
	/káɣa/	"to make, cause to be"

Only active verbs can incorporate an object noun, since all stative verbs are intransitive.

These two types of compounds are alike in terms of their stress patterns, which typify those of the majority of compound forms. In the discussion to follow we also discuss briefly a third variety of compound, one characterized by a different stress pattern:

/č'éɣa-t'ą̀ka kį/	"the large kettle"	
	/č'éɣa/	"kettle, pot"
	/t'ą́ka/	"big, large"
/šiná-lùta wą/	"a red blanket"	
	/šiná/	"blanket, shawl"
	/lúta/	"red"
/hą́pa-t'ò/	"blue moccasins"	
	/hą́pa/	"moccasin"
	/t'ó/	"blue"

These noun-verb compounds are produced by a transformation of Relative Clause Reduction, presumably similar in function to the English transformation which derives "the large kettle" from a structure like "the kettle that is large". These compounds are always marked with a hyphen, indicating our belief that they contain a boundary stronger than the usual compound (=) boundary.

5.1 Compound Stress Phenomena

The causative forms of verbs are typical examples of compounds produced by Predicate Raising, and the stress patterns which they exhibit can be taken as representative of this kind of compound structure. The causative is represented by the dependent verb stem /-yá/; the verb stem of the embedded S is adjoined to its left. If the stem from the embedded S is monosyllabic in underlying representation, then the resulting compound exhibits final stress; if the stem from the embedded S is multisyllabic in underlying representation, however, then the primary stress falls on the second syllable of the resulting compound. The following examples show both of these stress patterns:

/sápa/	"black"	/sàbyá/	"to blacken something"
/šíča/	"bad"	/šìlyá/	"to spoil something"
/ská/	"white"	/skàyá/	"to whiten something"
/k'ap'á/	"to excel"	/k'ap'éya/	"to cause to excel"
/ʔilé/	"to burn"	/ʔiléya/	"to set fire to"
/wašté/	"good"	/waštéya/	"to make something good"

Our generalization that primary stress never falls "later" than the second syllable of a word holds for all compounds, though, so that the final stress of the first type of causative discussed above is always moved leftward by STRESS MOVEMENT when the compound is inflected:

/sàbyá/	"to blacken"	/sàbmíčiya/	"I blackened myself"
/šìlyá/	"to spoil"	/šìlwáya/	"I spoiled it"

(The last example shows that the causative /-yá/ does not trigger the A-DELETION rule.) The secondary stress that appears on the first stem in forms of this type suggests the existence of a rule like the following:

$$\text{STRESS LAXING:} \quad \begin{bmatrix} V \\ 1\ \text{acc} \end{bmatrix} \longrightarrow \begin{bmatrix} 2\ \text{acc} \end{bmatrix} \Big/ \ \#C_0 \_\_ C_0 =$$

This rule weakens the primary stress of the first stem in a compound to secondary if the stem is monosyllabic; as noted above, the compounds produced by <u>Object Noun Incorporation</u> show the same stress pattern, thus providing additional support for the rule.

Various other compound forms reveal the need for a second rule which weakens primary stress:

/ʔiktómikàɣa/ "to play the fool"

/ʔiktómi/ "the Trickster"

/káɣa/ "to make, cause to be"

/č'ą́liwakpą̀/ "to cut tobacco"

/č'ą́li/ "tobacco"

	/wakpą́/	"to cut up fine"
/wanáɣiʔ ihą̀bla/	"to dream of ghosts"	
	/wanáɣi/	"a ghost"
	/ʔihą́bla/	"to dream"
/ʔį́yą-k'àta/	"a hot stone"	
	/ʔį́yą/	"stone"
	/k'áta/	"warm, hot"

This rule weakens all instances of primary stress in a word which fall to the right of the first, and can be formalized as follows:

$$\text{COMPOUND STRESS:} \quad \begin{bmatrix} \text{V} \\ \text{1 acc} \end{bmatrix} \longrightarrow [\text{2 acc}] \Big/ \begin{bmatrix} \text{V} \\ \text{1 acc} \end{bmatrix} \ \text{X} \ \_\_$$

where X is any string not containing #.

The derivations which follow show the effects of the two stress rules:

	#sáp=yá#	#wa$šté=yá#
STRESS LAXING	#sàp=yá#	inapplicable
COMPOUND STRESS	inapplicable	#wa$šté=yà#
STOP VOICING	#sàb=yá#	inapplicable
	/sàbyá/	* /waštéyà/

	#į́yą-kxát#	#wa$naɣí=i*hąplá#
STEM FORMATION	#į́yą-kxáta#	inapplicable
ASPIRATION	#į́yą-k'áta#	inapplicable

STRESS LAXING	inapplicable	inapplicable
COMPOUND STRESS	#į́yą-k'àta#	#wa$naɣí=i*hąplà#
STRESS MOVEMENT	inapplicable	#wa$náɣi=i*hąplà#
STOP VOICING	inapplicable	#wa$náɣi=i*hąblà#
GLOTTAL EPENTHESIS	#ʔį́yą-k'àta#	#wa$náɣi=ʔi*hąblà#
	/ʔį́yą-k'àta/	* /wanáɣiʔihąblà/

As can be seen in the two examples on the right, our grammar is not yet producing adequate predictions of stress patterns in these forms, and certain modifications are required. The first problem, that represented by the incorrect * /waštéyà/, can be obviated by the following rule:

$$\text{STRESS LOSS:} \quad \begin{bmatrix} \text{V} \\ 2\ \text{acc} \end{bmatrix} \longrightarrow \begin{bmatrix} -\ \text{acc} \end{bmatrix} \Big/ \begin{bmatrix} \text{V} \\ 1\ \text{acc} \end{bmatrix} C_0 \,\_\_\#$$

This rule captures the generalization that no syllable may carry secondary stress after a primary-stressed syllable if it is word-final. (There is the distinct possibility that this rule might be collapsed with STRESS LAXING through the use of a "neighborhood" or "mirror-image" convention. We have chosen to write STRESS LAXING as a rule which weakens stress, but it is not actually clear that a word like /sàbyá/ <u>has</u> an initial secondary stress; the difficulty here stems from the fact that all words with primary stress on the second syllable have strong secondary emphasis on the initial syllable as well. The pitch contour of a trisyllabic word with primary stress on the second syllable, for instance, is mid - high - low. If STRESS LAXING were actually <u>deleting</u> the primary stress of the first stem of a compound, then the appropriate generalization might be that no monosyllabic stem can carry primary stress in either word-initial or word-final position in a compound structure. Ordering such a rule after STEM FORMATION would assure that it did not apply to a final stem ending in a consonant.)

The second problem, that represented by the incorrect */wanáɣi-ʔihąblà/, must be accounted for in a different way. The difficulty here is that the secondary stress is located on the wrong syllable; clearly, STRESS MOVEMENT must be allowed to apply before COMPOUND STRESS. If a word contains <u>two</u> primary stresses at the time when STRESS MOVEMENT applies, however, which one is the rule to move? The correct form /wanáɣiʔihą̀bla/ shows quite decisively that it must move <u>both</u>, yet without some type of constraint such application should simply cause both stresses to fall together on the second syllable. Once again, we suggest that the correct solution results from the cyclical application of STRESS MOVEMENT, with a concomitant minor change in the statement of that rule. If we suppose that the surface structure of the form in question, ignoring the labels on the brackets, is something like the following, then we can see how the cycle might handle our difficulty:

[[wa [naɣí]] [i [hąplá]]]

In the first cycle, supposing that the entire structure is in the domain of the rule, STRESS MOVEMENT cannot apply. Erasing the innermost brackets produces a form in which STRESS MOVEMENT <u>can</u> apply, simultaneously, producing the string which follows.

$$\Big[\,[\text{wa}\quad \text{náγi}]\quad [\text{i}\quad \text{hą́pla}]\,\Big]$$

The next erasure of brackets also produces a string in which STRESS MOVEMENT can apply, but now it must <u>not</u>. In order to ensure that it does not apply to this string, we must change the statement of the rule so that it cannot apply when a primary stress appears to the left of the stress being moved <u>in the same constituent</u>:

$$\text{STRESS MOVEMENT:}\quad \underset{1}{\Big[}\quad \underset{2}{\text{X}}\quad \underset{3}{\begin{bmatrix} \text{V} \\ -\ \text{acc} \end{bmatrix}}\quad \underset{4}{C_0}\quad \underset{5}{\begin{bmatrix} \text{V} \\ -\ \text{acc} \end{bmatrix}}\quad \underset{6}{C_0}\quad \underset{7}{\begin{bmatrix} \text{V} \\ 1\ \text{acc} \end{bmatrix}}\quad \longrightarrow$$

$$1\ 2\ 3\ 4\ \begin{bmatrix} 5 \\ 1\ \text{acc} \end{bmatrix}\ 6\ \begin{bmatrix} 7 \\ -\ \text{acc} \end{bmatrix}$$

where X does not contain a stressed vowel.

The following derivations provide a further test of the rules and rule modification suggested to this point:

	#wa$a*pxá=wa$čxį̄́#
ABLAUT	#wa$a*pxé=wa$čxį́#
ASPIRATION	#wa$a*p'é=wa$č'į́#
STRESS LAXING	inapplicable

STRESS MOVEMENT (1)	inapplicable
STRESS MOVEMENT (2)	#wa$á*p'e=wa$č'į́#
COMPOUND STRESS	#wa$á*p'e=wa$č'į̀#
	/waáp'ewač'į̀/ "he intended to hit him"
	#lową́=wa$yu@pxí+ka#
ASPIRATION	#lową́=wa$yu@p'í+ka#
STRESS LAXING	inapplicable
STRESS MOVEMENT (1)	inapplicable
STRESS MOVEMENT (2)	#lową́=wa$yú@p'i+ka#
COMPOUND STRESS	#lową́=wa$yù@p'i+ka#
	/lową́wayùp'ika/ "to be a good singer"

Both of these compounds are correct, suggesting that the cyclical analysis will in fact handle forms of this type.

If we now turn to one of the compounds produced by Relative Clause Reduction, such as the form /č'éɣa-t'ą̀ka/ "large kettle", we see that it is explicable by means of the same rules proposed for our other compounds; we need only assume that the strong word-internal boundary possessed by these forms, symbolized by the hyphen, will trigger STEM FORMATION. The application of this rule now ensures that STRESS LAXING will not apply, as shown in the following derivation:

	//čxéɣ-txą́ka//
STEM FORMATION	#čxéɣa-txą́ka#
ASPIRATION	#č'éɣa-t'ą́ka#
STRESS LAXING	inapplicable
STRESS MOVEMENT	inapplicable
COMPOUND STRESS	#č'éɣa-t'ą̀ka#
	/č'éɣa-t'ą̀ka/

Compare this derivation with that for /č'èxʔólota/ "to borrow kettles":

	#čxéɣ=o*lót#
STEM FORMATION	#čxéɣ=o*lóta#
ASPIRATION	#č'éɣ=o*lóta#
STRESS LAXING	#č'èɣ=o*lóta#
STRESS MOVEMENT	#č'èɣ=ó*lota#
COMPOUND STRESS	inapplicable
SPIRANT DEVOICING	#č'èx=ó*lota#
GLOTTAL EPENTHESIS	#č'èx=ʔó*lota#
	/č'èxʔólota/

In the first of these derivations, note that we treat the stem +txą́ka+ as an exception with regard to stress; that this stem is actually vowel-final is indicated by its failure to undergo ABLAUT and by "peculiar" behavior in other types of environments.

In section 3.7 above we remarked that reduplicated verbs exhibit the same types of stress patterns that some compounds do; in particular, the reduplicated forms of stative verbs are subject to STRESS LAXING:

	#sap#R#	
REDUPLICATION	#sap#sap#	
Readjustment Rules	#sáp=sáp#	
STEM FORMATION	#sáp=sápa#	
STRESS LAXING	#sàp=sápa#	
STRESS MOVEMENT	inapplicable	
COMPOUND STRESS	inapplicable	
STRESS LOSS	inapplicable	
	/sapsápa/	"black"

We might also assume that reduplicated verbs are subject to COMPOUND STRESS and STRESS LOSS:

	#plaska#R#	
REDUPLICATION	#plaska#ska#	
Readjustment Rules	#plaská=ská#	
STRESS LAXING	inapplicable	
STRESS MOVEMENT	inapplicable	
COMPOUND STRESS	#plaská=skà#	
STRESS LOSS	#plaská=ska#	
STOP VOICING	#blaská=ska#	
	/blaskáska/	"flat"

Reduplicated active verbs, however, must be "exceptions" with regard to STRESS LAXING:

	#pxat#R#
REDUPLICATION	#pxat#pxat#
Readjustment Rules	#pxát=pxát#
STEM FORMATION	#pxát=pxáta#
ASPIRATION	#p'át=p'áta#
STRESS LAXING	inapplicable ?
STRESS MOVEMENT	inapplicable
COMPOUND STRESS	#p'át=p'àta#
CORONAL LAXING	#p'ál=p'àta#
	/p'álp'àta/ "to butcher"

As the sequence of pitches on this type of reduplicated form is high - mid - low, the prediction regarding secondary stress is perhaps correct.

In summary, we are able to maintain our position that STRESS PLACEMENT is a type of readjustment rule, and that it places primary stress on the last underlying vowel of each stem in a word (including the two "parts" of reduplicated forms). Evidence from compounds seems to provide independent motivation for the cyclical application of STRESS MOVEMENT; other rules are required to predict the location of secondary stress.

5.2 Compound Vowel Deletion

When the phonetic representation of a compound structure is compared with the phonetic representations of the "citation" forms of its constituent stems, it often proves to be the case that the leftmost stem of the compound lacks a final vowel present in the citation form. In most cases, as we have just seen, this simply means that the stem in question is consonant-final, since the STEM FORMATION rule does not apply before the compound (=) boundary. Other forms, however, contain stems which are obviously vowel-final, yet the vowel does not appear:

/ʔištógmuza/	"to hold the eyes shut"	
	/ʔištá/	"eye"
	/ʔogmúza/	"to be closed"
/p'ežógnake/	"a hay-loft"	
	/p'eží/	"grass"
	/ʔognáka/	"to place in"
/mak'ó̔ke/	"a pit"	
	/mak'á/	"earth, ground"
	/ʔo̔ká/	"to dig in"

The stems /ʔištá/, /p'eží/, and /mak'á/ must have the underlying canonical shapes VCCV, CCVCV, and CVCCV, respectively.

What is apparently required to account for these forms is a rather peculiar vowel-deletion rule:

$$\text{VOWEL DROP:}\quad \begin{bmatrix} \text{V} \\ \text{1 acc} \end{bmatrix} \;=\; \text{V}$$
$$\quad 1 \qquad 2 \;\; 3 \;\longrightarrow\; \emptyset \;\; 2 \; \begin{bmatrix} \text{V} \\ \text{1 acc} \end{bmatrix}$$

The following derivation shows how this rule would apply:

	#makxá=o*kʔá#
ABLAUT	#makxá=o*kʔé#
EJECTION	#makxá=o*k̓é#
ASPIRATION	#mak'á=o*k̓é#
COMPOUND STRESS	#mak'á=o*k̓è#
VOWEL DROP	#mak' =ó*k̓è#
STRESS LOSS	#mak' =ó*k̓e#
	/mak'ók̓e/

The VOWEL DROP rule looks extremely *ad hoc*, however, in that it seems to shift stress rightward. If we were to assume that the process were a very late contraction, this might be acceptable. Several other factors also argue that this rule is a late one; *e.g.*, the fact that VOWEL DROP has not exposed the *ž* of /p'ežógnake/ to SPIRANT DEVOICING.

Another interesting fact, however, suggests strongly that this entire line of reasoning is simply incorrect. The verbal prefix /wič'a-/ "third person animate object" is subject to exactly the same type of vowel deletion when it appears before the prefix /ųk-/ "first person plural".

/slolyá/	"to know"
/slolwíč'awaya/	"I know them"
/slolwíč'ųyąpi/	"we know them"
/kté/	"to kill"
/wič'áwakte/	"I killed them"
/wič'ų́ktepi/	"we killed them"

We have no independent motivation for a rule which would delete a in this environment prior to STRESS MOVEMENT, the order required to derive the form /wič'ų́ktepi/. Similarly, the fact that the prefix /wič'a-/ represents an old noun incorporation strongly suggests that it should behave like a "stem", and we would thus expect that it might be subject to the VOWEL DROP process. On the other hand, if VOWEL DROP is the cause of this deletion phenomenon, then to derive the form /slolwíč'ųyąpi/ we would have to order VOWEL DROP with the rules of the cycle.

We presently have no answer to this dilemma. Our only possibility seems to be the undesirable one of assuming that the behavior of /wič'a-/ is exceptional. It is fairly clear that some important generalization is being missed here, for the vowel deletion phenomenon at issue is fairly common. It may be the case that the forms which exhibit it are simply another "type" of compound, with distinct surface syntactic structure, and perhaps with a different phonological boundary to trigger a rule. The stress problem is the most refractory issue, however, and it must be admitted that this type of vowel deletion constitutes evidence against our STRESS PLACEMENT rule. These forms might be easier to account for if we deleted the vowel before assigning any primary stress to the word.

6. Rule Interaction

In the preceding substantive portion of this work we have motivated and formalized some forty phonological rules; since our analysis is far from exhaustive, it is undoubtedly the case that other rules will ultimately be required for an adequate account of Teton Dakota phonology. With just the set of rules offered here, however, we have often found it necessary to make explicit statements about the sequences in which they apply. Indeed, many of the individual derivations presented above simply will not work if the rules involved are applied in some sequence other than the one actually utilized. We turn now to the problem of how such applicational statements are to be formally incorporated into the grammar; our intent here is not that of "resolving" the debate concerning the relative merits of intrinsic _versus_ extrinsic rule ordering, but rather that of shedding some light on the kinds of rule sequences that Dakota exhibits, and on what the functional significance of those sequences might be. It is to be hoped, of course, that this kind of information will ultimately prove of value in the formulation of a theory of rule interaction, or in the refinement and testing of current theoretical models.

The simplest and most economical theory of rule interaction, that of simultaneous application of all rules, is clearly unable to account for the facts of Dakota phonology; the need for iterative application of VELAR

PALATALIZATION and multiple application of STRESS MOVEMENT suffice to justify this claim. It is the case, however, that many pairs of rules show no direct interaction, and can be allowed to apply simultaneously. The rules of STRESS LAXING and SYNCOPE provide an example: these rules do not directly interact with one another, nor do they interact with any third rule in such fashion as to preclude simultaneous application. The rules of SYNCOPE and A-DROP, on the other hand, could not apply simultaneously to a string; although they do not interact directly, they do interact differentially with the STRESS MOVEMENT rule, SYNCOPE always applying *before* STRESS MOVEMENT and A-DROP always applying *after* STRESS MOVEMENT. (Note that a form could not meet the structural descriptions of *both* SYNCOPE and A-DROP without *also* meeting the structural description of STRESS MOVEMENT.) A few rules seemingly do not interact with other rules at all; *e.g.*, GLOTTAL EPENTHESIS can apply at any point in a derivation, since if its structural description is met at *one* point in a derivation it will be met at all *other* points as well.

In the majority of cases where we have made the claim that some rule A must precede some other rule B, the order resulting is a *feeding* order; *i.e.*, rule A creates new strings which meet the structural description of rule B. For example, in the derivation of /mąká/ "I sit" from the underlying form #wa%yąká#, we observe a chain of rule interactions in which each rule feeds the rule which follows: A-DELETION feeds GLIDE ASSIMILATION and LATERALIZATION; they in turn feed

L-NASALIZATION, which feeds B-NASALIZATION, which then feeds N-DELETION. Feeding orders of this type are naturally produced by a grammar in which rules can apply whenever their structural descriptions are met, since only one rule of a "feeding chain" can apply at any one point in a derivation. This fact suggests that some type of unordered rule hypothesis would correctly predict many sequences of rule application in Dakota.

Further inspection of the derivation of /mąká/ reveals, however, that GLIDE ASSIMILATION and LATERALIZATION are not in a feeding relationship. It appears that these rules can be applied in either order to achieve the correct output string. Examination of the derivation of the second person form /nąká/ "you (sng.) sit" shows that GLIDE ASSIMILATION must follow LATERALIZATION, though, in order to retain a surface phonetic trace of the underlying second person agreement marker:

	#wa%yąka#	#ya%yąka#
A-DELETION	#w %yąka#	#y %yąka#
LATERALIZATION	#w %ląka#	#y %ląka#
GLIDE ASSIMILATION	#b %ląka#	#∅ %ląka#

If the opposite order of application were allowed, the string representing the second person form would now be #yąka#, and the second person agreement marker would be non-recoverable. After A-DELETION has applied, though, the resulting string meets the conditions for application of both rules, and it appears that the unordered rule principle fails to make an adequate prediction.

A moment's thought shows us how this difficulty might be rectified, with a minor change in the formalization of GLIDE ASSIMILATION. We have assumed that this rule deletes _y_ before any consonant, _i. e._, before any non-syllabic segment. If we rewrite the rule so that it deletes _y_ before a true consonant, _i. e._, one specified as positive for the feature _consonantal_, then LATERALIZATION _would_ feed GLIDE ASSIMILATION, and the correct order of application would be produced by the hypothesis of unordered rules. Note that this change in the formal statement of GLIDE ASSIMILATION would not complicate it in any way; the number of distinctive feature specifications needed would be the same for both forms of the rule. The latter version, however, permits the six rules of LATERALIZATION, GLIDE ASSIMILATION, STOP VOICING, L-NASALIZATION, B-NASALIZATION, and N-DELETION to be correctly applied by an unordered rule hypothesis.

This type of reformulation cannot always solve ordering problems in our grammar, as the over-all situation is not nearly that simple. We obviously cannot get all of our forty rules into one big feeding chain; the existence of a rule cycle, for instance, cannot possibly be accounted for in this way. Nevertheless, it appears that the principle of unmarked feeding order can be used to simplify the grammar; at the least, we could adopt a convention that any rule without an extrinsic ordering condition applies whenever its structural description is met.

In a few cases where we have made the claim that some rule A must precede some other rule B, the order resulting is a bleeding order; i. e., the application of rule A deprives rule B of some of its potential input. An example is provided by the mutually bleeding I-DELETION and K-DELETION rules, where the expression "mutually bleeding" implies that either order of application would be a bleeding order. We have shown above that I-DELETION must apply first, thus bleeding K-DELETION. Kenstowicz and Kisseberth (1973) have suggested that bleeding orders of this type, where the first rule to apply bleeds the second by changing the environment required for application of the second, are quite natural. They elaborate this notion by showing that, in their examples at least, the rule which takes applicational precedence is always one which affects syllable structure, through such processes as epenthesis, vowel copying, vowel deletion, or metathesis, while the second rule is always one which does not affect syllable structure. The bleeding order exhibited by I-DELETION and K-DELETION clearly fits this description; I-DELETION bleeds K-DELETION by removing a segment from the string which is required to trigger the latter rule. By deleting a vowel, I-DELETION alters the syllable structure of a string; although K-DELETION alters canonical form, it neither increases nor decreases the number of syllables in a string.

We have shown above that three vowel deletion rules, A-DELETION, I-DELETION, and SYNCOPE, must apply prior to STRESS MOVEMENT. Here we see that the principle suggested by Kenstowicz and Kisseberth correctly predicts that the vowel deletion rules, which alter syllable structure, will bleed STRESS MOVEMENT, a rule which refers to syllable structure, by taking applicational precedence. The basic idea in all such interactions is that rules determining syllable structure are always "deeper" than rules which must make reference to syllable structure. (Kenstowicz and Kisseberth 1973:9-10)

We have also shown, however, that STRESS MOVEMENT must apply before three other vowel deletion rules, A-DROP, SYNERESIS, and EQUI-VOWEL DELETION, cyclically in the case of the latter two rules. Although it appears that the principle suggested by Kenstowicz and Kisseberth makes faulty predictions about this applicational sequence, further analysis suggests that the problem is illusory. In ordering these vowel deletion rules after STRESS MOVEMENT we have ensured that the second vowel of the sequence mentioned in the structural description of each will be specified as $\left[1 \text{ accent}\right]$; in other words, we have used rule ordering to effect a "simplification" of the structural descriptions of these rules. If we were to simply rewrite each of these rules, explicitly specifying that the second vowel of the sequence must be $\left[1 \text{ accent}\right]$, then we would no longer require extrinsic statements to order them after STRESS MOVEMENT, since their structural descriptions could not be met until STRESS MOVEMENT had applied at least once.

This solution of the ordering problem, if we accept the suggestion of Kenstowicz and Kisseberth, has the added attraction of allowing us to predict the cyclical application of SYNERESIS and EQUI-VOWEL DELETION. Note that these rules are cyclical only in that they must be permitted to apply between successive applications of STRESS MOVEMENT; neither rule can itself apply more than once, at least in the derivations presented above. After each application of STRESS MOVEMENT, then, it may be the case that the resulting string meets the structural descriptions of both STRESS MOVEMENT and a vowel deletion rule; in this situation the Kenstowicz-Kisseberth principle correctly predicts that the vowel deletion rule will take precedence. Thus STRESS MOVEMENT feeds both SYNERESIS and EQUI-VOWEL DELETION, but may in turn be bled by them. The STRESS MOVEMENT rule must itself be applied cyclically, however, as its multiple application is conditioned by the "erasure" of labeled brackets. We are thus left with a cycle of two rules: STRESS MOVEMENT, and the metarule which sequentially eliminates nested brackets.

A second type of bleeding order is exemplified by GLOTTAL DELETION and EJECTION, where the former bleeds the latter by deleting some <u>ʔ</u> after <u>k</u>. Although it is true that GLOTTAL DELETION eliminates some potential input for EJECTION by modification of the environment needed for application of the latter rule, neither rule alters syllable structure. The proper order here is not predictable on these grounds. It <u>may</u> be predictable on <u>functional</u> grounds, though, as the sole function of this order is to avoid an impermissible consonant sequence; GLOTTAL DELETION prevents EJECTION from applying to just those strings in which it would produce a consonant cluster whose first element was an ejective stop. Although clusters of shape *Ck̓* are permissible, as in the form /yuk̓éxk̓eɣa/ "he scratched them", clusters of shape *k̓C* may not occur under any circumstances. In general, bleeding orders of this kind are correctly predicted by the principle of *proper inclusion precedence* (*cf*. Koutsoudas, Sanders, and Noll 1971; Iverson 1973); since the structural description of GLOTTAL DELETION properly includes that of EJECTION, the former takes precedence over the latter.

Four of the rules that have been formalized above, ABLAUT, E-DELETION, RELATIVE PALATALIZATION, and SYNERESIS, show global interaction with other rules. The ABLAUT rule apparently applies only to the stem-final *a*'s produced by STEM FORMATION, although many exceptions must be marked in the lexicon. This rule then feeds E-DELETION and RELATIVE PALATALIZATION, rules which are triggered only by the *e*'s produced by the application of ABLAUT; note that, once ABLAUT has applied in a form, the distinction between epenthetic *a*'s and organic *a*'s is lost, as all of the *e*'s produced by the rule behave alike. The SYNERESIS rule is fed by K-DELETION and Y-DELETION, applying only to vowel sequences produced by those rules. As we have repeatedly observed, the constraint on global rules suggested by Kiparsky (1973) will not correctly predict the behavior of any of these rules; each applies only in environments which are created by the prior application of some other phonological rule, not in environments produced by morphological rules. It would appear that some other metatheoretical device is needed to handle rules which interact globally.

We suggest that rule features constitute an appropriate means of capturing the type of interaction exhibited by global rules in Dakota. Just as we captured the "rightward propagation" effect of VELAR PALATALIZATION in benefactive constructions by allowing the rule to add a rule feature to its output, so we might allow the rules which feed the global rules to add rule features in the same way. The rule of STEM FORMATION would add the feature $[+\ \text{ablaut}]$ to its output, and this feature would then be included in the structural descriptions of ABLAUT, E-DELETION, and RELATIVE PALATALIZATION. Similarly, the K-DELETION and Y-DELETION rules would both add the rule feature $[+\ \text{syneresis}]$ to their outputs, and the feature would be included in the structural description of SYNERESIS. In this way the four global rules become strictly Markovian, and do not really "look back" at earlier lines of a derivation. The fact that both of these rule features can be independently motivated to mark exceptions in the lexicon suggests that this line of reasoning is not entirely ad hoc.

We now reformulate the various rules discussed here, incorporating the changes suggested:

GLIDE ASSIMILATION: $\begin{bmatrix} \text{w} \\ \text{y} \end{bmatrix} \longrightarrow \begin{bmatrix} \text{b} \\ \emptyset \end{bmatrix} \Big/ \_\_ \ [+\ \text{con}]$

A-DROP: $\text{a} \longrightarrow \emptyset \Big/ \_\_ \ ¢ \begin{bmatrix} \text{V} \\ 1\ \text{acc} \end{bmatrix}$

SYNERESIS:

$$\underset{1}{a} \quad \underset{2}{\begin{bmatrix} V \\ +\ \text{hgh} \\ -\ \text{nas} \\ 1\ \text{acc} \\ +\ \text{SYN} \end{bmatrix}} \longrightarrow \emptyset \quad \begin{bmatrix} 2 \\ -\ \text{hgh} \end{bmatrix}$$

EQUI-VOWEL DELETION:

$$V_\alpha \longrightarrow \emptyset \;/\; \_\_ \begin{bmatrix} V_\alpha \\ 1\ \text{acc} \end{bmatrix} \qquad \text{Rank: } \%$$

STEM FORMATION:

$$\emptyset \longrightarrow \begin{bmatrix} a \\ +\ \text{ABL} \end{bmatrix} \;/\; C\_\_ \left.\begin{matrix} + \\ \neq \\ - \\ \# \end{matrix}\right]_{\text{STEM}}$$

ABLAUT:

$$\begin{bmatrix} a \\ +\ \text{ABL} \end{bmatrix} \longrightarrow \begin{bmatrix} e \\ \vdots \\ \text{į} \end{bmatrix} \;/\; \_\_\,]_{\text{VERB}} \begin{bmatrix} \begin{Bmatrix} \begin{bmatrix} X \\ +\ \text{ABT} \end{bmatrix} \\ \#\# \\ = \\ ]_{\text{NOUN}} \end{Bmatrix} \\ \begin{Bmatrix} \#\ \text{ną} \\ +\ \text{kta} \end{Bmatrix} \end{bmatrix}$$

E-DELETION:

$$e \longrightarrow \emptyset \;/\; \begin{bmatrix} e \\ +\ \text{ABL} \end{bmatrix} \neq \_\_$$

RELATIVE PALATALIZATION: $\begin{bmatrix} -\text{ son} \\ -\text{ syl} \\ +\text{ con} \\ +\text{ bck} \\ -\text{ cnt} \end{bmatrix} \longrightarrow \begin{bmatrix} +\text{ cor} \\ -\text{ bck} \\ +\text{ dlr} \end{bmatrix} \Big/ \begin{bmatrix} \text{e} \\ +\text{ ABL} \end{bmatrix} \# \_\_ \text{V}$

CONDITION: environment a relative clause.

K-DELETION: $\begin{matrix} \begin{bmatrix} \text{V} \\ -\text{ nas} \end{bmatrix} & \text{k} & \text{i} & & & & \\ 1 & 2 & 3 & \longrightarrow & 1 & \emptyset & \begin{bmatrix} 3 \\ +\text{ syn} \end{bmatrix} \end{matrix}$ Rank: %

Y-DELETION: $\begin{matrix} \text{ç} & \text{y} & \text{u} & & & & \\ 1 & 2 & 3 & \longrightarrow & 1 & \emptyset & \begin{bmatrix} 3 \\ +\text{ syn} \end{bmatrix} \end{matrix}$

While these changes do not allow us to predict all rule interactions, they do permit a considerable simplification of the grammar in terms of extrinsic ordering statements. If the principles of application precedence discussed in this section should receive empirical confirmation in various languages, so that they can be incorporated into the metatheory as formal universals, then some theory of intrinsic ordering should be able to account for the great majority of Dakota rule sequences.

7. Conclusions

In the preceding sections of this work we have motivated and discussed a partial phonological component of a transformational-generative grammar of Teton Dakota. Although the rules which we have formulated do not account for all aspects of Dakota phonology, they do serve to outline the central and most characteristic phonological processes of the language in such fashion as to permit some basic generalizations about the probable form and content of an adequate grammar. In general, we have seen that Dakota has relatively "shallow" phonology, in that the abstract representations of lexical formatives are not too far removed from their surface phonetic counterparts. In spite of this, however, we have also seen that Dakota possesses no little phonological complexity, especially in the domains of such central and crucial processes as ABLAUT and VELAR PALATALIZATION. We can also claim that, in general, the metatheory of generative phonology has proved adequate to the task of revealing the salient points of Dakota phonological structure.

Our analysis has concentrated on the rules of the phonological component proper, to the virtual exclusion of feature interpretation rules, readjustment rules, and morphological rules. We have assumed, with some justification, that REDUPLICATION is a morphological rule, and that STRESS PLACEMENT can be included in the readjustment rules. We would now suggest that SOUND SYMBOLISM also does not belong in the phonological component proper, since it does not interact with any phonological rules in such fashion as to necessitate its being ordered with them; we would suggest that it might appropriately be included in the readjustment rules. The current lack of information on the surface constituent structure of Dakota has precluded any serious investigation of other readjustment rules, and it is clear that this whole area is in need of extensive empirical research. We feel that much of our current uncertainty about vowel contraction, stress placement, and velar palatalization phenomena would probably be resolved by more adequate knowledge of the constituent structure of words.

It also seems clear that the theory of phonological boundaries which we have utilized here is not really satisfactory; most of the boundaries that we have proposed are probably no more than *ad hoc* devices for limiting particular phonological rules to certain locations within the over-all phonological string. Increased knowledge of surface constituent structure would probably allow us to discard many of our suggested boundaries in favor of rules whose applicability is determined by direct reference to labels on constituent structure brackets. A return to the simpler boundary theory of *The Sound Pattern of English* is not too unlikely.

We have offered a fairly extensive treatment of segmental and sequential redundancy, and have motivated a set of morpheme structure conditions which is probably almost exhaustive. These conditions adequately define the permissible shapes of Dakota lexical matrices, and capture a number of significant generalizations about Dakota phonological structure. This suggests that the morpheme structure condition, as defined by Stanley (1967), is an appropriate metatheoretical device for the handling of redundancy, although we have stated a reservation about the need for negative conditions. The positive condition, however, must be highly valued, as it permits us to capture all constraints on Dakota canonical shapes and syllable structure in a single statement.

By admitting underlying obstruent-final stems, as first suggested by Boas and Deloria (1941), we have been able to develop a theory which subsumes a number of seemingly perplexing phenomena to this one basic fact. Perhaps most importantly, this assumption permits us to make the claim that, in the vast majority of cases, the location of primary stress in a word is completely predictable. Although our treatment of stress is not wholly adequate, it seems that the basic outline of the analysis is correct, and that independent rules of STRESS PLACEMENT, STRESS MOVEMENT, and COMPOUND STRESS are essential for appropriate explication of the facts. Similarly, the structure of reduplicated forms, the distribution and behavior of voiced spirants, and the structures exhibited by compounds all become more intelligible when we admit stems with underlying final obstruents. Finally, the perplexing ABLAUT rule (with the two global rules that it feeds, E-DELETION and RELATIVE PALATALIZATION) becomes somewhat more intelligible when we see that it applies primarily to such obstruent-final stems.

In our analysis of the complex velar palatalization phenomenon we have presented evidence which seems sufficient to motivate two distinct palatalization rules, VELAR PALATALIZATION and RELATIVE PALATALIZATION. The first of these is obviously a straight-forward rule of assimilation; its complexity devolves upon our incomplete understanding of the range of syntactic environments in which it applies. The RELATIVE PALATALIZATION rule, on the other hand, strikes us as being very uncommon. To call it an assimilation rule seems excessive, as it is not triggered by i, the typically palatalizing vowel. The fact that it seems to mark a particular syntactic structure, the relative clause, argues that it may not be appropriate to call it a phonological rule. Although rules which apply only in strings dominated by certain lexical categories are not too infrequent, we know of no other cases in which a phonological rule proper has access to the kind of syntactic information that is apparently required by RELATIVE PALATALIZATION.

In dealing with the so-called Y-Class verbs (cf. Boas and Deloria 1941; Buechel 1970), as exemplified by the forms /yuhá/ "to have", /bluhá/ "I have it", and /luhá/ "you have it", we have shown that an abstract analysis of the first and second person inflected forms is possible, and that such an analysis is almost certainly correct historically. We have also claimed, however, that most present-day Teton speakers have not performed this analysis during the course of their language learning experience, and that the inflected forms presented above must now be represented in the competence grammar of the speaker as a learned paradigm. It is only in this way that we are able to account for such apparent irregularities as /mayálaxtaka/ "you bit me", /wakí-bluška/ "I untied him", and /ʔiblábla/ "I am going (inceptive)". Our analysis has also shown that apparently irregular verbs like /yąká/ "to sit", with inflected forms /mąká/ "I sit" and /nąká/ "you sit", are simply verbs of the so-called Y-Class that are subject to additional nasal assimilation rules. We would claim that this analysis, in showing the underlying regularity of apparently irregular surface forms, is especially revealing.

Of even greater substantive interest is the examination of the complex possessive, reflexive, benefactive, and reciprocal constructions, with their various contraction phenomena. By positing an old possessive prefix of shape +i+, and by allowing cyclical application of STRESS MOVEMENT, we are able to account for the surface complexity of these forms in a revealing fashion. By independently motivating the +i+ prefix in the possessive forms of inalienable nouns, our over-all analysis of these various constructions is strengthened. Similarly, the need for cyclical application of STRESS MOVEMENT is independently motivated in the treatment of compound words. Of some theoretical interest is the high degree of homophony, or near homophony, of the various prefixes occupying affix Classes 10 and 11. We have suggested that the differential behavior of the benefactive and possessive prefixes, both with underlying shape +ki+, is predictable in terms of a general principle of homonym avoidance; if both prefixes were subject to the same phonological rules, they would be ambiguous in all constructions. Investigation of similar patterns of homophony in other languages might show that homonym avoidance is a valid metatheoretical constraint, perhaps on a par with Kiparsky's principle of paradigm coherence.

Patterns of rule interaction in Dakota appear to be largely predictable, and tend to support recent theoretical work on intrinsic rule ordering. Although the rules which we have motivated cannot be ordered entirely by such putative universal principles as proper inclusion precedence, it does seem to be the case that an unordered rule hypothesis permitting simultaneous application of most rules, and feeding orders for other rules, would greatly decrease the number of extrinsic ordering statements required for the appropriate sequencing of the over-all phonological component. In addition, the suggestion of Kenstowicz and Kisseberth (1973) that rules affecting syllable structure take precedence over those which do not allows us to correctly predict a number of crucial bleeding orders, and also provides correct predictions about the cyclical interaction of SYNERESIS and EQUI-VOWEL DELETION with STRESS MOVEMENT. If research in a wide variety of languages should establish such principles as formal universals, then it may well be the case that Dakota phonological rules could be intrinsically ordered _in toto_. Further examination of patterns of rule interaction in Dakota will undoubtedly shed additional light on these questions.

Neutralization rules in Dakota seem to substantiate the basic observations made by Kiparsky (1973). We have seen that such rules, e.g., VELAR PALATALIZATION, do not apply within morpheme boundaries; they apply only in derived environments. Of more interest, however, is the fact that the global rules of Dakota do not conform to Kiparsky's suggested constraints; although he claims that only neutralization rules may apply in global fashion, the global E-DELETION rule of Dakota is not a rule of this type. We have repeatedly noted that global rules in Dakota operate only in environments created by the prior application of another phonological rule; i.e., we claim that global application is simply a special type of rule interaction, best handled through the use of rule features. Whereas Kiparsky suggests that a global rule can apply in any type of derived environment, our data indicates that, in Dakota at least, this is simply not the case.

Finally, we offer some observations regarding the possible value of this work to Siouan studies in general. The comparative study of Siouan phonological processes per se was initiated by Matthews (1970), with results that have proved to be most revealing with regard to the probable course of development of the four branches of the Siouan family. It is clear that such studies can only proceed if we have more details on the specific structure of phonological rules in the various Siouan languages. Casual inspection of small amounts of data in Omaha and Oto, for example, has revealed the existence of several phonological processes which closely parallel those of Dakota; until those processes have been formalized in some way, however, rigorous comparison at this level is not possible. It is thus to be hoped that this study, in providing at least tentative formalizations of Teton Dakota phonological processes, will assist others working on Siouan phonological problems, and that it will serve as a source of data for further research in both synchronic and diachronic Siouan linguistics.

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