THE PHONOLOGY OF THE NAVAHO VERB

by

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submitted to the Department of Modern Languages and Linguistics on June 16, 1969, in partial fulfillment of the requirement for the degree of Doctor of Philosophy.

ABSTRACT

This thesis is an investigation of the phonological properties of the Navaho verb, and is carried out within the framework of generative phonology. Chapter One gives a general description of the type of formatives that comprise verbs in Navaho, and indicates how these formatives are sequentially related to one another. Chapter Two discusses the role of the system of phonological boundaries that underlies the remainder of the work.

Chapters Three through Six each treat a particular portion of the verb; in each of these chapters the procedure is to introduce and justify lexical representations for the formatives that occur in that portion of the verb, and to provide phonological rules that relate these lexical representations to phonetic representations (the phonetic representations being the given, the starting point of the analysis). Specifically, Chapter Three introduces a set of suffixes which mark tense and mode, and presents a set of phonological rules which combine these with the stem, producing the alternations in phonetic stem shape that characterize the various tenses and modes of a verb. Chapter Four shows how the alternations in the phonetic shape of the stem vowel of the verb can be handled in terms of the analysis of Chapter Three. Chapter Five deals with the prefixes, indicating what lexical representations and phonological rules are necessary to account for the complex manner in which prefixes (as many as a dozen of them in a single verb) interact with one another phonetically. Finally, Chapter Six extends the analysis of Chapter Five to account for the way in which the prefixes affect the stem-initial consonant of the verb.

A feature which pervades the entire work is that, according to the analysis of Navaho presented, much that has always been regarded as irregular or has simply been left unexplained in the literature on Navaho is seen to be quite regular and systematic.
Preface

My work on Navaho phonology began in the spring of 1965 when I had the opportunity to study The Navaho Language, a short grammar bound together with a Navaho-English and an English-Navaho dictionary which had been put together some twenty-two years earlier by Robert Young of the United States Indian Service in collaboration with a Navaho, William Morgan. This volume, though frustratingly vague in places, nevertheless proved to be a most excellent source of data on the language; without it the present dissertation could not possibly have been written.

What intrigued me from the beginning about Navaho was the intricate system of morphophonemic alternations occurring in the verb. These had never been treated adequately in the literature, since in all but the most trivial cases of morphophonemic alternation the alternants had simply been labeled "suppletive." Still, one felt that there was something quite systematic about these alternations, despite the fact that every attempt to write explicit rules for them ended in failure.

Thanks to the support of the M.I.T. Department of Linguistics and the Research Laboratory of Electronics, I was able to obtain support for my own field work that summer. I was also fortunate in locating two Navaho teen-agers, Steve Dalgai and Perry James, who were attending high school in Connecticut (boarding with a guardian who had recently moved from Arizona). Steve had been off the Navaho Reservation and in an English-speaking environment for about one year, Perry for two years. Neither of them had learned English until they were about nine years old.

Each of the boys was able to come to Cambridge for half the summer, thus providing me with an uninterrupted summer of field work. Some of
the time was spent working on the phonetics, making tapes, and attempting to perfect my own pronunciation; also, I made a few brief excursions into the syntax, working on relative clauses and the like. Still, the majority of the sessions were spent going over the extensive paradigms that were given in The Navaho Language, checking their correctness. The results convinced me that this work could be used with reasonable confidence; I have relied on it heavily in preparing the present dissertation, though in many cases the data can be checked in other sources (Sapir and Hoijer (1968); Reichard (1951); Haile (1941-1948, 1950, 1951)). I should note that, although some comparative studies involving Navaho exist (see IJAL 30.2 (1964) 165-174 for references), my approach has been to consider only evidence internal to (present-day) Navaho.

In the four years since the summer of 1965 teaching duties and other concerns have occupied much time and energy that would otherwise have been spent on Navaho. Still, gradually over this time the overall system of alternations began to take shape, and, one by one, apparent irregularities took their places among the regularities. The result is the analysis of the phonology of the Navaho verb that appears in Chapters Three through Six below.

With a few minor exceptions, the dissertation does not initiate proposals concerning the structure of phonological theory. Instead, the theoretical framework presented in Chomsky and Halle (1968) is accepted without question, and is applied to the Navaho data. Nevertheless, the correctness of this approach to phonology receives indirect though quite persuasive support from the analysis of Navaho that is developed below, due to the natural and straightforward way in which so many of the per-
plexing problems of Navaho phonology find their solution in this analysis. Previous approaches to Navaho phonology, on the other hand, have been concerned primarily with developing a system of "phonemic" notation (which, like most phonemic representations, hugs the phonetic ground rather closely), and with presenting various paradigmatic information in terms of this system of representation. The result is that the system of morphophonemic alternations, which really forms the heart of the phonology, in Navaho, receives only incomplete and unsystematic treatment, and insight into the nature of these alternations is nearly nonexistent.

The aspect of Chomsky and Halle's approach to phonology that makes it so much better suited to a phonological description of Navaho is the insistence that each formative (morpheme) be given a single underlying "lexical" representation, and that the grammar provide a set of phonological rules that develop from this lexical representation the various phonetic shapes that the formative takes on, depending on its environment. Thus, morphophonemic alternations are explained systematically as the environmentally influenced changes undergone by a single underlying segment. The crucial step is in making a choice of lexical representations that will lead to both a highly-patterned, unified system of lexical representation and a simple and general set of phonological rules. The success of the analysis depends, ultimately, on the auspiciousness of this choice.

It has been an honor and a most fortunate privilege to be a graduate student in the M.I.T. Department of Modern Languages and Linguistics. It is a department that has never ceased, for me, to be a source of stimulation and enthusiasm.

My debt to Morris Halle and Noam Chomsky, whose teaching has been consistently so excellent, is indeed profound. Dick Carter followed the work on Navaho closely, and was always willing to give of his time to
help me thrash out particularly vexing problems. Ken Hale, who knows so
much about Navaho, came to M.I.T. after I left, but he painstakingly read
an earlier version of the dissertation, and through his comments helped
me to avoid many embarrassing errors. Finally, to my thesis supervisor
Hugh Matthews, who patiently went over the details of my constantly
changing analysis of Navaho with such care and offered so many valuable
suggestions drawn out of his wide knowledge of American Indian languages,
I am deeply grateful; he directed my work from the beginning, always
keeping me on my toes and always pointing out pathways to pursue to
improve the analysis.
CHAPTER ONE

THE ORGANIZATION OF THE VERB SYSTEM

1. The principal published works dealing with Navaho phonology fall into four main groups. First, there is the work carried out over a long period of years by the members of the Franciscan Mission at St. Michaels, Arizona. This group published three Navaho dictionaries in the early part of this century (The Franciscan Fathers (1910), (1912a), (1912b)), but by far the most important work was conducted after this time by Father Berard Haile. Haile published a grammar (1925), the first of the language, and later brought out a four volume series designed to be used in learning to speak Navaho (1941, 1942, 1947, 1948). His work culminated in the appearance of a Navaho-English dictionary (1950) and an English-Navaho dictionary (1951).

Second, Edward Sapir did a great deal of field work with the Navahos, but published only a few articles, none of them even approaching a systematic survey of the language. However, Sapir's student, Harry Hoijer, has carried on with the study of Navaho, working largely from Sapir's field notes. Hoijer has written numerous articles on Navaho phonology, and published a monograph on this subject more than twenty years ago (1945). He has also just completed the second stage of a three pronged effort to publish the material on Navaho that Sapir accumulated. This work (Sapir and Hoijer (1968)) attempts a complete survey of the phonological and morphological structure of the language; it revises and extends Hoijer's earlier publications. The first stage in this effort was the compilation in Sapir and Hoijer (1942) of a large quantity of textual material. The third stage, yet to come, will
be the publication of all the lexical data present in Sapir's notes, perhaps to be arranged in dictionary form.

Another person who did extensive work on the Navaho was the anthropologist Gladys Reichard. She published various articles on the phonology during the forties and fifties, but her most important work is the grammar that appeared in 1951. This grammar represents the first attempt to analyze the phonological structure of the language in a way that goes beyond the recording of the data.

Finally, a member of the United States Indian Service, Robert Young, has published several studies of Navaho during the last thirty years; Young has often worked in collaboration with a Navaho, William Morgan. Of these studies, three are of greatest interest (Young and Morgan (1943a, 1943b, and 1951)). The first of these is a sketch of the phonological and morphological properties of the language, and includes extensive and systematic presentation of verbal paradigms; the second is a Navaho-English and English-Navaho dictionary, distinguished by the wealth of information it contains concerning the inflectional and derivational prefixes of the verb. Both of these works appear under one cover in a version titled The Navaho Language. The third study is constructed along the lines of the second, its main function being to include forms not appearing in the earlier dictionary.

By far the most valuable source of data on Navaho phonology comes from Young and Morgan's work. Almost without exception, information that is to be found anywhere in the published literature can also be found in one of the three cited works by these authors. The
value of their work is due to the fact that, in many ways, they are complete, systematic, and accurate in their recording of the data. Still, various aspects of their work suffer from the same lack of clarity that characterizes so much of the Navaho literature.

Haile's work has limited value since, in his dictionaries (1950, 1951) he limits himself, for the most part, to a listing of stems. This stem listing is of interest, of course, especially because of the large number of stems included, but it gives only a small part of the picture since most of the complexities of the phonology occur in the prefixes. Haile's other work suffers from lack of systematic presentation of the data as well as from a general tendency toward obscurity of exposition. He seems to share with Reichard and, to some extent, Young and Morgan, an inability to give simple and straightforward descriptions of simple and straightforward facts.

Hoijer has the distinction of being the only professional linguist to publish extensively on Navaho phonology; however, this distinction is a dubious one. It is true that he uses the terminology appropriate for an American structuralist, talking in terms of allophones, phonemes, morphemes, and so forth, but this fact does not render his work any more valuable as a source of information about the Navaho language. Viewed purely as a data source, Young and Morgan's works (1943a, 1943b) are more complete, better organized, and easier to use. In many situations Hoijer contents himself with giving an example or two of an alternation or construction type he is discussing; and the result is that many important questions about the phonology and morphology go unanswered in his work.

In many ways, Reichard's grammar is unclear and poorly organized.
Still, one important aspect of her work is that she includes an extensive tabulation (in Chapter 10) of how the various derivational prefixes of the verb affect (phonologically) the inflectional paradigms, but there are many unfilled gaps in this tabulation. Her analysis of the verb system is in many ways extremely detailed, but too difficult to follow to be of much use. We will make no attempt to explicate in a systematic fashion the kind of terminology she uses in her analysis. This terminology differs in basic ways from that of the other sources, and involves the recognition of many morphological distinctions not made elsewhere, but is of little value due to the unclarity of the presentation.

The data on which the present work is based has been drawn almost exclusively from Young and Morgan's publications, and all information that we present in this and the following chapters may be assumed to have this source unless stated otherwise. In many instances, the same information may also be found in one or another of the other works cited above, but we will not in general resort to multiple documentation.
2. The present work deals exclusively with the verb. By far, the most interesting and intricate aspects of Navaho phonology involve the verb, and the treatment of the entire phonology would involve a fairly straightforward extension of the treatment of the verbs.

In Table I we chart the system of obstruents, giving, for each segment, the particular symbol (or symbols) that we will use to represent it, its distinctive feature representation, and the symbols that have been used by other authors. In Tables II and III we do the same for the sonorant system and the vowel system, respectively. The system of representation used by Young and Morgan is the official Indian Service system, and is used in all government publications. It is also the system used by the Navaho Tribal Council, and appears in newspapers and other printed material on the Reservation.
<table>
<thead>
<tr>
<th>Vocalic</th>
<th>Consonantal</th>
<th>Sonorant</th>
<th>Continuant</th>
<th>Strident</th>
<th>Voiced</th>
<th>Lateral</th>
<th>Nasal</th>
<th>Glottal</th>
<th>Anterior</th>
<th>Coronal</th>
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</tr>
</tbody>
</table>

**Young**

b d t t' dz ts ts' z s j ch ch' zh sh dl tl tl' l l g k k' gh h

**Hoijer**

b d t t' j c c z s j c c' z s l k l l g k k' y k x

**Reichard**

b d t t' dz ts ts' z s dj tc t c j c d l tl tl' l d g k k' y k x

**Haile**

b d t t' z c c' z s j c c' z s l k l l g k k' y k x

**TABLE I** Obstruents
<table>
<thead>
<tr>
<th>Vocalic</th>
<th>Consonantal</th>
<th>Sonorant</th>
<th>Continuant</th>
<th>Strident</th>
<th>Voiced</th>
<th>Lateral</th>
<th>Nasal</th>
<th>Glottal</th>
<th>Anterior</th>
<th>Coronal</th>
<th>Young</th>
<th>Hoijer</th>
<th>Reichard</th>
<th>Haile</th>
</tr>
</thead>
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<tr>
<td>m</td>
<td>m'</td>
<td>n</td>
<td>n'</td>
<td>w</td>
<td>y</td>
<td>h'</td>
<td>?</td>
<td>y'</td>
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</table>

**TABLE II  Sonorants**
Representations of words in terms of the segments in these three tables are as close to phonetic as any representations that will be used in this work; hence, such representations will be called here "phonetic representations." This system of representation corresponds in all its essentials with the orthographies used in the works cited above, and it seems roughly accurate to call it "broad phonetic" transcription.

A narrower system of phonetic representation would have to include a syllabic [n], since a prefix consisting of a dental nasal and a following short unrounded vowel is (often) realized as a syllabic nasal (with no following vowel). In our representations, however, we will ignore this detail, and write out the nasal plus its following vowel.

In addition to the velars listed in Table I, there are also labiovelars [kʰ] and [xʰ]; similarly there is a labialized [hʰ]. However, these are very restricted in their distribution, and do not occur at all in the forms that will be treated in this work. Thus they will be ignored in what is to follow; see Sapir and Hoijer (1968) 7-9 for some discussion. Still, it is perhaps worthy of note that there are clear cases where [kʰ] is the realization of /k/: more specifically, a morpheme of the form /ko/ is realized as [ko] before a consonant and as [kʰ] before a vowel; see Young and Morgan (1951) 244 for an example.

Hoijer uses a system of "phonemic" representation which includes all the segments of Tables I, II, and III together with the syllabic nasals and labialized segments just mentioned. (Actually, Hoijer considers high tone and low tone to be separate phonemes, so that every syllabic element consists of a tone phoneme plus the segmental phoneme.) His discussion of the various allophonic realizations of these phonemes,
however, is probably oversimplified; in any case, the allophony is strikingly uninteresting, consisting almost entirely in the observation that velar fricatives are affected in the obvious way by the following vowel. Most of the phonemes are said to be "invariable" (that is, they have just one allophone).

Some remarks on further phonetic detail for some of the segments are in order. In Table I, the [b] is a bilabial, [d, t, t'] are dental stops, [j, c, c'] are dental affricates, [z, s] are dental fricatives, [y, č, č'] are palato-alveolar affricates, [ž, ʃ] are palato-alveolar fricatives, [λ, ƙ, ƙ'] are lateral affricates, [l, ƙ] are lateral fricatives, [g, k, k'] are velar stops, and [ɣ, x] are velar fricatives. The segments [t, c, č, λ, k] are unvoiced and highly aspirated stops (or affricates); in fact, the aspiration in [t] is so strong that there is even a very distinct velar friction following the release of the stop closure; this is reflected in Haile's symbol [t'] (Table I). The segments [b, d, j, y, λ, g] are unvoiced and unaspirated stops (or affricates), [s, ʃ, ƙ, ɣ] are voiceless fricatives, and [z, ž, l, y] are voiced fricatives. Thus note that, while the phonetic contrasts [s-z], etc. in the fricatives involve voicing, the contrasts [t-d] etc. in the stops and affricates involve only aspiration. It follows that the use of the distinctive feature "voiced" in Table I is relative; that is, to say that the segment [d] is [+voiced] as opposed to [-voiced] for the segment [t] is only to say that the onset of voicing in the latter is later than that in the former.

The segments [t', c', č', ƙ', k'] are glottalized stops, also called ejectives; they are unvoiced (as are all ejectives) and unaspirated. The segments [λ, ƙ, ƙ'] are lateral affricates; for example, [λ] is like
a [d] with a lateral release, sounding very much like a cross between an English [d1] and [g1]. In Navaho it seems clear that these are single segments, rather than sequences of segments. If they were sequences, they would be the only morpheme-initial consonant sequences, and [l] and [l] would be the only fricatives without stop (or affricate) counterparts. (For a cluster treatment of [l] and [l], see Landar (1959). Such a treatment, of course, allows a reduction in the segment inventory; however, any advantages this may entail seem to be offset by the disadvantages just mentioned.) It is also clear in Navaho that neither [l] nor [l] are "liquids;" they are both obstruents (that is, [-sonorant]) exactly on a par with [s, s, x] and [z, z, y], respectively. This is true both phonetically, where [l] has an associated local friction quite unlike the English [l], and distributionally, where [l] appears in exactly the same positions as do [s, s, x] and [l] appears in exactly the same positions as do [z, z, y].

Marginally there is a [cX] with strong velar affrication that contrasts with the [c] of Table I, and a [cX] which similarly contrasts with the [c] of Table I. Usually this affrication carries an emotional connotation only; e.g., [bice?] 'his stone,' [bicXe?] 'his stone (said emotionally).' In a few cases, however, the affrication is obligatory, resulting in clear cut cases of lexical contrast between [c] and [cX] or [cX] and [cX]; e.g., [bicXe?] 'he is strong' can never be [bicXe?]. See Young and Morgan (1948) ii; Reichard (1948) 15-17.

For the most part, the distinctive feature system used in the three tables follows Chomsky and Halle (1968). An exception is the use of the feature "glottal;" we will use this feature to denote any sound made with
an essential closing or narrowing of the glottis, so that all ejectives as well as \[?] and \[h] are [+glottal]. Further, we will give reason in Chapter 5 for saying that the nasals \[m] and \[n] are [+continuant] rather than [-continuant].

Table II is straightforward except, perhaps, for the glottalized sonorants \[m'\], \[n'\], \[y'\]. In these sounds, the release of the glottal stop is prior to the release of the oral closure; this is in direct contrast to the situation in the glottalized obstruents of Table I, where the oral closure is released first. The glottalized sonorants are rare, and are in all cases clearly to be derived from the corresponding unglottalized sonorants. In particular, a stem-initial sonorant becomes glottalized under the influence of any preceding prefix that ends in -d- (the -d- dropping out), and a prefix-initial sonorant becomes glottalized under the influence of a preceding -?-. (the -?- dropping out). See Chapter 6, section 3 and 4; Chapter 5, section 4 (rule 15). The labials of Navaho \[m\], \[b\], \[m'\], \[w\] are all fairly rare. Further, the labial series lacks \[p\], \[p'\], \[f\] entirely, though these segments might be expected on the basis of an analogy with the rest of the series.

The situation with \[x\] and \[h\] is fairly confusing, and it is difficult to determine whether there are real cases of minimal contrast between them. In any case, their realizations are fairly similar. In the material considered in this work their differentiation is not of crucial importance. In our underlying representations we will tentatively maintain a distinction between them, and include a rule that realizes -x- as -h- in various environments; see Sapir and Hoijer (1968) 9, Reichard (1948).
As can be seen from Table III, there are four basic vowel qualities, corresponding to the vowels [i, e, a, o]. Vowels may be oral or nasal; there are thorough-going contrasts between oral and nasal vowels phonetically, though we will see that all nasal vowels should be derived from oral vowels in the presence of an [n] which then drops out. Furthermore, vowels may be either long or short, and again there are widespread phonetic contrasts between long and short vowels; still, at a more abstract level, the long-short distinction will turn out to be predictable. (We will always represent long vowels by doubling the vowel letter. Still, it should be clearly understood that this is an orthographic device only; long vowels are single segments as far as the rules we will present are concerned.) Also, vowels may be either high tone or low tone; the difference in tone of the vowel is the sole distinguishing factor phonetically between many pairs of morphemes. Still, we will see that there is much to be said in favor of an analysis that derives all high tone vowels from low tone vowels upon "absorption" of a following consonant. Finally, the vowel [e] will be derived by various rules from /i/ or/o/, and will not appear in underlying representations. All four vowel qualities exhibit the same eight variants for nasality, length, and tone, though for lack of space we have indicated this only for the vowel [i] in Table III.

Roughly, [i] and [e] have the height of the vowels in English "bit" and "bet," respectively, while [o] has a height that is somewhat intermediate between them. [a] is low and central, though more front-central than back-central.
3. Throughout the present work the term "verb form" will refer to any word in a Navaho sentence that functions syntactically as a verb. We are interested in the analysis of verb forms at two levels, the level of "phonetic representation" and the level of "lexical representation." Phonetic representations of verb forms will, for our purposes, simply be representations in terms of the segments listed in the tables I through III above. In a more complete treatment of Navaho phonology these representations would be extended to include further phonetic detail. However, the most interesting aspects of the phonology seem to involve no more phonetic detail than is included in these tables. Moreover, the literature is generally poor as far as systematic and accurate treatment of the phonetics is concerned, so that a more detailed system of phonetic representation is not really feasible at this point anyway. Thus, we will content ourselves with assuming that the above tables provide the segments used in phonetic representations.

The level of lexical representation corresponds to what has been referred to elsewhere as the level of "systematic phonemic representation" (Chomsky (1964) 76), or in the American structuralist tradition, the level of "morphophonemic representation." The term lexical representation is introduced, in essentially the sense that we will use it here, in Chomsky and Halle (1968) 9ff.

At the level of lexical representation each verb form consists of a sequence of "formatives." Each formative is represented by a distinctive feature matrix which, by a harmless ambiguity, can be called its lexical representation; for a discussion of formatives see Chomsky and Halle (1968) 7. Roughly, formatives correspond to the "morphemes" of structural lin-
guistics, and no harm will arise if the two terms are equated in what follows. The difference is, essentially, that formatives are units of surface structures (not deep structures), and need not (though often do) contain a clearly discernible meaning.

A list of all the formatives is what we will refer to as a lexicon or dictionary, and each formative in this list will be referred to as a lexical entry. A crucial property of the lexicon is that each formative receives a single lexical representation, even though some formatives have several different phonetic realizations. We return to this question in more detail in the following chapter.

Phonetic representations of verb forms are wholly provided by the sources from which we are drawing our data; they form the point of departure for our analysis. As we proceed, the task before us is twofold. First, we must construct a system of lexical representation for the verb forms of Navaho, and, second, we must construct a set of "phonological rules" that relate lexical representations to phonetic representations. These two tasks, obviously, are not separate, but must be carried out simultaneously, since any decision made in one area has its effect in the other.

As it turns out, the set of segments used in lexical representations in Navaho (according to the analysis we will present) is a subset of segments used in phonetic representations given in Tables I through III. In fact, all the segments in these tables also appear in lexical representations, with the following three exceptions. First, the glottalized sonorants \([m^\prime],[n^\prime]\), and \([y^\prime]\) of Table II will not appear at the lexical level, but will be derived from the corresponding unglottalized segments
in the presence of a preceding -d-. Second, only the oral low-tone vowels will appear in lexical representations; the vowels that are phonetically [+nasal] and/or [+high tone] will be derived from the corresponding oral low-tone vowels in specified consonantal environments. Finally, we will show that only three vowel qualities are needed in lexical representations, namely those of the vowels [a], [i], and [o]; the vowel [e] will be derived from [i] and [o].

Actually, the contrasts that are present in lexical representations are even more limited than the inventory of segments just presented would imply. More specifically, we will see that there is no contrast between long and short vowels, nor between voiced and voiceless fricatives, at the lexical level. The reason for assuming that the presence of non-contrasting sets of segments lexically will be fully discussed in Chapters 3 and 6 below.

To give a more concrete idea of the nature of phonetic and lexical representations in Navaho, we present below in (1) an example of a verb represented both lexically and phonetically for some of its person and mode forms. In (1) we separate all formatives by "-". In the next chapter we will introduce a more elaborate system of boundaries.

<table>
<thead>
<tr>
<th>(1)</th>
<th>lexical representations</th>
<th>phonetic representations</th>
<th>meaning</th>
<th>mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>na-hi-śi-1-ḍool</td>
<td>naaśjool</td>
<td>I drop it</td>
<td>imperfective</td>
</tr>
<tr>
<td>(b)</td>
<td>na-hi-ni-1-ḍool</td>
<td>naniljool</td>
<td>you drop it</td>
<td>&quot;</td>
</tr>
<tr>
<td>(c)</td>
<td>na-ho-śi-n-i-ḍool-di</td>
<td>naaḍjool</td>
<td>I dropped it</td>
<td>perfective</td>
</tr>
<tr>
<td>(d)</td>
<td>na-ho-ni-n-i-ḍool-di</td>
<td>načiniljool</td>
<td>you dropped it</td>
<td>&quot;</td>
</tr>
</tbody>
</table>
This verb can be found on page 108 of Young and Morgan's dictionary (1943b). No attempt will be made at this point to justify the lexical representations in (1) or to state the phonological rules that relate them to the phonetic representations. These examples are given simply to have actual examples to refer to when illustrating various points about the verb system. The examples, especially (1c), illustrate a general point, namely that an extreme amount of collapsing may occur in the process of deriving phonetic representations from lexical representations. It is even a common occurrence for prefixes to disappear without a trace in phonetic representations.

Phonetically, every Navaho verb form can be analyzed into two parts. The first part is identifiable as a sequence of anywhere from one to about a dozen prefixes. (However, one verb, 'to say,' occurs phonetically with no prefixes at all in the third person imperfective; see Young and Morgan (1943b) 165.) The remainder of the verb form is identifiable as the stem. (There is also a class of suffixes that may be added to the verb form; these suffixes have the effect of nominalizing, participializing, or questioning, the verb form, and are fairly "loosely" attached to the stem phonologically. For discussion see Young and Morgan (1943a) 16-20. These suffixes will not be considered in the present work.)

The four example verb forms listed in (1) exhibit two different stems phonetically, namely [-yool\-
] and [-yoo1], according to whether the mode is imperfective or perfective. In lexical representations we will postulate modal suffixes (quite different from those mentioned in the previous paragraph) that account for such alternations in the phonetic shape of stems.

The stem is always easy to isolate, phonetically, since it consists
simply of the final [CV] or [CVC] of the verb form. (The singular forms of the verb 'to go, to walk' are exceptional in that the stem has an initial vowel. Thus in forms such as [ʕ'iniʕsāḥ] 'I go out' the [ʕ] is not part of the stem, but is a prefix; see Young and Morgan (1943b) 62. Similarly, the highly-irregular verb 'to eat' has a stem-initial vowel in some of its forms; see Young and Morgan (1943b) 81. All other stems begin with a consonant, a consonant which may be altered but never deleted.)

The individual prefixes, on the other hand, are rather difficult to separate from one another in phonetic representations, since there is a considerable amount of collapsing. In other words, we know from the meaning of a verb form what prefixes must be present, but looking at its phonetic representation it is often impossible to associate a particular section of this representation with each prefix. We will show that, nevertheless, it is profitable to set up the prefixes as separate and distinct in lexical representations (as we have done in (1)), since from such lexical representations we will be able to derive the whole range of phonetic representations by means of a fairly simple set of phonological rules. In the examples above the lexical representations contain the following prefixes: /š1-/ (first person singular subject), /n1-/ (second person singular subject), /nα-/ (a derivational prefix meaning 'downwards'), /hɔ-/ (progressive), /ɔ-/ (causative), /h1-/ (imperfective), and /n-/ (perfective). (We will adopt the practice of enclosing lexical representations in angle slashes "/", just as we have been enclosing phonetic representations in square brackets "[" and "]". In many cases we will cite representations simply between dashes "--"; in these cases we are not concerned with whether they are lexical or phonetic, and in many such
cases they will be neither, but merely particular states in the derivation of phonetic representations from lexical representations.)

Comparing the phonetic representations of the imperfective mode forms (1a) and (1b) with the perfective mode forms (1c) and (1d), we see that different stems are used in these two modes. And, in general, it is the case that different modes of the verb are characterized by different stem forms phonetically. Still, all stems are of the form [-CV] or [-CVC] phonetically, and the final consonant (when it is present) is almost always clearly identifiable as an integral part of the stem that is present in the other mode forms of the verb as well, rather than as a suffix that is used to mark the mode of the verb form. Differences in mode are marked phonetically by a variety of devices, including voiceless vs. voiced final consonant (as in the above example), high tone vs. low tone of the stem vowel, length vs. shortness of the stem vowel, nasality vs. lack of nasality of the stem vowel, quality of the stem vowel, or presence vs. absence of a final [ʔ] or [h]; often, a combination of these devices is used, so that the various mode forms of a verb may differ in extreme ways in phonetic representations. Nevertheless, a strong case can be given for an analysis which, in lexical representations, marks modal distinctions by suffixes, maintaining the same representation for the stem in all modes. Such an analysis is implicit in (1), where the imperfective forms have a suffix */-di/.* The effect of the phonological rules will generally be to make various changes in the stem of the verb on the basis of the following suffix, and then to delete the suffix, although in some cases the suffix shows up in the phonetic representations, replacing the final consonant of the stem. These modal suffixes and the rules that describe the effect that they have on the stem of the verb will
be fully discussed in Chapters 3 and 4. Of importance here is simply the fact that each verb stem has a single lexical representation that is the same for all modes, while the modes themselves are indicated by suffixes in lexical representations.
4. At this point we may begin a systematic discussion of the internal structure of the Navaho verb. To simplify the exposition we will talk frequently in terms of lexical representations, without always indicating what their various phonetic realizations are. This aspect of the presentation should be carefully born in mind for two reasons. First, in many instances, the lexical representations differ quite radically from the corresponding phonetic representations, a point that is well illustrated by the examples in (1) above. And second, the lexical representations are constructed according to an analysis of Navaho that is presented for the first time in the present work, so that these representations will be unfamiliar to those who have seen the language discussed in the literature. We will attempt to avert possible confusion by making as frequent references to the various sources as possible. Carrying out the discussion in terms of lexical representations seems preferable because of the relative simplicity of the verb system at the lexical level; any attempt to discuss the internal structure of the verb directly in terms of phonetic representations is bound to become hopelessly mired in complex details.

In lexical representation every Navaho verb form has the general structure indicated in (2).

(2)

(prefix) ... (prefix) stem (suffix) (suffix)

That is, every verb form consists of a sequence of prefixes followed by a stem which in turn is followed by a sequence of up to two suffixes. A verb may contain at most two suffixes, but the number of prefixes may
be much higher (as many as a dozen). It is important to note that every verb form contains at least one prefix (for mode or aspect) in lexical representation. With the one exception previously noted, all verb forms contain at least one prefix phonetically as well. Of the suffixes, one is the modal suffix, mentioned above, and the other is an aspectual suffix to be discussed below. Some verbs (those in the imperfective mode) may contain no suffix in lexical representations.

In Table IV below we present in much more detail the arrangement of formatives in the lexical representations of verb forms. In this chart, elements in parentheses are optional. In particular, each of the prefix and suffix positions may or may not be occupied, depending on the verb form; only the stem is necessarily present. Still, either position p3 or position p8 (but not both) must be occupied, marking the mode of the verb form. For convenience of reference, the various prefix positions have been numbered from p1 to p12, while the suffix positions have been numbered from s1 to s2. Moreover, the twelve prefix positions have been divided into five groups lettered from A to E; the significance of this grouping will become apparent in Chapters 5 and 6.

In the lower part of Table IV we have indicated, for each affix position, the type of affix that appears in this position. In many cases it has also been possible to give a complete enumeration of the affixes that occur in each position given. However, the postpositions that occur in position p1 are too numerous to present in a short list; an enumeration of the postpositions may be found in Young and Morgan (1943a) 20. Similarly, the adverbial prefixes of position p2 are illustrated only by some of the more frequently occurring ones; a more complete listing is given in Young and Morgan (1943a) 62. Finally, the list of aspectual prefixes that
occur in position p7 is not complete, though there are no more than about eight prefixes that occur in this position. See Sapir and Hoijer (1968) 97-98 where a list of position p7 prefixes is given. (In their scheme, these occupy "position 6."") These three types of prefixes (postpositions, adverbial prefixes, and aspectual prefixes) will not be considered in any detail in the present work. (In Table IV, two "progressive" formatives are listed: a p8 prefix /ho-/ and a s2 suffix /-½/. These are actually separate morphemes, and not a discontinuous morpheme; if /-½/ occurs, then /ho-/ does too, but /ho-/ occurs without /-½/ in the y-perfective (see section 7). Similarly, two "passive" formatives are listed: a p7 prefix /d1-/ and a p1l passive classifier prefix /d-/. These are also separate morphemes; /d-/ is always present when /d1-/ is, but /d-/ may occur in constructions not involving /d1-/ (see sections 5 and 7). Finally, two "iterative" formatives are listed, a p2 prefix /ná-/ and a s2 suffix /-x/. These are separate morphemes as well, since the suffix /-x/ is used with and without /ná-/ to mark the "iterative" and the "usitative" modes, respectively (see section 7).
<table>
<thead>
<tr>
<th>OPP</th>
<th>(Adv)</th>
<th>(Iter)</th>
<th>(Nu)</th>
<th>(Obj)</th>
<th>(Deic)</th>
<th>(Fut)</th>
<th>(Mod)</th>
<th>(Sub)</th>
<th>(Pf)</th>
<th>(Passcl)</th>
<th>(Caus)</th>
<th>STEM</th>
<th>(Asp)</th>
<th></th>
<th>Mod</th>
<th>(Asp)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p1</td>
<td>p2</td>
<td>p3</td>
<td>p4</td>
<td>p5</td>
<td>p6</td>
<td>p7</td>
<td>p8</td>
<td>p9</td>
<td>p10</td>
<td>p11</td>
<td>p12</td>
<td>s1</td>
<td>s2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### A

**p1** OPP = Pronominal object plus postposition: /bi-k'ı-/ (on its surface), ....

### B

**p2** Adv = Adverbial prefixes: /?a-/ (out of sight), /?á-/ (thus), /na-/ (downwards),

/na-/ (about, around), /ná-/ (again), /ni-/ (end), /xa-/ (up and out)

### C

**p3** Iter = Iterative prefix: /ná-/ (iterative)

### D

**p4** Nu = Number prefix: /da-/ (distributive plural)

### E

**p5** Obj = Direct object prefixes: /ši-/ (1sg), /ni-/ (2sg), /nixi-/ (1&2pl),

/ji-/ (res), /?a-/ (ind), /xo-/ (imp), /?axi-/ (recip), /?ádi-/ (refl)

**p6** Deic = Third person (deictic) subject prefixes: /ji-/ (4), /?a-/ (ind),

/xo-/ (imp)

### Table IV

**p7** Pas = Passive prefix: /di-/ (passive)

**p8** Fut = Future prefix: /di-/ (future)

**p9** Asp = Aspectual prefixes: /di-/ (inceptive), /ni-/ (uniform), /xi-/ (repetitive),

/yi-/ (semelfactive)

**p10** Mod = Modal prefixes: /hi-/ (imperfective), /ho-/ (progressive), /na-/ (goal),

/sa-/ (static), /nonhi-/ (optic)

**p11** Sub = Subject prefixes (1st and 2nd person): /ši-/ (1sg), /ni-/ (2sg),

/di-/ (1pl), /xo-/ (2pl)

**p12** Pf = Perfective prefix: /n-/ (perfective)

**s1** Asp = Aspectual suffixes: /?-/ (continuative), ....

**s2** Mod = Modal suffixes: /-l-/ (progressive), /-di-/ (perfective), /-x-/ (iterative)
5. As we proposed we will discuss more fully the various affixes of the verb illustrated in Table IV. First to be considered is a set of affixes which, for want of a better term, we will call "derivational affixes;" these are listed in (3), together with an indication of the position they occupy according to the notation used in Table IV.

(3) Derivational affixes

(a) Postpositions (p1)
(b) Adverbial prefixes (p2)
(c) Aspectual prefixes (p7)
(d) Passive classifier prefix (p11)
(e) Causative prefix (p12)
(f) Aspectual suffixes (s1)

All other affixes of the verb will be called "inflectional" affixes. Actually, affixes in Navaho do not separate as neatly into two groups as this terminology might imply, and classing affixes simply as "derivational" or "inflectional" is primarily an expository device. Still, generally speaking, the derivational affixes have in common the property of being non-productive. That is to say, each verb stem must be marked for just which of these affixes can occur with it, there being no general rule that determines which affixes can be used with which stems. Moreover, the meaning of the affix-stem combination is not wholly predictable from the separate meaning of the affixes and the stem, in the case of the derivational affixes. Examples will be given below to bring out these facts. Meanwhile, let us agree to use the term "verb" to refer to each acceptable combination of derivational affixes and stem. In Sapir and Hoijer (1968) 85 the term "base" is used in a sense more or less equivalent to our use of
the term "verb." However, they group together the prefixes in (3a, 3b, 3c) above under the term "adverbial prefixes." Moreover, they do not recognize the aspectual suffixes of (3f), since they choose to leave unexplained various changes in the phonetic shape of the stem that these suffixes account for. We discuss these aspectual suffixes and their effect on the stem later in this section.

We will assume that verbs are entered as units in the Navaho lexicon. In other words, the lexicon will contain a list of derivational affix plus stem combinations together with a meaning for each such combination. A verb form is constructed by adding various inflectional prefixes (discussed in sections 6 and 7 below) to some such verb listed in the lexicon. The specialized use of the terms "verb" and "verb form" should be kept clearly in mind, to avoid possible confusion.

It is common in Navaho for words consisting of a pronominal object plus a postposition to precede the verb form in a sentence. For example, the postposition /-χ'؟/ means "toward," and the sentence /n1-χ'؟ χ1-na-χ1-n-d-2-Yood-di/ = [χ1-fn1Yod] means "I ran out (of an enclosure) toward you (sg.);" see Young and Morgan (1943a) 115. The verb form is /χ'1-na-χ1-n-d-2-Yood-di/, and means "I ran out (of an enclosure)." The word /n1-χ'؟/ consists of a pronominal object /n1-/ meaning "you (sg.)," and the postposition /-χ'؟/. By simply changing this pronominal object we can form sentences meaning "I ran out toward him," "I ran out toward you (pl.)," and so forth. If we wanted to say, "I ran out toward Kee" we would use the sentence /k11 bi-χ'؟ χ1-f-na-χ1-n-d-2-Yood-di/ which means literally "Kee toward-him I-ran-out;" here /bi-/ is a pronominal object meaning "him, her, it, them." Thus, the postposition must always be accompanied by a preceding pronominal ob-
ject (which forms a part of the same word as the postposition). Even if there is a noun object of the postposition present as a separate word, there must be a (third person) pronominal object attached to the postposition.

The postposition /-k'i/ (with its pronominal object) is a separate word, and can quite generally precede verb forms denoting motion; moreover, the meaning of the resulting phrase is a straightforward composite of the meanings of the two words in isolation. This is the normal situation with postpositions. In certain cases, however, the postposition, together with its pronominal object, has been incorporated into the verb. This gives rise to the prefixes that occupy position pl of the verb, the first of the derivational prefix types listed in (3). As an example, consider the verb form /bi-k'i-ho-śi-n-good-di/= [bik'iiyigeed]; this verb form (by itself) forms a sentence meaning "I covered it (with dirt);" see Young and Morgan (19h3b) 91. Here there is a postposition /-k'i/ meaning "on or onto the surface of," together with the third person pronominal object /bi-/ , but /bi-k'i/ is phonologically a part of the same word as the rest of the verb form /ho-śi-n-good-di/= [-igeed]; this is obvious for many reasons. For example, no word in Navaho can begin with a vowel. Here the stem is /-good-/, meaning roughly "to dig, to scoop." Again, we could form sentences such as "I covered you (sg.)," "I covered you (pl.)," and so forth simply by replacing /bi-/ with the appropriate pronominal object. To say "I covered Kee," we would use the sentence /kii bi-k'i-ho-śi-n-good-di/= [kii bik'iiyigeed].

If the subject of the verb is third person then a third person object of a postposition (whether incorporated into the verb or not) is /yi-/ instead of /bi-/. Thus, "he covered him" is /yi-k'i-yi-ho-n-good-di/=
[yikáylyigeed] ; and "he ran out toward him" is /y1-ðäb\. This change from /bi-/ to /y1-/ is an unexplained peculiarity. However, see Parrish et al. (1968) for enlightening discussion of /bi-/ and /y1-\. It is an idiosyncratic fact that the postposition /-m1/ can be incorporated into the verb form when the stem is /-good/. Therefore, in this case, we would enter /m1 ... good/ as a unit in the lexicon, and assign it the meaning "to cover." In this case the meaning "to cover" is a fairly straightforward combination of "to dig, to scoop" (/-good/) and "on or onto the surface of" (/m1-\). This is not always the case. For example, Young and Morgan (1943b) 137 list a verb meaning "apply the brake to it." This verb has a stem meaning generally "act with a rope or cord," and a postposition incorporated into the verb meaning "against." While it is not implausible that "act with a cord against it" means "apply the brake to it," it still seems clear that this meaning is not a wholly automatic consequence of the meanings of its parts, and must be entered explicitly in the lexical entry.

We would also enter just /m1 ... good/ in the lexicon, and assign it the meaning "to dig, to scoop." It is not the case that incorporated and unincorporated postpositions form disjoint classes; for example, the postposition /-m1/ can also occur unincorporated similar to /y1-\/, illustrated above.

The lexical entries /m1 ... good/ and /good/ are what we have referred to as verbs. An actual verb form (such as /bi-m1-ho-ð1-n-good-di/) is formed by adding inflectional affixes to a verb.

We will not be concerned at all with the postpositions and their objects that are incorporated into position pl of the prefix system. Their
treatment is fairly straightforward, and we do not have much to add to
the description of these prefixes that appear in various places in the
literature. See Young and Morgan (1943a), 20-25, 64-65; Young and Morgan
(1943b), where leafing through the dictionary will yield large numbers of
verb-incorporated postpositions; Sapir and Hoijer (1968) 82-84.

Let us now move on to the second type of derivational prefix listed
in (3), the adverbial prefixes of position p2. A few illustrative examples
are listed in Table IV. Consider the first of these, the prefix /?a-/ meaning "into, away, beyond, out of sight." It is used in the verb form
/?a-di-ho-?iix-?=/[?adoo?ih] which means "a breeze will stop
blowing, move off into the distance." Here the stem is /-?iix-/ which,
by itself, means something like "to blow," where the subject is understood
to be something like a breeze. The verb, as entered in the lexicon, would
consist of the combination / .. ?a .. ?iix/together with its meaning,
"to stop blowing, to move off into the distance (a breeze)."

In this case the meaning of the combination of derivational prefix
plus stem comes fairly close to being a straightforward combination sum
of the meanings of the prefix and the stem separately. However, this is
not always the case with derivational prefixes. For example, the verb form
/?a-di-ho-?i-ciix-?=/[?adesci?h] means "I will set it (a post) up;" it contains the same adverbial prefix /?a-/. Here the stem is /-ciix/ and
means something like "point a slender stiff object;" surely, there is no
general principle that determines the meaning of the verb / .. ?a .. ciix/
from the meaning of /?a-/ and /-ciix/ separately.

There are cases of verbs with a position p2 adverbial prefix where
the corresponding verbs without this prefix simply do not exist. For example,
the verb form /ha-di-ho-štı-d-tiłx-₁/= [hadeeštih] means "I will be getting old." The verb is /... ha ... tiix/, where /ha-/ is an adverbial prefix of position p2 and /-tıix/ is the stem; moreover, this stem only appears in conjunction with the prefix /ha-/ and the literal meaning of the prefix, "up and out (of an enclosure)" is no longer discernible in the meaning of the whole verb. This type of behavior is not limited to the adverbial prefixes; in fact, for every derivational prefix there are verb stems that require their presence, being unable to stand alone.

It is possible for more than one adverbial prefix to occur in a single verb form. For example, /štı-ná-di-ho-štı-d-niłz-₁/= [štıdeedś-niłž] is a verb form meaning "I will release them." The verb is /... štı ... ná ... niłz/, and contains both the position p2 adverbial prefix /ówi-/ (horizontally out of an enclosure) and the position p2 adverbial prefix /ná-/ (again). The stem /-nillez-/ refers in general to the handling of plural objects, and the whole verb means literally something like "to take them (plural objects) back out (horizontally) of an enclosure;" see Young and Morgan (1943b) 168.

In this work we will not give a complete and systematic treatment of the adverbial prefixes of position p2. Such a treatment would involve a rather straightforward extension of the treatment of the prefixes closer to the stem that we will concern ourselves with in the later chapters. In certain cases, however, we will cite examples illustrating the behavior of adverbial prefixes in order to further justify decisions made regarding the description of these other prefixes. For the interested reader, lists of adverbial prefixes may be found in Reichard (1951) 159-162, 173-177; Sapir and Hoijer (1968) 96-99; Young and Morgan (1943a) 62-69. A much better picture of the way these prefixes function can be obtained by exhaustively
checking through the dictionary entries listed in Young and Morgan (1943a) 1-244; it might be mentioned that much of the data used in the preparation of the present work has been obtained by this sort of exhaustive (and exhausting) check.

The derivational prefixes referred to in (3c) are what we will call "aspectual prefixes;" these occur in position p7 of the prefix system. There is no generally agreed upon term that is used to refer to these prefixes; they are usually identified simply as the derivational prefixes that follow the third person subject prefixes (of our position p6). Still it seems appropriate to call them aspectual prefixes since they indicate whether the action is beginning, terminating, repeating, etc.; that is, they have just the scope of what is traditionally referred to as "aspect."

Some caution is nevertheless necessary in the use of the term "aspect" to refer to the prefixes of position p7. For one thing, the term aspect has been used traditionally in the literature on Navaho to refer to other aspectual distinctions that seem to be marked most frequently by differences in the phonetic shape of the stem (and thus lexically by suffixes, as is also the case with modes). Actually, though, there is really no sharp dividing line between the two kinds of aspect; the suffix aspect will be discussed directly. Another reason for caution is that, possibly, not all derivational prefixes of p7 are interpretable as aspectual in meaning. Still, this is difficult to determine since there are a few prefixes that occur in this general area of the prefix system that are so fused, both phonetically and semantically with the surrounding formatives that they are extremely difficult to isolate; due to certain metathesis rules that seem to operate, it is even difficult to locate with certainty the position that these prefixes occupy. Finally, it should not be assumed
that the group of prefixes in position p7 form a productive set of aspect markers, for in fact it is often quite idiosyncratic which of these prefixes occurs with which stems and what the meaning of the resulting combinations is.

In Table IV it can be seen that two other prefixes occupy p7 as well, namely the prefixes di-future and di-passive. The reason for this simultaneity in the table is that a verb form may contain more than one aspeclual prefix, in which case the prefixes di-future and/or di-passive may also be present, but interspersed among the aspeclual prefixes (in a fixed order).

In Table IV we have given only four examples of aspeclual prefixes of position p7. There are others that can be observed by checking through the dictionary, but they are not so easy to pinpoint, either phonetically or semantically. To illustrate further the ones that are cited in Table IV, consider /di-/ (inceptive), perhaps the most common deri vational prefix of all. This prefix occurs, for example, in the verb form /di-ši-tii/ [dištēeh] , "I start to carry an animate object along." Here the stem refers in general to the handling of an animate object, the prefix /ši-/ is the first person singular subject, and /di-/is the inceptive prefix. In this verb, /di-/ can be fairly accurately translated "start to," and this is often an accurate translation of /di-/. (Notice that the use of /di-/ carries with it a further specification of the meaning of the stem from a general "handle an animate object;" this is a quite general feature of /di-/. ) Still, in many other cases, /di-/ forms a much closer bond semantically with the stem, and no inceptive connotation is present. For example, the verb form /di-ši-tii-x-/ [dištēeh] means "I am lining up, I am getting in line." The stem refers in general to a thin
line stretching into the distance, and the combination of this stem with /di-/ to produce the meaning "line up" is idiosyncratic.

In all instances where these aspectual prefixes of position p7 are used, we will regard the verb (what is entered in the lexicon) as the combination of the prefix and the stem, and the meaning indicated will be for this combination, not for either of the separate elements. In cases such as that of /../di...tii/, cited above, where the prefix and the stem combine semantically in a predictable or nearly predictable manner, this practice leads to a certain amount of redundancy. Perhaps this can be eliminated by indicating no meaning for the combination /...di...tii/ , but only for /di-/ and /-tii/ separately, and by including a general instruction to the effect that the meaning of a complex form is the sum of the meanings of its components, unless indicated otherwise. However, since our primary concern is the phonological behavior of the various affixes, this sort of refinement will not be attempted here.

For some reason unclear to me, the addition of /di-/ (inceptive) is not generally regarded as resulting in an "inceptive aspect;" i.e., the term "aspect" is not used in the literature to refer to inceptsives. Two of the other prefixes of position p7, however, /x1-/ (repetitive) and /y1-/ (semelfactive), are regarded as forming the "repetitive aspect" and the "semelfactive aspect," respectively. Verbs in the repetitive aspect refer to an action done repeatedly, while verbs in the semelfactive aspect refer to an action performed only once. Still, these prefixes are not entirely productive, since what stems they occur with and precisely what meaning they contribute is sometimes somewhat idiosyncratic.

The other aspectual prefix listed in Table IV is /ni-/ (uniform). It is only Reichard (1951) 235 who uses the term "uniform" for this prefix;
it seems to indicate an action that is proceeding uniformly. Sapir and Hoijer call a prefix /ni-/ of position p7 both "terminative" and "becoming" (97-98); probably it has several meanings. However, it is important to distinguish this /ni-/ prefix or prefixes from the prefix /na-/ used in n-imperfectives and n-perfectives, discussed in section 7; /ni-/*and /na-/ are often both realized as [ni-] phonetically, but there are forms in which they have different phonetic effects, and their function in the verb system is quite different, /ni-/ being derivational and /na-/*inflectional. Finally, there is a prefix /ni-/*(end) meaning something like "brought to a conclusion" that appears in position p2; this should not be confused with the other prefixes of the form /ni-/*.

All the verb forms we have used to illustrate derivational prefixes have each contained prefixes of only one type, according to the categorization given in (3) above. However, there is no constraint to this effect, and many combinations of different types of derivational prefixes can occur. For example, /bi-mi-?a-di-ya-si-tiin/= [bi?ma?diisa?shi] contains, among other prefixes, the prefixes /di-/ (inceptive) and /yi-/*(semelfactive) as well as the postposition /-mi/ (on) and its third person object /bi-/

The literal meaning of this form would be something like "I start to carry some slender stiff object along on a surface," but the actual meaning is "I understand, I comprehend." This provides a good illustration of the fact that the meaning of the whole is not always a straightforward sum of the meanings of the parts. Here, the verb to be entered in the lexicon would be /.. ki .. di .. yi .. tiin/, and the meaning would refer to this sequence of formatives as a whole.

It is traditional to refer to the prefixes /a-/ of position p11 and /i-/ of position p12 as "classifiers." These prefixes can have a phonetic
effect on the stem-initial consonant, as we will show in Chapter 6. The passive classifier prefix /d-/ of position pl1 has been included with the derivational prefixes in (3) even though in many cases it functions as an entirely productive inflectional prefix producing forms not unlike the English passives. The productive use of /d-/ will be discussed in section 7 below along with the passive prefix of position p7. At that time we will also illustrate a non-productive use of the passive classifier which depends on the fact that some verbs require the presence of the passive classifier, whether they are true passives or not and regardless of the fact that they contain no apparent passive meaning.

Also included in the list of derivational prefixes in (3) is the prefix /i-/ (causative) of position pl2, the prefix that occurs closest to the stem. In many ways, /i-/ seems to be a fairly productive prefix, acting as a simple transitivizer. Thus the verb /xada ... gox/ means "to fall down" and is intransitive, while adding the causative prefix yields a new verb /xada .. i .. gox/ which is transitive and means "to make someone fall down, to push someone off a high place;" see Young and Morgan (1943b) 88. Similarly, the verb /nα .. Yis/ means "to turn around," while /nα .. i .. Yis/ means "to turn something around;" see Young and Morgan (1943b) 80, 97.

The prefix /i-/ does not always act in this straightforward manner, however. There are many examples of stems that must always occur with /i-/; the meaning of the verb in these cases may be transitive, but there is no corresponding intransitive formed by dropping the /i-/ . There are even cases, though fewer in number, where verbs must use /i-/ even though they are intransitive. In such cases it is clear that /i-/ has lost its causative meaning. We will proceed as we have for the other derivational prefixes listed in (3) and regard /i-/ as part of the lexical entry of the
verb whenever it appears in verb forms as something other than a productive causative prefix.

Last in the list of prefixes in (3) are the aspectual suffixes of position sl. Here the situation is extremely confusing, and there are no clear treatments in the literature. There is some agreement that there is a "momentaneous" aspect, denoting a kind of action that begins and ends in an instant, and a "continuative" aspect, denoting a kind of action that is continued over a period of time; see Young and Morgan (1943a) 42; Sapir and Hoijer (1968) 101-103. For example, a verb form meaning "put it down" would be momentaneous while a verb form meaning "carry it about" would be continuative. However, only a few verbs can occur in both of these aspects. Most verbs seem to be either always momentaneous or always continuative; still it is next to impossible for many verb forms to decide (from data existing in the literature) which aspect they exhibit. One reason for this is that the meanings of the aspects are not sharply enough delineated; to pick several examples nearly at random, there are Navaho verbs translated by Young and Morgan as "embrace," "erase," "laugh," "bewitch," and "dodge," and it is entirely unclear from the meanings which of these should be momentaneous and which continuative. The other reason that it is difficult to identify these aspects is that, apparently, there is no consistent phonological difference between them.

We will suggest that there is a suffix/ -ʔ/ which marks the continuative aspect, and that the momentaneous aspect is marked by absence of / -ʔ/.

In most cases the suffix / -ʔ/ (continuative) causes shortening of the stem vowel, though there is one environment where it also causes high tone; only in rare cases does the / -ʔ/ itself show up in phonetic representations.
However, most verbs show the effect of /-?/ only in one mode; in some verbs this is the imperfective mode, and in others it is the perfective mode, while a smaller number of verbs show the effect of /-?/ in both the imperfective and perfective modes. There are no clear cut cases where the suffix /-?/ has an effect in other modes. Still, there are scattered examples indicating that aspecific differences do, in fact, show up in other modes; see Young and Morgan (1943b) 61, Sapir and Hoijer (1968) 101-103. However, perusing the sources one finds that the continuative-momentaneous distinction, the most clear cut aspecific difference, is indicated often in the imperfective and/or perfective modes, and only rarely elsewhere. In Chapter 3 we will present an analysis whereby /-?/ is present in lexical representations only in those modes where it has a phonetic effect.

Since the continuative aspect is so difficult to identify on semantic grounds (at least from the kinds of glosses given in the dictionaries), we will base our decisions on whether or not the suffix /-?/ is present solely on phonological grounds. If the imperfective and/or perfective mode of a verb shows phonetically the shortening or high tone characteristic of the suffix /-?/, we will assume that /-?/ is present in the lexical representations (but only in the mode(s) that show its effect).

It is clear from the above remarks that the distinction between momentaneous aspect and continuative aspect is not part of a regular and productive aspecific system in Navaho. Rather, it seems as though what is present in the language today is simply the remnant of a once more extensive aspecific system, marked by both prefixes of position p7 and suffixes of position s1. Evidence supporting such an idea can be found
in Sapir and Hoijer (1968) 101-103. However, in the present work we must content ourselves with the above rather sketchy account of aspect, since precise information in this area is so difficult to obtain.

Since the aspectual system in Navaho is apparently far from being productive, we must consider the aspectual suffix /-ʔ/ as being a derivational affix which occurs as part of the lexical entry of those stems that occur with it. Further, the meaning of the combination of /-ʔ/ and the stem (and other derivational prefixes, if present) in the lexical entry must be explicitly given, rather than being predictable from the meanings of the formatives separately.

To summarize the discussion of the present section, a "verb" in Navaho is an entry in the Navaho lexicon which has the general form indicated in (4).

\[(4)\]

\[\ldots(PP)\ldots(Adv)\ldots(Asp)\ldots(Pascl)(Caus)\text{ stem (Asp)}\ldots/\]

Here the abbreviations used are those of Table IV; "Adv" and "Asp" may indicate a sequence of formatives, though all the other terms indicate at most one formative. All these formatives in an actual lexical entry are given in lexical representation. In addition to the phonological information about the verb provided by representations of the form of (4), each lexical entry indicates the meaning of its particular combination of stem and affixes. Actual verb forms are obtained by adding various inflectional affixes to these lexical entries. These inflectional affixes will concern us in the following two sections.
6. Inflectional affixes in Navaho are of two sharply distinguishable types, pronominal affixes and affixes for tense and mode. They will be discussed, in that order, in the following two sections.

Pronominal prefixes can occur at several positions of the prefix system, namely at positions p1, p5, p6, and p9 of Table IV above. Those that occur at p1 have already been discussed; they are the pronominal objects of postpositions that have been incorporated into the verb. Next to be considered are the prefixes for subject that occur at positions p6 and p9. If the subject is first or second person it is indicated by a prefix in position p9. The phonetic shape of these prefixes each vary widely in a way that will be discussed in Chapter 5, but in lexical representation they have the shape indicated in (5).

(5)  
first person singular 1sg 61  
second person singular 2sg  n1  
first person plural  1pl  d1  
second person plural  2pl  xo

Subject prefixes of position 9

If the subject is first or second person, these position p9 prefixes are usually the only overt marker of this subject. However, for emphasis, the first or second person pronoun may also occur as a separate word preceding the verb form; we will not be concerned with this phenomenon in the present work.

If the subject is a third person it is indicated by a prefix in position p6 (and p9 is empty). Actually there are four types of third person subject; these are listed in (6).
Subject prefixes of position 6

These prefixes do not specify number; that is, they can be used to refer to either singular or plural subjects. The "ordinary" third person is marked by the absence of any subject prefix at all. The "fourth" person subject is used to refer to human subjects only, the "indefinite" third person subject is roughly equivalent to English "someone," and the "impersonal" third person subject is used to refer to space or time. More specifically, the impersonal subject refers to places, areas, times, events, etc. Thus, sentences such as "it (an area) is blue," and "it (an event) took place," and so forth would, in Navaho, be expressed by a verb form with an impersonal subject. The behavior of the third person subject prefixes of (6) is treated only in a very scattered and unsystematic fashion in the literature, and I have nothing to contribute here. Some very promising analyses of these prefixes are developed in Parrish, et al., (1968) and Akmajian (1968).

The "fourth," "indefinite," and "impersonal" pronominal prefixes are often referred to as "deictic" prefixes, (cf. Table IV, position p6), although this is a rather strange use of the term.

If the subject is ordinary third person, it may (optionally) be present as a full noun phrase subject preceding the verb form. For example, /ho-d-loox-i=/yiloh/ means "he is laughing" (and has no subject prefix at all), while [kii yiloh] means "Kee is laughing."

The situation with the object pronominal prefixes is slightly more
complicated. These prefixes, which all occur in position p5, are listed in (7) in their lexical representation.

<table>
<thead>
<tr>
<th>Role</th>
<th>Prefix</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>first person singular</td>
<td>1sg</td>
<td>yi</td>
</tr>
<tr>
<td>second person singular</td>
<td>2sg</td>
<td>ni</td>
</tr>
<tr>
<td>first person plural</td>
<td>1pl</td>
<td>nixi</td>
</tr>
<tr>
<td>second person plural</td>
<td>2pl</td>
<td>nixi</td>
</tr>
<tr>
<td>(ordinary) third person</td>
<td>3</td>
<td>Ø, yi, bi</td>
</tr>
<tr>
<td>fourth person</td>
<td>4</td>
<td>xo</td>
</tr>
<tr>
<td>indefinite third person</td>
<td>ind.</td>
<td>?a</td>
</tr>
<tr>
<td>impersonal third person</td>
<td>imp.</td>
<td>xo</td>
</tr>
</tbody>
</table>

**Direct object prefixes of position 5**

Note that in the case of 1sg, 2sg, ind, and imp, the direct object prefixes (in (7)) are the same as the subject prefixes (in (5) and (6)). The remaining pronominal prefixes, however, are suppletive, analogous to English I-me, we-us, etc.

Let us divide the verbs that can take direct objects into two groups. One group, containing the great majority of such verbs, we will call "transitive," the other group we will call "transitivized;" the terminology is due to Sapir and Hoijer (1968:66). To begin with, we will restrict our attention to the transitive verbs. Here the only complication arises when the object is ordinary third person 3. As in the case of an ordinary third person subject, an ordinary third person object may (optionally) be present (and following the subject noun phrase, if it is present) as a full object noun phrase preceding the verb form. Inside the verb form, the ordinary third person object is represented by Ø when the subject is other than ordinary third person, by /yi-/ in most cases where the subject is ordinary third person, and by /bi-/ when the subject and object noun phrases have undergone an (optional) interchange of position. Subject and/or object noun phrases are deleted if they are pronominal,
but the leftmost one may be deleted only if the rightmost one has been.

Examples are given below in (8); the first column contains the English translation, the second column contains the phonetic representation of the Navaho sentence, and the third column indicates the lexical representation of the pronominal prefixes in positions p5 (direct object), p6 (third person subject), and p9 (non-third person subject).

(8)

(a) I carry him  dišteweh  Ø  Ø  ø1
(b) I carry Kee  kii dišteweh  Ø  Ø  ø1
(c) I carry you  nidišteweh  ni  Ø  ø1
(d) he(4) carries him  yiditeweh  Ø  y1  Ø
(e) he(4) carries Kee  kii yiditeweh  Ø  y1  Ø
(f) he(4) carries you  niiyiditeweh  ni  y1  Ø
(g) he carries him  yiditeweh  y1  Ø  Ø
(h) he carries Kee  kii yiditeweh  y1  Ø  Ø
(i) he carries you  nidišteweh  ni  Ø  Ø
(j) Baa carries him  baa? biditeweh  bi  Ø  Ø
(k) Baa carries Kee  baa? kii yiditeweh  y1  Ø  Ø
(l) "  "  "  kii baa? biditeweh  bi  Ø  Ø
(m) Baa carries you  baa? nidišteweh  ni  Ø  Ø

In cases (a) through (f) the subject is not ordinary third person, so that, while objects other than ordinary third person are expressed, third person objects are not expressed. In cases (g) through (m) the subject is ordinary third person; thus all objects are expressed, and the ordinary third person object is /y1-/ unless subject and object noun phrases have been interchanged, in which case it is /bi-/. The contrast between /y1-/ and /bi-/ can best be seen by comparing (h) with (j) and (k) with (l). The "you" used throughout these examples refers to a singular object, and the "he" and "him" refer always to an ordinary third person. Recall also that noun objects and subjects are ordinary third person.

Having considered the transitive verbs we may go on to look at
the transivitized verbs. Such verbs differ in that they express an ordinary third person direct object explicitly (with a prefix /bi-/ when the subject is not ordinary third person; when the subject is ordinary third person, an ordinary third person object is expressed by /bi-/ or /yi-/ under the same conditions as for the transitive verbs. The situation is confusing, however, since in some transivitized verbs this object does not fall in position p5 at all; for some of these verbs it falls in position p1 and in others it falls between positions p2 and p3. Moreover when it falls in p1 the object sometimes has high tone on its vowel, which is interesting since there is a postposition (meaning "against") which is realized only as a high tone on the vowel of the preceding pronominal object. We will have nothing more to say about transivitized verbs in this work; discussion of them can be found in Young and Morgan (1943a) 49, (1943b) passim; Sapir and Hoijer (1968) 86-87.

Another point to be made about pronominal objects concerns the expression of reciprocals and reflexives. When the subject is the same as the object in meaning, then the pronominal prefix is replaced by the reflexive /?ad1/ in all persons. When a reciprocal meaning is intended, the object pronominal prefix is replaced by /?ax1/.

Finally, we may conclude the discussion of pronominal prefixes with the distributive plural prefix /da-/ of position p4. This prefix, when present, gives a distributive meaning to a following pronominal subject and/or object. A subject made distributive in this way refers to the separate action of many individuals, while an object made distributive refers to an action carried out separately on many individuals. Naturally, only non-singular pronouns can be made distributive: the
non-singular pronouns are the first and second person plural pronouns and the third person pronouns (which are neither singular nor plural). When both the subject and the direct object of a verb are non-singular the use of /da-/ (distributive plural) leads to a triple ambiguity: one doesn't know whether the subject or the object or both are made distributive. For example, /da-nixi-di-t'iis/ = [danhiit'ees] has the p4 prefix da-, the p5 2nd person plural object prefix nixi-, and the p9 1st person plural subject prefix di-. (We need not be concerned at this point with the rules deriving the phonetic representation from the lexical representation.) The meaning is "each one of us blackens you (pl.)," "we blacken each one of you (pl.)," or "each one of us blackens each one of you (pl.)"; see Sapir and Hoijer (1968:90). Apparently the da-prefix comes, syntactically, from the subject and/or object noun phrase by a rule that incorporates it into the verb with the convention that if two prefixes are incorporated, only one shows up in the verb. This is plausible since /da-/ also serves as a distributive plural prefix on nouns; see Sapir and Hoijer (1968:70).

The distributive plural should not be confused with the so-called "dual," which refers to exactly two. A few verbs in Navaho have one stem for singular subjects, another stem for dual subjects, and a third stem for subjects consisting of more than two actors. Among such verbs are the verbs meaning "go" and "run". This dual number does not play any other role in the language. It is common, in the literature, to refer to more than one with the term "duoplural" and to more than two with the term "plural". Because of the limited role that the dual plays, however, this seems to be an unnecessary proliferation of terminology; consequently, we have used "plural" in its more usual sense of more than one.
7. The remaining affixes of the verb fall roughly under the heading of "tense," "mode," and "voice" affixes. These are listed in (9), together with an indication of the position in verb forms they occupy according to the notation of Table IV, and their lexical representations.

(9)

Tense, mode, and voice affixes

(a) iterative prefix        p3        ná
(b) future prefix          p7        di
(c) passive prefix         p7        di
(d) modal prefixes         p8        hi, ho, sa, na, honhi
(e) perfective prefix      p10       n
(f) modal suffixes         s2        di, 1, x

One of the main devices for indicating tense in Navaho involves periphrastic use of two particles, [nít'ëz?] (meaning "it used to be"), and [doozëeë] (meaning "it will be"). Thus, putting the former after a verb form implies a past tense, while putting the latter after a verb form implies a future tense. In such cases, the verb form itself may have tense or mode indicated by affixes, and, moreover, both of the particles may be present at the same time. The result is a complex system giving shades of meaning similar to English perfectives and conditionals. However, since these particles are not part of the verb form, we will have nothing further to say about them; a good discussion may be found in Young and Morgan (1943a) 46-47.

Elsewhere the term "tense" is used only in connection with a non-periphrastic future tense that is closely linked with the progressive mode. The treatment of this future tense will be delayed until after a discussion of the modes.

There are six generally recognized modes in Navaho, and every verb form
is in exactly one of these modes. (We are not considering a class of verbs called "neuter verbs" which are not conjugated for tense and mode. They are frequently translatable as adjectives in English, and often have a prefix which behaves similarly to the prefix /na-/ used in the n-imperfective and n-perfective. See Young and Morgan (1963a) 81-82; Sapir and Hoijer (1968) 93-95; Reichard (1951) 234). Moreover, the great majority of verbs can appear in all six modes. These modes are indicated in (10) below, together with a brief indication of their meaning. See Young and Morgan (1963a) 112, 121ff, for a discussion of modes; the descriptions in (10) follow their treatment closely.

(10)  
I imperfective  denotes that the action of the verb, though still incomplete, is in the process of being completed  
P perfective  denotes that the action of the verb is complete  
Pr progressive  denotes that the action of the verb is in progress  
R iterative  denotes repetition of the action of the verb  
U usitative  indicates that the action of the verb is habitual  
O optative  expresses wish or desire

The letters at the left are the abbreviations that will be used throughout the present work. It should be emphasized that the characterization of the meanings of the modes given in (10) is very rough; our primary concern is not what the modes mean, but rather what modes exist and how they are indicated phonologically. (The difference between the meaning of the imperfective and the progressive is not brought out clearly in the
literature. However, there are strong indications that the progressive is used to denote an action that is performed while the agent is moving along; cf. Young and Morgan (1943a) 95.) Notice, incidentally, that use of the term "mode" for the optative and usitative is fairly natural, although the other modes of (10) refer to what is more usually included under the scope of "aspect". Still, to avoid confusion, we will retain the terminology used in the Navaho literature.

The situation with the modes is complicated by the fact that there are two different kinds of imperfective mode (which we will call the "h-imperfective" and the "n-imperfective"), as well as three different kinds of perfective mode (which we will call the "y-perfective", the "n-perfective", and the "s-perfective"). The modes are marked in a fairly complicated way by both prefixes and suffixes in a way indicated below in (11). The affixes given in (11) are in lexical representation; this should be kept in mind since the phonetic realizations of some of these affixes vary quite radically. See Chapter 5, Tables I through VII for the phonetic representations that result when the various modal prefixes combine with the subject prefixes, and Chapter 3, Tables III through V for the phonetic representations that result when the various modal suffixes combine with the stem. The headings of the columns in (11) refer to the positions that the affixes occupy in the verb form according to the terminology of Table IV.
<table>
<thead>
<tr>
<th>Mode</th>
<th>p3</th>
<th>p8</th>
<th>p10</th>
<th>s2</th>
</tr>
</thead>
<tbody>
<tr>
<td>h-imperfective</td>
<td>/hi-/</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n-imperfective</td>
<td>/na-/</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>γ-perfective</td>
<td>/ho-/</td>
<td>/n-/</td>
<td>/-di/</td>
<td></td>
</tr>
<tr>
<td>n-perfective</td>
<td>/na-/</td>
<td>/n-/</td>
<td>/-di/</td>
<td></td>
</tr>
<tr>
<td>s-perfective</td>
<td>/sa-/</td>
<td>/n-/</td>
<td>/-di/</td>
<td></td>
</tr>
<tr>
<td>progressive</td>
<td>/ho-/</td>
<td></td>
<td>/-i/</td>
<td></td>
</tr>
<tr>
<td>iterative</td>
<td>/na-/</td>
<td></td>
<td>/-x/</td>
<td></td>
</tr>
<tr>
<td>usitative</td>
<td>/hi-/</td>
<td></td>
<td>/-x/</td>
<td></td>
</tr>
<tr>
<td>optative</td>
<td>/nonhi-/</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notice that the prefix /hi-/ is present in lexical representatations in the h-imperfective and the usitative modes. Phonetically, this prefix is almost always lost without a trace. Only when there are no prefixes preceding it, or only prefixes of Part A (Table IV), does /hi-/ have any effect at all phonetically. When /hi-/ is word-initial it is phonetically -yi-, and, as such, has often been referred to as the "yi peg element"; cf., Young and Morgan (1943a) 56-57, 77-79. Sapir and Hoijer (1968) 26, refer to imperfectives where the imperfective prefix (which they write -yi- ) has an observable phonetic effect as "γ-imperfectives", and to imperfectives with no overt manifestation of a modal prefix as "∅-imperfectives". These questions will be discussed further in Chapter 5.

There are many features of the presentation in (11) that must be clarified. First, it may be helpful to remark that the most typical phonetic realizations of the prefixes /na-/ , /ho-/ , /sa-/ , and /nonhi-/ are, respectively, -ni-, -yi-, -si-, and -γ-. The
motivations for the more abstract lexical representations are strong, but will not be presented until Chapter 5. Thus notice that the "y-perfective" is so named because the formative that marks it, namely /no-/ , is often realized as -yi- phonetically. The term "y-perfective" is from Sapir and Hoijer (1968) 30; Young and Morgan (1943a) 82, used the term "yi-perfective".

Note further that the position p10 prefix /n-/ (perfective) never shows up as such phonetically; nevertheless, its presence may be inferred from the effect that it has on the modal prefixes of position p8 and the subject prefixes of position p9, as will be shown in Chapter 5. Finally, the -d- of the suffix -di- (perfective) is often realized as -?i- or lost completely phonetically, while the vowel -i- is nearly always lost phonetically, after it causes voicing of a stem-final continuant. These rules are treated in Chapter 3.

Every verb must be marked for which of the two types of imperfective mode it takes, and also for which of the three types of perfective mode it takes. It should be made clear, however, that the progressive, iterative, usitative, and optative modes of a verb are not affected in any way by the type of imperfective and perfective mode that it requires. Not all possibilities are possible, however, since every verb that requires the n-imperfective also requires the n-perfective, and conversely; see Sapir and Hoijer (1968) 95 (bottom). Moreover, choice of derivational prefixes seems to affect what type of perfective a verb takes. For example, almost all verbs that have the position p7 prefix /xi-/ (repetitive) seem to require the s-perfective. Still, no mention of this sort of constraint is ever made in the literature, and, by searching the dictionary, I can find
only general trends of this sort, not any binding rules.

Notice that the position p3 prefix /na-/ has been given the meaning "goal"; this is the prefix used in the n-imperfective and the n-perfective. And, in fact, verbs using the n-imperfective and the n-perfective seem to refer to a type of action that involves starting for or arriving at a goal. Reichard treats the n-imperfective and the n-perfective in her section 10.99, and translates the meaning as "start for" in the imperfective and as "arrive at" in the perfective; Reichard (1951) 233-240. Hoijer (1946a) l, calls the n-imperfective the "completive imperfective", and this seems not incompatible with Reichard's description. Finally, Young and Morgan (1943a, 82) characterize the n-perfective as "describing the act as completed and resulting in a static condition". Oddly, they do not discuss the n-imperfective at all, but in the examples in their dictionary they frequently translate examples showing the n-imperfective and n-perfective as "arrive ...ing". Thus, a verb meaning "crawl" when it appears with h-imperfective (and, in this case, with s-perfective) becomes another verb meaning "arrive crawling" when it appears with n-imperfective and n-perfective; for this and other examples see Young and Morgan (1943b) 138, 143, 148, 152. In this case, the distinction between h-imperfective and n-imperfective is, more or less, a productive one, but in many other cases a verb forms its imperfective either always with the h-imperfective or always with the n-imperfective; moreover, the meaning of verbs used in the n-imperfective does not always involve "arrival at a goal". Thus, in general, verbs will simply have to be marked for which kind of imperfective they take. It may be that the meaning of the stem and/or of the derivational affixes determines, to
some extent, which type of imperfective is used, but I have been able to uncover no hard and fast rules. See, however, Sapir and Hoijer (1963) 97-98, where it is suggested that the derivational prefixes present in a verb form determine, to some extent, which type of imperfective (and perfective) is used.

The situation with the other two types of perfective (the y-perfective and the s-perfective) is similar. Each of these seems to carry with it a certain general meaning; the y-perfective "describes an act as just completed" while the s-perfective "implies that the act is completed and at the same time that it is durative and static" (Young and Morgan (1943a) 82). Still, most verbs seem to require just one of the perfective types, where just which one apparently must simply be marked in the lexical entry of the verb, being unpredictable by any general rule. See, however, Sapir and Hoijer (1963) 97-98. Also, it may be noted that there is some evidence that there might be an S-imperfective; see verb #26 in Young and Morgan (1943b) 8.

The above discussion suggests that one of the formatives /na-/, /ho-/, and /sa-/ of position p8 should form part of the lexical entry of every verb, just as did the derivational prefixes discussed in section 5. However, we will remain neutral here as to the exact status of these three formatives in their use in the imperfective and perfective modes, and simply note that verbs must be marked in some way for which kind of imperfective and perfective they take.

The use of the same formative /ho-/ in both the progressive mode and the y-perfective in (11) is somewhat justified semantically if, as Young and Morgan state, the y-perfective describes an act as just completed. This might suggest that the meaning of a y-perfective is something like "I have just been ...ing". However, as in so many other ways, the
literature on the Navaho fails to provide an accurate characterization. Perhaps of most interest are Reichard’s remarks (1951, 216): "The yi-perfective is the progressive completive, corresponding to the progressive and continuative. It differs from the ni-perfective in that it does not indicate the finish of the action, or the arrival at a goal. It differs from the si-perfective in not indicating a state that has been brought about."

In any case, we will see in Chapter 6 that the use of the same formative /na-/ in both the progressive and the y-perfective has strong phonological motivation.

Continuing with the explication of (11) we observe that one of the modes, the iterative, is marked by a prefix in position p3 (whereas, prefixes for all other modes occur in positions p8 or p10). There are two reasons for calling the prefix /nå-/ (iterative) a modal prefix, rather than a derivational prefix. First, /nå-/ can occur with almost any verb, while a derivational prefix can appear with only a small minority of verbs. But second, and more important, the use of /nå-/ requires a different stem form of the verb phonetically, and thus a different suffix lexically; this suffix is /-x/. Thus, the presence of /nå-/ and /-x/ precludes the possibility of the verb’s occurring in the other modes; this clearly points to the fact that the prefix /nå-/ and the suffix /-x/ together are the markers of a separate mode, a mode that we, following traditional practice, have called the iterative.

Ken Hale has pointed out to me that a prefix /na-/ of position pl, meaning "about" (as in "he wandered about") requires the continuative form of the verb stem, and thus the continuative suffix /-ʔ/ of position
Still, verbs with this prefix /na-/ may occur in all modes. Thus, the prefix /na-/ can be correlated with a difference in stem shape, but clearly not a prefix marking a separate mode, as is /ná-/.

The iterative mode seems to mean that the action is done repeatedly within a short period of time, whereas the aspectual prefix of position p7 /xi-/ (repetitive) denotes that the action is carried out in a serial fashion, implying "one after the other". See Young and Morgan (1943a) 75; Sapir and Hoijs (1968) 98. This characterization of the meaning of the iterative will have to be revised, apparently, since many verbs use the iterative with a usitative meaning while lacking a usitative paradigm (Ken Hale, personal communication). There are also adverbial prefixes of position p2 with related meanings. One of them also has the shape /ná-/ (it can co-occur with /ná/- (iterative)) and means "back, returning", while the other has the shape /náá/- and means "again, another, once more". See Young and Morgan (1943a) 71-75.

The usitative mode is straightforward. It employs the /hi-/ (imperfective) prefix, but is marked by the /-x/ (iterative) suffix. The optative mode in many cases has the same stem shape phonetically as the imperfective and thus is marked by the absence of a modal suffix. In a significant number of other cases, however, the optative has the stem shape of some other mode, and in still other verbs the stem for the optative is different from that of any of the other modes. There is no pattern whatsoever that I can determine in these alternations, and I must leave the varying stem shape of the optative as an unexplained irregularity.
Notice that in (11) there are lexically four different possibilities for suffixes: /∅, i, d1, x/. Thus, phonetically, there are a total of four different stem shapes that a given verb can exhibit, although often some of them are homophonous. Adding the irregular optative gives a total of five possible stem shapes, and, in the dictionary (Young and Morgan (1943b)) these five shapes are included under the entry for each verb.

Returning now to the list of prefixes given at the beginning of this section in (9), we see that all have been discussed except (9b) (the future prefix) and (9c) (the passive prefix). The position p7 prefix /d1-/ (future) is straightforward: addition of this prefix to the progressive mode results in verb forms with a future meaning. The presence vs. the absence of /d1-/ is the only phonological difference between the future tense and the progressive mode. Still, it might be noted that the addition of the distributive plural prefix /da-/ (position ph) to active transitive verbs in the progressive mode requires another stem than the progressive stem (apparently the imperfective stem). This is not true of the future. See Young and Morgan (1943a), 71, 95.

Verb forms are usually called "passive" whenever the position pl1 prefix /d-/ (passive) is present. This /d-/ causes a following /±-/ (causative) prefix to become a voiced -l- and causes various changes in the stem-initial consonant when /±-/ is not present; the /d-/ itself, however, is lost phonetically except in verbs which, irregularly, have vowel-initial stems. These matters are discussed in Chapter 6. One type of passive is the "simple passive". See Sapir and Hoijer (1968) 92; Young and Morgan (1943a) 51, call this the "Passive A". In a simple
passive, no subject (agent) of the action is indicated anywhere in the sentence; that is, there is no pronominal prefix in position p6 or p9, nor any subject noun phrase preceding the verb. Moreover, there is no pronominal object prefix in position p5, although there may (optionally) be an object noun phrase preceding the verb form to indicate the receiver of the verbal action. All that is present in the verb form itself is the /d-/ (passive classifier) of position pl1 (plus, possibly, various modal and derivational affixes). For example, when the verb meaning "to skin (an animal)" is used in a simple passive (in the perfective mode, say) it has a very general meaning, something like "skinning was done."

If the verb form is preceded by a noun phrase meaning "prairie dog", the meaning is "the prairie dog was skinned". It is not possible to say "the prairie dog was skinned by me" or "the prairie dog was skinned by Kee" in Navaho; these would be expressed with the corresponding actives.

Another type of passive is the "agentive passive"; cf., Sapir and Hoijer (1968) 92. Here the agent of the action is always indicated by what is (apparently) the indefinite third person subject prefix /?a-/ (which means "someone") appearing in position p6, the normal position for third person subjects. Another prefix, /di-/ (passive), must appear in position p7, and, as in all passives, the prefix /d-/ (passive classifier) appears in position pl1. Finally, the pronominal direct object prefix, indicating the receiver of the action, appears in its p5 position. In Navaho, prefixes in the subject positions p6 and p9 always represent the agent or doer of the action, while prefixes in the direct object position p5 always represent the patient or receiver of the action. This is true in both actives and passives, making the situation unlike that of English where, in passives, surface subjects are the receiver of the action. As
an example, /nasi?da-ho-n-d-ì-tìi-t?di=/ [nasi?doolt'ë?] is an agentic passive meaning "I was dropped"; here, the direct object /nì-/ (1sg.), the indefinite third person subject /?a-/ , the passive prefix /dì-/ , and the passive classifier /d-/ all appear in the lexical representation. To form the sentence "Kee was dropped", we would change the first person /nì-/ to third person /bi-/ and add the noun: [kìi nabi?doolt'ë?].

In the agentic passive it is not possible to replace the indefinite subject /?a-/ by any other subject. Thus, it is not possible to use an agentic passive in sentences such as "I was dropped by you", "Kee was dropped by me", "Kee was chosen by Baa", and so forth. When a (definite) agent is expressed in Navaho, the verb form must be in the active. Nevertheless, in complex sentences the so-called "indefinite" prefix /?a-/ may have a definite antecedent; cf. Parrish et al. (1968) 12.

Apparently, any transitive verb can appear either as an agentic passive or as a simple passive, but the sources are not clear on this. It is curious, though, that Young and Morgan (193b) indicate in their dictionary an agentic passive for most transitive verbs, a simple passive for other transitive verbs, and no passive at all for other transitive verbs. For example, the transitivized verb meaning "to release it from the grasp" (35) has a simple passive, rather than an agentic passive. The transitive verb meaning "to rape her" similarly has just a simple passive and no agentic passive indicated (49). The significance of this is not clear. Still it should be noted that recent field work has tended to indicate that many of the agentic passives included in
Young and Morgan (19b3b) are wrong. Specifically, verbs which require inanimate or abstract objects should not have agentive passive forms (Ken Hale, personal communication).

In addition to being required in the simple passives and the agentive passives, the prefix /d-/ (passive classifier) is required in the presence of certain other prefixes. For example, /d-/ must be present when any of the following prefixes are present: /?axi-/ (reciprocal), /?adi-/ (reflexive), or (often) /nag-/ (again). We are not prepared to give a full discussion of this sort of phenomenon.

There is one final use of the prefix /d-/ (passive classifier) in which it behaves, essentially, as a derivational prefix. It is due to this use that /d-/ was included in the list of derivational affixes in section 5 above (3d). This sort of situation arises since there are some verbs that always appear with /d-/ , even when they are not simple passives, agentive passives, or constructed with prefixes like /?axi-/ , /?adi-/ , and /nag-. Such verbs will be called "pseudopassives"; they must include the prefix /d-/ in their lexical entry. "Pseudopassive" is our own term, there being no traditional designation for these verbs. Sapir and Hoijer refer to a class of verbs which require the passive classifier /d-/ as "mediopassives" (1968) 92-93. These are verbs in which the subject prefix "symbolizes both actor and goal", and, from the examples given, appear indeed to be reflexive in meaning; e.g., "to hold one's head", "to fatten oneself", "to pray" (literally, "to bless oneself"). We will include mediopassives under the heading pseudopassive. In some cases, pseudopassives bear recognizable meaning relationships to the corresponding verbs without /d-/ ; still, it should be emphasized that
the pseudopassives are not really passives (that is, simple passives or agentive passives), since they occur with all possibilities for subject and object. Moreover, there are many cases of pseudopassives for which there is no corresponding verb without the passive classifier /ḍ-/.

For example, the verb meaning "to hunt it" (Young and Morgan, 1943a, 236) is a pseudopassive verb, since it requires the classifier /ḍ-/ Still, it has all the possibilities for subject and object, and even has an agentive passive; moreover, dropping the /ḍ-/ prefix from this verb does not yield any verb at all. Or, to give an intransitive example, the verb meaning "to step down onto a surface" (104) is pseudopassive.

Thus, the use of the passive classifier in pseudopassives is quite different from its use elsewhere. In pseudopassives, it functions simply as a derivational prefix which, furthermore, need not even have any remnant of a passive meaning.
8. This completes our discussion of the organization of the Navaho verb, a discussion that began with the presentation of the chart in Table IV. It should be emphasized that we have not attempted to give an authoritative account; indeed, our only source of data has been the published material on Navaho, and we have merely attempted to present, as clearly as possible, the main outline of the structure of the verb as it is described in these sources. This task has been difficult to perform, in many ways, since the various sources are frequently extremely hard to follow, vague, in conflict with one another, and, most annoyingly, guilty of innovating incompletely explicated terminology often without bothering to state its relationship to already existing terminology of other authors for similar phenomena. As a result, the above account is bound to be proven inaccurate in many of its features when more satisfactory descriptions of Navaho emerge. Still, it can serve our purpose in the present work, which is to provide a framework for the treatment of some of the primary phonological processes.

The remainder of the present work will be organized in the following way. In Chapter 2 we will discuss certain aspects of the phonological theory that will underlie the remainder of the presentation. In Chapter 3 we will describe the effect that the various suffixes have on the stem of the verb; in so doing we will be providing an account of the rather complex system of verb stem alternations. Chapter 4 will contain a treatment of various alternations in vowel quality from one stem form of a verb to another; this is actually part of the general problem treated in Chapter 3, but is best handled separately. In Chapter 5 we will consider the behavior of the prefixes that mark tense and mode, noting how these prefixes interact with the subject prefixes. Finally, in Chapter 6 we will discuss the
two prefixes that occur closest to the stem, \(/d-/ (passive classifier) and \(/z-/ (causative), and show how these form clusters with or effect changes in the initial consonant of the verb stem.
9. In concluding this chapter we will describe the manner in which verbs are entered in \textit{A Dictionary of the Navaho Language} (Young and Morgan (1943b)). This is necessary since we will make frequent references to the entries of this dictionary. The organization of the dictionary is, perhaps, best illustrated by presenting a sample entry. This we will do in (12).

(12) \begin{itemize}
\item tas, taas, taaz, tas, taas, to bend
\begin{enumerate}
\item to bend
F. yidoootas I. yiitæs P. yiitaaz
R. néítas O. ghootæs (shi-zhah, it is bent)
\item to bend it
F. yidees-tas (yidĩi, yiido, yi-zhdo, yidiil, yiido) (bi'doold-)
I. yiis-tæs (yiil, yiil, jii, yiil ghoo) (bi'diil-)
P. yiil-taaz (yi-niil, yiil, jii, yiil, ghoo) (bi-diil-)
R. néis-tas (niiil, niiil, niiil, niiil, niiil, niiil) (nabidiil-)
O. ghoo-stæs (gho, yo, joo, ghool, ghoo) (bi'doold-)
\item to run (lit. bend) after it (a term often used to a child; similar to English "run and get").
\end{enumerate}
\end{itemize}

The postposition bïkå, after it, is prepounded to the following:
F. dees-tas (diff, doo, jidoo, dii, dooh) I. yiis-tas (yii, yii, jii, yii, ghoo) S-P. së-tas (sinf, yiz, jiz, sii, soo) R. néis-tas (nëii, néii, nëii, néii, nëii, nëii) O. ghös-tas (ghōo, ghō, jō, ghoo, ghoo)

bëesh bïkå yiitas, run after the knife!
This entry appears on page 188; it is reproduced exactly as it appears in the dictionary, down to the punctuation and the spacing of the lines.

We will refer to the heading of such an entry (as reproduced in (13)) as a "verb stem entry."

(13) \(\text{tas, tåås, taaz, tas, tåås, to bend}\)

This heading includes five shapes of a particular verb stem, given in what, in all its essentials, corresponds to our phonetic representations. These five stem forms are designated by the abbreviations F, I, P, R, and O, in that order; the abbreviations are spelled out in (14).

(14) F future tense 
    I imperfective mode 
    P perfective mode 
    R iterative mode 
    O optative mode 

Recall that the stem is the same in the future tense and in the progressive mode. Likewise, the stem of the iterative mode is the same as the stem of the usitative mode. As explained in section 7 above, these five stem shapes in phonetic representation correspond to the five possibilities for modal suffix in lexical representation.

What follows the verb stem entry in (12) is divided into three parts, each marked by an arabic number. Each of these parts will be called a "verb entry;" there may be anywhere from one to about fifty such verb entries under a verb stem entry. A verb entry illustrates a particular
combination of derivational prefixes that can appear with the stem of the verb stem entry under which it appears. The combination of stem and derivational prefixes of a verb entry corresponds roughly to what we have referred to above as a "verb." The verb entry contains an indication of the meaning of this combination, and then goes on to indicate, for each of the five forms of the verb listed in (14), the verb form that arises by adding each of the possible subject prefixes to this combination. Again, all representations in the dictionary are (except for notational differences) in what we have called phonetic representations. The subjects are listed in an order that we describe in (15) by illustrating the Future tense forms of the verb entry numbered "2" in (12).

\[
(15) \begin{align*}
yides & \text{ first person singular subject} \\
yidif & \text{ second person singular subject} \\
yidool & \text{ third person subject} \\
yizhdoool & \text{ fourth person subject} \\
yidiil & \text{ first person plural subject} \\
yidoool & \text{ second person plural subject}
\end{align*}
\]

Notice that the indefinite third person subject and the impersonal third person subject are not included. The third person of (15) is the "ordinary third person." The form "bidi?dool-" which appears in parentheses after the person forms listed in (15) is the agentive passive, illustrated with the third person object "bi". When the object is other than third person this "bi" is simply replaced by the appropriate pronominal form; no collapsing occurs in this object position, and the replacement of with the other objects is straightforward. Notice that the stem of the verb is not written out for all the person forms, but is indicated only once for each mode. Thus, the representations as in (15) include only
the prefixes; the full verb forms would be "yideestas", and so on down to "yidočitas" and the agentive passive "bididooltas".

Turning to verb entry number 3, we see that the Perfective mode is referred to by "S-P" rather than simply by "P". This indicates that it is an s-Perfective; still, y-Perfectives and n-Perfectives are both referred to by "P" (as in verb entry number 2, which happens to be a y-Perfective).

Notice that in verb entry number 3 the Imperfective and Optative have the stem "tas"; while the verb stem entry (reproduced in (13)) indicates that this should be "tadas". This is a rather annoying inconsistency that appears fairly often in the dictionary. Apparently, the verb in 3 differs in aspect from the verbs in 1 and 2, and this difference is evidenced overtly only by the stem shape in the Imperfective and Optative. A similar shortening and lowering of the stem vowel seems to occur in cases specifically designated as being "continuative" (as opposed to "momentary") in aspect, and perhaps the same is true here. When a verb entry is specifically designated as continuative, the Imperfective is abbreviated as "C-I" rather than as just "I", but there are frequent cases where what is quite probably a verb exhibiting the continuative aspect is not marked in this way.

The verb entry numbered 1 is indicated for third person subject only. This is due to the fact that the subject of this verb is always the material that is being bent (not the bender of the material), and also that (apparently) the material bent is inanimate and thus incapable of being designated by a non-third person subject. For example, [k'aa? yiltaas] means literally "the-arrow it-bends," that is, "the arrow is bent." Many verbs are indicated only for third person subjects due to these apparently semantic restrictions. Notice that in verb entry number 2 the verb has been made
causative by the addition of the prefix */i−*/ (causative); in this verb, the subject is the one who is doing the bending. The form "shizhah" in number 1 is just an alternative way of saying "it is bent."

One final and extremely important remark must be made concerning the dictionary entries. In the case of a transitive verb (such as 2 of (12), but not 1 or 3), all the person forms are given with a third person pronominal object prefix, representing a third person direct object of the verb. Recall that such a prefix is represented by zero in all cases except when the subject is also third person; in this case it is represented by */yi−*/. Thus the third person subject forms of transitive verbs in the dictionary always include this prefix */yi−*/ (although */yi−*/ may be absorbed by other prefixes in some situations). For example, in verb entry number 2 the third person subject form for the Imperfective mode is */yiyyihēyās*; here the initial */yi−*/ is the third person object prefix, and the form means "he bent it, him, her, them." If one were to say "he bent me," the form would be */siyyihēyās*, where */si−*/ is "me;" this */si−*/ not being third person, would appear for all subjects: thus, */siyyihēyās*, "he (respected) bent me."

The verb that we have been discussing (the entry numbered 2 in (12)) will be referred to as verb #188.1(2). This number indicates that the verb is the verb entry numbered 2 of the first verb stem entry that is listed on page 188 of Young and Morgan (1943b). A similar numbering system will be used throughout the present work when citing examples.
CHAPTER TWO

FORMALISM

1. In Chapter 1 we have, essentially, shown what formatives occur in Navaho and what sequences of them make up verb forms. The treatment was incomplete and informal, to be sure, but if we continued along the same lines we would end up with a set of principles that completely enumerated the verb forms of Navaho, specifying each as a sequence of formatives. These principles would include a list of what we called "verbs," where each verb is a particular combination of derivational affixes and verb stem, as well as rules for inserting inflectional affixes into these verbs. (Doubtless, transformational rules would play an important role in a complete statement of these principles. For example, the various pronominal prefixes marking subject would most likely be absent in deep structure; they would be inserted by transformations on the basis of a separate word for the subject that would always precede the verb in the sentence, and this separate word would then (optionally) be deleted if it was pronominal itself. In this work we will content ourselves with the informal presentation in Chapter 1 since our primary concern is the phonology, rather than the morphology and syntax.)

In our discussion, each formative considered was provided with a lexical representation. In each case, the lexical representation consists of a single distinctive feature matrix (which we always abbreviate with letters and diacritics according to the system given in Tables I through III of Chapter 1).

The assumption that each formative has a single lexical representation is the guiding principle underlying this entire work. This assumption has radical consequences, in Navaho, for reasons that have been
briefly alluded to in the course of the first chapter. To illustrate the
general point, let us consider Table III of Chapter 5 below. The forms in
the right-hand column represent sequences of prefixes in phonetic repre-
sentation. (Actually, a few more rules, given in Chapter 6, must apply
for these right-hand column representations to be phonetic representations,
but they are close enough to phonetic as they stand to illustrate the point
being made.) We know from the meaning that these forms contain a formative
in common, namely the formative that marks the n-imperfective mode. How-
ever, this formative does not appear in a constant shape in all the person
forms. In fact, it never appears as [na], but variously as [ni], [ni],
[no], [e], or just high tone [\*]. It is somewhat unrealistic even to
attempt to identify a certain piece of the phonetic representations as being
the realization of the n-imperfective formative, as we have just done.
For example, in the 2sg form, [ni] is not really the n-imperfective for-
mative alone, but rather the combination of this and the 2sg subject. In
short, if we attempted to give as the phonological characterization of
each formative the list of its phonetic realizations, we would quickly get
tied up in having to make complex and unnatural segmentations of the words.
Moreover, even if this problem of segmentation could be solved, the state-
ment of what phonetic realizations occur in what environments would be
hopelessly complex. Essentially, we would have to abandon a phonological
characterization altogether and give instead a morphological character-
ization of the alternations, saying that the n-imperfective formative
appears as [ni] when the subject is 1sg or 1pl, as [ni] when the subject
is 2sg, and so forth. (This is actually the approach of Sapir and Hoijer
(1965).)

It turns out to be far simpler to describe the phonetic effects of a
formative such as the n-imperfective if, following the assumption mentioned above, we (i) postulate for it a single lexical representation (in this case, /na-/), and (ii) provide phonological rules that alter this lexical representation in various ways depending on the surrounding formatives, producing as output the phonetic representations. The consequences of this assumption are radical in that the alternations of the lexical representations by the phonological rules are often extreme. Still, this is really a fact about Navaho, rather than being a property of our particular way of analyzing Navaho. That is, in Navaho, formatives do not even come close to having a constant phonetic shape in all environments. (In fact, there is one formative in Navaho, the prefix of the perfective mode, that never shows up at all phonetically. It is manifested solely by the effect it has on surrounding formatives; for example, in some environments it causes high tone on vowels, in others it causes a preceding consonant to drop, and in other environments it has still other effects.)

To sum up, then, we will start off by assuming that each formative has a single lexical representation. The problem is to find just what the lexical representations should be. We will want to choose lexical representations in such a way that the phonological rules can be fairly simple; this, in effect, puts some constraints on what the lexical representations should be, since having a lexical representation of a formative be similar to or identical with the most frequent phonetic realizations of the formative means that fewer rules are needed.

It happens to be a fact that the assumption that each morpheme has a single lexical representation leads to an analysis of Navaho that is far simpler than any analysis that attempts to list, for every formative,
the various phonetic shapes in which this formative appears, together with the environment in which each of these shapes occurs. This point can be made convincingly simply by comparing the simplicity and generality of the analysis of Navaho developed in the following chapters with the analysis given in Sapir and Hoijer (1968).
2. For the most part, we are not concerned with making new proposals regarding phonological theory. In fact, we will, insofar as is possible, make use of the type of phonological theory presented in Chomsky and Halle (1968), and we assume familiarity with this sort of approach to phonology. In particular, the role of distinctive features, the conventions for rule application, and the use of lexical representations are adopted without change from this work. Still, the theory of the transformational cycle that plays such a crucial role in the description of stress contours in English will not be required in our description of Navaho. (Stress does not seem to play a major role in Navaho phonology. Most sources do not mention it at all, and the two articles devoted to a discussion of Navaho stress (Landar, 1959; Hung, 1959) do not even agree on the phonetic facts or on whether stress is "phonemic." Having never done field work on Navaho stress, I am unable to contribute to a resolution of the controversy.) We will also find cause to depart, in various minor ways, from the conventions adopted by Chomsky and Halle; we will make note of such cases as we proceed.

There is one respect in which we will, out of necessity, be forced to depart in a fairly major way from the phonological theory of Chomsky and Halle. This departure arises in the area of phonological boundaries and the conventions for their use. Chomsky and Halle (1968, 36ff) introduce three types of boundaries: word boundary "\n", which is inserted by major lexical category rule before and after every \new in lexical representations; formative boundary "+", which appears automatically between every pair of formatives in lexical representations; and a third boundary "+", which is used to break up words such as "permit," "contradict," "resemble," "combat," etc., which, syntactically and semantically, are indivisible units but which
phonologically act like two formatives.

We will find that these three boundaries are not nearly sufficient to account for the phonological behavior of Navaho words. In fact, we will propose seven different boundaries which vary linearly from "weak" to "strong." Recall that verb forms in Navaho always have at least two formatives, and frequently have many more; as many as fifteen formatives can occur in a single verb form. Some sequences of formatives in a verb form undergo considerable collapsing and fusion by the phonological rules; in such cases, we will assume that relatively weak boundaries separate the formatives. Other sequences of formatives in verb forms undergo hardly any collapsing at all by the phonological rules; in these cases we will assume that relatively strong boundaries separate the formatives. As a general rule, affixes close to the stem undergo more collapsing, with each other and with the stem, than formatives far from the stem. (In the terminology of Table IV, Chapter 1, prefixes in low-numbered positions (p1, p2, etc.) are "far" from the stem while prefixes in high-numbered positions (pl1, pl2, etc.) are "close" to the stem. It is important to notice, however, that, in these terms, a formative that occurs "far" from the stem will, in some verb forms, be adjacent to the stem, while a formative that occurs "close" to the stem might, in some verb forms, be separated from the stem by several formatives.)

The need for some system of boundaries of varying strengths can be best illustrated by an example. Looking at Table IV, Chapter 1, we see that there is a p2 prefix with lexical representation /ni-/ that means "end." If this prefix is combined with the p9 prefix for second person singular subject, which happens also to have the lexical representation
/ni-/ the phonetic result is simply [nini...]; there is no collapsing since the p2 prefix /ni-/ being "far" from the stem, is separated from what follows by a relatively strong boundary. However, in Table IV we see that there is another prefix with the same lexical representation /ni-/ this one occurring in position p7 and meaning "uniform." Now if this p7 prefix /ni-/ is combined with the p9 second person singular subject /ni-/ the phonetic result is [nfi...] that is, the two prefixes have collapsed, phonetically, and this is related to the fact that the p7 prefix /ni-/ being relatively close to the stem, is separated from what follows it by a relatively weak boundary.

It would, of course, be possible to assign different lexical representations to prefixes that behave differently phonologically, and simply use one boundary, say "-", between each pair of formatives. Thus, for example, since the p2 prefix /ni-/ and the p7 prefix /ni-/ just discussed behave differently, we could assign them different lexical representations. However, any attempt to carry out such a treatment for the whole prefix system soon would run awry, since one would have to postulate several different kinds of /I/ lexically, several different kinds of /n/, etc., and this would just obscure the fact that all these differences are related to the differing positions of the formatives in the prefix system.

While it is true that strong boundaries separate the stem from prefixes far from the stem, it is not necessarily true that prefixes far from the stem are separated from each other by strong boundaries. Thus, for example, postpositional prefixes and their pronominal objects occur far from the stem, though phonetically the postposition is often collapsed considerably with its object, and so should be separated from this object by a relatively weak boundary.
To cope with the general situation in Navaho we will propose, quite tentatively, a new set of boundaries together with conventions for their use. First, we will make a distinction between two kinds of boundaries, "positional" boundaries and "formative" boundaries. Positional boundaries will be used to break up the verb form into several sections of varying degrees of distance from the stem, while formative boundaries will be used to separate formatives that occur in the same section. We will find a need for six positional boundaries; these are listed in (1), in order of decreasing strength from left to right. However, only one formative boundary is needed; we will write this as "-" (though Chomsky and Halle use "+""); "-" is weaker than any of the positional boundaries.

(1)  
#  =  *  !  "  +

The boundary "#", which we will continue to call word boundary, appears before and after every word and nowhere else. The boundary "=", which we will refer to as the stem boundary, appears before and after every verb stem and nowhere else. The other positional boundaries each occur in one particular position in the prefix system. We summarize this information in (2).

(2)  
#  ...  *  ...  !  ...  "  ...  +  ...  =  ......  =  ..........  #

A  B  C  D  E  stem  suffixes
Here, the letters "A" through "E" refer to the sections of the prefix system identified in Table IV, Chapter 1. Every verb form, in lexical representation, will contain all and only the positional boundaries in the arrangement given in (2). When two or more formatives occur between any adjacent pair of positional boundaries, a formative boundary appears between them. Thus, every adjacent pair of formatives in a word is separated by at least one boundary, and possibly by a string of several boundaries. To illustrate, we give several examples of verb forms in lexical representations in (3); below each example is its phonetic representation and a reference to Young and Morgan's dictionary.

(3)

(a) # bi - k'i * ji ! di - di " ho + d - l = taal - l #
   [bik'i2didooltal] #186.1(8) F (4)

(b) # na * ! " + si = k'iid = x #
   [nask'i7] #118.1(2) R (1sg.)

(c) # * ! " hi + = goox = #
   [yigeeh] #88.1(5) I (3)

(d) # k'i * bi - ?a ! di " na - n - d = ?aa-n-=? - di #
   [k'ibi?deet'i2] #4.1(2) P (pas.)

We leave many details of these examples unexplained at this point.
(In particular, the reason for the stem form /?aa-n-/? in (3d) will not be given until the next chapter.) Our primary purpose in (3) is simply to illustrate the use of boundaries in lexical representations. Notice that all positional boundaries are present in every verb form, regardless
of whether or not formatives appear between them. This is necessary in order that the position of each formative in a verb form be identifiable from the lexical representation. For example, the case mentioned earlier in this section would involve the lexical representations /* ni */
" + ni = ... / and /* * ! ni " + ni = ... / (where the phonetic representations are respectively [nini...] and [nι...]). Here the two lexical representations are kept apart only through the use of sequences of boundaries.

It is not possible to avoid the use of sequences of boundaries by adopting a convention that states that a sequence of boundaries is reduced to the strongest member of the sequence. Under such a convention the lexical representations /* ni */
" + = ... / and /* * ! " + ni =.../ would both reduce to/*ni=/, since "=" and "#" are the two strongest positional boundaries. But then there would be no way to differentiate between prefixes in position A and position E. And even where lexically homophonous prefixes of different positions don't occur, or else happen to produce the same results phonetically, the convention just stated would make the formulation of many phonological rules overly complex, since these rules depend to a large extent on the presence of all positional boundaries. This will be seen in Chapter 5 when we discuss the rules for prefixes.

As an even more convincing proof that no convention that collapses sequences of positional boundaries to the strongest boundary in the sequence will work, consider the following example. There are prefixes with the shape /di-/ (in lexical representation) that can occur in both position p7 (the inceptive prefix) and in position p9 (the first person plural subject prefix); see Table I, chapter 5. These prefixes, however, combine differently with preceding prefixes. For example, lexical /* na */
" + di " + = .../ yields phonetic [na di ...], while lexical /*na*/
+ di = .../ yields phonetic...
[nai(d). .] (where the -d- is generally merged with the stem initial consonant; see chapter 6). Here, /na-/ is a position p2 prefix meaning downwards; see Table IV, Chapter 1. Any convention collapsing sequences of positional boundaries to the strongest one would yield lexical /#na*di=. ./ for both of the above, and there would be no basis on which to account for the phonetic difference.

In short, letting all positional boundaries appear in the lexical representation of each verb form provides a natural way of guaranteeing that the position of every prefix, in terms of the sections A through E of Table IV, Chapter 1, is identifiable in lexical representations. Such identification is necessary since, in general, prefixes from different positions undergo different degrees of collapsing with what follows.
According to the conventions that we will adopt, each phonological rule applies to a section of the lexical representation of words delineated by positional boundaries. More specifically, each phonological rule has the general form (4).

(4) \[ X \to Y \mid b_1 W \quad Z \quad b_2 \]

Here, \(X, Y, Z,\) and \(W\) stand for (possibly null) distinctive feature matrices, while \(b_1\) and \(b_2\) are (possibly different) positional boundaries. A rule such as (4) will apply to sections of representations bounded by the positional boundary \(b_1\) on the left and \(b_2\) on the right; the section to which it applies may contain positional boundaries between \(b_1\) and \(b_2\), provided they are strictly weaker than the weaker of \(b_1\) and \(b_2\).

As an illustration, let us consider once again our earlier example where \(\# ni \neq ! " + ni = \ldots \to [nini\ldots]\) on the one hand and \(\# \neq ! ni " + ni = \ldots \to [n\ldots]\) on the other. If we were to include rule (5) in the grammar, the correct collapsing would be performed in this case.

(5) (a) \[ i \to \emptyset \mid ^* CVn \quad \ldots = \]

(b) \[ CVn \to CV^* \mid \# \quad \ldots \quad C \quad \ldots \# \]

That is, (5a) would apply to \(\# \neq ! ni " + ni = \ldots\) since this contains the subsequence \(* ! ni " + ni = \) where \("1", "\ldot\ldot", and "\ldot\ldot\) are each weaker than the endpoint boundaries "\*" and "\ldot\ldot" of the environment of (5a). Rule (5b) then applies to yield [n\ldots], as desired.
Rule (5a) would not, however, apply to \# n1 "! + n1 = since the first -n1- is to the left of "#" in this form. Thus, the environment for (5b) is not met, so that, as desired, no collapsing occurs.

The actual rules that we give in Chapter 5 will be more general than (5a) and (5b); nevertheless, these will serve now to illustrate the use of boundaries.

Actually, we will also find cases where we must let W and/or Z in (4) themselves contain one or more positional or formative boundaries. In such a case, the sections of representations to which the rule applies must not only be bounded by b₁ on the left and b₂ on the right; they must also contain these other positional boundaries in the appropriate places.

Further discussion of these conventions for the use of boundaries is best left until the following chapters, where we actually present the phonological rules. Meanwhile, note that the convention stated after (4) above (that the section of a word to which a rule of the form (4) applies may contain positional boundaries provided they are weaker than the weaker of the positional boundaries b₁ and b₂) means in particular that a rule will always apply across formative boundaries "-" in a word even though the rule does not explicitly mention these formative boundaries; this follows since formative boundary is weaker than any positional boundary. Thus the convention above has the same effect as the convention established by Chomsky and Halle (1968:364) regarding the status of formative boundary in rules.

In short, no rule can require the absence of formative boundary in any part of any word to which it applies. A rule may, however, require the presence of formative boundary; according to our conventions this is done by including formative boundary in the appropriate place in W and/or Z of (4).
CHAPTER THREE

VERB STEM ALTERNATIONS

1. In this chapter we will be concerned with describing in detail the various different stem shapes that verbs exhibit in different modes. The necessary background to the discussion appears in Chapter 1, especially sections 5 and 7, where we saw that following a verb stem there may be an aspectual suffix */-?/ (continuative) and, independently, one of the three modal suffixes */-l/ (progressive), */-di/ (perfective), and */-x/ (iterative). (We will simply assume, for now, that these are the correct lexical representations for these suffixes. In section 6 of this chapter we will summarize the arguments in favor of this choice.)

Leaving aside the aspectual suffix */-?/ for the moment, we show the remaining modal suffixes in (1), together with the mode they are associated with, and an abbreviatory symbol for each mode.

(1) mode: imperfective perfective progressive iterative

abbr.: I P F R

suffix: ø di l x

The suffixes are all given in lexical representation, in (1). (The progressive mode cannot be abbreviated "P," since the perfective mode is. Thus, following the traditional practice we use "F" (since the future tense takes the stem of the progressive mode). Similarly, the iterative mode cannot be abbreviated "I;" it is common to use "R" instead, where "R" stands for "repetitive." Still, it is important to remember that "repetitive" is a kind of aspect in Navaho, whereas "iterative" is a kind of
mode, cf. Chapter 1, section 7.) There are six modes in Navaho, but only four are represented in (1). Of the other two, the usitative need not concern us, since its stem form in phonetic representation (and thus its suffix in lexical representation) is the same as that of the iterative. On the other hand, the optative mode is highly irregular in its stem shape, and we will have nothing to say about it in this work.

In the Navaho dictionary, all four stem shapes (I, F, P, R) are simply listed, in phonetic representation, for each verb; see Young and Morgan (1943b). (In addition, the stem shape for the optative mode is listed, but this will not concern us.) No attempt is made to provide general rules describing how the phonetic shapes of the various stem alternants are related to one another. In fact, throughout the literature on Navaho, general rules of this sort are nowhere given; instead, each source simply notes that the phonetic shape of the verb stem may vary according to the mode, and goes on to give examples. (For one attempt to come to grips with the verb stem alternations, see Pike and Becker (1964).) We will show, however, that the various stem alternants can be related by quite simple and general rules. In particular, we will postulate for each verb a single stem shape, in lexical representation and will provide phonological rules showing how the suffixes listed in (1) combine with each such lexical stem shape to give the various phonetic alternants of the stem.

In addition to the modal suffixes, the aspectual suffix /-ʔ/ (continuative) will play an important role in our analysis. (We will be talking in this chapter as though there were just two aspects, momentaneous and continuative, since these are the only aspects marked by a difference in stem shape; see Chapter 1, section 5 for a discussion of other aspects.)
The suffix /-ʔ/ (continuative) is proposed here for the first time; in fact, none of the published works on Navaho makes any sort of proposal regarding the difference in stem shapes that can exist in the momentaneous and the continuative aspect. It is true that the suffix /-ʔ/ rarely appears as such in phonetic representations, but most often shows up only indirectly (in the effect that it has on the preceding vowel). Thus, the choice specifically of /-ʔ/ for the lexical representation of the suffix is difficult to justify conclusively; nevertheless, some arguments will be given showing that /-ʔ/ is an entirely plausible candidate. It should be recalled from the discussion in Chapter 1, section 5 that this suffix is, to a large extent, no longer productive; many verbs must simply be marked as to whether they occur with it (i.e., in the continuative aspect), or without it (i.e., in the momentaneous aspect). Nevertheless, there are a considerable number of verbs that can appear in either a momentaneous form (with one stem shape) or in a continuative form (with another stem shape). For example, verb #h0.2 has the stem shapes indicated in (2) for the four modes and two aspects that are relevant.

(2)  

\[
\begin{array}{cccc}
\text{momentaneous} & \text{I} & \text{P} & \text{F} & \text{R} \\
\text{continuative} & \text{I} & \text{P} & \text{F} & \text{R} \\
\end{array}
\]

\[
\begin{array}{c}
\text{I} \\
\text{P} \\
\text{F} \\
\text{R} \\
\end{array}
\]

\[
\begin{array}{c}
\text{\$iid} \\
\text{\$iid} \\
\text{\$i$} \\
\text{\$i$} \\
\end{array}
\]

Still, note that the only difference in aspect is in the I forms. And, in fact, verbs in general do not show aspectral differences in the F or the R forms, though differences in the I forms (as in (2)) or the P forms (or both) are common. The stem shape of the F and R modes is the same regardless of whether the aspect is momentaneous or continuative, and we thus assume that the suffix /-ʔ/ never appears at all in these modes in
lexical representation.

It is thus apparent that there is much that is non-productive and idiosyncratic about the marking of the momentaneous-continuative distinction by alternations in the stem shape. As a result, we will approach the problem by simply marking, in the lexical entry of each verb, whether or not it takes the suffix /-ʔ/ in the Imperfective, and, independently, whether or not it takes the suffix /-ʔ/ in the Perfective. For this purpose, we will use the two features in (3).

(3) (a) ?I
     (b) ?P

If a verb takes the suffix /-ʔ/ in just its Imperfective form, it will be marked [+ʔI] and [-ʔP] in its lexical entry; if /-ʔ/ appears in just the Perfective form the verb will be marked [-ʔI] and [+ʔP]; if neither of these modes shows /-ʔ/, both of these features will be marked "-"; if both modes take /-ʔ/, both these features will be marked "+". Thus, note that the different aspectual forms of a verb, where they both exist, will have lexical entries that differ only with respect to their values for these features. For example, one of the effects that the suffix /-ʔ/ has is shortening the vowel; thus in the example given in (2) there will be two lexical entries; one for the momentaneous aspect form (which will be marked [-ʔI] and [+ʔP]) and one for the continuative aspect form (which will be marked [+ʔI] and [+ʔP]). Still, the phonological shape of the stem is the same in these two lexical entries, namely /ʔiːid/. We will use these features so as to include the suffix /-ʔ/ in lexical representations in just the cases where it is needed to account for the observed stem alternations. As we have emphasized, the use of
this suffix is in many ways non-productive, so that its presence need not indicate continuative aspect (though it often does, and it is assumed that at one stage in the history of the language it did).
2. To simplify the exposition, we will begin by considering only verbs without the suffix /-?/ (that is, verbs that are [-?I] and [-?P]). Moreover, we will, for the moment, only look at the I, F, and R modes, leaving the more problematic P forms until later. With these restrictions, the stem alternations are fairly straightforward, and most verbs exhibit one of the types of stem alternation listed in Table I.
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<td>Cvv</td>
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**TABLE I**
In this table, each row represents a type of alternation exhibited by many verbs. "C" stands for any consonant (that is, any segment that is [-vocalic] according to the feature matrices of Chapter I); similarly, "v" stands for any vowel (that is, any [+vocalic] segment). Recall that long vowels are indicated by doubling, nasal vowels by a nasal hook "̃", and high tone vowels by an acute accent "'". (The use of a sequence of two vowel symbols to represent long vowels is an orthographic device only; in all significant respects, long vowels are single segments.)

The representations in the three columns headed "I", "F", and "F" are the phonetic representations exhibited by the verb stem in question in each of these three modes. On the other hand, the representations in the left-hand column are the lexical representations that we postulate for these verb stems; these lexical representations will be explained as we proceed. (Meanwhile, recall that "=" is the boundary that marks the extent of the stem.) Further, the segments heading the columns are the lexical representations of the modal suffixes. The statement of the phonological rules that produce the phonetic representations from the stem plus the suffix in lexical representation will be delayed until later in the chapter.

It is clear that the "a" verbs are opposed to the "b" verbs as low tone to high tone. The only thing to notice is that short high tone vowels become low tone; in fact, it is a general constraint that stems of the phonetic shape [-CVs], [-CVs], [-CVs], [-CVh], [CV?] do not occur at all in Navaho. The solution that immediately comes to mind is to mark all the "b" verbs as [+high tone] in lexical representation, and to supply a phonological rule which changes this to [-high tone] in short vowels. However, there are reasons (not apparent from the forms of Table I) to assume instead that high tone is not itself marked in lexical represen-
tations, but is produced by a phonological rule upon "absorption" of a following -?-. Thus, the lexical representations of the "b" verbs as well as the "a" verbs in Table I are [-high tone], but the "b" verbs have a -?- included in their lexical representation.

This -?-, should not be confused with the suffix /-?/ (continuative); the latter does not appear in any of the forms of Table I. Notice that in the lexical representations given in the first column of Table I, the ? is separated from the part of the stem that proceeds it by a hyphen "-"; this hyphen is a formative boundary." (See Chapter 2, section 2, for a discussion of boundaries.) The reasons for assuming that the -?- is separated from what precedes it by this boundary will only become apparent in the course of the discussion that follows. Meanwhile, we will refer to the -?- as an "increment," to what precedes it as a "root," and to a root plus the (optional) increment as a "stem." Thus, in the "a" verbs the stem consists of the root plus the increment -?-. The lexical entry of each verb will contain the full stem, since the increment -?- is in no way a suffix, and carries with it no trace of a meaning distinction. Again, the justification for using the increment -?- as the source of high tone in the verbs of Table I will become clear only as we proceed.

Notice that the verbs in 6a and 6b of Table I have a root-final -x- in lexical representations, whereas this shows up as -h- in phonetic representations. There are two main reasons for wanting to derive -h- from -x- in these verbs. First, there are rules which generally apply only to obstruents (that is, to [-son] segments) which also apply to the root-final segment of these verbs; to account for this, we simply need to let such rules apply before the x-h rule, since -x- but not -h- is [-son]. (See below, Table VI, rules (2b), (3b), and (5).) Second, having -x- as a
root-final in lexical representations means that all the continuant obstruents of the language can occur as root-finals, whereas otherwise we would have to say that all the continuant obstruents except -x- can so occur. Notice that the -x-h rule also applies in the R forms of the verbs 1a through 2b.

The verbs in 2a and 2b on Table I have nasal vowels phonetically, although, lexically, these consist of (oral) vowels plus -n-. Moreover, this lexical -n- is never realized phonetically as such, but is always absorbed into the preceding vowel. The motivation for the analysis with -n- lexically consists in the fact that in other cases, not illustrated in Table I, a sequence of what is known to be an oral vowel and -n- leads to a nasalized vowel. (see below, Table III, (11), (12), (15), (16).)

In any event, the rule for converting vowel plus -n- sequence to a nasalized vowel is a very early one in the phonology.

In Table I, a root in lexical representation may have either no final consonant or else one of the consonants -n-, -s-, -š-, -z-, -x-, or -d-. And, in fact, these are the only possibilities. Every verb root in Navaho is either of the shape -Cvv- or of the shape -CvvC- where the final consonant is one of these six. To facilitate the discussion, we will say that verbs are of the type "Cvv" if they are like those of 1 in Table I, "Cvvn" if they are like those of 2, and "Cvvo" (where "O" stands for "obstruent") if they are like those of 3 through 7.

Verb forms exhibit both long and short vowels phonetically, but from Table I it can be seen that this length difference is entirely predictable; vowels are long in lexical representations, and are made short before a sequence of two obstruents.
In our analysis, we will assume that the final -h- that appears in the phonetic representations of the I forms of verbs 1a through 2b is inserted by a late phonological rule after word-final long vowels; this rule explains the fact that no verb may end in a long vowel in Navaho. Thus note that the I forms and the R forms of verbs 1a through 2b, though phonetically homophonous, respectively, are quite different lexically. The -h- insertion rule must, of course, follow the nasalization rule already mentioned (that converts -v- plus -n- to -y-).

It is fairly obvious that the only possibility for the lexical representation of the suffix for the F forms is -h-. We simply need a rule that drops this -h- after an obstruent. This rule also drops the -x- suffix of the R forms after an obstruent. Notice that it must be preceded by a rule dropping -d- before -h- and changing -d- to ?- before -x- as the verbs 7a and 7b show. These rules will be more fully discussed below.

This completes the discussion of Table I. To summarize, vowels in lexical representations are [-nasal, +long, -high tone]. Phonetically, nasal vowels come from vowel plus -n-, short vowels occur before obstruent clusters, and high tone is produced by the absorption of a following ?-. The two consonantal suffixes either drop or else cause the root-final consonants to drop or alter.

It does not seem necessary to actually present, at this point, the phonological rules involved in mapping the lexical representations onto the phonetic representations in Table I, since they are fairly straightforward (absorption of -n- to give nasalized vowels, absorption of ?- to give high tone vowels, shortening of vowels before two obstruents,
lowering of the tone in short vowels, change of -d- to -?-, loss of -d- before -x-, loss of the second member of a consonant cluster, insertion of -h- after a word-final vowel). The full set of rules will be presented (in Table VI) when we have considered the rest of the verbs and the Perfective mode.
3. In the discussion of Table I it was assumed that the vowels in Cvv and CvvO verbs were oral phonetically. Actually, however, there are CvvO verbs that have nasal vowels in all modes (although those with oral vowels outnumber those with nasal vowels by about 7 to 1). Moreover, when we extend the analysis to the P forms (though still excluding verbs that use the /-ʔ/ (continuative) suffix), we find that the Cvv verbs split into two groups depending on whether the vowel in the P forms is phonetically nasal or oral, even though in all such verbs the vowel in the I, F, and R forms is oral.

In order to explain the appearance of nasal vowels in the two kinds of cases just cited, we will postulate the existence of an increment that can occur in lexical representations (where its appearance is independent of that of the increment -ʔ- that has already been discussed). This increment -n- will turn out to have an effect in the Cvvn verbs as well, but only in connection with the suffix /-ʔ/ (continuative). In Table II below we show the effect of the increment -n- and, at the same time, extend the analysis to include the P forms. Table II does not explicitly show verbs with -s- or -ʔ- root final, but these can be filled in readily by comparison with such verbs in Table I and with the -s- root-final verbs given in Table II. Notice that, for the reader's convenience, all the data of Table I has been incorporated into Table II.

We will refer to the increments -ʔ- and -n- as, respectively, the "glottal increment" and the "nasal increment." When both of these occur in a verb form, the nasal increment precedes the glottal increment.
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<td>Cvvd</td>
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<td>Cvvh</td>
<td>Cvvd?</td>
<td>Cvvd?</td>
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<td>Cay?</td>
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</tbody>
</table>

**TABLE II**
Table II is organized in the same way as Table I. Notice that the stem of a verb, as it is entered in the lexicon, may have no increments, just one of the increments, or both of the increments; this gives four possibilities which are listed separately under the "a," "b," "c," and "d" rows of Table II.

The phonetic effect of the nasal increment in CvvO verbs is straightforward: it simply nasalizes the vowel. Further, in such verbs, the /-di/ suffix of the P forms loses its consonant after an obstruent, then its vowel causes voicing of a preceding continuant, and finally this vowel drops out. It might be expected that P form of the 3b verbs should have high tone, since the vowel is long and the tone lowering rule mentioned in the previous section applies only to short vowels. However, the vowel is not high tone, but low tone. This gives us reason to eliminate this tone lowering rule altogether, and adopt instead a rule that drops the glottal increment between an obstruent and a suffix. This rule would, of course, apply before the rule absorbing -?- to give high tone; it would explain why in CvvO verbs just the I form, the forms with no suffix, have high tone.

It should be noted that final -d- is the same phonetically in P forms as in other forms since, being a stop, it is not affected by the voicing rule mentioned in the last paragraph. Also, notice that the voiced counterpart of -h- is -?-; to bring this about we will let the x-h rule precede the voicing rule, and introduce a special rule that changes any -h- with the feature [+voiced] added to -?-.

The situation in the other verbs is somewhat more complex. In the Cvv verbs, the nasal increment is dropped out without a trace in all modes
but the Perfective. (Actually, in the next chapter, we will see that the nasal increment can have an effect on the quality of the vowel in non-Perfective modes.) In the Perfective, on the other hand, the nasal increment remains to nasalize the preceding vowel by the nasalization rule already discussed. The Perfective suffix /-di/, in Cvv verbs, always loses its vowel while the remaining -d- goes to -? - if it is preceded by a high tone vowel. Finally, the reason for the high tone vowel in the P forms of the 1c verbs in Table II is that absorption of the nasal increment causes high tone, just as does the absorption of the glottal increment. Thus, the nasal increment is responsible for both the high tone and the nasality of vowels in the P forms.

It should be emphasized that, as in the case of the glottal increment, the nasal increment does not ever appear as -n- phonetically. (This is true of the verbs in Table II. Actually, we will show later that the nasal increment does show up as -n- phonetically in conjunction with the suffix /-?/ continuative.) Moreover, the nasal increment is not identifiable because of any meaning associated with it, since there is none. We have postulated its existence solely on the basis of the indirect phonological evidence provided by the alternations that occur in verb stems.

Turning finally to the Cvvm verbs of Table II, we see that, as in the case of the Cvv verbs, the -d- of the Perfective suffix goes to -? - after a high tone vowel. The reason that the nasal increment produced high tone in the P forms of the 1c verbs but not in the P form of the 2c verbs has to do with the fact that only in the former case does it directly follow the vowel. This is a fine point that will become clear in the actual
statement of the rules in Table VI.

The 2c and 2d verbs are those with -Cvvm- root and the nasal increment. The important thing to notice about them is that 2c and 2d are homophonous in all modes with 2a and 2b, respectively. This situation arises since the nasal increment happens to have no effect after a root-final -n- in the forms cited in Table II (though it does in the presence of the continuative suffix /-?/, as we will see). It is clear, then, that no verb in its lexical entry will have stems like those of 2c and 2d with [-?I] and [-?P] since the same phonetic results can be obtained by the simpler stem forms of 2a and 2b. In an actual grammar there would be an explicitly stated constraint to this effect. We have included the 2c and 2d rows simply to bring out the fact that they do produce forms homophonous with those of rows 2a and 2b.
4. Table II of the preceding section illustrates the main types of stem alternation that occur in verbs that do not require the aspectual suffix /-?/ (continuative) in either their I forms or their P forms (that is, in verbs that are marked [-?I] and [-?P] in their lexical entry). In this section, the analysis will be extended to include verbs utilizing /-?/. This will multiply the number of alternation types by four, since there are four possible ways that verbs can be specified for the two features ?I and ?P. Tables III through V below contain the relevant data. These tables repeat all the information in Tables I and II above, as well as introducing the new information concerning the behavior of the suffix /-?/. Tables for root-final -s- and -1- have not been given, but can readily be constructed on the basis of Table V (for -s- root-final) and Table II.

In each of these tables, the left hand column contains lexical representations of verb stems. The second column gives an indication of whether the suffix /-?/ is to be employed in the I forms and/or the P forms. The figure in the right hand column represents the number of verbs listed in Young and Morgan (1943b) which exhibit the type of alternation in question. (The figures in Table V are for all Cvvo verbs, not just the Cvvs verbs.) Some of the cases where no verbs illustrate an alternation type will be explained in the next section. (In certain cases in Young and Morgan (1943b) the verb entries included under a verb stem entry may not all show the same stem alternations; cf. the example given in Chapter I. In these cases, we count as different all the sets of stem alternants that are different. But in the normal case where all the verb entries under a verb stem entry show the same set of stem alternants, this
is counted only once. Thus the total number of stem alternation types we list will be greater than the number of verb-stem entries but less than the number of verb entries.)

Under the headings I, P, F, and R of the tables appears the lexical representation of the suffix for the mode in question. For example, the second row of Table III corresponds to a verb which has the stem and suffixes indicated in (4) for the four modes.

\[(4)\]

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</tr>
<tr>
<td>F</td>
<td># .. =Cvv=I#</td>
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<tr>
<td>R</td>
<td># .. =Cvv=x#</td>
<td>Cvvh</td>
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</table>

In (4) we have included the word boundaries "#" that surround each word in its lexical representation. The use of boundaries in lexical representations, as well as in the application of the phonological rules, follows the conventions set down in Chapter 2, section 2.

Instead of discussing informally the relation between the lexical and phonetic representations in Tables III through V (as we did for Tables I and II), we will present the phonological rules that relate the two types of representations, and then proceed to an explication of the tables in terms of these rules. The rules are given in Table VI below.

It should be noted that, though most Navaho verbs show a type of
stem alternation that is exhibited in one or another of the tables above (III through V), others fall outside these categories. These will be treated in the following section.
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<td>$Cyh$</td>
</tr>
<tr>
<td>13</td>
<td>$[-?I, -?P]$</td>
<td>$CyVh$</td>
<td>$CyV?$</td>
<td>$Cyh$</td>
</tr>
<tr>
<td>14</td>
<td>$[-?I, +?P]$</td>
<td>$CyVh$</td>
<td>$Cy?$</td>
<td>$Cyh$</td>
</tr>
<tr>
<td>15</td>
<td>$[+?I, -?P]$</td>
<td>$Cyh$</td>
<td>$CyV?$</td>
<td>$Cyh$</td>
</tr>
</tbody>
</table>

**TABLE V**
<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>P</th>
<th>F</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-?I, -?P</td>
<td>Cvvd</td>
<td>Cvvd</td>
<td>Cv?</td>
</tr>
<tr>
<td>2</td>
<td>-?I, +?P</td>
<td>Cvvd</td>
<td>Cvvd</td>
<td>Cv?</td>
</tr>
<tr>
<td>3</td>
<td>+?I, -?P</td>
<td>Cvd</td>
<td>Cvvd</td>
<td>Cv?</td>
</tr>
<tr>
<td>4</td>
<td>+?I, +?P</td>
<td>Cvd</td>
<td>Cvvd</td>
<td>Cv?</td>
</tr>
<tr>
<td>5</td>
<td>-?I, -?P</td>
<td>Cvvd</td>
<td>Cvvd</td>
<td>Cv?</td>
</tr>
<tr>
<td>6</td>
<td>-?I, +?P</td>
<td>Cvvd</td>
<td>Cvd</td>
<td>Cv?</td>
</tr>
<tr>
<td>7</td>
<td>+?I, -?P</td>
<td>Cvd</td>
<td>Cvvd</td>
<td>Cv?</td>
</tr>
<tr>
<td>8</td>
<td>+?I, +?P</td>
<td>Cvd</td>
<td>Cvd</td>
<td>Cv?</td>
</tr>
<tr>
<td>9</td>
<td>-?I, -?P</td>
<td>Cyvd</td>
<td>Cyvd</td>
<td>Cy?</td>
</tr>
<tr>
<td>10</td>
<td>-?I, +?P</td>
<td>Cyvd</td>
<td>Cyvd</td>
<td>Cy?</td>
</tr>
<tr>
<td>11</td>
<td>+?I, -?P</td>
<td>Cyd</td>
<td>Cyvd</td>
<td>Cy?</td>
</tr>
<tr>
<td>12</td>
<td>+?I, +?P</td>
<td>Cyd</td>
<td>Cyvd</td>
<td>Cy?</td>
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<td>-?I, -?P</td>
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<tr>
<td>14</td>
<td>-?I, +?P</td>
<td>Cyvd</td>
<td>Cyd</td>
<td>Cy?</td>
</tr>
<tr>
<td>15</td>
<td>+?I, -?P</td>
<td>Cyd</td>
<td>Cyvd</td>
<td>Cy?</td>
</tr>
<tr>
<td>16</td>
<td>+?I, +?P</td>
<td>Cyd</td>
<td>Cyd</td>
<td>Cy?</td>
</tr>
</tbody>
</table>

**TABLE V**
1a \( n \rightarrow \emptyset / [ ]_o [\text{+voc}] = \ldots (?) = [-\text{voc}]_o \) #

1b \([\text{+voc}]\{\langle-\rangle\} \{\langle\text{+nas}\rangle\} \{\langle\text{+ht}\rangle\} \langle\text{-son}\rangle \ldots (\ldots) = [ ]_o \) #

2a \([\text{+voc}] \rightarrow [-\text{long}] / = [ ]_o \ldots [-\text{voc}]_o = \ldots [ ]_o \) #

2b \([\text{+voc}] \rightarrow [-\text{long}] / = [ ]_o \ldots [-\text{son}] (?) = [-\text{son}] \) #

2c \(n \rightarrow \emptyset / = [ ]_o [\text{+voc}] \ldots (?) = \)

3a \(? \rightarrow \emptyset / \ldots [-\text{cont}] = \ldots [-\text{cont}] [ ]_o \) #

3b \(? \rightarrow \emptyset / = [ ]_o \ldots [-\text{voc}] \ldots [\ldots [\text{?}]_o \) #

3c \(? \rightarrow \emptyset / = [ ]_o \ldots [-\text{voc}] = \ldots \)

4 \([\text{+voc}]\{\langle\text{-son}\rangle\} \rightarrow [\text{+voc}]\{\langle\text{-son}\rangle\} \ldots [\ldots [\text{?}]_o \) #

5 \([\text{+voc}]_o \rightarrow [\text{+long}] / = [ ]_o \ldots [\text{-son}] = \)

6a \(\emptyset \rightarrow \text{h} / \ldots [ ]_o [\text{+voc}] \ldots \)

6b \(x \rightarrow \text{h} / \ldots [ ]_o \ldots [-\text{voc}]_o \) #

7a \(\text{d} \rightarrow \emptyset / = [ ]_o [\text{+voc}] = \ldots [\text{+voc}] [ ]_o \) #

7b \(\text{d} \rightarrow \emptyset / = [ ]_o \ldots [\text{+glot}] \)

7c \(\text{d} \rightarrow \emptyset / = [ ]_o \ldots [\text{-son}] \)

7d \([-\text{voc}]_o \rightarrow \emptyset / = [ ]_o \ldots [\text{+voc}] \ldots [-\text{long}] = \ldots [\text{+voc}] \ldots \) #

7e \([-\text{voc}]_o \rightarrow \emptyset / = [ ]_o [\text{+voc}] [-\text{voc}] = \ldots [\text{+voc}] \ldots \) #

8a \([\text{+cont}] \rightarrow [\text{+vcd}] / = [ ]_o [\text{+voc}] \ldots [\text{+voc}] \) #

8b \([\text{+glot}]_o \rightarrow \emptyset \)

9 \([\text{+voc}] \rightarrow \emptyset / \ldots [-\text{voc}] = \ldots \) #

\textbf{TABLE VI}
The environment of each of the rules in Table VI contains a boundary symbol at each endpoint, and each rule applies to sections of representations that lie between successive occurrences of the boundaries of its endpoints. In general, a rule will apply across all boundaries that are weaker than the weaker of the two endpoint boundaries of its environment. However, if the environment of a rule contains a boundary (or boundaries) in its interior, then these boundaries must appear in the representations to which the rule applies.

No attempt has been made to state the rules in their simplest form. In fact, when a rule affects (or applies in the environment of) just a single segment, then this segment appears as such in the statement of the rule. Only when classes of segments are involved do we resort to distinctive feature notation. There is no theoretical import to these decisions; we are simply attempting to reach a happy medium between rules that are easy to read and rules that are fully formalized.

Rule 4 is formulated in a way not provided for in the theory developed by Chomsky and Halle (1968); it states that a vowel absorbs a following -?-, thereby becoming a high-tone vowel, even if an obstruent intervenes between the vowel and -?-. A more standard formulation would proceed in two steps, first making a vowel high tone in the environment

\[ \# [ \_{-\text{son}} ] \_{-\text{voc}} [ \_{-\text{son}} ]_{-\text{voc}} \# \], and then dropping -?- in the environment

\[ \# [ \_{+\text{voc}} ]_{-\text{son}} [ \_{-\text{son}} ]_{-\text{voc}} ]_{-\text{son}} \# \]

However, this entails a considerable repetition of environments, and seems to obscure the fact that one process is involved, namely an absorption of -?- that results in high tone.

Rule 1b involves a similar absorption, this time of -n- to produce
a nasal vowel. The use of angled brackets "(" and ")" in this rule conforms to the usual conventions; that is, the rule is actually a schema that stands for two rules, one with the material in angled brackets and one without it. The effect is that the absorption of \(-n\)- produces high tone just in case the \(-n\)- is preceded by the boundary "-" (that is, just in case the \(-n\)- is the nasal increment, and not in case the \(-n\)- is part of the verb root). Furthermore, if an obstruent intervenes between the vowel and the nasal, absorption of the nasal does not result in a high tone vowel, since the material in angled brackets and the obstruent also appear in different cases of the rule because of the braces "{ " and "}".

To illustrate these points, we show in (5) how rule 1b can be expanded into its three sub-parts.

\[
(5) \begin{cases}
(1) \quad [+\text{voc}] - n \rightarrow [+\text{voc}] [+\text{nas}] [+\text{ht}] \\
(11) \quad [+\text{voc}] n \rightarrow [+\text{voc}] [+\text{nas}] / \#[ ]_0 - ([-\text{voc}] [ ]_0 )# \\
(111) \quad [+\text{voc}] [-\text{son}] n \rightarrow [+\text{voc}] [+\text{nas}] [-\text{son}] 
\end{cases}
\]

Inspection of Tables III through V shows that the effect of the aspectual suffix /-?/ is generally to shorten the stem vowel. This is provided for by rule 2a. The only other case where short vowels arise is before two obstruents; cf. rule 2b and the F and R forms of Table V.

There is one case where the shortening of the vowels before the suffix /-?/ is overridden, namely in the case of a high tone vowel followed by
an obstruent; cf. rule 5 and the P forms of Table V. Rule 5 reflects the fact that short high tone vowels never appear before obstruents in Navaho verb stems. In the next section we will give additional support for rule 5.

Another rule involving a related phenomenon is rule 7d. This rule states that all suffix consonants drop out after a short high tone vowel. This rule and rule 5 together have the effect of guaranteeing that every short high tone stem vowel will be word final.

Rule 1a states that in Cvv verbs the nasal increment drops out if no vowel follows in the word; the effect is that the nasal increment is retained just in the P forms (whose suffix /-dl/ contains a vowel). This accounts for the fact that the verbs with =Cvv-n= or =Cvv-n=?= stem have a nasal vowel just in the P forms.

Rule 3 drops =?-= in various environments. Its most important effect is in CvvO verbs, illustrated by the verbs in Table V. In CvvO verbs, the stem vowel can be made high tone either by a following glottal increment (see the I forms of verbs 5 and 6 of Table V) or by a following /-?=/= suffix (see the P forms of verbs 2 and 4 of Table V). However, rule 3b drops the glottal increment whenever a consonant follows, so that the only time it remains is in the I forms of [-?-I] verbs; this is why all other modes of verbs 5 and 6 have low tone vowels. Similarly, rules 3a and 3c drop the suffix /-?=/ in various environments; this is why this suffix does not always cause high tone in CvvO verbs. Notice that the effect of these rules is that the I forms tend to differ in tone from the P forms; in particular, no verb can show high tone in both the I form and the P form. (There are some exceptions to this statement, but not many; they will be discussed in the next section.) Notice also that the rules for deleting
-?- (given in 3) can be stated in a rather natural fashion, even though their effect is to produce alternations of high and low tone which would be rather cumbersome to state directly in terms of tone. This is one of the motivations for deriving high tone vowels from low tone vowels by absorption of -?- or -?-. In the prefix system we will see a clear case of a formative which in some environments appears phonetically as -n- but which in other environments is absorbed into the preceding vowel, causing it to become high tone.

Rule (2c) simply deletes -n- after a long vowel. Thus observe in Table IV (verbs 8 through 16) that an -n- can appear in stem-final position phonetically, but only when the preceding vowel is short. In fact, these verbs show that the combination of the nasal increment with the suffix /?-/ in Cvvn verbs results in stem-final -n- phonetically; this is the only source of phonetic stem-final -n-. Rule 7c drops the root-final -d- when it is before an obstruent. It will actually apply only before the suffix /-½/ of F forms (see Table II, 7a - 7d), since rule 7b has already taken this -d- to -?- when it precedes the [+glot] -h- (derived from -x- by rule 6b) in the R forms.

All the other rules are straightforward, and have been mentioned previously in the chapter. For concreteness, we give a few complete derivations in (6).
(6) (a) Table III, verb 11:

<table>
<thead>
<tr>
<th>I</th>
<th>=Cvv-n-?# →(1a) =Cvv=?# →(2a) =Cv=?# →(4b) =Cv=#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P =Cvv-n=d1# →(1b) =Cv#d1# →(7a) =Cv#i# →(9)</td>
</tr>
<tr>
<td></td>
<td>=Cv#?=#</td>
</tr>
<tr>
<td></td>
<td>F =Cvv-n=x# →(1a) =Cvv=x# →(5b) =Cvv=h#</td>
</tr>
</tbody>
</table>

(b) Table IV, verb 14:

<table>
<thead>
<tr>
<th>I</th>
<th>=Cvvn-n-?# →(1b) =Cv#n-?# →(4a) =Cv#-?=#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>→(4b) =Cv#x# →(5a) =Cv#h#</td>
</tr>
<tr>
<td></td>
<td>P =Cvvn-n=?-d1# →(1b) =Cv#n=?-d1# →(2a) =Cy-n=?-d1#</td>
</tr>
<tr>
<td></td>
<td>→(3a) =Cy-n=?-d1# →(7e) =Cy-n=i# →(9) =Cy-n=</td>
</tr>
<tr>
<td></td>
<td>F =Cvvn-n=?=x# →(1b) =Cv#n=?=x# →(4a) =Cv#x# →(4b)</td>
</tr>
<tr>
<td></td>
<td>=Cv#x# →(5b) =Cv#h#</td>
</tr>
</tbody>
</table>

(c) Table V, verb 6:

<table>
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<tr>
<th>I</th>
<th>=Cvvs-?=# →(4b) =Cv#s=#</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P =Cvvs=?-d1# →(2a) =Cvs=?-d1# →(3a) =Cvz=?-d1#</td>
</tr>
<tr>
<td></td>
<td>→(3b) =Cvs=d1# →(7e) =Cvs=i# →(8a) =Cvz=i# →(9)</td>
</tr>
<tr>
<td></td>
<td>=Cvz=#</td>
</tr>
<tr>
<td></td>
<td>F =Cvvs=?=x# →(2b) =Cvs=?=x# →(3a) =Cvs=x# →(7e)</td>
</tr>
<tr>
<td></td>
<td>=Cvs=#</td>
</tr>
<tr>
<td></td>
<td>R =Cvvs=?=x# →(2b) =Cvs=?=x# →(3a) =Cvs=x# →(5b)</td>
</tr>
<tr>
<td></td>
<td>=Cvs=h# →(7e) =Cvs=#</td>
</tr>
</tbody>
</table>

Notice that the verbs 9 through 16 of Table V are just like verbs 1 through 8 except for the nasality of the vowel. In Tables III and IV, however, the rules produce other differences between the verbs with and without the nasal increment.

It should be noticed that there are several instances where the same
type of stem alternation can be derived from two different lexical representations of stems. In Table IV, for example, verb 9 yields the same phonetic result in all modes as verb 1 (as has already been mentioned). Similarly, verb 13 yields the same phonetic result in all modes as verb 5. Turning to Table V, we see that verb 7 and verb 3 are the same phonetically in all modes, as is also the case with verb 11 and verb 15.

We will adopt the term "paradigmatic homonymy" to refer to all such cases where two different lexical representations of verb stems yield the same phonetic results in all modes.

Paradigmatic homonymy should be clearly distinguished from what we might call "individual homonymy," where a single verb form in phonetic representation has the possibility of two (or more) lexical representations. For example, verbs 1 and 5 are individual homonyms in each of the P, F, and R forms, but not in the I forms. Thus, they are not paradigmatic homonyms.

It is both reasonable and necessary, of course, to postulate different lexical representations for the stems of verbs 1 and 5, even though they differ phonetically in only one mode. However, in cases of paradigmatic homonymy (such as verb 1 and verb 9 of Table IV), we clearly do not want to leave open the possibility that some verbs showing the stem alternants in question have one of the lexical representations for the stem while other verbs showing the same stem alternants have the other lexical representation for the stem. Thus, in all cases of paradigmatic homonymy, we will impose constraints on lexical entries to the effect that the more complex of two entries that are paradigmatic homonyms is to be avoided, and will not appear in the dictionary.
The reason that paradigmatic homonyms exist at all, in our analysis of Navaho, is quite simple. To illustrate what is involved, let us consider verbs 1 and 9 of Table IV. In these verbs, there is no suffix, so that the vowel is always long. Consider now rule 2c, which is motivated by verbs 10 to 12 and 14 to 16 in Table IV (since in these verbs the nasal increment appears just when the vowel is short, being dropped after long vowels). But notice that once 2c is stated, it automatically drops the nasal increment in all the modes of verb 9, since this verb, having no glottal increment, always has a long vowel; restricting 2c so as not to apply to verb 9 would be totally ad hoc. The result (of not so restricting rule 2a) is that verb 9 becomes homophonous with verb 1.

This is perfectly analogous to standard cases of neutralization. For example, if a language has a rule devoicing obstruents in word-final position, then formatives with a final obstruent that are always word final lead to paradigmatic homonymity, since this final obstruent can be either voiced or voiceless in lexical representations. Frequently in such cases the indeterminancy is eliminated by decreeing that only the unmarked member of a neutralized opposition is present in lexical representations. This is similar to our decree that the more complex of the two lexical representations is to be avoided; it would be natural to refer to the more complex representation as the "marked" one in this case as well.

As in the case just discussed, it is generally true that paradigmatic homonymity arises when rules motivated by a certain class of forms are allowed to apply to all forms; these rules may simply have the effect of eliminating the only difference between certain pairs of lexical items.
It is to be expected (although we don't require it) that what are paradigmatic homonyms in the present-day language were once non-homo-
phonous, but were merged by a sound change. Perhaps comparative or
historical evidence would bear this out in the case of Navaho.

It is not surprising that Navaho provides cases of paradigmatic
homonymity. For, notice that a large number of pairs of verbs differ in
their phonetic stem forms in just one or two modes, being homophonous
in all the others. (As can be seen from the tables, most homonymity
occurs in the F and the R forms.) This implies that there is much
individual homonymity. Paradigmatic homonymity is just the extreme case
of this tendency toward individual homonymity where the individual homo-
nymity spreads to all the modal forms of the two verbs.
5. Although there is a total of 267 verbs that exhibit stem alteration types illustrated in Tables III through V, there are about half as many verbs that do not fit under any of these types. Still, most of these can be accounted for if they are marked as exceptions to one or another of the rules of Table VI, or, in rarer cases, if they are marked as undergoing a rule not included in Table VI. The verbs that can be accounted for in this way are illustrated in Table VII.

In the second column of this table, the Roman plus Arabic numeral combination gives a reference to the alternation type of Tables III through V that most closely resembles the alternation type of that row. The phonetic form or forms in that row that differ from those of the alternation type referred to are marked with an asterisk "*". The number in the right hand column indicates the number of verbs exhibiting this alternation type. For example, the alternation type listed in the first row of Table VII most closely resembles verb 1 of Table III; it differs from this verb only in having -Cv?- instead of -Cvvd- in the P form. Moreover, there is a total of five verbs with this alternation type. (The careful reader will observe that the five "exceptions" of 1 in Table VII correspond to only two "regular" cases in 1 of Table III. This situation is not typical; the regular cases usually outnumber the exceptions of Table VII by a significant margin. In Table VII-1 we have what we might refer to as a subregularity: it is normal for verbs of type III-1 to deviate from the expected shape Cvvd of the P form and exhibit the shape Cv? instead. In a complete treatment we would want to exploit such subregularities as fully as possible. Here, however, we will content ourselves with pointing out (below) some of the cases
<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>F</th>
<th>F</th>
<th>R</th>
</tr>
</thead>
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<td>*Cv?</td>
<td>Cvvh</td>
</tr>
<tr>
<td>2</td>
<td>III-3</td>
<td>Cv</td>
<td>*Cv?</td>
<td>Cvvh</td>
</tr>
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<td>III-4</td>
<td>Cv</td>
<td>*Cvv?</td>
<td>Cvvh</td>
</tr>
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<td>*Cv?</td>
<td>*Cv?</td>
<td>Cvvh</td>
</tr>
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<td>Cyyh</td>
<td>*Cyy</td>
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<td>*C?</td>
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<td>*Cyyz</td>
</tr>
</tbody>
</table>

**TABLE VII**
where distinguishing between regularities and exceptions at all becomes somewhat arbitrary.

Verb 4 provides a good illustration of the way in which the verbs in Table VII deviate from the verbs of Tables III though V. The "III-4" in the second column of verb 4 indicates that this verb, in its stem alternations, most closely resembles verb 4 of Table III. Suppose we let verb 4 of Table VII have the same lexical representation as verb 4 of Table III, namely a stem =Cvv= with the features [+?I, +?F]. Then it is not hard to see that if we let all the rules of Table VI apply to this lexical representation except the high tone rule, rule 4, then the forms of verb 4, Table VII will be obtained. The reason for this is that, if rule 4 doesn't apply, the suffix /-?/ is not absorbed to produce high tone on the vowel, but is retained in phonetic representations. Thus, all we have to do is mark the lexical entries of verb 4, Table VII as not undergoing rule 4. We will use a device of Chomsky and Halle (1968, 373-380) to accomplish this, and simply mark the lexical entries of verb 4, Table VII as [−rule 4]. Notice that verb 11 of Table VII behaves in an exactly parallel fashion; here we would use lexical entries just like those of Table IV, verb 4, but mark these entries [−rule 4].

One justification for the use specifically of /-?/ as the suffix for the continuative aspect is that it allows us to account in this rather natural way for the appearance of the phonetic -?-- in these verbs.

Frequently the distribution of exception features such as [−rule 4] will exhibit considerable regularity. In this case, for example, we know that all verbs that are exceptions to rule 4 are verbs of the form =Cvv(n)= that are marked [+?I, +?F]. Thus, it is only for this rela-
tively small class of verbs that the application of rule 4 is idiosyncratic. All other verbs are known to undergo rule 4 without exception.

The treatment of verbs 1, 2, and 7 of Table VII is slightly more complex. To make the discussion easier, suppose we replace rule 7a by a more general rule, call it 7a', that takes -d- to -?- after all vowels, not just after high tone vowels. Suppose further that we add a new rule, call it 7f, that shortens low tone vowels before -?-. With these changes, verbs 1 and 3 of Table III and verbs 1, 3, 9, and 11 of Table IV become exceptions to rule 7a', since they do not show the d→? change; thus these verbs will be marked [-rule 7a'] in their lexical entries. On the other hand, verbs 1, 2, and 7 of Table VII are not exceptions to rule 7a'; in fact, these verbs undergo both rule 7a' and the subsequent shortening rule 7f.

However, given the solution using rules 7a' and 7f instead of rule 7a, the regular verbs (verbs 1, 2, and 7 of Table VII) are not as numerous (18 verbs) as the regular verbs (verbs 1 and 3 of Table III, verbs 1, 3, 9, and 11 of Table IV) (24 verbs) in the relevant cases (where the vowel is low tone). This is the reason we adopted the solution using the original rule 7a, since then the regular cases outnumber the exceptions. Actually, however, it is somewhat arbitrary to call one class regular and the other class exceptional; that is, either of the two solutions is about as natural. It is more nearly accurate to simply say (continuing with the solution using rules 7a' and 7f) that the application vs. non-application of 7a' is just an idiosyncratic property of these verbs; that is, each of these verbs must simply be marked either [+rule 7a'] or [-rule 7a']. Once we have done this we might
wish to capitalize on various tendencies we can see in the distribution of the feature "rule 7a'". For example, as we have just noted, verbs with low tone vowel tend to be [−rule 7a']. However, among the verbs with low tone vowel, those with nasal increment show the reverse tendency toward [+rule 7a']. In our discussion of Table VII, however, we will content ourselves with simply determining what verbs are exceptions to what rules, without going on to elaborate on the various sub-regularities the exceptions exhibit.

The use of exception features to handle such cases as that of verbs 1, 2, and 7 of Table VII (just discussed), seems to be unavoidable. An apparent alternative would be to abandon our assumption that every formative has just one lexical shape and say that there are two suffixes for P forms, /-di/ and /-ʔ/. Then no phonological rules would have exceptions. However, verbs would still have to be marked as to which of these suffixes they require. Moreover, under this proposal, it would be just as natural to have alternate suffixes that are phonologically totally unrelated, say /-di/ and /-xo/, yet it seems to be a fact that when alternatives occur (such as -d- and -ʔ- in the case discussed), they are related by a simple and natural phonological rule; this fact is captured by the use of exception features in the way we have suggested. (Recall from Table I that the rule taking -d- to -ʔ- is, in Navaho, independently motivated by the verbs with root-final -d-.)

Of course one might pursue other means of eliminating the necessity of exception features. For example, one might search for a reasonable phonological difference in the lexical representations of pairs of verbs such as 1 of Table III and 1 of Table VII, instead of having such pairs
differ only in their specification for some exception feature. We could then avoid having to use different lexical shapes for the same formative (as was considered in the last paragraph). If such a phonological difference could be found, it would be much preferable to the use of exception features to keep such pairs of verbs apart. (For example, we might let verbs of type 1, Table VII have a lexically short vowel, while letting those of type 1, Table III have a lexically long vowel. Then we could add a rule which takes -d-to-? only after a short vowel, eliminating 7a' and 7f and retaining 7a. However, these would be the only cases of a short stem vowel lexically. Further, we would have to add ad hoc rules lengthening this vowel in modes other than the perfective. In short, such a move turns out to be no more than another, though less satisfactory, means of marking exceptions.) In all the cases where exception features are used I have been unable to find an appropriate phonological device to eliminate them. It seems, then, that the use of exception features involves nothing more than facing up to the fact that there is much in the system of stem alternations in Navaho that is non-productive and idiosyncratic. At the same time, since our analysis does involve setting up a single lexical representation for each stem and suffix, wherever it occurs, and a set of phonological rules that produces the various stem alternants, it is clear that we are able to capture in a natural way what regularities there are in the stem alternations. It seems unacceptable to proceed as others have, assuming that the existence of irregularities somehow eliminates the necessity of stating the regularities.

Proceeding with the discussion of the verbs in Table VII, we observe
that verbs 8 and 8.5 are exceptions to the rule just discussed, rule 7f, which shortens a low vowel before -ʔ-, thus these verbs will be marked [-rule 7f]. Also, note that verbs 3, 9, and 10 can be handled if we assume they are exceptions to the shortening rule 2a, for then the final consonant will not be dropped by rule 7d. (Notice, however, that the exceptionality is only in the perfective mode.) Verbs 5, 6, 12, and 13 involve a loss of the glottal increment in the I form, and thus show up with low tone phonetically; apparently we must simply add a special rule applying only to these forms that drops the glottal increment. It is significant that verbs of type 5 and 6 almost all belong to a syntactically and semantically very special class, namely the so-called classificatory verbs. (See Young and Morgan (1943a) 43, (1943b) 3-8.) Conversely, all the classificatory verbs that are of the form Cvv or Cvvn (the others are not relevant anyway) lose this glottal increment in the I form.

In verb 14 of Table VII, the only exceptionality is that the vowel becomes high tone (since then the d→ʔ rule 7a′ will apply); we can say that this involves eliminating the restriction to increment -n- on rule 1b producing high tone, and letting any nasal absorbed by this rule produce high tone. Verb 15 involves the loss of the nasal increment in the P form, thus necessitating a special rule. On the other hand, verb 16 involves loss of the glottal increment; this, too, would require a special rule.

Turning now to the CvvO verbs of Table VII, we see that there is a considerable number of verbs like 17 that have -Cvz- instead of -Cýz- in the P form. Recall that the forms -Cýz- were derived from -Cýz- by
rule 5, where the function of rule 5 seemed to be to capture the fact that in Navaho no short high stem vowels can exist before obstruents. However, another way of eliminating this situation in forms like \(-CVz\) would be to lower the vowel instead of lengthening it, and the verbs like 17 seem to have done just this. Notice that verb 22 is handled in just the same way.

Verbs 18 and 23 involve a high tone vowel in both the I forms and the P forms, a situation that is usually forbidden. However, if we assume that these are exceptions to the rule 3b that drops the glottal increment, they are accounted for if we also assume that, like verb 17, they undergo the rule that makes a short high vowel low.

Verbs 19 and 24 involve voicing in the I forms, as well as in the P forms, while verbs 20 and 25 involve voicing in neither the I forms nor the P forms. Although there is a significant number of such verbs (48), the correct way to treat them is not obvious to me. Perhaps the suffix \(/-?1/\), which is involved in all of them, is actually \(/-?1/\). If the lexical shape of the suffix is indeed \(/-?1/\), then we would need two vowel deletion rules that applied before the continuant voicing rule 8a. One rule (call it \(R_d\)) would drop the vowel in the suffix \(-di\), while the other rule (call it \(R_p\)) would drop the vowel in the suffix \(-?1\). Most verbs would be marked \([\neg R_d, +R_p]\), verbs like 20 and 25 would be marked \([+R_d, +R_p]\), and verbs like 19 and 24 would be marked \([\neg R_d, \neg R_p]\).

Finally, in Table VII are the verbs 21 and 26. These are unusual in that they have long vowels throughout all modes. Still, notice that all these verbs have high tone vowels in all their modes; there is no case of a CvvO verb with low tone vowel that has long vowels in all its
modes. Since this is the case, we are able to say that these verbs are simply exceptions to rule 3b, the rule that drops the glottal increment. Notice the crucial role that rule 5 plays in these forms; this rule makes the short high vowel of the F and R forms long again, and accounts for the fact that stems of the phonetic form [-CvO] do not exist in Navaho.

There are approximately forty verbs whose stem alternation types do not fall under any of the categories of Tables III, IV, V, and VII; this amounts to about ten percent of all verbs in Young and Morgan's dictionary. Included in these truly exceptional verbs are those that are clearly suppletive. For example, verb #160.1(1), meaning "to act, to do," has I = [-t'i], P = [-jaa], F = [-nif], and R = [-t'i1h]. (Most suppletive verbs are not actually exceptions to any of the rules of Table VI; they must simply be provided with different lexical representations in different modes. For example, the verb just cited would have lexical representation =t'i1in=together with the specification [+?I] in the I and the R forms; cf. verb 3, Table IV. However, the P form of this verb is an exception in itself, since it involves a word-final long vowel.)

There are still many verbs in this exceptional group that are not suppletive in the above sense. Among these, there are several sorts of subregularities that can be found. For example, several verbs act just like verbs with root-final -d- except that they have the phonetic shape [-CvH] or [-Cv?] in the I forms or P forms or both. Other verbs are just like verbs with root-final -n-, except that they have the shape [-Cv?] in the I forms. Still other verbs act like verbs with root-final -x- except that they have the shape [-Cvi1] or [-Cvi] in the P forms and/or the shape [-Cvi] in the I forms. (If, as seems plausible, these verbs have shape [-Cvi] with a short final -1- just in case the contin-
uative suffix appears, this might suggest that the form of this suffix is /-?i/ lexically. Then these verbs would be exceptional in that they lose the stem-final consonant whenever the suffix has a vowel, but do not lose the vowel or vowels of the suffixes.

Finally, there are still other exceptions that seem to fall into no classes involving subregularities at all.
6. To conclude this chapter we will summarize the motivations for using the particular modal suffixes listed in (1) of section 1 and the particular aspectual suffix /-?/ (continuative) to account for the stem alternations of the verb.

The choice of /-z/ for the F forms is straightforward. In Cvv and Cvvn verbs, this /-z/ shows up explicitly in phonetic representations (Tables III and IV). Moreover, in Cvvd verbs the root-final -d- drops, so that here too the suffix /-z/ shows up as such phonetically (Table V'). Even in the rest of the Cvvo verbs, which phonetically show no suffix in the F forms, we must assume an underlying obstruent suffix so that rule 2b (which shortens a vowel before two obstruents) can account for the shortness of the vowel in these forms (Table V and Table V').

The justification for saying that /-x/ is the lexical shape of the suffix in the R forms is less obvious. Just looking at the Cvv and Cvvn verbs (Tables III and IV), it is clear that the simplest solution would be to say that the R forms have /-∅/ suffix, since they are always homophonous with the corresponding I forms. (More precisely, the R forms are homophonous with the corresponding I forms without the aspectual suffix /-?/; this is what would be expected, given a /-∅/ shape for the suffix on the R forms, since the aspectual suffix /-?/ never appears on R (or F) forms.) However, once we proceed to the Cvvo verbs (Tables V, V', and V''), it becomes evident that a /-∅/ shape for the R form suffix will not account for the shortness of the vowel. Given rule 2b and rule 7e (which deletes the second of two consonants in an obstruent cluster) it is evident that as far as the Cvvo verbs are concerned, if the suffix for the R forms was, instead, an obstruent, then the shortness of the
vowel would be accounted for. Looking back to the Cvv and Cvvm verbs, we see that if this obstruent is /-x/ then no extra rules are necessary; rule 6b (independently motivated by the Cvvx verbs which show up with final -h- phonetically) will take this -x- to the required phonetic -h-.

The -d- of the P form suffix /-d1/ is motivated by the fact that this -d- shows up phonetically in many forms (Table III: 1 and 3; Table IV: 1, 3, 9, and 11; Table VII: 16). It is true that when the P forms have a suffix phonetically it is more often -?- than -d-. However, it would not do to assume that the lexical form of the suffix contained -?-. For one thing, a rule taking -?- to -d- would be unusual, while a rule going in the opposite direction is quite natural. Moreover, having -?- in the lexical form of the P form suffix would interfere with the otherwise quite straightforward vowel shortening rule 2b; i.e., 2b would incorrectly make the vowel of the P forms short everywhere. This could be avoided only at the expense of unnecessarily complicating 2b.

The -i- of the P form suffix /-d1/ is more open to question. Still, rule 1a can be stated most easily if we assume that this suffix has some vowel, since it is necessary that this rule distinguish the P form suffix from all others; i.e., 1a must apply to all verbs except the P forms. Moreover, rule 8a, which voices the stem-final fricative in the P forms (Table V, Table V'), can be stated very naturally as an intervocalic voicing rule if the P form suffix contains a vowel. Of course it would also be possible to account for this voicing process if the lexical representation of the P form suffix were just /-d/; we would simply have to let the voicing rule 8a apply in the environment [+voc] d (also, 8a would have to precede rather than follow rule 7e which deletes the -d- of the
suffix after an obstruent). Thus, the voicing typical of P forms does not really provide evidence for the presence of a vowel in the lexical representation of the P form suffix.

Suggestive evidence in favor of the shape /-di/ rather than /-d/ is, nevertheless, provided by those exceptional Cvo verbs mentioned at the end of the last section that have P forms of the general form -Cvi- or -Cvii-. The presence of this word final -i- here is baffling unless we assume that the -i- is present in the lexical representation of the suffix. Once we make this assumption, however, then it is clear that the only irregularity of such verbs is that they lose the stem-final obstruent (after having regularly lost the consonantal suffix after this stem-final obstruent by rule 7e); this follows since, once the stem-final obstruent and the consonantal suffix are both lost, rule 9 will not apply, and the vowel of the suffix will remain. Notice that the considerations just presented provide evidence that the vowel of the P form suffix is specifically -i-.

In assigning to the I forms an empty /-∅/ suffix, we have assumed that the phonetic -h- which marks the I forms (Table III, Table IV) has been inserted by a phonological rule (rule 6a). An alternative would be simply to assume that the lexical shape of the suffix was /-h/. However, this would be the only clear cut case of a contrast at the lexical level between /-x/ (in the R form suffix) and /-h/. Furthermore, it seems to me that the presence of the word-final phonetic -h- in I forms is really a fairly low level phonetic fact. Finally, it is natural to expect a zero suffix in the imperfective which is, after all, the unmarked mode.

Most difficult of all to justify is the particular shape /-ʔ/ for
the suffix of the continuative aspect. Notice that in the "regular" types of verb stem alternation (Tables III through V') this suffix never shows up as such phonetically. However, recall that in certain exceptional instances the -? - of the continuative is not deleted, and does show up phonetically as -? - (Table VII: 4, 11). Moreover, the reason that the -? - does not show up phonetically in the regular cases is that it is absorbed by rule 4, thereby causing high tone in the stem vowel; and, of course, this high tone (characteristic of the continuative in many environments) would not be accounted for if we did not assume that the shape of the continuative suffix was -? -. Further, rule 4, the rule causing high tone upon absorption of -? -, is not limited to those cases where the -? - is that of the continuative suffix; in fact a more widespread source of high tone is the -? - that forms part of the verb stem, the so-called "glottal increment" that appears in verbs 5-8 and 13-16 of Tables III through V'.'

At this point one can, of course, raise the question as to why the particular segment -? - is used as the source of high tone in any of these cases. Two points can be made by way of an answer to this question: (1) given the types of morphophonemic alternation involving tone in Navaho, high tone is most profitably viewed as being caused by the absorption of some segment, rather than as being a feature of vowels in lexical representations, and (2) given this fact, -? - is the most likely candidate for the segment which, when absorbed, causes high tone.

To expand on (1), we may note that tonal alternations are explained in an extremely simple and natural way by rule 3, which drops the -? - in various positions in consonant clusters; when the environment of this rule is not met, the -? - remains to produce high tone, when the envi-
ronment is met, the -?- is dropped so that low tone results.

The alternative would be to say that high tone is already present in lexical representations. Thus, wherever in Tables III through V we have a glottal increment in lexical representations we would remove this and let the stem vowel be marked high tone instead. Since the continuative aspect is characteristically high tone, we might say that the continuative aspect is signaled in lexical representations by a high tone stem vowel as well. But this won't work, since that would mean that, for the forms that have a glottal increment in the previous analysis, continuative aspect would be homophonous with the non-continuative aspect, and this is simply not the case; compare, for example, Table III, 5 and 6 (P form) or Table III, 6 and 7 (I form). The best we could do would be to say that the continuative aspect is signaled in lexical representations by a short high tone stem vowel. But this is unusual; morphemes generally are represented by separate segments in lexical representations rather than by requirements that other morphemes (in this case, stem morphemes) have certain feature values (in this case, [-long, -high tone] in the vowel). Moreover, rule 3 would now have to be restated as a rule which lowered the tone of stem vowels in the environments given, and it seems rather unusual for a tonal alternation to take place in a segmental environment of this nature.

If we accept the above sorts of arguments that high tone should not be a feature of lexical representations, but should be created by a phonological rule that absorbs some segment, then we are still left with the problem of determining which segment should be absorbed. This returns us to point (2) mentioned above. In Chapter 5 we will see indisputable cases
where -n- is absorbed to yield high tone on the vowel of the preceding prefix, so the first segment that comes to mind as the source of high tone in the stem vowel is -n-. However, we have seen that the nasal increment -n- (Tables III through V', verbs 9-16) is already used as a source for the nasality of the stem vowel. Considering the other possibilities, it is difficult to imagine how one could motivate one or another true consonant (-t-, -k-, -s-, etc.) as being the source of high tone; on the other hand, it seems not unlikely that phonetic justification could be discovered that would link -?- with tone. Further, letting the continuative suffix be -?- allows us to give a natural rule (rule 2a) to account for the shortness of the stem vowel which, along with high tone of the stem vowel, is the most characteristic phonetic reflex of the continuative aspect. Finally, as we have mentioned, justification for the shape -?- of the continuative suffix allows us to account most naturally for those exceptional cases where continuative is marked phonetically by -?-. 
CHAPTER FOUR

STEM VOWEL ALTERNATIONS

1. It is commonly said that Navaho has a four-vowel system consisting of the vowels listed in (1).

(1)

\begin{align*}
& i \\
& e \\
& o \\
& a
\end{align*}

It is noted that each of these vowels can occur long or short, high tone or low tone, and nasal or oral, giving a total of 32 different vowels. This is the picture of the Navaho vowel system that emerges after even fairly close scrutiny of the various sources. However, it is a very misleading picture. For one thing, these four vowels by no means have the same distributional behavior. (For example, the vowel -e- when short almost never appears in stems before an obstruent, though it appears long before an obstruent and short when no obstruent follows. Moreover, -e- only rarely appears as nasal, though the other vowels are frequently nasal. Below we will discuss many other sorts of constraints.) Further, in the prefixes, the vowel -e- occurs only as a derivative of -a- or -o-, never as primary; that is, in lexical representations, there is quite clearly a three-vowel system -i-, -o-, and -a- in prefixes. Finally, and this is what will concern us primarily in this chapter, many verb stems exhibit alternations such as -e-a-, -e-o-, -i-a-, or -i-e- in their various different phonetic stem shapes, and these alternations bring out strongly the secondary, derivative nature of the vowel -e-.

Precise information about the phonetic system of Navaho is not presented in the literature. Nevertheless, some remarks in Sapir and
Hoijer (1968) with regard to the vowels may be helpful. The vowel -a-
"may vary freely from the low central position to a position somewhat
more to the front" (11); the vowel -e- is "pronounced in the lower
mid-front position (roughly the position of the vowel of English 'met')"
(11); when short the vowel -i- is "pronounced in the lower-high front
position (roughly the position of the vowel of English 'ship')," when
long, "the position of articulation rises to high front" (11); when
short the vowel -o- "may be pronounced either in lower mid-back posi-
tion (roughly the position of the vowel of German 'voll') or in the
lower-high back position (roughly the position of the vowel of English
'book')," when long it is "either higher mid-back (roughly the vowel of
German 'Sohn') or high back (roughly the vowel of English 'soothe')"
(12). It is claimed that the nasal vowels show the same position of
articulation. The variants listed "are in each case free, with the
first one listed the more frequent" (12).

The point of interest to us in these descriptions is that the
vowel -o- covers a range of heights which is the same as the range of
heights covered by the vowels -i- and -e- together. Thus, the designa-
tion of this vowel as -o- is somewhat arbitrary; -u- would have been
about as appropriate. The essential fact is that -o- is simply a back
rounded vowel undistinguished for height except in that it is non-low.

In the remainder of this chapter we will present evidence from
verb stems that, in lexical representations, Navaho has a three-vowel
system, a system that we will represent by the symbols in (2).
We are only following traditional practice in representing the rounded vowel as -o-; as we remarked above, -u- might just as well have been used.

The features used in (2) are those necessary in lexical representations. In phonetic representations an additional feature is needed to identify -e-. The feature "low" will be used for this purpose in the way indicated in (3).
2. The primary evidence for the three-vowel system in (2) is contained in the stem vowel alternations. In this section we will be concerned with these alternations in Cvvo verbs; the alternations in the Cvvn and the Cvv verbs will be treated in the next section.

The majority of Cvvo verbs exhibit the same vowel quality in all their phonetic stem shapes; the only variations are those for length and tone that have been fully described in the previous chapter. However, these verbs with constant vowel quality almost never have the vowel -e-, but only the vowels -i-, -a-, or -o-. (There are only six exceptions to this statement. Four of these involve nasal vowels (#74.2, #97.1, #97.2, #117.2). The others are verbs #79.1, which has the stem shape -Yeh- in all modes, and #196.2. These verbs are exceptions to the rules we will present.) Moreover, the verbs that do show vowel alternations in their stem shapes almost invariably involve the vowel -e-. The three most common types of alternation are illustrated in Table I by examples from Young and Morgan (1943b). (There are also scattered instances of -o-a-, -o-i-, and -i-a- alternations in eight Cvvo verbs, but there seems to be no pattern to them; they will be ignored here.)

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>P</th>
<th>F</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>-i-e-</td>
<td>Yeei</td>
<td>Yeel</td>
<td>Yil</td>
<td>Yil</td>
</tr>
<tr>
<td></td>
<td>t'êeh</td>
<td>t'êi?</td>
<td>t'ih</td>
<td>t'ih</td>
</tr>
<tr>
<td>-a-e-</td>
<td>deeh</td>
<td>dee?</td>
<td>dah</td>
<td>dah</td>
</tr>
<tr>
<td></td>
<td>zéeh</td>
<td>za?</td>
<td>zah</td>
<td>zah</td>
</tr>
</tbody>
</table>

TABLE I
-o-e-  
(10)  
kees  kééz  kos  kos  #120.2  
god  geed  go?  go?  #90.1(10)  
kęs  kęź  koś  koś  #122.1  

TABLE I (continued)

The number in parentheses at the left indicates the number of verbs exhibiting the given type of alternation. The numbers at the right are references to Young and Morgan's dictionary.

It appears from inspection of these examples that the vowel is always -e- when long; the three vowels -a-, -o-, and -i- are maintained only in the short vowels. And, in fact, this is true of all the (4?) examples summarized in Table I. Still, it should be recalled that there are many verbs that show no vowel alternations at all, and in these verbs the vowels -a-, -o-, and -i- appear both long and short. Moreover, there is no independent way of identifying which CvvO verbs will exhibit alternations and which will not. To handle this situation we will introduce a new feature "E" in lexical entries of CvvO verbs; all verbs that show no stem vowel alternations will be marked [-E], and all those (such as the verbs in Table I) that do show alternations will be marked [+E]. Moreover, just the three vowel qualities indicated in (2) will appear in lexical representations. Then we will simply add the phonological rule (4).

(4)  
\begin{align*}
[+\text{voc}] & \rightarrow [-\text{round}] \\
[+\text{long}] & \rightarrow [-\text{high}] \\
[+E] & \rightarrow [-\text{low}] 
\end{align*}
The verbs that show -i-e-, -a-e-, and -o-e- alternations will be represented lexically as -i-, -a-, and -o-, respectively.

It seems likely that the feature "E" must have had a more direct phonetic characterization at one time in the history of the language, and perhaps comparative work will shed light on just what this characterization is. However, from evidence internal to Navaho it appears that there is very little that can be learned about the nature of "E".
3. The situation in the Cvvn and Cvv verbs is slightly more complex. Unlike the Cvvo verbs, these verbs do not show -o-e-alternations at all; however, they do have -i-a-alternations, which (except for a few scattered examples which we are ignoring) do not appear in the Cvvo verbs. Examples of the types of vowel alternations found in Cvvn and Cvv verbs are given in Table II.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>P</th>
<th>F</th>
<th>R</th>
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<tbody>
<tr>
<td>-i-e-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(12)</td>
<td>bé</td>
<td>bifi</td>
<td>beex</td>
<td>beex</td>
</tr>
<tr>
<td></td>
<td>leeh</td>
<td>leif</td>
<td>leex</td>
<td>leex</td>
</tr>
<tr>
<td>-e-a-</td>
<td>jéeh</td>
<td>jex</td>
<td>jéex</td>
<td>jéex</td>
</tr>
<tr>
<td>(8)</td>
<td>sé</td>
<td>sxf</td>
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</tr>
<tr>
<td>-i-a-</td>
<td>c'íih</td>
<td>c'íix</td>
<td>c'íix</td>
<td>c'íih</td>
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<tr>
<td>(20)</td>
<td>chin</td>
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<td>t'ix</td>
<td>t'ix</td>
<td>t'ix</td>
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</tr>
</tbody>
</table>

**TABLE II**

There are many regularities that can be observed about these alternations. All the cases of -i-a-alternation involve verbs with nasal vowels in all modes; these are just the verbs that have a root of the
form Cvn, according to the analysis of the previous chapter. Moreover, all the cases of -i-e- and -e-a-alternation involve verbs with nasal vowels in just the Perfective mode; these are just the verbs that have a root of the form Cvv plus a nasal increment. In -i-e-alternations, the vowel is -i- when it is nasal, -e- otherwise. Similarly, in -e-a-alternations, the vowel is -a- when it is nasal, and -e- otherwise. Finally, in -i-a-alternations, the vowel is -a- just when it appears in the environment ??-[-cont] immediately before the application of rule 3 of Table VI, Chapter 1, otherwise it is -i-.

The significance of these regularities will become apparent as we proceed. Meanwhile, some comments are in order concerning Cvn and Cvv verbs that show no vowel alternations. When the vowel in such verbs is -o- or -a- , they are fairly evenly distributed among the sixteen types of stem alternations illustrated in Tables III and IV of Chapter 3. That is, when the vowel is -o- or -n- verbs seem to occur freely with the nasal and glottal increments, and with the aspectual suffix /-?/. (It happens that there are about four times as many verbs with -a- as with -o-, but we may safely assume that this is due to reasons unrelated to vowel alternations.)

However, when verbs showing the vowel -e- in all modes phonetically are considered, we find no cases of Cvn verbs (Table IV, Chapter 1), and of the Cvv verbs (Table III), none have a nasal increment. The effect is that -e- never appears phonetically as nasal (in Cvn and Cvv verbs). Moreover, verbs with the vowel -i- phonetically in all modes almost invariably have a nasal vowel; that is, these are all Cvn verbs. (There are actually five Cvv verbs with -i- throughout, as opposed to 32
Cvvn verbs with -i- throughout; the former will be exceptions to our rules.) It is clear then that both of these types of verbs can be represented with -i- lexically if we provide a phonological rule taking non-nasal -i- to -e-. Further, this same rule will account for the -i-e-alternations if we assume that verbs showing this type of alternation have lexical -i-, since such verbs have -i- when the vowel is nasal and -e- when it is oral.

We can also show that, with the addition of one rule changing -i-to-a-, verbs with -e-a- and -i-a-alternations can have a source -i- in lexical representations as well. To be more specific, we will assume that in lexical representations of Cvvn and Cvv verbs only the vowels -i-, -a-, and -o- occur. The vowels -a- and -o- never undergo changes in quality, and thus always end up as -a- and -o- phonetically. The vowel -i-, however, may be changed to -a- in some cases and to -e- in others by rules (5) and (6).

\[(5) \begin{align*} \text{[+voc]} & \rightarrow [\text{+low}] / [\text{-high}] = [ ]_o \quad ? = [-\text{cont}] [ ]_o \quad \# \\
[\text{+nas} & \text{-rnd}] \end{align*}\]

\[(6) \begin{align*} \text{[+voc]} & \rightarrow [\text{-high}] / = [ ]_o \quad ___ = \\
[\text{-nas} & \text{-rnd}] \end{align*}\]

Rule (5) takes nasal -i- to -a- in the stated environment; it must apply between rules 2c and 3a of the last chapter. Rule (6) takes non-nasal -i- to -e- in stem-final position; it must apply between rules 4 and 5.
of the last chapter. Notice that neither of these rules will apply to the vowels of CvvO verbs, since their environment requires that no obstruent intervene between the vowel and the stem-final boundary "-a". In (7) we show the various phonetic reflexes of lexical -1- for each of the stem types of Cvv and Cvvn verbs.

(7)  =Cii=    -e-       =Cln=    -1-
     =Cii-?=    -e-       =Cln-?=    -1-a-
     =Cii-n=    -i-e-       =Cln-n=    -i-
     =Cii-n-?=    -e-a-       =Cln-n-?=    -i-a-

That is, verbs with stems of the form =Cii= or =Cii-?= have the vowel -e- phonetically in all modes, verbs with stems of the form =Cii-n= have an -i-e- alternation in their stem forms (provided for by rule (6)), and so on. The verbs that have an -e-a-alternation in their stem forms (namely those with lexical stem form =Cii-n=) are simply the verbs that undergo both rule (5) and rule (6).

Since the situation is complicated, we will proceed to explain the forms case by case. Verbs of the form =Cii= and =Cii-?= in lexical representations (verbs 1 through 8 in Table III, Chapter 3) can never undergo rule (5), since their vowels are never [+nasal]; thus the -i- of the stem never becomes -a-. On the other hand, rule (6) will always apply, taking the -i- to -e-.. (Notice that the glottal increment will have been absorbed by rule 4, so that the vowel is stem-final, as (6) requires.)

Verbs with the lexical shape =Cii-n= will have a nasal vowel only in the P forms because of rules 1a and 1b of Chapter 1. Rule (5) will not apply to such verbs (in any of their modes) since they lack the glottal increment. Rule (6) will then apply to all forms but the P
forms, giving the desired results; see Table II.

Verbs with the lexical shape =Ciî-n-?= will also have a nasal vowel only in the P forms. Moreover, this nasal vowel in the P forms is in the environment ___ ? = di # in [-?P] verbs and in the environment ___ ? = ? - di # in [+?P] verbs. Thus, rule (5) will apply to just the P forms of such verbs, taking the vowel -i- to -a-. Then, after rule 4 has absorbed the glottal increment (giving high tone), rule (6) will apply to all the remaining vowels -i-, changing them to -e-. The result is the -e-a- alternations of Table II.

Verbs with the lexical shape =Ciîn= or =Ciîn-n= will always have a nasal vowel, and thus will never undergo rule (6). On the other hand they will never have a glottal increment, and so will never undergo rule (5). Such verbs, then, will retain -i- in all modes.

Verbs with the lexical shape =Ciîn-?= will also have a nasal vowel in all forms, and so will never undergo rule (6). These verbs do, however, have a glottal increment, and will thus undergo rule (5) whenever the suffix begins in a stop. All P forms have such a suffix, and so do I forms employing the suffix /-?=/ (that is, [+?I] verbs); cf. Table IV, verbs 5 through 8 in Chapter 3. The result is that the stems that are phonetically of the form -Cî- or -Cî?= have the vowel -a-, while others have the vowel -i-. This situation is illustrated by the examples of -i-a- alternations in Table II.

Verbs with the lexical shape =Ciîn-n-?= also have -i-a- alternations. The reasons are essentially those given in the previous paragraph. The only difference arises in those stems that have the phonetic shape -Cî-; as Table IV, verbs 13 through 16 in Chapter 3, shows, there are two possible lexical sources for such a stem. In each of these cases rule
(5) will fail to apply, since an -n- and not a -?­- directly follows the vowel, so that the desired result -Cin- (and not -Can-) is obtained.
4. In order for the analysis of the vowel alternations in Cvvn and Cvv verbs to give the correct results, the various regularities observed about the verbs exhibiting these alternations must of course hold true. Actually, however, these regularities are subject to exceptions, and thus represent a general trend rather than hard and fast rules.

As we mentioned earlier, there are five verbs with non-nasal -i- in all modes; these verbs are exceptions to rule (6). Also, some verbs that have the -i-e- alternation seem to have the lexical shape =Cii-n-?= (that is, they have phonetic high tone in the F and R forms); these are exceptions to rule (5). Two verbs with -e-a- alternations have oral vowels in all their stem forms phonetically, though they still show the vowel -a- in the P forms (#27.2, #211.1); in such verbs, rule (5) seems to have been generalized to apply to [+nas] vowels as well as to [-nas] vowels, although forms like -së- in Table II show that such a generalization of (5) is not always possible. Finally, there appear to be cases of -i-a- alternation in Cvvn verbs without a glottal increment as well as cases of verbs with a glottal increment phonetic -i- in all modes; these verbs would provide further examples of exceptions to rule (6).

Still, in spite of these exceptions, it seems that the regularities that remain are important, and should not go unmentioned. In all likelihood these vowel alternations are the remnant of processes that once were much more regular and productive; the situation is perhaps not unlike that of the strong verbs in Germanic languages.

It is curious that the vowel alternations in Cvvo verbs on the one
hand and those in Cvvn and Cvv verbs on the other hand, though both involving the vowel -e- in a central way, seem to bear no relation to one another. In particular, the feature E appears to have no relevance in the Cvvn and Cvv verbs. I have no explanation for this fact.
CHAPTER FIVE

PREFIXES

1. In this chapter we will begin the formidable task of determining how the prefixes of the verb interact with one another. The problem is difficult because of the large number of prefixes involved (up to twelve prefixes can occur in a single verb form), and also because of the often rather drastic changes in phonological shape that various prefixes undergo under the influence of other prefixes. To keep the discussion within feasible limits we will restrict our attention to the inflectional prefixes. More specifically, we will treat only the prefixes of positions p6 through p12 according to Table IV of Chapter 1; moreover, of the prefixes of position p7 we will consider only the passive prefix and the future prefix, leaving out altogether the aspecutal prefixes of this position. The prefixes we do consider include all the subject prefixes (though not the direct object prefixes), all the prefixes for tense and mode (except the iterative mode), the passive classifier, and the causative prefix. Extending the analysis to include all the prefixes should not be too difficult, given the analysis of the inflectional prefixes that we will present.

In Table I below we show the arrangement of those portions of the of the prefix system that we will be concerned with. All of the relevant prefixes are included in this table, in their lexical representation. We are interested in how these seventeen prefixes interact with one another to produce phonetic representations. (The use of the abbreviations p1 to p12 and A to E to identify the various portions of the prefix system follows that of Table IV, Chapter 1.)
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>P6</td>
<td>P7</td>
<td>P8</td>
<td>P9</td>
<td>P10</td>
</tr>
<tr>
<td># ... * ... ( j1 ) ! ... (di) .. (di) ... &quot;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pronominal prefixes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p6: /j1-/ (fourth person subject)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/?a-/ (indefinite 3rd per. sub.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/xo-/ (impersonal 3rd per. sub.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p9: /?i-/ (first person sing. sub.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/ni-/ (second person sing. sub.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/di-/ (first person plur. sub.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/xo-/ (second person plur. sub.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p10: /n-/ (perfective)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p11: /d-/ (passive classifier)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p12: /z-/ (causative classifier)</td>
<td></td>
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</tr>
</tbody>
</table>

TABLE I
Most aspects of Table I should be familiar from the discussion in Chapter 1. However, Table I contains a more elaborate system of boundaries than was presented at that time. The boundaries used are listed in (1) below.

(1) \# = * ! " +

These boundaries are listed in order of decreasing strength from left to right; thus "#" is the strongest boundary, "=" the next strongest, and so on. All of them are "positional" boundaries in the sense used in Chapter 2; that is, they are all present in the lexical representation of every verb form, serving to locate the position of the various formatives. We assume that a single "formative" boundary "=" appears between each pair of formatives in a verb form not separated by positional boundaries. Several examples are given in (2).

(2) (a) \# * \[i ! " ho + d - z =
(b) \# * ! di " ho + =
(c) \# * ! " na + =
(d) \# * ! " sa + \[i - n - d - z =

Each of these lines is the lexical representation of a portion of a verb form; an entire verb form could be formed in each case by adding appropriate stem and suffixes.

It is important to notice that all positional prefixes are present in each verb form, whether or not any lexical material intervenes. It
is necessary that this be the case in order that the position of each prefix in a verb form be discernible from its lexical representation regardless of what other prefixes are also present, for we will find that prefixes closer to the stem undergo more collapsing than prefixes farther out. This will be brought out clearly in the course of developing the phonological rules for prefixes.
2. The inflectional prefixes of Table I are utilized to indicate tense and mode in a way described in Chapter 1. For convenience we summarize this information below in (3). (Suffixes also figure in the marking of tense and mode, but these will not concern us here; see (11) of Chapter 1.)

(3) prefix(es) | tense or mode
---|---
# .. * .. ! .. " hi + .. = | h-imperfective
# .. * .. ! .. " na + .. = | n-imperfective
# .. * .. ! .. " na + .. n .. = | n-perfective
# .. * .. ! .. " sa + .. n .. = | s-perfective
# .. * .. ! .. " ho + .. n .. = | y-perfective
# .. * .. ! .. " ho + .. = | progressive
# .. * .. ! .. " di .. " ho + .. = | future
# .. * .. ! .. " honhi + .. = | optative
# .. nå * .. ! .. " + .. = | iterative

The iterative mode is marked by a prefix /nå-/> in part A of the prefix system; it will not be considered since we have restricted our attention to prefixes that occur closer to the stem. Our task is to determine the way in which the remainder of the tense and mode prefixes of (3) interact with the pronominal prefixes for subject listed in Table I. We illustrate these combinations in Tables II through IX below, giving both lexical and phonetic representations for every choice of subject in each of the modes.
1sg.  

# * ! " hi + $i = 

yī$ & 

2sg.  

# * ! " hi + ni = 

ni & 

1pl.  

# * ! " hi + di = 

yīid & 

2pl.  

# * ! " hi + xo = 

yŏh & 

3  

# * ! " hi + = 

yī & 

4  

# * ji ! " hi + = 

ji & 

ind.  

# * ?a ! " hi + = 

?a & 

imp.  

# * xo ! " hi + = 

ha & 

pas.  

# * bi - ?a ! di " hi + d = 

bī?did & 

<table>
<thead>
<tr>
<th>TABLE II</th>
<th>h-imperfective</th>
</tr>
</thead>
</table>

1sg.  

# * ! " na + $i = 

ni$ & 

2sg.  

# * ! " na + ni = 

nf & 

1pl.  

# * ! " na + di = 

niid & 

2pl.  

# * ! " na + xo = 

noh & 

3  

# * ! " na + = 

yī & 

4  

# * ji ! " na + = 

ji & 

ind.  

# * ?a ! " na + = 

?f & 

imp.  

# * xo ! " na + = 

hō & 

pas.  

# * bi - ?a ! di " na + d = 

bī?deed & 

<p>| TABLE III | n-imperfective |</p>
<table>
<thead>
<tr>
<th>Active</th>
<th>Passive</th>
</tr>
</thead>
<tbody>
<tr>
<td>1sg.</td>
<td>$\ast \ast \ast$ &quot; na + $\bar{\mathfrak{g}}$i - n (d) =</td>
</tr>
<tr>
<td>2sg.</td>
<td>$\ast \ast \ast$ &quot; na + ni - n (d) =</td>
</tr>
<tr>
<td>1pl.</td>
<td>$\ast \ast \ast$ &quot; na + di - n (d) =</td>
</tr>
<tr>
<td>2pl.</td>
<td>$\ast \ast \ast$ &quot; na + xo - n (d) =</td>
</tr>
<tr>
<td>3</td>
<td>$\ast \ast \ast$ &quot; na + n (d) =</td>
</tr>
<tr>
<td>4</td>
<td>$\ast \ast \ast$ $\bar{\mathfrak{j}}$i ! &quot; na + n (d) =</td>
</tr>
<tr>
<td>Ind.</td>
<td>$\ast \ast \ast$ $\bar{\mathfrak{a}}$ ! &quot; na + n (d) =</td>
</tr>
<tr>
<td>Imp.</td>
<td>$\ast \ast \ast$ xo ! &quot; na + n (d) =</td>
</tr>
<tr>
<td>Pas.</td>
<td>$\ast \ast \ast$ bi - $\bar{\mathfrak{a}}$! di &quot;$\mathfrak{n}$a + n - d =</td>
</tr>
</tbody>
</table>

**TABLE IV**

**n-perfective**

<table>
<thead>
<tr>
<th>Active</th>
<th>Passive</th>
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<tbody>
<tr>
<td>1sg.</td>
<td>$\ast \ast \ast$ &quot; sa + $\bar{\mathfrak{g}}$i - n (d) =</td>
</tr>
<tr>
<td>2sg.</td>
<td>$\ast \ast \ast$ &quot; sa + ni - n (d) =</td>
</tr>
<tr>
<td>1pl.</td>
<td>$\ast \ast \ast$ &quot; sa + di - n (d) =</td>
</tr>
<tr>
<td>2pl.</td>
<td>$\ast \ast \ast$ &quot; sa + xo - n (d) =</td>
</tr>
<tr>
<td>3</td>
<td>$\ast \ast \ast$ &quot; sa + n (d) =</td>
</tr>
<tr>
<td>4</td>
<td>$\ast \ast \ast$ $\bar{\mathfrak{j}}$i ! &quot; sa + n (d) =</td>
</tr>
<tr>
<td>Ind.</td>
<td>$\ast \ast \ast$ $\bar{\mathfrak{a}}$ ! &quot; sa + n (d) =</td>
</tr>
<tr>
<td>Imp.</td>
<td>$\ast \ast \ast$ xo ! &quot; sa + n (d) =</td>
</tr>
<tr>
<td>Pas.</td>
<td>$\ast \ast \ast$ bi - $\bar{\mathfrak{a}}$! di &quot;$\mathfrak{s}$a + n - d =</td>
</tr>
</tbody>
</table>

**TABLE V**

**s-perfective**
<table>
<thead>
<tr>
<th>1sg.</th>
<th># * ! &quot; ho + §i - n (d) =</th>
<th>active</th>
<th>passive</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yf</td>
<td>yisd</td>
<td></td>
</tr>
<tr>
<td>2sg.</td>
<td># * ! &quot; ho + ni - n (d) =</td>
<td>yinf</td>
<td>yinfid</td>
</tr>
<tr>
<td>1pl.</td>
<td># * ! &quot; ho + di - n (d) =</td>
<td>yiïd</td>
<td>yiïdd</td>
</tr>
<tr>
<td>2pl.</td>
<td># * ! &quot; ho + xo - n (d) =</td>
<td>Yoo</td>
<td>Yoohd</td>
</tr>
<tr>
<td></td>
<td>yf</td>
<td>yid</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td># * jï ! &quot; ho + n (d) =</td>
<td>jïf</td>
<td>jood</td>
</tr>
<tr>
<td>ind.</td>
<td># * ?a ! &quot; ho + n (d) =</td>
<td>?ïf</td>
<td>?ood</td>
</tr>
<tr>
<td>imp.</td>
<td># * xo ! &quot; ho + n (d) =</td>
<td>hïë</td>
<td>hïïd</td>
</tr>
<tr>
<td>pas.</td>
<td># * bi - ?a ! di &quot; ho + n - d =</td>
<td>bi?dood</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE VI**     y-perfective

<table>
<thead>
<tr>
<th>1sg.</th>
<th># * ! &quot; ho + §i =</th>
<th>active</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yis</td>
<td></td>
</tr>
<tr>
<td>2sg.</td>
<td># * ! &quot; ho + ni =</td>
<td>active</td>
</tr>
<tr>
<td></td>
<td>yf</td>
<td></td>
</tr>
<tr>
<td>1pl.</td>
<td># * ! &quot; ho + di =</td>
<td>active</td>
</tr>
<tr>
<td></td>
<td>yiïd</td>
<td></td>
</tr>
<tr>
<td>2pl.</td>
<td># * ! &quot; ho + xo =</td>
<td>active</td>
</tr>
<tr>
<td></td>
<td>Yoh</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td># * ! &quot; ho + =</td>
<td>active</td>
</tr>
<tr>
<td></td>
<td>yi</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td># * jï ! &quot; ho + =</td>
<td>active</td>
</tr>
<tr>
<td></td>
<td>Yoo</td>
<td></td>
</tr>
<tr>
<td>ind.</td>
<td># * ?a ! &quot; ho + =</td>
<td>active</td>
</tr>
<tr>
<td></td>
<td>?oo</td>
<td></td>
</tr>
<tr>
<td>imp.</td>
<td># * xo ! &quot; ho + =</td>
<td>active</td>
</tr>
<tr>
<td></td>
<td>hoo</td>
<td></td>
</tr>
<tr>
<td>pas.</td>
<td># * bi - ?a ! di &quot; ho + d =</td>
<td>active</td>
</tr>
<tr>
<td></td>
<td>bi?dood</td>
<td></td>
</tr>
</tbody>
</table>

**TABLE VII**     progressive
TABLE VIII  

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1sg.</td>
<td># * ! di &quot; ho + $i =</td>
<td>dees</td>
<td></td>
</tr>
<tr>
<td>2sg.</td>
<td># * ! di &quot; ho + ni =</td>
<td>daf</td>
<td></td>
</tr>
<tr>
<td>1pl.</td>
<td># * ! di &quot; ho + di =</td>
<td>diid</td>
<td></td>
</tr>
<tr>
<td>2pl.</td>
<td># * ! di &quot; ho + xo =</td>
<td>dooh</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td># * ! di &quot; ho + =</td>
<td>doo</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td># * £i ! di &quot; ho + =</td>
<td>yidoo</td>
<td></td>
</tr>
<tr>
<td>ind.</td>
<td># * ?a ! di &quot; ho + =</td>
<td>?adoo</td>
<td></td>
</tr>
<tr>
<td>imp.</td>
<td># * xo ! di &quot; ho + =</td>
<td>bidi?dood</td>
<td></td>
</tr>
<tr>
<td>pas.</td>
<td># * bi - ?a ! di - di &quot; ho + d =</td>
<td>bidi?dood</td>
<td></td>
</tr>
</tbody>
</table>

TABLE IX  

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1sg.</td>
<td># * ! &quot; honhi + $i =</td>
<td>Y6$</td>
<td></td>
</tr>
<tr>
<td>2sg.</td>
<td># * ! &quot; honhi + ni =</td>
<td>Y66</td>
<td></td>
</tr>
<tr>
<td>1pl.</td>
<td># * ! &quot; honhi + di =</td>
<td>Yood</td>
<td></td>
</tr>
<tr>
<td>2pl.</td>
<td># * ! &quot; honhi + xo =</td>
<td>Yooh</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td># * ! &quot; honhi + =</td>
<td>Y6</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td># * £i ! &quot; honhi + =</td>
<td>$6</td>
<td></td>
</tr>
<tr>
<td>ind.</td>
<td># * ?a ! &quot; honhi + =</td>
<td>?$</td>
<td></td>
</tr>
<tr>
<td>imp.</td>
<td># * xo ! &quot; honhi + =</td>
<td>h6</td>
<td></td>
</tr>
<tr>
<td>pas.</td>
<td># * bi - ?a ! di - &quot; honhi +$ =</td>
<td>bi?d6d</td>
<td></td>
</tr>
</tbody>
</table>

optative
The abbreviations for the type of subject, appearing in the left-hand column of these tables, are those of section 6, Chapter 1. The row headed by "pas." in each table represents an "agentive passive," discussed in section 7 of Chapter 1. We have only given the direct object "bi" (that is, the third person direct object) in these agentive passives; substitution of any of the other direct objects, though, is straightforward, since phonetically they undergo no collapsing in this construction.

It might be noticed that the passive prefix /di-/ of position p7 precedes the future prefix /di-/ of position p7. This fact is not apparent from the above tables; however, there is an aspectual prefix /xi-/ of position p7, and this prefix precedes the future prefix while following the passive prefix. Moreover, various other p7 prefixes follow the future prefix, while at least one seems to precede the passive prefix.

Notice that the prefix /d-/ (passive classifier) of position pl1 and the prefix /z-/ (causative) of position pl2 are absent from the tables. The behavior of these two prefixes is more or less independent of that of the other prefixes, and will be considered separately in the next chapter. The final -d- that appears in the right-hand column of pl1 forms behaves in the same way as the -d- of the passive classifier so that this too will be treated in the next chapter. To this extent, then, the right-hand column of these tables does not indicate phonetic representations, but only the input to the later rules of the next chapter. There is actually one other respect in which the representations of these tables will be affected by later rules: namely, the final -s- in the s-perfective (Table V) is voiced
when no other prefixes follow.

There is one way in which the behavior of the prefix /d-/ (passive classifier) is not independent of the prefixes that precede it. In the perfective paradigms, the active forms (without /d-/ ) are different phonetically from the passive forms (which have /d-/ ). Thus, in the tables for the perfectives (Tables IV through VI), both active and passive forms are given. In all other modes the prefix /d-/ has no effect on the prefixes that precede it.
3. In this section we will present the phonological rules that relate the lexical representations and the phonetic representations in the above tables, delaying a step-by-step justification of the lexical representations used until the following section.

It should be noted at the outset that these rules are quite complex. This is simply a consequence of the fact that the various modal prefixes undergo much collapsing and fusing with surrounding prefixes. The result is paradigms that, on the surface, appear to have little regularity. Given this state of affairs, it is tempting to consider all the alternations as suppletive, and let the analysis consist simply of the list of phonetic representations that appear in the right-hand column of the above tables. This has been, essentially, the approach of those who have published material on Navaho. (Reichard (1951) does attempt to set up underlying forms for the formatives involved in the paradigms, in some cases showing real insight. But her work has limited value due to inconsistencies and inaccuracies in her reporting of the data, the absence of any kind of rules that relate her underlying forms to the phonetic output, and a general lack of clarity in her exposition.) However, relegating the problem to suppletion leaves what regularities do exist in the paradigms unexplained, and is just a way of avoiding looking in detail at the types of alternations that occur. On the other hand, postulating a single lexical form for every prefix, as we have done, can lead to explanations of many otherwise irregular aspects of the paradigms.

Following the conventions we have been using, the environment of each rule contains boundaries at its end points; the rule is assumed to apply across all boundaries strictly weaker than the weaker of these two
end boundaries. But any boundaries mentioned in the environment of a rule, whether at its end points or internally, must be explicitly present in any form to which the rule applies.

As an illustration, consider rule (1a) in Table X below. This rule has the boundaries "*" and "-" at its endpoints. Since "*" is the weaker of these, (1a) applies across all boundaries weaker than "*", namely "!", "#", "^", and "-". Thus, for example, (1a) will apply to a vowel V in (b), (c), and (d) below, but not in (a).

(4)  
(a)  \[ CV * ! " + xo = \]
(b)  \[ * CV ! " + xo = \]
(c)  \[ * ! CV " + xo = \]
(d)  \[ * ! " CV + xo = \]

The effect of this use of boundaries is straightforward. Any vowel immediately preceding the subject prefix /xo-/ will be rounded provided it appears after the boundary "*"; vowels in part A of the prefix system appear before the boundary "*" and thus are not rounded even when the next prefix is /xo-. Moreover, the use of the boundary "^" in the environment of (1a) guarantees that only rounded vowels in part E can cause rounding of a preceding vowel.

No attempt has been made to present rules in their most abbreviated form. In fact, we have again adopted the procedure, in rules that refer to a single segment, (whether in the input, the output, or the environment) of simply including the letter abbreviation of this segment in the statement of the rule. Only where rules refer to classes of segments will we utilize the distinctive feature notation.
1a  [+voc] Æ o / * [ ] o  ___ [+voc] o [+voc] o =
1b  a Æ e / ! [ ] o 1 " [+voc] ___ [-voc] o =
1c  o Æ e / * [ ] o  ___ [+corr] [ ] o =
1d  [+voc] [+back] Æ i / " [-voc] ___ [ ] o [+voc] [-rmd] [-voc] o =
1e  o Æ i / # " [-voc] ___ [-rmd] o =
2a  [+voc] Æ Ø / * [ ] 1 + [+cont] ___ [-nas] o =
2b  [+voc] [-rmd] Æ Ø / * [ ] 1 + [+cont] ___ [ ] o =
3a  n Æ Ø / " [ ] o + [-nas] o ___ [-cont] [-voc] o =
3b  n Æ Ø / " [+strid] [+voc] + [-nas] o ___ [-voc] o =
4  [+voc] [-rmd] Æ Ø / * [ ] 1 + [+cons] ___ + (d) (z) =
5  [-son] [+voc] Æ [+voc] [-son] / # [ ]{+} ___ [-voc] o =
6  [+cons] [+cont] Æ Ø / " [ ] o ___ n [-voc] o =
7a  [+voc] Æ i / " [-voc] ___ n [-voc] o =
7b  [+voc] Æ i / # [ ] o ? ___ n [-voc] o =
8  n Æ Ø / # [ ] o [+voc] " ___ [+voc] [-high] [ ] o =
9a  [+voc] [-long] Æ [+high tone] / # [ ] 0 [-voc] ___ n [-voc] o =
9b  n Æ Ø / # [ ] o ___ [-voc] o =
9c  [+voc] [-long] Æ [+high tone] / " [-voc] ___ [+son] [+voc] [-ht] [ ] o =

TABLE X
10  h → ∅ / # [ ]_o [+voc] [+voc] [ ]_o =

11a  [+voc] → ∅ / # [ ]_o ∅ [ ]_o =
11b  [+voc] → ∅ / # [ ]_o ∅ [ ]_o =
11c  [+voc] → ∅ / # [ ]_o ∅ [ ]_o =
11d  [+voc] → [αhigh] / ∗ [ ]_o [+voc] [αhigh] [ ]_o =
12a  [+strid] → [αant] / # [ ]_o [+strid] [ ]_o [ ]_o =
12b  h → Y / #∗ [ ]_o =
12c  Y → y / #∗ [ ]_o [+voc] [ ]_o =
13a  [+voc] → i / # [+son] [ ]_o =
13b  [+voc] → a / # [ ]_o [−voc] [−voc]_o =
14  x → h / # [ ]_o [ ]_o =
15  ? a [ ]_o → [ ]_o ? / # [ ]_o [+voc] [−voc] [+voc]_o =

TABLE X  (continued)
4. In this section we will proceed to discuss the way in which the rules of Table X apply in each of the Tables II through IX. At the same time, we will be concerned with justifying the particular choices of lexical representations for the prefixes that figure in these tables.

The first point to be noted is that the prefixes, in lexical representation, all contain short vowels; and, in fact, in phonetic representations, long vowels arise only through merging of two (or more) vowels upon the dropping of consonants. Thus, in the prefix system, there are no rules either lengthening or shortening vowels; all vowels are short lexically, and remain short unless they merge with another vowel to produce a long vowel. In order to effect this merger of sequences of short vowels to a single long vowel, we will adopt the following convention.

(5) Any sequence of vowels which agree in all features (except, possibly, the feature "long") is replaced by a single [+long] vowel that agrees in all other features with the vowels of the sequence.

This convention is assumed to apply throughout derivations; that is, whenever the application of some phonological rule gives rise to a sequence of identical vowels, this sequence is immediately converted to a long vowel. The part of (5) enclosed in parentheses is necessary to allow for the possibility that a short vowel and a long vowel produced by an earlier merger may come together; the result in such a case is still a single long vowel. (Recall that, for typographical convenience, we write long vowels with two vowel letters. Still, in actuality, long
vowels are single segments.)

In Chapter 3 where we dealt with the verb stems we saw that in lexical representation the stem vowel is always long; this vowel is then shortened in certain environments, namely before a glottal increment or a sequence of two obstruents. Thus we have the following situation. There is no contrast between long and short vowels, in lexical representations. Still, both long and short vowels exist in lexical representations, long vowels in stems and short vowels elsewhere. It is not usual to allow such a situation to exist. Since vowel length is never involved in contrasts, in lexical representation, standard procedure dictates that both long and short vowels may not exist lexically. Instead, all vowels would be long, lexically, and short vowels would be derived by a phonological rule, or else all vowels would be short lexically, and long vowels would be derived by a phonological rule. Either of these alternatives is possible, and either would eliminate the situation where non-contrastting sets of segments exist in lexical representations.

However, neither of these alternatives is satisfactory, since each would involve an unnatural and ad hoc rule. Adopting the first alternative would mean having a rule shortening all vowels except stem vowels, while adopting the second alternative would mean having a rule lengthening all stem vowels. In either case, the rule would serve no purpose other than eliminating non-contrastting sets of segments from lexical representations. It seems to me to be much more natural, in this case, to allow non-contrastting sets of segments in lexical representations, and state the relevant constraint as a property of lexical representations. This is the approach we have adopted. Vowels will be
long in stems and short elsewhere, in lexical representations, and the lexicon will contain a statement of this fact about the distribution of the feature "long." (This statement might be made in a "morpheme structure condition;" cf. Stanley (1967).)

The prefix which, in lexical representations, marks the h-imperfective paradigm in Table II above is /hi-/: phonetically the -h- of this prefix is most frequently changed to -y- (by rule 12c), but when the vowel -i- has become -o- (cf. rule 1a) the -h- is changed to -Y- (by rule 12b). This alternation between -y- and -Y- cannot be accounted for on the basis of a lexical -y-, since initial -y- does not change to -Y- before -o-. (For example, if the ordinary third person direct object prefix /yi-/ is added to the ordinary third person forms of the progressive, we get # * y1! " ho += ... → -yoo ... ; cf. Table VII.) On the other hand, we could assume that the lexical shape of the imperfective prefix was /Yi-/: our choice of /hi-/ instead is bases mainly on the fact that voiced continuant obstruents (such as -Y-) do not appear in lexical representations of prefixes, whereas [-vocalic, -consonantal] segments (such as -h-) are common in prefixes. It is also interesting to note that what shows up phonetically in Navaho as -Y- alternating with -y- shows up in other Apachean languages as -h-; see Hoijer (1946).

Looking at Table II, we see that the /hi-/ prefix of the imperfective has no realization at all phonetically in the 2sg., 4, ind., imp., and pas. forms. To account for this fact, we will add the rules given in (6).
These rules have not been included in the list of phonological rules in Table X since, unlike the rules given there, they seem to have no phonological motivation at all. Chomsky and Halle (1968) call such rules "readjustment rules," and we will, correspondingly, refer to the rules in (6) by this term. Readjustment rules apply before any of the phonological rules; thus, in this case, the prefix -hi- will be deleted in the specified environments before the rules of Table X apply. Still, we will assume that the readjustment rules apply according to the same conventions as the phonological rules, in particular, with respect to boundaries. Thus rule (6a), being bounded in its environment by the boundaries 'x' and 'z', will apply across all weaker boundaries, that is, across the boundaries 'x', '!/', 'r', and '+' . The result is that the ' [ ]_1 ' of this rule stands for one or more segments that lie anywhere between the boundary 'x' and the boundary 'r', regardless of which side of the boundary '/' this sequence lies on. The boundary 'r' in the environment guarantees that the -hi- that is dropped is to the right of this boundary. (See Table I for an indication of how the various boundaries are distributed in the prefix system.)

Rule (6a) implies that if only part A prefixes precede the /hi-/ (imperfective) prefix, the -hi- will not be deleted; and indeed, in this situation -hi- does have a realization phonetically. To illustrate more
fully than is done in Table II the effect of /hi-/(imperfective), we present in (7) below the phonetic result of adding the part A prefix /xa-/ (up and out) to the forms of Table II, and also the phonetic result of adding the part C prefix /di-/ (inceptive) to the same forms.

<table>
<thead>
<tr>
<th></th>
<th>/xa-/</th>
<th>/di-/</th>
</tr>
</thead>
<tbody>
<tr>
<td>1sg.</td>
<td>haaʔ</td>
<td>diʔ</td>
</tr>
<tr>
<td>2sg.</td>
<td>hani</td>
<td>di</td>
</tr>
<tr>
<td>1pl.</td>
<td>halid</td>
<td>diid</td>
</tr>
<tr>
<td>2pl.</td>
<td>haah (or haoh)</td>
<td>doh</td>
</tr>
<tr>
<td>3</td>
<td>haa</td>
<td>di</td>
</tr>
<tr>
<td>4</td>
<td>haʔi</td>
<td>jidi</td>
</tr>
<tr>
<td>ind.</td>
<td>haʔa</td>
<td>?adi</td>
</tr>
<tr>
<td>imp.</td>
<td>haa</td>
<td>hodi</td>
</tr>
<tr>
<td>pas.</td>
<td>habiʔid</td>
<td>bidiʔid</td>
</tr>
</tbody>
</table>

Many aspects of the relation of phonetic to lexical representations in (7) will not be clear until after a full discussion of the rules of Table X. Still, the behavior of the prefix /hi-/ (imperfective) can be illustrated by the ordinary third person forms. Thus, -haa- will be derived from "# xa * i " hi + ... by three rules; rule 10 of Table X drops the -h-, rule 14 takes -x- to -h-, and a rule not included in Table X changes -i- to -a- after -a-. The important point is that /hi-/ has a phonetic effect, namely in the length of the vowel. When the part C prefix /di-/ precedes /hi-/ , however, -hi- is dropped completely by rule (6a), so that "# * i di " hi + ... yields -di-.
Other readjustment rules are evidently needed in the n-imperfective and the n-perfective paradigm. Specifically, we would expect -ni- for the 3 form of Table III and -nid- for the 3 form of the passive of Table IV, but instead we get -yf- and -yfd- respectively. These forms can be accounted for by assuming there is a readjustment rule of the form in (8).

(8) \( \emptyset \rightarrow y_1 \quad / \quad ^* \quad \text{"na + (d) \ (\#)} = \)

(Thus, the intransitive forms are irregularly treated as if they had a -yf- object prefix.) However, notice that if (8) is to apply correctly to the forms of Table IV it must follow the nasal deletion rule 3a of Table X, for (8) only applies to the passive 3 form in which rule 3a has dropped the nasal. Thus, rule (8) is a readjustment rule which must appear along with the phonological rules, and not before these rules as has been assumed (Chomsky and Halle, 1968, 9).

Also in Table IV, we would expect -nifi- and -nifid- respectively for the active and passive of the 2sg. forms, but get -yfinf- and -yfinfd- instead. This situation can be handled with the readjustment rule (9), which can precede the phonological rules.

(9) \( \text{na} \rightarrow h_1 \quad / \quad ^* \quad \text{"} + n_1 - n \ (d) \ (\#) = \)

As we have said before, the cases where readjustment rules are necessary are totally idiosyncratic from a phonological point of view. The use of readjustment rules is, at this point in the development of linguistic
theory, a purely ad hoc descriptive device to account for irregular natural phenomena inexplicable in terms of phonological rules.

Turning now to the progressive paradigm (Table VII) we see the same alternation between phonetic -Y- (before -o-) and phonetic -y- (elsewhere) that characterized the h-imperfective. It seems clear, then, that the progressive should be marked lexically by a prefix beginning with -h-. The lexical value of the vowel of this prefix presents more of a problem, however, since it sometimes appears as -i- (in the lsg., 2 sg., 1 pl., and 3 forms), elsewhere as -o-. Still, it would certainly not do to let this vowel be -i-, since this would render the h-imperfective prefix (Table II) indistinguishable from the progressive prefix lexically. On the other hand, letting the vowel of the progressive prefix be -o- lexically results in a natural analysis. All we need is rules unrounding this -o- to -i- in the appropriate environments. These rules are given as 1d and 1e of Table X; as we will see, these rules represent a general tendency for vowels in part D of the prefix system to go to -i- when short. The progressive forms -joo-, -joo-, and -hoo- retain the effect of the lexical -o- of the progressive prefix, being derived by a rule that drops intervocalic -h- (rule 10), and a vowel assimilation rule (rule 11d).

As has frequently been pointed out in the literature, the future paradigm is, quite simply, the progressive paradigm together with the addition of a prefix -di-; see Table VIII.

The existence of phonetic high tone vowels in the prefixes illustrated in Tables II through IX raises some interesting problems. In particular, we may note the existence of alternations between high tone and low tone vowels in the 2 sg. forms, the n-imperfective forms (Table
III), all the perfective forms (Tables IV through VI), and in the optative forms (Table IX). On the surface these high tone-low tone alternations appear to be quite irregular; however, we will show that is all vowels are low in tone lexically and if high tone is caused by absorption of a following preconsonantal -n-, then these alternations become entirely straightforward. (High tone in prefixes of positions p1 to p5 is beyond the scope of this study.) First consider the 2 sg. forms. Here we note that letting the lexical representation of the 2 sg. subject prefix be /ni-/ is entirely natural; for, on the one hand, the 2 sg. object prefix is -ni- phonetically, and, on the other hand, the 2 sg. subject prefix itself shows up as -ni- phonetically when no prefixes of parts B, C, or D precede it. (See Table II and also the form -hani- in (7) above; the situation where no prefixes of parts B, C, or D precede the 2 sg. subject prefix arises due to the application of the readjustment rule 6b.) Notice, however, that when prefixes of parts B, C, or D do precede the 2 sg. subject, it shows up as high tone on the rightmost such prefix; this can be seen in Tables III through IX, though perhaps most clearly in Table III, where there are fewer complications due to other rules not yet discussed. (The change of -na- to -ni- in the 2 sg. form of Table III is described in rule 1d of Table X.) Thus we need a rule with the effect -Cv-ni- → -Cv-, where -Cv- is any prefix of part B, C, or D and -ni- is the 2 sg. subject prefix.

As it stands, this rule is somewhat unnatural and implausible. However, it can be broken up into two quite natural and independently motivated steps, the first of them dropping the vowel in -ni- and the second absorbing the remaining -n- to give high tone on the vowel that precedes. The vowel dropping rule is given as 2a of Table X; it will be
discussed and justified below. The absorption of -n- to produce high
tone is described by rules 9a and 9b of Table X. Recall that such a
source of high tone has justification in the suffix system as well; cf.
Chapter 3, Table VI, rule 1b, where absorption of the consonants -n-
and -?- cause high tone. Rules 9a and 9b will also be discussed further
below. We are content at this point with demonstrating that absorption
of -n- is a natural source for the occurrence of high tone in the pre-
fixes in Tables II through IX.

Moving on, then, to another case of high toned prefixes, consider
the n-imperfective paradigm in Table III. Here, aside from the usual
high tone in the 2 sg. form, there is high tone only in the presence of
a part B subject prefix -?i- , -?a- , or -xo- preceding the -na- pre-
fix which marks the paradigm. Further, in these forms all trace of the
-na- itself has disappeared. Clearly what we need is a rule that drops
the -a- of -na- in the presence of a preceding part B prefix; this rule
is given as 4 in Table X. (The rules 2a, 2b, and 4 have much in common,
and seem to be part of a general tendency to drop vowels from prefixes
of part D and E. It is not difficult to see that 2a and 2b can be col-
lapsed into a single rule; this will be discussed below, after we have
illustrated rule 2b. However, it is not possible to collapse 4 with
these rules, since, as we will show later, rule 3 must follow rule 2b
and precede rule 4.) At this point the rules 9a and 9b will apply as
before, absorbing the -n- (from -na-) and giving high tone. Here,
then, is further support for deriving high tone from -n-.

When we turn to the perfective paradigms in Tables IV through VI,
we find a complex set of alternations of high vs. low tone. Nevertheless,
it is important to notice that in the passive forms of the perfective paradigms, all the cases of high tone occur either in the 2 sg. forms or in the case of a part D prefix -ma- in the presence of a part B prefix (Table IV), and so can be explained by means of the considerations already given. It is only the cases of high tone in the active forms of the perfective paradigms that still need to be accounted for. In our analysis, this high tone in active perfectives will arise due to the presence of the position pl0 prefix /n-/ (perfective) by the same rules (9a and 9b) that produce high tone elsewhere in the prefixes. In order to account for the lack of high tone in passive perfectives we will simply provide a rule (rule 3a) that drops the -n- prefix of the perfective in the presence of a following -d- prefix of the passive.

Notice that the prefix /n-/ (perfective) never shows up as such phonetically. In fact it is always dropped out completely, and can be detected only by its effect on the surrounding prefixes. One such effect, the causing of high tone, has just been discussed. As it turns out, there is another quite different way in which the presence of the prefix /n-/ manifests itself. Consider the 1 sg. and 2 pl. forms of the active perfectives of Tables IV through VI; notice that these forms lack the characteristic -s- and -h- of these persons. In order to account for this situation, we simply need to add a rule (rule 6) that drops continuant consonants in the environment of the consonant -n- of the perfective. Notice that the passive forms of the 1 sg. and 2 pl. do not lose their consonant; this is as expected since rule 3a has deleted the -n- of the perfectives in the presence of the passive prefix -d-.
In summary, the two main characteristics of perfective paradigms, occurrence of high tone and loss of subject prefix consonants, can be accounted for rather naturally if we assume that the perfectives are all marked lexically by the presence of a prefix /n-/ in position p10. Further, since these characteristics show up only in active perfectives, we may infer the existence of a rule which deletes this -n- in the presence of the prefix -d- that marks the passives. The details of the derivation of the various paradigms will be delayed until later, when we discuss each of the rules individually.

The final case where high tone vowels show up in the paradigms of Tables II through IX is in the optative paradigm, Table IX. Here, high tone is quite pervasive, being absent in only the plural forms. Since we already have a means of deriving high tone vowels from -n-, we include -n- in the lexical representation that we propose for the optative prefix, namely /honhi-/. Justification for the other aspects of the representation /honhi-/ will be given later; the question we are interested in at this point is whether or not the high tone of the optatives should be derived from -n-. It might seem more straightforward to let the lexical representation of the optative prefix be something like /hɔ-/ or /yɔ-/, i.e., to let the high tone be explicitly a feature of the lexical representation. However, this would be the only case of a prefix of parts C, D, and E of the prefix system with a lexical high tone; as we have shown, all the other cases of high tone in parts C, D, and E must be derived from -n-. Furthermore, if the optative prefix were to have lexical high tone we would require a rule lowering the tone in the 1 pl. and 2 pl. forms; this would be the only case in the language of a tone lowering
rule, though there are many motivated cases of rules which introduce high tone (including rules which introduce high tone in the environment of other high tone vowels, as in rule 9c, as well as rules which introduce high tone upon absorption of a consonant). It seems justifiable, then, to proceed as we have and derive the high tone of the optatives from an underlying -n-.

One final general point concerning the paradigms should be made before we begin a detailed discussion of the rules of Table X. Notice that the three paradigms y-perfective (Table VI), progressive (Table VII), and future (Table VIII) all contain a formative in common in lexical representations, namely the prefix /ho-/ (progressive). There are strong reasons, both phonological and semantic, for adopting this analysis. Phonologically, these three paradigms frequently have forms with a long vowel -oo-, and this is explained quite naturally on the basis of an underlying prefix /ho-/: rule 10 drops intervocalic -h-, and rule 11d rounds a vowel directly before -o-. The vowel -o- does not appear phonetically in all forms where the prefix /ho-/ appears lexically on account of the previously mentioned tendency for vowels to become -i- in part D of the prefix system. Specifically, rules 1d, 1e, and 7a all take vowels to -i- in part D. The result is that the vowel of -ho- becomes -i- when subject prefixes with non-rounded vowels follow, when the prefix -ho- is word-initial, or when the -n- of the perfective paradigms follow. (In passive forms in perfective paradigms the -n- of the perfective prefix has been deleted (by rule 3a), so that the vowel of -ho- stays as -o-. This accounts for the -oo- in the passive y-perfective that corresponds to the -ff- in the active.)
Notice also that the alternation between phonetic word-initial 
\(-y-\) and \(-Y-\) in the \(\gamma\)-perfective and progressive paradigms can be 
accounted for on the basis of an underlying \(-h-\) in the way discussed 
above in connection with the \(h\)-imperfective prefix. This gives justifi-
cation for the use of \(-h-\) in the lexical form /ho-\(\) of the pro-
gressive prefix. Moreover, since intervocalic \(-h-\) always drops (rule 
10), we have a natural explanation for the fact that the consonant of 
the progressive prefix disappears whenever prefixes precede it.

Recall that the future and the progressive paradigms use the same 
stem form of the verb; (Chapter 1, section 7). According to the analy-
sis implicit in Tables VII and VIII, their similarity goes even further; 
in fact, the two paradigms are exactly the same except that the future 
has a prefix /di-\(\) which the progressive lacks, since they both contain 
the inflectional prefix /ho-\(\) (progressive). Moreover, the \(\gamma\)-perfective 
is, in fact, semantically progressive. That is, the \(\gamma\)-perfective de-
notes an act in the process of being brought to a conclusion; it is 
opposed both to the \(s\)-perfective, which emphasizes a static condition 
brought about by the completion of the action, and to the \(n\)-perfective, 
which emphasizes the arrival at a goal through the completion of the 
action. (See Reichard (1951) 246 and Young and Morgan (1943a) 82.)

In summary, then, letting the future, the progressive, and the \(\gamma\)- 
perfective all contain the prefix /ho-\(\) (progressive) lexically helps 
to account for both phonological and semantic characteristics of these 
paradigms.

Having completed our discussion of the more general aspects of the 
paradigms of Tables II through IX, we will now proceed to discuss individ-
ually each of the rules of Table X and the way they operate in these paradigms.

Rule 1a refers in its environment to a vowel -o- that occurs between the boundaries "+" and "-" (i.e., in part E of the prefix system). As it happens, the only formative which can supply such an is the part E prefix /xo-/ (2pl. subject). Thus, the effect of the rule is to change vowels to -o- in prefixes that are followed directly by -xo-. It is this vowel that has been assimilated to -o- that shows up as the characteristic -o- of 2 pl. subject forms; the -o- of /xo-/ itself is later deleted. Notice that the environment of rule 1a contains the boundary "+" on the left. This implies that prefixes affected by this rule must not be in part A of the prefix system, but rather in parts B, C, or D. Thus in (7) above, which involves the part A prefix /xa-/; notice that the -a- does not assimilate to -o- when it precedes -xo-; however, in each of the Tables II through IX there is a prefix from part D preceding -xo-, so that the vowel is assimilated to -o-.

Rule 1b raises and fronts a vowel -a- to -e- in any part D or part E prefix if such a prefix is immediately preceded by a part C prefix of the form -Ci-. Since most part C prefixes are derivational prefixes not considered in the present work, the effect of rule 1b is only infrequently noticeable in the tables presented above. The only instance where rule 1b applies in these tables, in fact, is when the part C prefix /di-/ (passive) is present. Thus, for example, in Table III we see that /di-/ (passive) and /na-/ (goal) combine by rule 1b to give -dine-; later rules drop the -n- and assimilate the -i- to -e-, giving the final result -dee-.
Rule lc fronts the vowel -o- to -e- when a [+cor, -ant] consonant (i.e., a palato-alveolar consonant) of part E immediately follows. The only palato-alveolar consonant occurring in part E is the -ṣ- of the first person singular subject, and the only prefix containing -o- in our tables is the prefix /ho-/ (progressive). Consider, then, the future paradigm of Table VIII. Here the -ho- becomes -he- by rule lc in the 1 sg. form; later rules drop the -h- and assimilate the -i- before -e- to -e- yielding the long vowel -ee- that appears in this form. The reason that the vowel -e- does not appear in the 1 sg. forms of the progressive and y-perfective paradigms is that a later raising rule (13a) raises the -e- to -i-. We should note that the effect of rule lc is much better illustrated in the behavior of part C prefixes which do not form part of this study.

Rule ld refers to [+voc, -rnd] vowels in its environment; it is clear that these vowels can only be the vowels of the subject prefixes in part E. Thus the rule has the effect of taking to -i- all back vowels in part C prefixes when these are followed by the subject prefixes -ṣi-, -ni-, or -di-, (but not -xo-, which contains a rounded vowel). Thus, -na- becomes -ni- in the first three forms of Tables III and IV, -sa- becomes -si- in the first three forms of Table V, and -ho- becomes -hi- in the second and third forms of Tables VI, VII, and VIII. (In the 1 sg. forms of Tables VI, VII, and VIII the -ho- has become -he- by rule lc, and so is not affected by rule ld.)

Rule le is necessary to account for the fact that in the y-perfective and progressive paradigms a word-initial -ho- becomes -hi- (and later -yi-) as the 3 form shows. The 3 form of the future shows that the restriction to word-initial position is necessary.
Rule 2a drops the vowel of the part E subject prefix if three conditions are met. First, the subject prefix must have a [+cont] consonant. Only /di-/ , the 1 pl. subject prefix, has a [-cont] consonant; rule 2a thus never deletes the vowel in this -di- (Notice that we are regarding -n- as [+cont] ; cf., Table III, Chapter 1. It is perhaps more common to regard nasal consonants as [-cont]; cf. Chomsky and Halle (1968) 317. However, I know of no cases in Navaho where the nasal consonants must be regarded as [-cont], and the present rule (rule 2a) is at least one case where they pattern as [+cont] segments.) Second, only [-nas] segments may separate the subject prefix from the stem. This implies that the rule will never apply in the perfective paradigm; as we will see, it is rule 2b that drops subject vowels (under slightly different conditions) in the perfectives. Finally, some prefix from part B, C, or D must be present. Since every verb form in lexical representation contains some inflectional prefix of part B, C, or D, this last condition will almost always be met. It is only when the readjustment rule given in (6b) above has applied that there will be a subject prefix (in this case 2 sg. /ni-/ ) not preceded by any prefixes of parts B, C, or D, and this is, in fact, the only situation in which a subject prefix (other than the 1 pl. /di-/ just discussed) retains its vowel in non-perfective paradigms. See the 2 sg. -hani- in (7) above and the 2 sg. form -ni- in Table II for instances where the 2 sg. subject prefix has retained its vowel.

Rule 2b also drops the vowel in part E subject prefixes, and, unlike 2a, is not restricted to apply to non-perfectives. However, notice that 2b drops only [-rnd] vowels, and thus will never drop the -o- of
the 2 pl. subject prefix /xo-/ . And, in fact, in perfectives the prefix /xo-/ remains intact until the metathesis rule given in rule 5 takes it to -ox- ; this -ox- then combines with the previous vowel (see rule 1a) to give the long -oo- characteristic of the 2 pl. forms in the perfective. Notice further that rule 2b applies only if the subject prefix has a [-son] consonant. This is true of all the subject prefixes except -ni-; thus, -ni- retains its vowel in the perfective paradigms (see Tables IV, V, and VI).

Rule 3a drops -n- before a stop. The only situation where -n- can precede a stop is in the passive forms of the perfective paradigms, where /n-/ (perfective) precedes /d-/ (passive classifier). Thus rule 3a deletes the /n-/ (perfective) prefix, but only in the passive. As has been mentioned above, the differences in the active and passive forms of perfective paradigms can be reduced to the presence vs. absence of the /n-/ perfective prefix. (The /n-/ of the perfective does have an effect in the passive forms of perfectives, namely in preventing rule 2a from applying; this is why 2a must precede 3a.)

Rule 3b is needed to drop the /n-/ of the perfective entirely in the case of the s-perfective, not only in passives but in actives as well. The s-perfectives are, in fact, unusual in not showing the high tone in their third person active forms that is characteristic of the other perfective paradigms and that is caused by the perfective prefix. /n-/

Rule 4 drops an -i- or an -a- from a part D prefix if a part B prefix but no part C prefix precedes and if no prefixes other than the classifiers /d-/ and /z-/ follow. Thus, in particular, the rule will not apply when there is a part E subject prefix present. Further, it
will only apply in perfectives when the /n-/ (perfective) prefix has been dropped (i.e., in the passive perfectives and in s-perfectives). The effect of rule 4 can be seen in Table III, Table V, and the passive forms of Table IV. Rule 4 is an unusual rule in that it applies in the environment of a preceding part B prefix but not in the environment of a preceding part C prefix, even though part C prefixes are closer to the segment affected by the rule. Nevertheless, this is the state of affairs. For example, rule 4 applies to * j1 ! " na + = to give ultimately -j1- (Table III) in the case of the part B prefix /j1-/; however, in * ! d1 " na + = , with the part C prefix /d1-/ (inceptive) the rule does not apply: the vowel in -na- is retained and appears as -e- in the phonetic -dee-. (In one form rule 4 does appear to apply when a part C prefix precedes, namely in passives of s-perfective forms. For example, the passive form -bi?disd- of Table V can only be explained if we assume that it exceptionally undergoes rule 4, deleting the vowel from the prefix /sa-/. If rule 4 did not apply to this form the vowel in -sa- would be retained and the other rules would apply yielding the output -bi?deesd. It is only the passive forms of the s-perfective that are exceptional. In other s-perfectives, part C prefixes do not trigger rule 4. For example, when the part C prefix /d1-/ (inceptive) appears before -sa- rule 4 does not apply and the result is what the rules predict, namely -dees-.)

It might be assumed that rules 2a and 2b could be collapsed with rule 4, since they are all rules that delete vowels in prefixes that occur close to the stem. However, this is not the case. Rule 4 must follow rules 3a and 3b, since it depends for its proper application on having been the -n- of the perfective dropped by these rules. On the other hand,
rule 2a must precede rules 3a and 3b, for the -n- perfective dropped by these rules is needed for the proper application of rule 2a.

Notice that rule 4 is unusual in still another way: it must refer in its environment to the particular classifier prefixes d- and 2- , since the rule does not apply when any other prefixes intervene between the vowel to be deleted and the stem. This oddity could be removed if we added a new positional boundary ";" (weaker than "+") to the system, where ";" would occur always between pl1 and pl2, separating the classifiers from the rest of the prefixes. Rule 4 could then be stated with the more natural environment *[[ ;]+[cns]] [[ ]] . The new boundary could also simplify the _n[-vc]_ of rules 6, 7a, 7b, and 9a to a formulation _[-vc]_ , which does not have to refer specifically to n- .
Rule 5 metathesizes any obstruent-vowel sequence that constitutes the only vowel-containing prefix in parts D or, alternatively, part E of a verb form. It will always apply in the case of the 1 pl. prefix /di-/. This prefix, whose vowel, recall, was not deleted by the rule (rule 2a) which dropped vowels in other subject prefixes, will always be metathesized to -id-. Its vowel will then combine with the vowel of the preceding prefix to produce the long -ii- (in the optative, long -oo-, by rule 11c) that characterizes 1 pl. forms. Rule 5 will also apply in the 2 pl. perfective forms where the subject prefix -xo- remains intact: -xo- will be metathesized to -ox-, and its vowel will then likewise combine with the vowel of the preceding prefix to produce the long -oo- that is typical of 1 pl. perfective (but not non-perfective) forms. Finally, rule 5 will apply in s-perfectives. This effect can not be seen in Table V because rule 4 has deleted the vowel of -sa- in all environments. However, when rule 4 does not apply, rule 5 will. For example, # * ! di " sa = + yields phonetic -dees- through the metathesis of -sa- and other rules (where /di-/ is the inceptive prefix), and # xa * ! " sa = + yields phonetic -haas- again via the metathesis of -sa- (where /xa-/) is the part A prefix meaning "up and out"); cf. (7) above.

Rule 6 simply deletes continuant consonants when they directly precede -n-. It accounts for the fact that the 1 sg. and 2 pl. subject prefixes lose their consonants in the active perfective paradigms (though not in the passive perfective paradigms, where the -n- has been deleted by rule 3a).
(Actually, notice that rule 3b deletes the n- of the perfective in both the active and the passive of s-perfectives. Thus, rule 6 cannot delete the consonants of the 1 sg. and 2 pl. prefixes in the active forms of the S-perfective; still, rule 6 should delete these consonants, since the active forms of the s-perfective are like the active forms of all perfectives in that these consonants are absent phonetically.

This problem cannot be solved merely by letting rule 3b follow rule 6, since rule 3b must precede rule 4, rule 4 must precede rule 5, and rule 5 must precede rule 6. Rule 3b must precede rule 4 since rule 4 drops vowels just when the n- of the perfective is absent, including those cases in s-perfectives where the n- of the perfective is absent because it has been dropped by rule 3b. Rule 4 must precede rule 5 since rule 4 drops vowels both in forms that undergo metathesis by rule 5 and in forms that do not; if rule 5 applied first, rule 4 could not have a general formulation. Rule 5 must precede rule 6 since the consonants dropped by rule 6 will not be in the proper environment (before n) until after the metathesis of rule 5 has been carried out.

It seems that this is a case where no linear ordering of the rules is possible. That is, the n- of s-perfective actives must be dropped early (before rule 4) for some purposes, but must be dropped late (after rule 6) for other purposes. Still, the changes carried out by the rules of Table X are so intricate and complex, it is possible that a different formulation of these rules would avoid this problem of ordering. The only reformulation that occurs to me, however, seems to involve a loss of generality. Specifically, rule 3b could be moved to the same point in the ordering as rule 8, so that the n- of the perfective would still be present in the active s-perfectives at the point when rule 6 applies, as desired. Then to rule 4
we could add another environment stating that a vowel drops also in the environment \([+\text{strid}]+[-\text{vc}]_0\) (that is, in the 3rd person forms of the s-perfective, as desired). This is not wholly satisfactory since this reformulation of rule 4 misses the generalization that the vowel drops just in those cases where the n- of the perfective has no phonetic effect. Still, there is no obvious way to improve the situation, and I must leave the discussion in this unsatisfactory state.)
Rule 7a takes the vowel in -na- in the third person active forms of Table IV to -i-, accounting for the fact that we get -ni-, -jini-, not -ná-, -jíná-, etc. It also operates in Table VI, accounting for the fact that -i- and not -o- is the vowel of the active third person forms.

Rule 7b guarantees that -?a- will become -?i- in the environment of a following pre-consonantal nasal. Its effect can be seen in Table III and in the passive of Table IV. Rules 7a and 7b represent part of the general tendency for vowels to go to -i- in parts D and E of the prefix system. Other such rules are 1d and 1e. Still, it is important to notice that these rules can not all be collapsed, for rules 1d and le must precede the subject-vowel dropping rule 2a, while rules 7a and 7b must follow the nasal-dropping rule 3a.

Rule 8 drops the -n- of the prefix -na- of Tables III and IV when a part C prefix precedes. It accounts for the disappearance of the -n- in the passive forms of Tables III and IV, since these contain the part C prefix /di-/ (passive).

Rules 9a and 9b were mentioned earlier in this section in the discussion of tone. 9a says quite simply that a short vowel becomes high in tone if it is followed by -n- and if it is the last prefix vowel. 9b then drops the -n-. Note that long vowels are not made high in tone by 9a. Consider, for example, the 2 pl. active form of Table IV. Just before the application of rule 9a this form has the representation -noon- , but 9a fails to apply since the vowel preceding the -n- is a long -oo-. Notice also that 9a and 9b cannot be collapsed into one rule that both absorbs a preconsonantal -n- and gives high tone on the vowel. The reason for this is that, whether or not a preconsonantal -n-
is in a position to cause high tone (i.e., after a short vowel) it is deleted. Thus, in the case just cited, where the preconsonantal -n- follows a long vowel, rule 9b is needed to delete the -n- even though 9a is inapplicable. Or take a case such as the 1 pl. active form in Table IV. Here the representation is -niidn- just before rule 9a, and though 9a does not apply (since the -n- does not follow a vowel), 9b must apply to delete the -n-.

Rule 9c is necessary to account for the high tone on the first syllable of the 2 sg. forms of all perfective paradigms. Notice that the rule applies to part D prefixes, and not to prefixes farther from the verb stem. Thus, compare the form -yîfin- with the form -yîninf- of the n-perfective (table IV). In a complete study of the prefix system rule 9c would be much more general since there are many situations where high tone is caused by assimilation. Still, all the other cases involve derivational prefixes that have been excluded from this work.

Rule 10 is entirely straightforward, merely dropping intervocalic -h-.

Rule 11a applies only in the last four forms of the optative paradigm (Table IX). For example, the 4th form is -jîôî- before 11a eliminates the first vowel, leaving -jîôî-.

Rule 11b is also illustrated by the forms of the optative paradigm, dropping the vowel after -ô- in the 1 sg. form as well as in the four forms affected by 11a. Notice that 11b does not apply to long vowels (the 1 pl. form, -hôiiîd- at this point, is not affected), nor to rounded vowels (the 2 pl. form -hôoôx- remains unchanged), nor to high tone vowels (the 2 sg. form -hôîî- retains the -î-).

Rule 11c shows that rounding of vowels undergoes progressive assimi-
lation. Its effect is seen in the 1 pl. form of the optative.

Rule 11d is much more general, asserting that the features high, low, and high tone undergo regressive assimilation. Its effect can be seen in the pas. of Tables III and IV, in the last four forms of Tables VI and VII, in all the forms of Table VIII except the 1 pl., and the 2 sg., 1 pl., and 2 pl. forms of Table IX.

Rule 12a is a rule of progressive assimilation of stridents. It applies only in the 1 sg. passive form of the a-perfective, taking -sis- to -sis-. Assibilations play a big role in the total phonology of Navaho, and their formulation is problematic. According to Sapir and Hoijer (1968) 1ff, most of the assibilations are regressive; they fail to note the existence of the progressive assimilation just cited. The problem is to give a general characterization of assibilations which explains why it is progressive in some cases and regressive in others.

Rules 12b and 12c, discussed previously, simply have the effect of taking word-initial -h- to -y- before -o- and to -y- elsewhere.

Rule 13a takes -e- to -i- after a word-initial sonorant. It will apply to those forms affected by rules 1b and 1c; i.e., the 1 sg. forms of Tables III, IV, VI, and VII, but not to the 1 sg. forms of Table V. This rule may turn out to be somewhat misleading if Sapir and Hoijer (1968)87 are correct in saying that -e- and -i- are in free variation in certain cases.

Rule 13b is necessary to account for the fact that the formative /xo-/ (impersonal subject) becomes -xa- when its vowel is the prefix vowel closest to the stem; cf., Tables II and IV.

Rule 14 simply states that all occurrences of the consonant -x- in the prefix system are realized as the glide -h- phonetically. Rules 10,
12b, 12c show why the -x- segments of the prefix system could not have been lexically -h-.

Finally, we have included under one rule in 15 an unusual phenomenon connected with the behavior of the prefix -?a-. As rule 15 is stated, when -?a- is preceded by a vowel and followed (though not necessarily directly) by a consonant in the prefix system, it loses its vowel and the -?- itself clusters with the last consonant in the prefix system. (In the next chapter we will see that by the time rule 15 applies, all the instances of the -d- passive prefix of position pl1 will have been deleted, so that it will not serve as the [-voc] in the environment of rule 15.) The effect of rule 15 in Tables II through IX is simply in the dropping of the vowel in -?a-. However, if other prefixes are present, the effect is more complex. For example, a verb form with the lexical representation # " bi - ?a ! di - di - ni " hi - d = (the passive imperfective with two derivational prefixes /di-/ and /ni-/ ) is phonetically -bididi?ni. The source of the high tone need not concern us. What is of interest is that rule 15 has caused the -?- to hop over the sequence -didif- to land in front of the sequence -ni-. 
CHAPTER SIX

STEM-INITIAL POSITION

1. In this chapter we will extend the discussion of Chapter 5 to include the stem-initial consonants of the verb and the prefixes that cluster with or cause changes in the stem-initial consonant. One of the main points that will emerge from the discussion is that there is no contrast in lexical representation between voiced and voiceless fricatives in stem-initial position, even though phonetically such contrasts as $x$-$y$, $s$-$z$, $s$-$z$, and $l$-$l$ are widespread there.

Recall that the representations given in the right-hand columns of Tables II through IX in Chapter 5 were not phonetic representations; rather, these representations were simply the output of the rules given in Chapter 5 (Table X). It is the purpose of the present chapter to give the remaining rules, rules that will map these output representations of Chapter 5 onto the phonetic representations. It should be stressed that the rules describing the phonological behavior of prefixes are separated into two groups (Chapter 5 and the present chapter) only for reasons of exposition; there is no theoretical significance to be attached to this grouping.

There are three main ways in which the phonological rules of Chapter 5 are incomplete. First, they do not provide for the behavior of the classifiers (the pl1 prefix /d-/ and the pl2 prefix /z-/); that is, the rules of Chapter 5 were formulated for the special case of verbs which had neither of the two classifiers. Second, notice that the 1 sg forms, the 1 pl forms, and the 2 pl forms typically end in consonants (-$s$-, -$d$-, and -$h$-, respectively) in the output (right-hand column) representations of Chapter 5; these consonants undergo collapsing with the
following stem-initial consonant (or classifier) in a way not described by the rules of Chapter 5. Third, notice that the third person forms of the s-perfective paradigm (Chapter 5, Table V) end in the consonant -s-; this -s- also undergoes collapsing with a following consonant according to principles yet to be accounted for. The rules presented in the present chapter will, therefore, be concerned precisely with these three areas.

The data relevant to the kinds of phenomena just mentioned may be conveniently displayed by considering the behavior of just five prefix combinations; these are listed in (1) in the form in which they appear in output representations of Chapter 5 together with a reference to the place in Chapter 5 where the combination occurs.

(1)  
(a)  \( yi^- \)  3  Table II (h-imperfective)  
(b)  \( yi^\hat{s}^- \)  1sg. " " "  
(c)  \( yiid^- \)  1pl. " " "  
(d)  \( Yoh^- \)  2pl. " " "  
(e)  \( ?as^- \)  ind. Table V (s-perfective).

In other words, in the tables we present below, we will use \(-yi^\hat{s}^-\) to illustrate the way 1 sg -\( \hat{s}^- \) collapses with the consonant(s) that follow, \(-yiid^-\) to illustrate the collapsings of 1 pl -d-, \(-Yoh^-\) for 2 pl -h-, \(-?as^-\) for the -s- of the s-perfective in third person forms, and \(-yi^-\) to illustrate how prefixes ending in a vowel combine with what follows.

Tables I through VII below give a systematic presentation of the facts regarding just how the forms of (1) combine with the following
<table>
<thead>
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<th>Output representations of chapter 5</th>
<th>Phonetic classifier initial</th>
<th>Phonetic examples</th>
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**TABLE I**
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</table>

**TABLE VII**
classifier and stem-initial consonant. Most stem-initial consonants remain unchanged by the prefixes that precede them, these are listed in (2).

(2) /b d t t' j c c' j ɛ ɛ' ʌ ʌ' ɡ k k'/

The way in which prefixes cluster with these stem-initials is illustrated below in Table I, where stem-initial /t/ has been arbitrarily chosen for use in the examples.

The other stem-initial consonants do show changes under the influence of the prefixes. According to the analysis that we are proposing, these consonants are; in lexical representation:

(3) /? Y l z ɛ n m y/

Of these, stem-initial /y/ is rare; it seems to participate in morphophonemic alternations with /z/, but examples are so few and the pattern so erratic that there is little point to considering them further. Stem-initial /m/, also rare, behaves like /n/ and will not be treated separately. The rest of the stem-initials in (5) combine with prefixes as indicated in Tables II through VII below. Table I illustrates (with -t- ) the stem-initial consonants of (2), the stem-initial consonants that are never affected phonetically by what prefixes precede. Each of Tables II through VII illustrates a particular one of the stem-initial consonants of (3), the stem-initial consonants that are altered in the indicated ways by preceding prefixes.

For the stem vowel of the verb we simply use -a- in the above
tables; thus we are ignoring all alternations of stem vowels (and all final consonants as well), since these are not germane to the problem at hand. This aspect of the presentation of the tables should be carefully noted, to avoid confusion. In particular, note that the forms listed in the tables are incomplete. This is simply to maintain uniformity; actual verbs illustrating the relevant phenomena can be found in Young and Morgan (1943b) by referring to the examples cited in the last column of the tables.

Tables I through VII illustrate the way the forms listed in (1) (themselves the output of the rules of Chapter 5) combine with a following consonant. The lettering "a" through "e" corresponds to the lettering of (1), in each of the tables. Further, in each table, the forms numbered "1" have no classifier ("∅-classifier" in the terminology of the literature; see Young and Morgan (1943a) 45-46, Sapir and Hoijer (1968) 25); the forms numbered "2" have just the pl1 prefix /d-/("d-classifier" in the literature); the forms numbered "3" have just the pl2 prefix /z-/ ("z-classifier" in the literature); finally, the forms numbered "4" have both /d-/ and /z-/ (in the literature these are referred to as "l-classifier" because of the -l- prominent in the phonetic representations of this paradigm; we will give ample justification below that the l-classifier is derived from -l- plus -l-, as our tables imply). We are suggesting that classifiers are present in a few cases where they have not traditionally been recognized as being present; this is particularly true of the classifier of Tables V and VI. However, our decisions will be supported fully as we proceed. Meanwhile, notice that we have included the traditional classifier terminology in the third column of the tables so as to aid comparison
with the literature.

The fourth column of each of the tables gives the "phonetic stem-initial" consonant. This is simply the phonetic shape taken by the stem-initial consonant (for a particular combination of classifiers) when this stem-initial consonant is not influenced by a preceding subject prefix; that is, it is the phonetic shape taken by the "a" forms of the tables. The phonetic stem-initial is listed primarily because Young and Morgan list verbs alphabetically according to this, rather than according to the lexical representation of the stem-initial consonant. Thus, for example, consider Table III. Young and Morgan would list the $\theta$-classifier form of a verb with -Y-initial under -Y-, but the causative of such a verb, formed by prefixing $-\underline{\lambda}$-, would be listed under -x- in their dictionary since, phonetically, $-\underline{\lambda}$- causes a following -Y- to devoice to -x-.

Tables I through VII are all constructed with just the five particular prefix combinations listed in (1). However, all other prefix combinations behave analogously. For example, any 1 sg form of Tables II through IX in Chapter 5 whose (output) representation ends in -$\gamma$- will behave exactly like the "b" forms of Tables I through VII in the present chapter with respect to combination with following classifiers or stem-initial consonants. Thus Tables I through VII above suffice to represent the full range of data under consideration.
2. Before proceeding to justify the lexical representations for prefixes and stem-initials in Tables I through VII above, we present in Table VIII below, a set of rules that will map the input representations of these tables onto the corresponding phonetic representations.

1. Voicing

\[ [+\text{cont}] \rightarrow [+\text{vcd}] \]

\[
\{ [+\text{voc}] \quad + \quad = \}
\]

(1)

\[
\{ d \quad = \quad = \}
\]

(2)

2. D-effect

(i) \( d = ? \rightarrow t' \)

(ii) \([+\text{nas}] \rightarrow [+\text{glot}] \quad / \quad [-\text{cont}] \quad = \quad [+\text{voc}]\)

(iii) \([-\text{cont}] \rightarrow \emptyset \quad / \quad = \quad [-\text{voc}]\)

3. Devoicing

\[ [+\text{cont}] \rightarrow [-\text{vcd}] \quad / \quad [-\text{vcd}] \quad = \quad = \]

4. Lateral deletion

\[ [+\text{lat}] \quad / \quad ( = ) \quad [+\text{cont}] \quad = \quad = \]

\[ +\text{cor} \quad / \quad +\text{cor} \quad = \quad = \]

5. Strident assimilation

\[ [+\text{cont}] \quad / \quad [+\text{ant}] \quad / \quad = \quad = \]

6. Cluster simplification

\[ [-\text{voc}] \rightarrow \emptyset \quad / \quad = \quad [-\text{voc}]_2 \]

**TABLE VIII**
Rules (li) and (lii) apply in exactly the same way in all the tables, and we will discuss them first. Rule (li) applies only to forms numbered (le) in the tables, since only there is there a continuant occurring before the boundary "+" with no classifiers separating it from the stem-initial boundary "="; (li) voices the -s- of the s-perfective to -z-.

Rule (lii) applies to forms (3c) and (4a-e); its effect is to voice the -ξ- classifier to -l- whenever it is preceded by the -d- of the passive prefix or of the 1 pl subject prefix. The application of the remaining rules is best discussed by looking at each table individually.
3. Consider first Table I. Assuming that rules (i) and (iii) have already applied as described above, the next rule to apply is (2iii); it deletes every occurrence of -d- from passive and first person plural subject, and so applies to forms (1c), (2a-e), (3c), and (4a-e). Notice that in the cases where there are two occurrences of -d- in the same form (that is, in forms (2c) and (4c)), rule (2iii) deletes both of them. This follows since, in applying any rule, we first mark all segments that meet the environmental conditions and then carry out the change specified by the rule for all segments so marked. In the case of rule (2iii), we mark every [-cont] segment that occurs before a [-voc] segment, so that, in particular, we mark both of the above-mentioned -d- segments; then we delete all the segments so marked.

(See Chomsky and Halle (1968), Chapter 8, for a discussion of the conventions of rule application. See also section 6 below, where it turns out that another rule simplifies these -d-d- sequences.)

The main effect that the -d- segments just deleted have in Table I is in form (2e), where it is the -d- passive that keeps the -s- from being devoiced by rule (i); cf. form (1e) where -d- passive is absent and where the -s- is voiced. In the following tables the effect of the -d- will be much more pronounced.

The devoicing rule (3) applies to forms (4b, d, and e), devoicing the -l- that was voiced by rule (iii); clearly rule (3) must follow rule (2iii). As an alternative, rule (3) could be dispensed with in Table I, provided we added to the environment of rule (iii) and stipulated that a voiceless continuant does not precede the [-cont] mentioned in the environment. Still, this addition seems somewhat unnatural; moreover, we will see that rule (3) plays a much more crucial role in Tables III through VI.
As can be seen from forms (3b, e) and (4b, e), the lateral classifier is dropped after -s- and -š-. Since -s- and -š- are both voiceless coronal continuants, this phenomenon can be accounted for by the lateral deletion rule (4) if we include the rightmost but not the leftmost occurrence of "____ = ". In fact, rule (4) is to be understood as a rule schema that expands into two rules, one applying in the environment 

____=[+cont, +cor, -voc] and the other applying in the environment 

[+cont, +cor, -voc] ____ = 

Deletion of laterals in the first environment will be seen in Tables V and VI. The fact that we collapse the two rules into one rule schema (4) implies that, in our opinion, it is no accident that laterals happen to be deleted both before and after -s- and -š-. However, it is surely incorrect to claim that every rule that applies in both environments ____ X and X ____ is more general in a linguistically significant way than the same rule applying in just one of these environments. This would mean, for example, that a rule that shortens vowels both before and after voiceless consonants is more general in a linguistically significant way than a rule that shortens vowels just before voiceless consonants, and this is clearly false. It is an interesting though non-trivial task to determine just which processes are linguistically more general as processes operating in mirror image environments than in one-sided environments.

Finally, in form (4d) of Table I we would expect -Yoḥlta... phonetically, but we get -Yoḥta... instead. Thus rule (6) simplifying clusters of three or more consonants is needed; it applies in a similar fashion in (3d). It must follow rule (4), lest -s- and -š- rather than -š- be deleted by rule (6) in forms (3b, e) and (4b, e).
The use of -d- in passive and first person plural subject is shown to be unavoidable when the forms of Table II are considered, since this -d- changes a following -?- to -t'-; cf. Table II (1c, 2a-e). The rule that brings about this change is (2i). This rule could be given a distinctive feature formulation if it applied in two stages, the first stage glottalizing the -d- in the presence of a following -?- , the second deleting the -?- . However, we will leave (2i) as it stands for now, pending later discussion of the relation among (2i), (2ii), and (2iii).

Rule (2i) is the only additional rule needed in Table II; all the other forms are handled exactly as in Table I.

Notice that we are now prepared to give strong support to the hypothesis that the 1-classifier is in fact derived from an underlying /l-/ causative under the influence of a preceding /d-/ passive. For the forms of Table II show that the passive prefix and the first person plural subject prefix have exactly the same effect on what follows and, thus, quite plausibly, end in the same consonant (-d-). Moreover, forms (3c) of all the tables show that the first person plural subject prefix causes a following -l- classifier to go to -l-. Thus, regardless of how the passive forms are handled, we need a rule that voices -l- after -d- , and this rule is all that is needed to derive the 1-classifier from -l- under the influence of a preceding passive -d- . This means that there is phonological justification for deriving -l- from -d- plus -l- to add to the obvious morphological justification for so doing (1-classifier forms are the passive counterparts to l-classifier form).

An independent argument showing that 1-classifier is derived from -d- (passive) plus -l- (causative) is provided by the two exceptional verbs which lexically have no initial consonant; these verbs are #61.3 "to go
(singular subject)" and #81.1 "to eat" (see Chapter 1, section 3). Verb
#138.3(2) gives a case where the causative prefix -ι- has been added to
verb 61.3. Now the crucial point is that the passive forms of this verb,
formed by prefixing the passive prefix -d- , show -λ- phonetically.
For example, the future passives are of the form [ ... doolaaλ ]
If we went along with the traditional idea, which is simply to state that
the passive form of the causative prefix -ι- is -λ- , then we would
expect [ ... doolaaλ ] for these forms (which would be lexically
/...di"ho+1=aa=ι/). The -λ- that actually appears is explained by our
analysis, which says that the passive form of the causative prefix -ι-
is formed by prefixing the passive prefix -d- to -ι- (so that the lexi-
cal representation would be / ... di"ho+d-ι=aa=ι/ ). This follows
since, as we will see in discussing Table IV, there is widespread indepen-
dent evidence that intervocalic -d-ι- becomes -λ- .

Incidentally, these same exceptional verbs which have vowel-initial
lexically give strong independent support for the analysis we have adopted
which includes the specific consonant -d- in the lexical representations
of the passive (/d-/) and the 1 pl subject prefix (/di-/), since this
-d- actually shows up phonetically in these vowel-initial verbs; that is,
both the passive and the 1 pl forms of these verbs phonetically have a -d-
before the stem. As an example, consider the form [diīdîγι1]-
"we will eat it," where the medial -d- is from 1 pl subject /di-/
(metathesized to -id- by rule 5, Chapter 5); this -d- is not deleted by
rule (2iii) of Table VIII above since the verb stem has vowel-initial lexi-
cally:/...+di=ii-n-?=/. In the normal verbs, all of which have consonants
in stem-initial position lexically, this -d- never shows up as such in
phonetic representations (though the -d- still manifests itself indirectly
in many ways that we discuss in this chapter).
5. In Table III we have used an underlying \(-\text{Y}\)-stem-initial consonant for what shows up variously as \(-\text{Y}\)-, \(-\text{x}\)-, and \(-\text{g}\)- phonetically. In fact, \(-\text{Y}\)- is the only source for phonetic stem-initial \(-\text{Y}\)- and \(-\text{x}\)-; that is, Table III (1), (3), and (4) represent the only possibilities for deriving phonetic stem-initial \(-\text{Y}\)- and \(-\text{x}\)-. However, phonetic stem-initial \(-\text{g}\)- can be derived either from a lexical \(-\text{Y}\)- under the influence of a preceding \(-\text{d}\)- classifier, as in Table III (2), or from a lexical \(-\text{g}\)- (regardless of what classifiers are present), analogous to \(-\text{t}\)- in Table I.

It is interesting to note that, in the case of non-causative passive forms, it is impossible on phonological grounds to distinguish between an underlying \(-\text{g}\)-initial and an underlying \(-\text{Y}\)-initial. Thus, we have a case where whole paradigms are homophonous; the paradigm represented in Table III (2) is phonetically identical in every respect with the corresponding paradigm with underlying \(-\text{g}\)-instead of \(-\text{Y}\)-stem-initial. Given such a paradigm we would assign it lexical \(-\text{Y}\)-stem-initial only if the forms were recognizable as the passive forms of corresponding actives with phonetic (and thus lexical) \(-\text{Y}\)-stem-initial; otherwise we would assign it \(-\text{g}\)-stem-initial lexically. Thus, for example, the form listed as an example of phonetic \(-\text{g}\)-stem-initial in Table III (2) is verb \#73.1(1), which means "to commit suicide," and this is obviously related to the example of phonetic \(-\text{Y}\)-stem-initial listed in Table III (1), verb \#75.2(1), which means "to kill." (Reflexive and reciprocal forms require the passive prefix \(-\text{d}\)- in Navaho; cf. Young and Morgan (1943a) 61.)

It is not, of course, possible to derive all cases of phonetic stem-initial \(-\text{g}\)- from lexical \(-\text{Y}\)-under the influence of a preceding /d-/
passive prefix. For one thing, not all phonetic \(-g-\) initial verbs are
construable as passive on semantic grounds. Further, such an analysis
would not be able to account for the cases where \(-g-\) initial verbs appear
with \(-l-\) and \(-l-\) classifiers; cf. verbs \#91.1(1), \#74.2(1).

The most significant aspect of the analysis implied by Table III is
that all occurrences of phonetic \(-Y-\) initial and of phonetic \(-x-\)
initial are derived from a single underlying consonant, \(-Y-\). The reason
for using \(-Y-\) instead of \(-x-\) as the underlying consonant is, at this
point, not obvious; we will argue below that \(-Y-\) is indeed the correct
choice. However, the fact that \(-Y-\) and \(-x-\) have just one source lexically
(whether it be \(-Y-\) or \(-x-\)) is much easier to demonstrate. For it is
the case that every verb with phonetic stem-initial \(-x-\) appears with the
\(-l-\) causative prefix (as in Table III(3)); moreover, no verb with phonetic
stem-initial \(-Y-\) appears with the \(-l-\) causative prefix (but only with no
classifier, as in Table III (1), or with \(l-\) classifier, as in Table III (h)).
(There is actually one exception to the former statement, namely verb \#93.1,
but this seems to be a verb recently formed from a noun; there are no excep-
tions to the latter statement.) Thus it is clear that there is no real
contrast at the lexical level between stem-initial \(-Y-\) and \(-x-\),
since which one appears is always predictable from the classifier(s). There
are, nevertheless, phonetic minimal pairs which involve \(-Y-\) and \(-x-\)
(for example, Table III (3d) and (4d)), so that the lexical representations
are not biuniuquely related to the phonetic ones. However, biuniqueness is
never required of a level as abstract as the lexical level (the traditional
morphophonemic level).

The two main rules used in the derivation of the forms in Table III
were not (crucially) needed in Tables I and II; they are (2ii) and (3).
Rule (2ii) is actually a rule schema which expands into two rules, one including the material in angled brackets ⟨ ⟩, and the other not including this material. (For discussion of the angled bracket notation, see Chomsky and Halle (1968) 76.) It is the latter rule that applies in this case; that is, the rule \([-\text{voc}] \rightarrow [-\text{cont}] \lor [-\text{cont}] \) \([+\text{voc}]\). The only case where a continuant consonant can appear before a vowel and after a stop is the case of a stem-initial continuant appearing after a -d- from the prefix /d-/ passive or /di-/ first person plural subject. Thus, in Table III, the stem-initial -Y- is made [-cont] in forms (1c) and (2a-e). Actually, to effect a change from -Y- to -g- we [+cont] to [-cont] but also not only have to change \([+\text{voc}]\) to \([-\text{voc}]\) since, in Navaho, all non-nasal stops are unvoiced. However, there is already a redundancy rule to this effect in the grammar; that is, a rule [-cont, -nas] \rightarrow [-voc]. We will assume that this rule remains in effect, and brings about the necessary change to \([-\text{voc}]\). (See Stanley (1967) 402 and Chomsky and Halle (1968) 419ff for further discussion of this use of redundancy rules.)

Clearly, rule (2ii) must precede rule (2iii), which applies in Table III in just the way it applied in Tables I and II. Note also that the [+voc] specification is needed in the environment of rule (2ii), for even though the -d- classifier is always voiced to -l- by a preceding -d- by rule (1ii), rule (2ii) only takes this -l- to -l- in the case of the vowel-initial verbs just discussed; in the normal case of consonant-initial verbs rule (2ii) does not apply to the -l- prefix following -d-, and rule (2iii) drops the -d-, leaving only the -l- (seen in Table III (ic), (4a, c)).
Rule (3) is the rule that devoices stem-initial -Y- to -x- following the voiceless segments -s- (form (1b)), -h- (form (1d)), and, most important, -l- (forms ja, b, d, e)). Note that the -Y- of Table (3c) is, as desired, not devoiced by rule (3), since the prefix before it is -l-, having been voiced by rule (iii) from -l-.

Finally, to complete the discussion of Table III, notice that rules (4) and (6) apply in just those cases where they applied in the previous two tables. However, in Table III the lateral deletion rule (4) has the interesting consequence that obstruct clusters whose members differ in voicing appear in its output; cf. Table III (4b, e). This is in fact the desired phonetic result; cf., Young and Morgan (1943b) v; Sapir and Hoijer (1968) 33(f). This result is obtained notwithstanding the fact that there is a devoicing rule (3) which devoices continuants after unvoiced sounds, since the lateral deletion rule (4) follows the devoicing rule (3). Notice further that the phonetic sequence -lY- occurs in Table III (4d). In this case, we have the derivation Yo+h-d-4=Ya.. → (rule iii) Yo+h-d-l=Ya.. → (rule 2iii) Yo+h-l=Ya.. → (rule 3) Yo+h-l=Ya.. → (rule 6) Yo+l=Ya; the crucial point is that in the application of rule (3) only the -l-, and not the -Y-, becomes devoiced.
6. Moving on to Table IV, let us consider first the sets of forms (1) and (2), where the -\( \lambda \)-classifier is not present. These forms behave in an exactly analogous fashion to the -\( Y \)- initial forms of Table III (1, 2). The same rules apply in each case, and nothing more need be said. (Recall that, in Navaho, -\( l \)- is not a "liquid," but a voiced lateral fricative exactly on a par with /\( Y \), \( Z \), and \( Z' \). Moreover, -\( \lambda \)- is the [-cont] counterpart to -\( l \)-, just as -\( g \)- is the [-cont] counterpart to -\( Y \).)

However, the parallelism between Tables III and IV ceases when forms with the -\( \lambda \)- classifier are considered. For example, since Table III (3c) has [yi\( \lambda \)la..] , we would expect [yi\( \lambda \)lla..] for Table IV (3c), but instead we get [yi\( \lambda \)la..]. Similarly, all the forms of Table III (4) have -\( Y \)- initial phonetically, but Table IV (4) shows -\( \lambda \)-, not -\( l \)-. Finally, we would expect [yi\( \lambda \)la..] and [yo\( \lambda \)la..] for Table IV (3a and 3c'), respectively, but get [yi\( \lambda \)la..] and [yo\( \lambda \)la..] instead.

Clearly, a degemination rule is needed to explain the lack of parallelism between the two tables. In the left-hand column representations of Table IV (3 and 4) there are no geminate clusters. But as soon as the voicing rule (iii) voices the -\( \lambda \)- classifier when it is preceded by -\( d \)-, geminate clusters -\( l \)l- result in forms (3c) and (4a-e). Suppose at this point (that is, between rules (1) and (2) of Table VII) we let the degemination rule stated in (4) apply:

\[ (4) \text{ degemination:} \]

Delete the first of two identical consonants.
(This informal prose statement of the rule will suffice for our purposes; Chomsky and Halle (1968) Chapter 8 discusses the sorts of formalism necessary to give a more formal statement of processes such as degemination.) Clearly, rule (4) will apply to delete the -h- classifier that has just been voiced to -l- by rule (iii), Table VIII, in forms (3c) and (4a-e), Table IV. It is easy to see that the remaining rules of Table VIII will now suffice to produce the correct phonetic forms of Table IV. In particular, rule (2) produces a -l- in the forms just discussed; a crucial point for the discussion of the later tables is that the degemination rule (4) must precede rule (2).

In summary, then, we see that the degemination rule is responsible for the appearance of phonetic stem-initial -l- in the set of forms (4) of Table IV, rather than the -l- that would be expected by analogy with the -Y- that appears in the set of forms (4) of Table III. As far as the forms of Table IV are concerned, the degemination rule (4) could simply be placed between rules (1) and (2) of Table VIII in the ordering. However, the forms of Tables V and VI will provide evidence that the ordering of the degemination rule (4) is not so straightforward.

It is important to notice that the "m" boundary is necessary in the statement of the lateral deletion rule (4), since, otherwise, the stem-initial lateral would be incorrectly deleted in Table IV (3a, e).

Notice that, just as there is no contrast between -h- and -x- in lexical representations (see section 5), neither is there a contrast between lexical -l- and -h-; verbs with phonetic -l- initial all have underlying -h- classifier. As further support for this analysis, we may note that the verbs listed as having -l- initial in the dictionaries all
seem to be causative in force, and quite frequently the corresponding non-causative form will be found under -l- initial verbs; e.g., verb #123.2 with stem-initial -l- phonetically has a causative form #140.1 with -l- initial phonetically. Young and Morgan even note (193b) 138 that "the stems given as 2 initial are quite probably 1-initials with the 2-classifier inserted."

Finally, note that it is not possible to derive all cases of phonetic -λ- in stem-initial position from an underlying -l- (as in Table IV (2 and 4)), since this would not explain the fact that verbs with -λ- initial phonetically can occur with the 1-classifier (#54.3(1)), as well as with 2-classifier (#52.1). Thus, again, there is homonymy of whole paradigms, since the phonetic forms of Table IV (2) could have been derived either from -l- or from -λ-. In fact, for -l- initial verbs, the passive and the passive causative paradigms are homophonous (Table IV (2 and 4)).
7. In Table V are listed verbs which, we propose, all have lexical -z- as stem-initial. At first such an analysis does not seem possible since there is a fairly clear contrast between the verbs with -z- stem-initial phonetically in Table V (1) and the verbs with -s- stem-initial phonetically in Table V (3). However, it is important to note that every verb with -s- initial phonetically that is listed in the dictionaries has a mysterious -1- inserted in the first person plural subject forms (whereby the following -s- becomes -z- ); cf. Table V (3c).

It is not hard to see that the apparent contrast of -s- and the inserted -1- can both be explained if verbs with phonetic -s- as stem-initial are derived from lexical -z- stem-initial in the presence of the -1- classifier, as is implicit in the lexical representations of Table V. Such an analysis, of course, brings the -z- initial verbs into close parallelism with the -x- and -1- initial verbs already discussed, but it must be emphasized that the analysis is motivated on the basis of the forms in Table V alone.

All that is required, to allow for a derivation of -s- from -z- in the presence of -1-, is the addition of the part of the lateral deletion rule (h) that drops lateral continuants before -s- and -x-; that is, we need the case of rule (h) that applies in the environment

\[ [+\text{cont}, +\text{cor}, -\text{voc}] \quad \text{(whereas previously we have only used the case of rule (e) that applies in the environment [+cont, +cor, -voc]} \quad \] = \}

This new case of the lateral deletion rule applies in Table V (3a, b, d, e); note carefully that it doesn't apply in (3c), since there we have the sequence -1z- where the coronal continuant is not [-voc].
Rules (2ii), (2iii), and (3), the original case of (4), and (6) apply in essentially the same way as they have in the previous tables. In particular, rule (2ii) takes -z- to -j- in the presence of a preceding -d-. What is different about Table V is the complex interplay between the degemination rule (4) and the assimilation rule (5). Before discussing these rules it will be helpful to bring the forms of Table VI into consideration. Here the situation is exactly analogous to that of Table V; note that verbs with -z- initial phonetically have the same -l- appearing in the first person plural subject forms (Table VI (3c)), whereby the following consonant is voiced. But in the cases where -l- appears before -z-, the -l- is dropped. This is the reason that rule (4) can indeed refer to all voiceless coronal continuants in its environment.

Consider now rule (5). In Table V it applies in all the "b" forms, taking -s- to -z- in the presence of a following -z- (4b), -s- (1b, 3b), or -j- (2b). (Recall that the [+strid, +cor] consonants are s, z, c, j, š, ž, č, j.) Thus, note that rule (5) must follow the lateral deletion rule (4). In Table VI rule (5) applies in all the "e" forms, taking -s- to -š- in the presence of a following -š- (3e), -ž- (4e), or -j- (2e), and taking -z- to -ž- in the presence of a following -ž-. Rule (5) also applies in the case of verbs with stem-initial /c, j, š, ž/ in the expected fashion.

We now come to the discussion of the degemination rule (4). It is not hard to see that if this rule retains the place in the ordering assigned to it in the last section (between rules (1) and (2) of Table VIII), the correct results will not be obtained in Tables V and VI. The crucial forms
are the (3e) forms of Tables V and VI; these show clearly that the degem-
ination rule (4) must follow the lateral deletion rule of Table VIII.
Further, forms (4a-e) of these tables show that the lateral deletion rule
itself must follow the d-effect rule (2) of Table VIII, since otherwise
we would get -j- and -j- as the phonetic stem-initial in these forms.
The conclusion is that, as far as the forms of Tables V and VI are con-
cerned, the degemination rule must follow the d-effect rule (2). How-
ever, we saw from Table IV that the degemination rule must precede rule
(2). This apparent dilemma can be solved if we let the degemination
rule both precede and follow rule (2). In fact, we will say that the
degemination rule is a "persistent rule," meaning a rule that applies at
each point in the ordering; see Chafe (1967) for a discussion of persis-
tent rules. It is not difficult to see that this procedure will lead to
the correct results in all the forms (Tables I through VI) considered so
far. In particular, in Table V the degemination rule applies to form (1e)
after rule (1ii), to form (3e) after rule (4), and to forms (1b) and (3b)
after rule (5). In Table VI it applies to form (1b) after rule (3), to form
(3b) after rule (4), and to forms (1e) and (3e) after rule (5).
8. Finally, consider the last table, Table VII. Here the situation is exactly the same as in Table I, except that in the presence of a preceding -d-, stem-initial -n- is glottalized to -n'-. This change is accomplished by the case of rule (2ii) that includes the material within the angled brackets. Rule (2iii) will then drop the -d- before the -n'-, and all the forms of Table VII are accounted for.

To summarize the discussion up to this point, we have suggested that the following consonants appear at stem-initial position in lexical representations.

<table>
<thead>
<tr>
<th>5</th>
<th>b</th>
<th>d</th>
<th>j</th>
<th>j'</th>
<th>l</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>c</td>
<td>c'</td>
<td>k</td>
<td>z</td>
<td>l</td>
<td>Y</td>
</tr>
<tr>
<td>t'</td>
<td>c'</td>
<td>c'</td>
<td>k'</td>
<td>m</td>
<td>n</td>
<td>y</td>
</tr>
</tbody>
</table>

The prefix combinations that end in consonants in the output of the rules of Chapter 5 combine with and cause changes in the stem-initial consonant in a way that is illustrated in Tables I through VII above and described in the rules given in Table VIII (plus the degemination rule (4)).
9. In this section we will comment in some greater detail on certain aspects of the analysis that has been presented above.

It is voiced continuants /r, s, z, l/ that have been used in lexical representations in stem-initial position, rather than voiceless continuants /x, s, z, l/. Actually, it is possible to use voiceless continuants; we would simply have to add to Table VIII a rule (liii) which voiced stem-initial continuants when they are preceded by voiced segments. Rule (liii) would have to follow rule (l ii), which voices the 1-classifier after -d-, since stem-initial continuants are in fact voiced after the l-classifier (cf., Tables III-VI (3c, la-e)). Thus rule (l iii) would have the effect of voicing stem-initial continuants everywhere except after voiceless consonants. However, note that, since rule (3) devoices stem-initial continuants after voiceless segments, the environmental restriction on rule (l iii) is not necessary at all, and it would thus be stated as a rule that voiced stem-initial continuants everywhere. But then, the rule serves no purpose except to allow the stem-initial continuants to be voiceless lexically; the preferable solution seems to be the one we have adopted, namely to exclude rule (l iii) altogether and to let the continuants in stem-initial position be voiced lexically. (Notice that there does not seem to be any possibility to save rule (l iii) (and thus the voiceless continuants in lexical representation) by collapsing it with the other voicing rules (li) and (l ii), since, as pointed out above, rule (l iii) would have to follow (l ii).)

This situation is interesting for two reasons. First, recall that in Chapter 3 we saw that, in stem-final position, it is the voiceless continuants that occur in lexical representations. Thus, lexically, in
stem-initial position there are only voiced continuants, in stem-final position there are only voiceless continuants, in our analysis. As it happens, it would be a relatively straightforward matter to alter the analysis of stem-final consonants, having voiced continuants in lexical representations and having a rule which devoices word-final continuants (instead of the previous rule that voiced continuants before a word-final vowel). But this leads to the second point; namely, that to have only voiced continuants and not their voiceless counterparts in lexical representations is rather odd in light of the fact that for obstruents, the voiceless segments are unmarked and the voiced segments marked; cf. Greenberg (1966), Chomsky and Halle (1968).

At the moment I can see no really compelling reasons for adopting one or the other of the above-discussed proposals regarding the voicing of continuants in lexical representations. It is in such a situation as this that one could call upon the evaluation measure provided by linguistic theory to make the decision, if a well-motivated evaluation measure were available; see Chomsky (1965) 37ff for a discussion of evaluation measures. However, there is no formulation of an evaluation measure for phonology that I am familiar with that is well enough motivated by its success in clear cases (where we already know the right answer on linguistic grounds) to justify its use in the rather complex problem at hand. It has been suggested that the evaluation measure be formulated in terms of the length of the proposed grammars, so that the shorter grammar is the more highly valued. Clearly, though, this suggestion does not, in itself, characterize a specific evaluation measure; rather, it represents a decision about the general form that evaluation measures should take.
Once this decision is made, the largest task still lies ahead. Namely, we must still construct a theory of distinctive features, a theory of rules and their application, a theory of notational conventions which tells us what sets of rules involve a linguistically significant generalization and can thus be collapsed to a shorter and thus more highly valued formulation, etc. Moreover, each aspect of this theory construction must be verified empirically by showing that in a large number of clear cases grammars constructed according to the theory and chosen by the evaluation measure are known, on independent grounds, to be the correct grammar. It is somewhat ludicrous to proceed, as many have, to take a largely unjustified set of distinctive features and formalism for writing phonological rules, to write several grammars for a given language, and then to select the shortest such grammar and proclaim it to be the correct grammar.

Returning to the discussion of the stem-initials, some remarks are in order concerning the two voicing rules (li) and (lii). Rule (li) is fairly natural, though rule (lii) is not. That is, voicing continuants after -d- is not a plausible rule, especially since, in this case, the -d- that occurs in the environment is voiceless; see Chapter 1. It seems to me that a more plausible solution would involve a lexical representation /di-/ for the passive, instead of /d-/ . Then, with an appropriate theory of boundaries, the voicing rule could simply voice stem-initial continuants when they are preceded by a vowel, provided boundaries of a certain strength did not intervene; e.g., the /di-/ passive would voice a following continuant, but the /di-/ inceptive prefix would not since the boundary "+" intervenes. However, such an analysis would imply that
the first person plural subject prefix be /1-/; and that it always requires the presence of a following passive prefix. (It would not do to simply assume that the lexical form of this prefix is /di-/; since the voicing rule can not apply across the boundary following the subject prefixes; for example, /ni-/ second person singular subject prefix does not cause voicing in what follows.) This, together with the fact that the details of such an analysis are complex and difficult to work out, is what has motivated the analysis we gave earlier.

The d-effect rules (2i) to (2iii) have an effect that is summarized in (6).

(6)

\[
\begin{align*}
    \cdots d = ? \cdots & \quad \rightarrow \quad \cdots t' \cdots \\
    \cdots d = y \cdots & \quad \rightarrow \quad \cdots s \cdots \\
    \cdots d = l \cdots & \quad \rightarrow \quad \cdots \lambda \cdots \\
    \cdots d = z \cdots & \quad \rightarrow \quad \cdots j \cdots \\
    \cdots d = \mathcal{z} \cdots & \quad \rightarrow \quad \cdots \mathcal{y} \cdots \\
    \cdots d = n \cdots & \quad \rightarrow \quad \cdots n' \cdots \\
    \cdots d = m \cdots & \quad \rightarrow \quad \cdots m' \cdots \\
    \cdots d = C \cdots & \quad \rightarrow \quad \cdots C \cdots
\end{align*}
\]

Here, "C" stands for all other consonants not previously mentioned in (6). It seems to me that the formulation of the rules in (2i) to (2iii) is excessively clumsy, and does not capture the underlying generalization involved in the process illustrated in (6). The generalization seems to be, roughly, that -d- combines with a following consonant, contributing its position of articulation features if the following consonant has none
(i.e., -?- ), and contributing a feature of interruptedness that is realized as [-cont] in the case of the obstruents and as [+glot] in the case of the sonorants. (In the rare cases where stem-initial -y- is preceded by -d- a glottalized -y' - results; cf. Sapir and Hoijer (1968) 50.) Needless to say, the presently available theories of phonology do not come close to being able to express such a generalization; certainly research in this area would be highly rewarding.

Finally, we might remark that the assilation rule (5), though formulated as a strictly regressive type of assimilation, applies in other parts of the word as a progressive assimilation rule. What seems to block its application as a rule of progressive assimilation in the cases considered in this section is a more general consideration that disallows a situation where a prefix determines the s-ness or s'-ness of the stem-initial, rather than conversely.

In closing this chapter, I might note several of the sources for the kinds of data presented in Tables I through VII of section 3. There is a brief and confusing discussion in Young and Morgan (1943b) iv-vi; these authors often have a difficult time saying what they mean. Haile (1950) gives an even briefer and more confusing discussion, xi-xii. Finally, the relevant data may be found in section 13, especially Table 9, in Sapir and Hoijer (1968).
BIBLIOGRAPHY


BIOGRAPHY

The author was born in 1941, in New Jersey. He attended public schools in Pittsfield, Massachusetts, until 1959, when he went to M.I.T. to study architecture. After switching to mathematics, he received his S.B. in 1963, and went on to graduate school in linguistics at M.I.T. Since the fall of 1967, he has been teaching in the Department of Linguistics at the University of California, Berkeley; his position there is Assistant Professor of Linguistics.