na-sh-l-nish
na-ni-l-nish
na-   -l-nish
na-ii-l-nish
na-oh-l-nish

and we made some initial attempts to state the phonological rules which convert these abstract representations into their phonetic (i.e., actually pronounced) forms:

naashnish
nanilnish
naalnish
neililnish
nai1nish.

Although it makes some sense to introduce the topic of Navajo phonology in the way we have, it is far too ambitious to hope at this point to develop a complete treatment -- in a sense, we have plunged into the middle of the problem without laying the proper foundation; this is a reasonable way to introduce the subject, but it is appropriate now to retreat somewhat and to discuss thoroughly certain elementary concepts of phonological theory.

There are three concepts which are fundamental in phonology. These are: (1) abstract (or 'underlying') phonological representation, (2) phonological rule, and (3) phonetic representation. Accordingly, the central concerns of phonology are those of determining the proper abstract representation of morphemes and of discovering the phonological rules which convert abstract representations of morpheme sequences into their phonetic representations. There is a (somewhat weak) analogy between phonology and syntax here -- abstract represen-
tations in phonology are analogous to deep structures in syntax, phonological rules are analogous to transformational rules, and phonetic representations are analogous to surface structures.

The justification for positing abstract representations for morphemes and morpheme sequences is the principle of simplicity and generality which motivates all of our decisions in developing a linguistic theory -- i.e., we seek to represent the facts of the language in the simplest and most general way possible. This point can be illustrated most clearly by considering an actual example. Let us consider the morpheme /iʃiʃ/ 'horse' and ask exactly how this should be represented phonologically in the lexicon of Navajo. If the morpheme appeared always as /iʃiʃ/ , then the problem of its proper lexical representation would not exist. However, it is not always /iʃiʃ/ -- it is sometimes /-liʃiʃ/ , with initial /l/ instead of /i/ ; this happens when it is preceded by a prefix: /shi-liʃiʃ/ 'my horse', /bi-liʃiʃ/ 'his horse', and so on. In other words, the morpheme has two alternants, or variants: /iʃiʃ/ ~ liʃiʃ/ (the symbol ~ is used to relate the alternants of a morpheme). The question now is: how should this morpheme be represented in the lexicon? Should both alternants be listed? Or should only one be listed? If we list both alternants, e.g., in roughly the following form

```
  N  
 /iʃiʃ/ ~ liʃiʃ/ 
```

we could state the relationship among the alternants as follows:

Choose /iʃiʃ/ if no prefix precedes and /liʃiʃ/ if a prefix precedes.

Now in order to decide whether this is the correct way to handle the
problem, we must take into consideration the effect of this solution on the overall simplicity of the grammar. To do this, it is sufficient to note that there are other morphemes which exhibit a similar alternation:

<table>
<thead>
<tr>
<th>without prefix</th>
<th>with prefix</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>שלך</td>
<td>sleezh</td>
<td>'soil'</td>
</tr>
<tr>
<td>lid</td>
<td>lid</td>
<td>'smoke'</td>
</tr>
<tr>
<td>looh</td>
<td>loh</td>
<td>'noose'</td>
</tr>
<tr>
<td>lóód</td>
<td>lóód</td>
<td>'sore'</td>
</tr>
</tbody>
</table>

If we enter each of these morphemes in the lexicon with both alternants, i.e.,

```
      N
     / \
   sleezh     sleezh
```

and so on, we can see that the lexicon is made much more complicated than it would be if only one alternant were entered. Furthermore, the rules of the grammar are made much more complicated as well -- for each one of these morphemes, we must have a statement of the conditions under which one or the other alternant is chosen. In short, this solution is not the correct one. The principal reason for this is that it fails to reflect a true generalization about Navajo phonology -- namely, the following:

All morphemes which have initial /l/ after a prefix have initial /ʃ/ when no prefix appears.

This suggests that the relationship between the alternants should be stated in the form of a phonological rule:
\[ 1 \rightarrow \hat{1} / \# \]

That is, /l/ becomes /\hat{1}/ when preceded immediately by a word boundary. (The symbol \# represents word boundary, the dash ___ represents the position of the element which undergoes the change, and the symbol / is to be read "when the element appears in the following environment".) By applying this rule to the form /\hat{1}l\hat{1}/, when it appears in the environment \# ____., we derive /\hat{1}\hat{1}l\hat{1}/; and similarly for the other morphemes. And by positing this phonological rule, we can enter all of the morphemes in a single form:

\[
\begin{array}{ccc}
N & N & N \\
\hat{1}l\hat{1} & lid & leezh \\
\end{array}
\]

We can refer to these as the 'underlying representations'. The grammar is greatly simplified by this solution -- each lexical item is entered in a single form, thereby simplifying the lexicon, and a single statement is sufficient to provide the correct phonetic representation in the various environments in which the morphemes may appear. This solution, therefore, expresses a true generalization about these forms. One might ask, incidentally, why we did not formulate the rule in the following way:

\[ \hat{1} \rightarrow 1 / \text{prefix} \]

i.e., /\hat{1}/ becomes /l/ when preceded by a prefix. The reason is that this would give the wrong result in the case of /\hat{1}óó/ 'fish'. This stem remains /\hat{1}óó/ when prefixed: /b\hat{1}óó/ 'his fish'. It seems, therefore, that the solution suggested above is the correct one -- while /\hat{1}óó/ is entered in the lexicon with initial /\hat{1}/, /\hat{1}l\hat{1}/,
/iːd/, etc., are entered with initial /l/; the phonological rule changes /l/ to /iː/ when immediately preceded by word boundary (#).

We must continue to ask, however, if this is general enough -- how does this solution fare in terms of the phonology as a whole? Does it express all of the generalizations which are possible to discover with respect to alternations of this type? To answer this question, we must look at other alternations which depend on the presence or absence of a prefix. Some other examples are:

<table>
<thead>
<tr>
<th>without prefix</th>
<th>with prefix</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>saad</td>
<td>zaad</td>
<td>'word, language'</td>
</tr>
<tr>
<td>sɛɛs</td>
<td>zɛɛs</td>
<td>'wart'</td>
</tr>
<tr>
<td>sid</td>
<td>zid</td>
<td>'scar'</td>
</tr>
<tr>
<td>sis</td>
<td>ziiz</td>
<td>'belt'</td>
</tr>
<tr>
<td>hééi</td>
<td>ghéél</td>
<td>'pack, burden'</td>
</tr>
<tr>
<td>hosh</td>
<td>ghosh</td>
<td>'thorn, cactus'</td>
</tr>
</tbody>
</table>

These forms present the same problem as the alternation /lɪːl/ ~ lɪːl/, and furthermore, they suggest the same solution. We might propose that there are two additional phonological rules:

\[ z \rightarrow s / # \]

and

\[ gh \rightarrow h / # \]

This would allow us to enter each of the morphemes in a single form in the lexicon:
And it would reflect a true generalization about the alternations in these forms:

Morphemes with initial /z/ after a prefix have initial /s/ when no prefix appears.

Morphemes with initial /gh/ after a prefix have initial /h/ when no prefix appears.

We now have three phonological rules.

\[
\begin{align*}
1 & \rightarrow 1 / # \quad \# \\
Z & \rightarrow S / # \quad \# \\
Gh & \rightarrow H / # \quad \#
\end{align*}
\]

They apply correctly to give phonological derivations like

\[
\begin{align*}
#1i'1i' & \rightarrow \#1i'1i' \\
#zaad & \rightarrow \#saad \\
#ghosh & \rightarrow \#hosh
\end{align*}
\]

and yet one might legitimately ask whether they express the true generalization which seems to be lurking here. Notice, for example, that the three rules apply in the same environment. And there is a sense in which the three rules are doing the same job, which suggests that there should be only one rule instead of three. We should consider, therefore, whether there is any way in which we could collapse these three rules into a single statement. To do
this, we must identify the sense in which the three rules are accomplishing the same task. We know that the rules effect a change in consonants, but is it possible to say that the consonants are all changing in the same way? If so, then we could reformulate the rules in terms of this single change, thereby reducing the number of rules from three to one.

The three rules convert the consonants in the left-hand column below into the corresponding members of the right-hand column:

\[
\begin{array}{ll}
 l & \dd\nn z & s \\
 gh & h \\
\end{array}
\]

In order to determine precisely what the rules do in effecting this change, it is necessary to identify what the members of the left-hand set /l, z, gh/ have in common as opposed to the right-hand set /\dd/, s, h/. To do this it is instructive to pay close attention to what happens to one's organs of speech during their production.

Notice first, that all of these sounds can be sustained -- i.e., it is possible to continue producing any one of them as long as the breath holds out: lllll..., zzzzz..., ghghghgh..., \dd\dd\dd..., and so on. Sounds which can be held in this way are referred to as 'continuants'.

Now notice that when you produce one of the set /l, z, gh/ in this way, and at the same time place your hand against your throat at the larynx (or 'adam's apple'), you can detect a vibration -- the vibration can be detected even more strongly by pressing your finger-tips against your ears. This vibration is referred to as 'voicing'. If you produce the sounds in the set /\dd/, s, h/ in the same way, you notice that the vibration is lacking. Thus, it is the property of voicing which distinguishes the two sets -- /l, z, gh/
are **voiced**, while /ɪ, s, h/ are **voiceless**. And it is evidently
the voicing feature which changes when the rules we are considering
are applied -- /l/ and /ɿ/ are the same kind of sound with the
exception that the first is voiced and the second voiceless; and
similarly for the pairs /z, s/ and /gh, h/. If this is so, then
we can in fact express the effect of the rules in a single state-
ment:

\[
\text{[voiced continuant]} \rightarrow \text{[voiceless]} / \# \text{____}
\]

That is, a voiced continuant becomes voiceless when it is immediately
preceded by word boundary. This is much simpler in the sense that
it expresses a generalization which holds for all of the forms we
have considered.

However, in order to maintain this analysis, we must revise
our thinking somewhat in regard to the way in which morphemes and
morpheme combinations are to be represented both phonologically
(i.e., in underlying representation) and phonetically. In particular,
we must cease to think of phonological segments in terms of their
alphabetic representations, but rather in terms of what we shall
refer to as their 'feature representations'. In writing the word
/ɪld/ 'smoke', for example, we represent the initial segment by
the letter /ɪ/, the medial segment by the letter /l/, and the final
segment by the letter /d/. This is highly convenient, and we will
continue to refer to words in their alphabetic spellings -- but we
must begin to think of the alphabetic symbols as being, from a lin-
guistic point of view, merely abbreviations for bundles of phono-
logical features, since, as we have seen, it is phonological features
which appear to be relevant to the proper formulation of phonological
rules. Thus, the actual representation in the lexicon of a noun like
/lid/ would be very roughly:

\[
\begin{array}{ccc}
\text{"l"} & \text{"i"} & \text{"d"} \\
\text{consonant} & \text{vowel} & \text{consonant} \\
apico-alveolar & \text{high} & \text{apico-alveolar} \\
continuant & \text{front} & \text{stop} \\
lateral & & \\
\text{voiced} & & \\
\end{array}
\]

and its phonetic representation, after application of the rule which devoices word initial continuants would be roughly:

\[
\begin{array}{ccc}
\text{"i"} & \text{"i"} & \text{"d"} \\
\text{consonant} & \text{vowel} & \text{consonant} \\
apico-alveolar & \text{high} & \text{apico-alveolar} \\
continuant & \text{front} & \text{stop} \\
lateral & & \\
\text{voiceless} & & \\
\end{array}
\]

The phonetic representation is the same as the underlying one except that the feature [voiced] has been changed to [voiceless].

In the following section, I will explore the classification of Navajo sounds in an effort to reveal the phonological features which appear to be important in the Navajo sound system. I will proceed more or less inductively, beginning with the most obvious phonological contrasts and similarities, and I will attempt ultimately to relate this aspect of Navajo phonology to its practical implications for education, concretely in terms of the development of possible curriculum materials.
3. It is usual for linguists to think of the phonological or phonetic representation of a morpheme as consisting of a sequence of 'segments' -- like the three segments which comprise each of the two representations of Navajo /lìd/ 'smoke' in the example cited above. It is a characteristic of human languages that particular phonological segments appear in many morphemes. Thus, for example, the segments /l/, /i/, and /d/ are not limited in their occurrence to the phonological representation of /lìd/; rather, each of them appears in a great many morphemes. It is also a characteristic of any human language that, while the number of morphemes in its lexicon is extremely large (thousands), the number of distinct phonological segments is extremely small (probably always fewer than one hundred, often fewer than twenty) -- this makes sense, for if individual phonological segments recur in many different morphemes, a relatively small number of distinct phonological segments is sufficient to form a large collection of distinct segment sequences for representing different morphemes. Consider, for example, all of the theoretically possible three-segment sequences, well-formed from the point of view of Navajo phonology, which could be formed with just /b, d, g, ì, s, i/ -- i.e., /bid/, /biì/, /bis/, /did/, /diì/, /dis/, /gid/, /giì/, /gis/, /ìid/, /ìì/, /ìis/, /ïid/, /ïì/, /ïis/. Many of these are actually occurring forms in Navajo, while others, although consistent with the sound pattern of Navajo, do not occur as actual forms. And this is another characteristic of human language -- the number of theoretically possible distinct segment sequences typically exceeds the actual needs of a particular language. The use by language of phonological segments as a means of representing the meaningful elements in a physical medium (i.e., sound) is, therefore, supremely efficient.

In these brief introductory remarks, I have used the expressions
'phonological segment', 'phonetic segment', 'distinct (phonological) segment', and so forth. Actually, it is more common to refer to these entities as the 'sounds' of a language, and I will follow that usage here. (Phonologically distinct sounds are also often referred to by the term 'phoneme' -- very roughly, the phonemes of a language are the segments which appear in the underlying, or phonological, representations of morphemes.) Nonetheless, it is appropriate, and in fact accurate, to think of the phonological and phonetic representations of linguistic forms in segmental terms -- linguistic sounds are perceived by the speakers of a language as segments which occur in sequence, even though it is a fact from the strictly physical point of view that a linguistic utterance cannot be neatly segmented. What is relevant linguistically is what the speaker perceives -- that he perceives linguistic sounds segmentally is perhaps best proven by the ability of human beings to learn, with considerable ease, to represent linguistic forms as sequences of alphabetic symbols. Generally speaking, in an efficient alphabetic writing system, alphabetic symbols correspond to the linguistically relevant sound segments of the language for which the alphabet is designed.

Alphabetic writing correctly reflects the segmental nature of the phonological representation of linguistic forms. However, as I mentioned in the conclusion of the preceding section, the alphabetic symbols we are accustomed to using are best understood, from the linguistic point of view, as being abbreviations (used for the sake of efficiency) of representations in terms of phonological features -- the Latin alphabet, which we use, does not reflect the linguistically relevant feature composition of linguistic sounds. (It is appropriate, in this connection, to mention that the Korean alphabet does succeed in reflecting this aspect of linguistic sounds). I have given one kind of evidence which demonstrates the linguistic
significance of a feature representation of Navajo sounds -- namely, a rule whose maximally general formulation requires mention of a phonological feature. Other examples of this type could be given. However, it is possible to demonstrate the validity of phonological features in another way -- the most appropriate description of Navajo sounds will involve a classification in terms of features; such a description and classification will be the concern of the present section. It will become evident that the sounds of Navajo, or of any language, fall naturally into classes on the basis of their feature composition.

The sounds of a language can be described from one or the other of two points of view: (1) from the point of view of their acoustic properties, i.e., what they sound like, or (2) from the point of view of their production, i.e., how they are pronounced. The study of the acoustic properties of linguistic sounds is called acoustic phonetics, and the study of the production of linguistic sounds is referred to as articulatory phonetics. The latter is by far the most accessible, and hence, the more appropriate for our purposes, since we are able to observe with considerable accuracy the movements (i.e., articulatory gestures) made by our organs of speech while we are pronouncing a given linguistic sound. Therefore, the classification and feature system which I will develop here will be from the articulatory point of view.

I will begin by attempting to describe with some care precisely what happens, from an articulatory point of view, when one produces the sound /b/, the initial segment in such words as /bi/ 'he', /bí̯h/ 'deer', /bááh/ 'bread', /béésh/ 'knife, metal'. The most obvious fact about the production of this sound is that the lips are placed against one another for a brief period and then parted --
that is to say, the principle gesture made in producing the sound /b/ is that of closing the mouth by means of the lips; the lips remain closed for a brief period and then are opened as the speaker goes on to produce the immediately following sound. It is possible to observe this sequence of events by pronouncing a word like /bi/, or /bááh/, very slowly paying close attention to the action of the lips during the articulation of the initial segment. During the interval in which the lips are closed, the flow of air from the lungs -- i.e., the breath -- is momentarily cut off. In fact, the breath is allowed to accumulate in the oral cavity during this brief interval, thereby creating a certain amount of pressure behind the lips; when the lips are parted, the release of this pressure, combined with the oral configuration created by the parting lips, produces the acoustic effect (i.e., noise) which is characteristic of /b/.

The above brief description of the pronunciation of /b/ is far from complete, but it is sufficiently detailed to permit a partial analysis of the sound. There are two principle aspects to its pronunciation: (1) the primary articulators involved in its production are the lips, and (2) the breath is momentarily cut off, or stopped, during its production. It is customary to describe the production of speech in terms such as these -- i.e., in terms of their position of articulation (in the case of /b/, articulation at the lips), and in terms of their manner of articulation (in the case of /b/, momentary interruption, or stopping, of the breath flow). These two dimensions -- i.e., position and manner -- provide the basic framework for the classification of speech sounds from the articulatory point of view. And they also provide the basic framework for the elaboration of a system of articulatory features. In terms of its position of articulation, the sound /b/ is a 'lip sound', or to use the accepted linguistic terminology, it is a labial sound -- more accurately, it is bilabial, since its production involves both the upper and lower
lips. In terms of its manner of articulation, /b/ is a stop, since its production involves complete, although brief, stoppage of the breath flow. A partial feature representation of /b/ is, therefore

\[
\begin{bmatrix}
\text{bilabial} \\
\text{stop}
\end{bmatrix}
\]

That is, it is partially characterized by the two articulatory features [bilabial] and [stop].

It is appropriate at this point to turn to another of the sounds of Navajo and to compare its production with that of /b/—it is by means of comparisons and contrasts among sounds that the Navajo feature system can be revealed most efficiently. Consider the sound /m/, which appears as the initial segment in such words as /má'ii/ 'coyote', /máazo/ 'marble', /magí/ 'monkey', /mósí/ 'cat'. Notice that it has something in common with /b/—namely, the position of articulation of /m/, like that of /b/, is bilabial. However, it differs from /b/ in terms of its manner of articulation. During the period in which the lips are closed in the pronunciation of /m/, the breath flow is not stopped; rather, it is allowed to pass into the nasal cavity and out through the nose. At the very rear of the oral cavity, at the entrance into the nasal passage, there is a valve formed by the velum (the soft palate) and the rear wall of the pharynx (upper throat). This mechanism (called the 'velic valve') can open and close—when it is open, the breath is allowed to pass through the nasal cavity (as in the pronunciation of /m/). When the velic valve is closed, on the other hand, the breath is prevented from passing into the nasal cavity; if, at the same time, the oral cavity is completely obstructed at some point, say by closure at the lips, the breath is prevented from escaping either through the mouth or through the nose, and air pressure is created within the oral
cavity (as in the pronunciation of /b/).

Since the pronunciation of /m/ involves the nasal cavity -- specifically, it involves allowing the breath to pass out through the nose -- it is classified as a nasal sound. While /m/ and /b/ are identical with respect to their position of articulation, they are distinct with respect to their manner of articulation:

```
/m/ [bilabial] [nasal] /b/ [bilabial] [stop]
```

In contrast to /b/ and /m/, consider the sounds /d/ and /n/ -- the first appears as the initial segment in such words as /diʃ/ 'this', /dʌʊ/ 'and', /dɪə/ 'four', /dɛə/ 'tea', and the second appears initially in such words as /ni/ 'you', /naaki/ 'two', /nʊʊ/ 'storage pit'. Like the pair /b, m/, the sounds /d/ and /n/ are identical with respect to their position of articulation. What happens during their production is that the tip of the tongue is placed against the gum directly behind the upper front teeth, more or less at the point where the teeth emerge from the gum. In the case of both sounds, the tongue is held in such a way as to prevent the air coming from the lungs (i.e., the breath) from passing out through the mouth until the tongue tip is lowered as the speaker goes on to pronounce the immediately following segment. But in the case of /n/, the breath is allowed to pass through the velic valve, into the nasal cavity, and out through the nose, while in the case of /d/ the breath is momentarily trapped in the oral cavity -- thus, the two sounds differ in terms of their manner of articulation: /n/ is a nasal, while /d/ is a stop. The position of articulation which the two sounds share is apico-alveolar -- that is, the apex (i.e., tip) of the tongue is placed against the alveolar ridge (i.e., the
gum ridge located directly behind the upper front teeth). A partial representation of these sounds in terms of articulatory features is, therefore

\[
\begin{align*}
/n/ & \quad \text{[apico-alveolar]} \\
\text{nasal} & \\
/d/ & \quad \text{[apico-alveolar]} \\
\text{stop} &
\end{align*}
\]

Notice that the four sounds considered thus far are interrelated in the following ways: /m/ and /n/ share the feature [nasal]; /b/ and /d/ share the feature [stop]; /b/ and /m/ share the feature [bilabial]; and /d/ and /n/ share the feature [apico-alveolar]. This system of interrelationships can be portrayed most effectively by means of a phonetic chart which incorporates the two dimensions we have been using in the description of these sounds. In the chart, the sounds are arranged in columns (labeled at the top) according to their positions of articulation and in rows (labeled at the left-hand side) according to their manner of articulation:

<table>
<thead>
<tr>
<th></th>
<th>bilabial</th>
<th>apico-alveolar</th>
</tr>
</thead>
<tbody>
<tr>
<td>stop</td>
<td>b</td>
<td>d</td>
</tr>
<tr>
<td>nasal</td>
<td>m</td>
<td>n</td>
</tr>
</tbody>
</table>

As the discussion proceeds, this chart will be appropriately modified to accommodate the other sounds of Navajo.

Let us turn now to the sound /t/, the initial segment in such words as /táá'/ 'three', /tó/ 'water', /télii/ 'burro', /tin/ 'ice'. Consider first its position of articulation. Like /d/, the sound /t/ is produced by placing the tip of the tongue against the gum ridge directly behind the upper front teeth -- /t/ and /d/ are, therefore, both apico-alveolar. They are also alike in that their pronunciation involves a momentary interruption of the breath -- therefore, they are
both stops. Nonetheless, they are different. The question is, in what way are they different? In attempting to answer this question, it is helpful to compare the pronunciations of the two sounds in similar, or if possible, identical phonological environments. Consider, for example, the difference in pronunciation between /bidaa'/ 'his lip' and /bitaa'/ 'his father'. This is what is known as a 'minimal pair' for the distinction between /d/ and /t/ -- that is to say, the words are distinguished phonetically solely on the basis of the difference between these two sounds. In pronouncing the two words carefully, one after the other, paying close attention to the medial segment (/bidaa'/, /bitaa'/), one is able to detect the phonetic difference between the two sounds -- the difference has to do with the manner in which the stops are released. When the /t/ is released, i.e., when the tongue tip is lowered as the speaker goes on to pronounce the remainder of the word, there is a very noticeable puff of breath associated with it -- in fact, this puff of breath is so strong that it can be felt, much like a gust of wind, by placing the palm of the hand directly in front of the mouth when pronouncing a word like /táá'/. By contrast, when the stop sound /d/ is released, there is no comparable puff of breath.

The puff of breath which is characteristic of the release of /t/ is referred to as 'aspiration', and it is customary to refer to sounds which have it as being aspirated. The distinction between /d/ and /t/ is, therefore, that the former is unaspirated while the latter is aspirated:

\[
\begin{align*}
/d/ & \quad /t/ \\
\text{apico-alveolar} & \quad \text{apico-alveolar} \\
\text{stop} & \quad \text{stop} \\
\text{ unaspirated} & \quad \text{ aspirated}
\end{align*}
\]
Aspiration is another of the features which pertains to the dimension of manner of articulation.

Notice that the stop /b/, like the stop /d/, is unaspirated rather than aspirated -- i.e., it is not characterized by the strong puff of breath which is so prominent in the release of /t/. A more accurate feature representation of /b/ would, therefore, be as follows

```
/b/
[ bilabial
   stop
   unaspirated
```

Theoretically, one might expect there to exist also a segment defined by the following combination of features

```
[ bilabial
   stop
   aspirated
```

However, it is a fact of Navajo phonology that such a segment is not a part of the system. The sound does occur in many other languages, however -- e.g., the /p/ of English appearing initially in such words as pin, pie, pack.

The feature [aspirated] is not restricted to /t/ in Navajo -- there are other pairs of sounds which are distinct in the same way that /d/ and /t/ are. One such pair is /g, k/ -- /g/ appears initially in such words as /gah/ 'rabbit', /gish/ 'walking stick', /gēeso/ 'cheese', /gólizhii/ 'skunk', and /k/ appears initially in such words as /ké/ 'shoe', /kin/ 'house', /kǫ'/ 'fire'. The pair /g, k/ differs in terms of position of articulation from all of the sounds yet discussed. Their pronunciation involves placing the back
of the tongue up against the soft palate -- i.e., against the roof of the mouth toward the rear. In both cases, the tongue is held in this position for a brief period in such a way as to prevent the breath from passing out through the mouth -- they are both stops, therefore. The distinction between the two stops has to do with the manner in which they are released -- just as in the case of /d/ versus /t/. When /k/ is released, i.e., when the back of the tongue is lowered as the speaker goes on to pronounce the next segment, there is a strong aspiration, as in the case of /t/ -- thus, /k/, like /t/, is aspirated. This aspiration is absent from the release of /g/, as it is from the release of /d/ -- i.e., /g/ and /d/ are unaspirated.

The position feature shared by /g/ and /k/ is dorso-velar -- that is to say, the dorsum (back of the tongue) is articulated against the velum (soft palate). Partial feature representations of these two sounds are, therefore

\[
\begin{align*}
/g/ & \quad /k/ \\
\text{dorso-velar} & \quad \text{dorso-velar} \\
\text{stop} & \quad \text{stop} \\
\text{unaspirated} & \quad \text{aspirated}
\end{align*}
\]

The interrelationships among the sounds discussed so far can be portrayed in the following chart, amplified from the one presented earlier:

\[
\begin{array}{cccc}
\text{stop} & \text{unaspirated} & \text{apico-alveolar} & \text{dorso-velar} \\
\text{aspirated} & b & d & g \\
\text{nasal} & m & n & --
\end{array}
\]

Notice that there are two gaps in the system -- as already mentioned,
the Navajo sound system does not include an aspirated bilabial stop /p/. It also does not include a dorso-velar nasal, i.e., a segment with the feature composition

\[
\begin{array}{c}
\text{dorso-velar} \\
\text{nasal}
\end{array}
\]

This sound, written /ŋ/ in phonetic notation, is found in a number of languages--e.g., in Hopi, in such words as /ŋahí/ 'medicine', /ŋímmí/ 'corn meal, wheat flour', /ŋóma/ 'to coil it up', /leŋí 'tongue'; and it appears in English, where it is written ng, in such words as sing, song, long, bang, singer.

I will turn now to a class of sounds which differ systematically in terms of their manner of articulation from those included in the above chart--namely, /s/ and /z/. The first of these appears initially in such words as /sis/ 'belt', /sin/ 'song', /sq'/ 'star', /saad/ 'word, language'. The second is found initially in one pronunciation of the word for 'snow', to wit /zas/--recall from the preceding section that many Navajo morphemes are entered in the lexicon with an initial /z/ but that this initial segment is turned to /s/ when it is in word-initial position. The sound /z/ is found medially in a great many words--e.g., /bizaad/ 'his language', /'azee'/ 'medicine', /'azis'/ 'bag'.

When /s/ is pronounced, the tip of the tongue is placed near the gum ridge behind the upper front teeth--however, it is not placed against it, as it is in the case of /d/ or /t/. Rather, in the case of /s/, the tongue-tip is held in the alveolar position in such a way as to allow the breath to squeeze through--the breath passes over the tongue-tip through a passage which is narrow enough to cause the breath air to be set into turbulence, producing a sound similar to a hiss not unlike that of air escaping from a tire. Sounds
of this type are sometimes referred to as fricatives or spirants. A characteristic of these sounds, already noticed in the preceding section, is that they are capable of being sustained -- a fact which is reflected in the term continuant which is also applied to them.

The sound /z/ is also a continuant, and it is also produced by creating a narrow passage between the tip of the tongue and the alveolar ridge. Both /s/ and /z/ are, from the point of view of their position of articulation, apico-alveolar, as are the stops /d/ and /t/; however, /s/ and /z/ are continuants, while /d/ and /t/ are stops.

The distinction between /s/ and /z/ is the one mentioned in the preceding section -- i.e., they are distinct in terms of their manner of articulation: /s/ is voiceless, while /z/ is voiced. Voicing is produced in the larynx (the organ whose external manifestation is the so-called 'Adam's apple', the protrusion which can be felt at the front of the throat) -- the larynx contains a system of opposed muscles, the vocal cords or vocal bands, which can be closed or opened; when they are lightly closed, the breath, coming from the lungs, can force its way between the vocal bands and set them into vibration. A sound, such as Navajo /z/, whose pronunciation is accompanied by vibrations of the vocal bands is said to be voiced. If the vocal bands are held completely open, no vibration is possible as the lung air passes through the larynx -- a sound, like Navajo /s/, whose pronunciation is not accompanied by vibrations of the vocal bands is said to voiceless. A partial feature representation of Navajo /s/ and /z/ is as follows:

/s/  
[apico-alveolar] [continuant] [voiceless]  
/z/  
[apico-alveolar] [continuant] [voiced]
It should be mentioned at this point that the Navajo nasals are also voiced -- however, the feature [voiced] is, in effect, redundant in nasals; that is to say, it is predictable, since in the Navajo sound system if a sound is nasal, it is also voiced. Similarly, the sounds /t/ and /k/ are predictably voiceless, since aspiration in the Navajo sound system implies lack of voicing. The sounds /b/ and /d/ are sometimes voiced and sometimes voiceless, depending on their position within words, and on other factors -- typically in discussions of Navajo phonology, they are said to be voiceless in the majority of cases. In any event, the voiced/voiceless opposition does not play the distinctive role in nasals and stops that it does in the continuants.

Another pair of Navajo continuants, distinguished in terms of voicing, are /sh/ and /zh/ -- /sh/ appears in such words as /shasha/ 'bear', /shí/ 'I', /sháqí/ 'sunshine', /shoh/ 'frost'; and /zh/ (rarely, if ever, word-initial) appears in such words as /nizhóní/ 'beautiful', /bizhi/ 'his name', /názhah/ 'bent', /yázhí/ 'small'. Like /s/, /sh/ is voiceless; and like /z/, /zh/ is voiced. But the pair /sh, zh/ differs from the pair /s, z/ in terms of position of articulation -- or, to be more precise, the two pairs differ primarily in terms of the attitude which the tongue assumes during their articulation -- in the case of /s, z/ the tip of the tongue is pointed directly at the alveolar ridge so that the breath passes over the tip; but in the case of /sh, zh/, the tip of the tongue is pointed forward so that the flat upper surface of the tongue, directly behind the tip, is opposed to the alveolar ridge. This portion of the tongue is commonly referred to as the 'blade', and in the pronunciation of /sh/ and /zh/ the blade of the tongue is brought near the alveolar ridge, thereby creating a narrow passage through which the breath passes turbulently -- the breath is not stopped by this maneuver, therefore, /sh/ and /zh/, like /s/ and /z/, are continuants.
Their position of articulation is referred to by the term lamino-alveolar -- i.e., the blade (laminal portion) of the tongue is positioned opposite the alveolar ridge. A partial feature representation of the continuants so far described is as follows:

/s/  /z/  /sh/  /zh/
[apico-alveolar] [apico-alveolar] [lamino-alveolar] [lamino-alveolar]
continuant  continuant  continuant  continuant
voiceless  voiced  voiceless  voiced

Navajo also has a pair of continuants produced in the dorso-velar position of articulation -- these are /h/ (sometimes written /x/), as in /hosh/ 'cactus', /hééé/ 'pack, burden', /hah/ 'quickly', /his/ 'pus', and /gh/ (never word-initial in phonetic representations), as in '/'aghəa'/ 'wool', /hooghan/ 'hogan', /shighoo'/ (often written /shiwoo'/) 'my tooth', /bighe'/ (often written /biye'/) 'his son'. The distinction between /h/ and /gh/ is exactly the same as the distinction between /s/ and /z/ -- /h/ is voiceless, while /gh/ is voiced. Like the stops /g/ and /k/, they are dorso-velar, but unlike /g/ and /k/, /h/ and /gh/ are continuants -- that is, they are pronounced by bringing the back of the tongue close to the soft palate, thereby creating a narrow passage through which the breath is allowed to pass; the passage is narrow enough to cause the breath air to be set into turbulence in the dorso-velar region. A partial feature representation of the two sounds is as follows:

/h/  /gh/
[dorso-velar] [dorso-velar]
continuant  continuant
voiceless  voiced
The inventory of Navajo continuants also includes the pair /ɬ, ɬ/ -- the first of these appears in the phonetic representations of such words as /lɛɛɬ'ɛ/ 'horse', /lɔó'/ 'fish', /lání/ 'much, many', /leezɬ/ 'soil, earth', and the second (rare word-initially) appears in such words as /bilɛɬ'/ 'his horse', /hóla/ 'I don't know', /hólɬ/ 'there exists'. These continuants are distinct from one another in terms of voicing -- /ɬ/ is voiceless, while /ɬ/ is voiced. They differ from the continuants /s/ and /z/ in the following manner: /s, z/ are pronounced by creating a narrow passage between the tip of the tongue and the alveolar ridge; by contrast /ɬ, ɬ/ are produced by placing the tip of the tongue firmly against the alveolar ridge and allowing the breath to pass around the sides of the tongue -- as in the production of the other fricatives, a narrow passage is created, but in this case the passage is located at the sides of the tongue rather than along the median line passing over the tongue. For this reason, the continuants /ɬ/ and /ɬ/ are called laterals (since the passage is located laterally with respect to the tongue).

In the Navajo phonological system, all sounds which involve a lateral passage are also apico-alveolar, since the tip of the tongue makes contact at the alveolar ridge; therefore, strictly speaking, the fricatives /s/ and /z/ should be identified as non-lateral, or perhaps median, in order to keep their feature representations distinct from those of the laterals:


It is appropriate at this point to incorporate the Navajo
continuants into the phonetic chart begun earlier. The amplified chart is as follows:

<table>
<thead>
<tr>
<th></th>
<th>bilabial</th>
<th>apico-alveolar</th>
<th>lamino-alveolar</th>
<th>dorso-velar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>median</td>
<td>lateral</td>
<td></td>
</tr>
<tr>
<td>stop</td>
<td>unaspirated</td>
<td>b</td>
<td>d</td>
<td>g</td>
</tr>
<tr>
<td></td>
<td>aspirated</td>
<td>—</td>
<td>t</td>
<td>k</td>
</tr>
<tr>
<td>continuant</td>
<td>voiceless</td>
<td>—</td>
<td>s</td>
<td>Ʉ</td>
</tr>
<tr>
<td></td>
<td>voiced</td>
<td>—</td>
<td>z</td>
<td>l</td>
</tr>
<tr>
<td>nasal</td>
<td>m</td>
<td>n</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

As can be seen from this chart, there are certain logical possibilities for which no segments have been provided as yet. Some of these logical possibilities, i.e., those represented by a dash, are actually absent from the Navajo sound system -- thus, as noted earlier, there is no bilabial aspirated stop /p/ in Navajo, and there is no dorso-velar nasal /ŋ/; furthermore, there are no labial continuants, there is neither a lateral nasal /ɭ/, nor is there a lamino-alveolar nasal /ʍ/. Labial continuants, or fricatives, do appear in other languages -- English /f/ and /v/ are labial fricatives (strictly speaking, however, they are not bilabial, since the lower lip articulates against the upper front teeth rather than against the upper lip); lamino-alveolar nasals are also common in other languages, Spanish /ʍ/ (as in señor) is such a sound; lateral nasals are found in some languages (e.g., certain languages in South America), but they are exceedingly rare in the world as a whole.

On the other hand, the portions of the above chart left entirely blank represent logical possibilities which are in fact occupied by actual phonological segments of Navajo. Consider, for example, the sounds /j/ and /ch/ -- the first appears in such words as /jádí/ 'antelope', /jeh/ 'resin', /jɛ/ 'day', /joo/ 'ball', and the
second appears in such words as /chaː/ 'beaver', /chɪz/ 'firewood', /χoo̞/ 'useful'. In terms of their position of articulation, /j/ and /ch/ are lamino-alveolar -- i.e., they are pronounced by placing the blade of the tongue against the alveolar ridge. Furthermore, both involve momentary interruption of the breath flow -- that is to say, they are stops. The two sounds are distinct in the same way that /d/ and /t/ are distinct -- i.e., /j/ is unaspirated and /ch/ is aspirated:

\[
\begin{array}{ll}
/j/ & /ch/ \\
\begin{array}{c}
\text{lamino-alveolar} \\
\text{stop} \\
\text{unaspirated}
\end{array} & \begin{array}{c}
\text{lamino-alveolar} \\
\text{stop} \\
\text{aspirated}
\end{array}
\end{array}
\]

Accordingly, the two sounds fit naturally into the chart in the same column as the other lamino-alveolars /sh, zh/.

Now consider the sounds /dl/ and /tɬ/ -- the first appears in such words as /dlʊt/ 'prairie dog', /dloʊ/ 'laughter', /dleʃ/ 'white clay', /dláːd/ 'lichen', and the second appears in such words as /tɬə/ 'grease', /dɪtɬɛː/ 'it is wet'. These again are stops, and they are produced by placing the tip of the tongue against the alveolar ridge -- i.e., they are apico-alveolar. But they differ from the other apico-alveolar stops in that they are released laterally rather than medially -- the initial motion in releasing /dl, tɬ/ involves creating a passage at the sides of the tongue, through which the pent-up breath is allowed to escape to produce the acoustic effect which characterizes them. It is appropriate, therefore, to think of these sounds as stops which possess the feature [lateral], i.e., as lateral stops, in contrast with /d/ and /t/, which are released medially and might appropriately be called median stops.

The distinction between /dl/ and /tɬ/ is, again, the same as that
between /d/ and /t/ -- i.e., /dl/ is unaspirated, and /tl/ is aspirated:

/\d/ \n| apico-alveolar \n| stop \n| median \n| unaspirated \\
/\t/ \n| apico-alveolar \n| stop \n| median \n| aspirated \\
/\dl/ \n| apico-alveolar \n| stop \n| lateral \n| unaspirated \\
/\tl/ \n| apico-alveolar \n| stop \n| lateral \n| aspirated \\

The lateral stops /dl, tl/ also fit naturally into the chart, in the same column as the lateral continuants /l, l/.

There is another pair of stops which must be considered at this point. These are /dz/, as in /dzaanéez/ 'mule', /dzééh/ 'elk', /dzil/ 'mountain', and /ts/, as in /tsah/ 'awl, needle', /tsé/ 'stone', /tsin/ 'stick'. These are produced at the apico-alveolar position of articulation, as are /d/ and /t/, but they differ from the latter in the way they are released. In pronouncing /d/ or /t/, the tongue tip is lowered very suddenly from the alveolar ridge -- that is to say, /d/ and /t/ are released abruptly. By contrast, when /dz/ or /ts/ is released, the tip of the tongue is withdrawn gradually from the alveolar ridge; this means that there is a period of time during which the tip of the tongue remains close enough to the alveolar ridge to cause the air which rushes out upon the release of the stop to be set into local turbulence. In effect, /dz/ and /ts/ begin as stops but they end as fricatives; to put it another way, the stop is first released into a continuant before the tongue tip is fully withdrawn as the speaker continues to pronounce the next sound segment. This sequence of events is reflected in the orthographic practice of writing the sounds as if they were sequences of a stop followed by a fricative -- i.e., as d+z, t+s. Sounds of this type are termed affricates in the usual phonetic terminology. I should point out,
in this connection, that the lamino-alveolar stops /j, ch/ are also **affricates** -- a detailed examination of their production reveals that when they are released, the blade of the tongue is withdrawn gradually, rather than abruptly; they begin as stops and end as fricatives, just as do /dz/ and /ts/. A similar comment is appropriate to /dl, tl/ as well -- these are also affricates, since they are stops which are released into lateral fricatives, or continuants, before the tongue is fully withdrawn from the contact position.

The contrast between /d, t/ and /dz, ts/ consists in the fact that the former are simple stops, while the latter are affricates. The distinction between /dz/ and /ts/ is the same as that between /d/ and /t/ -- i.e., /dz/ is unaspirated while /ts/ is aspirated:

<table>
<thead>
<tr>
<th>/d/</th>
<th>/t/</th>
<th>/dz/</th>
<th>/ts/</th>
</tr>
</thead>
<tbody>
<tr>
<td>apico-alveolar stop</td>
<td>apico-alveolar stop</td>
<td>apico-alveolar stop</td>
<td>apico-alveolar stop</td>
</tr>
<tr>
<td>median simple unaspirated</td>
<td>median simple aspirated</td>
<td>median simple unaspirated</td>
<td>median simple aspirated</td>
</tr>
</tbody>
</table>

The chart of Navajo sounds described to this point appears as follows:

<table>
<thead>
<tr>
<th>bilabial</th>
<th>apico-alveolar (median lateral)</th>
<th>lamino-alveolar</th>
<th>dorso-velar</th>
</tr>
</thead>
<tbody>
<tr>
<td>stop</td>
<td>[unaspirated: b d dz dl j g]</td>
<td>[aspirated: t ts tl ch k]</td>
<td></td>
</tr>
<tr>
<td>continuant</td>
<td>voiceless: s l sh h (x)</td>
<td>voiced: z l zh gh</td>
<td></td>
</tr>
<tr>
<td>nasal</td>
<td>m n</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Notice that the system includes two series of stops, *unaspirated* /b, d, dz, dl, j, g/, and *aspirated* /t, ts, tl, ch, k/. There is a third series of stops in Navajo whose pronunciation will require further mention of the larynx. Recall from the discussion of the feature [voiced] that the vocal bands located in the larynx are capable of closing and opening. When the vocal bands are tightly closed, so that no air can pass through them, a sound known as the *glottal stop* is produced -- the name comes from the term 'glottis' which refers to the space between the vocal bands. The glottal stop is one of the sounds of Navajo -- it is written /ʔ/ by phoneticians, and is represented in the Navajo writing system as an apostrophe /'/ (although some writers omit it in word-initial position); it appears in such words as /'e'e'aah/ 'west', /té'é'ɪ'/ 'poverty'.

Now it is possible to produce a stop in the oral cavity (say at apico-alveolar position) and a glottal stop at the same time -- when this is done, a special sort of stop sound, known as a glottalized stop, is produced. Consider, for example, the sound /t'ː/, as in /t'ah/ 'yet, still', /t'eesh/ 'charcoal', /t'iis/ 'cottonwood', /t'ʊʊ/ 'merely, just'. This sound is pronounced by producing simultaneously an apico-alveolar stop and a glottal stop; once this is done, the larynx is raised slightly to create air pressure between the glottal closure and the apico-alveolar closure; the two stops are released almost simultaneously, with the apico-alveolar release being a little ahead of the glottal release. This produces the acoustic effect characteristic of glottalized stops.

The feature [glottalized] is combined with stop articulation at much the same positions of articulation as is the feature [aspiration] -- that is to say, for each aspirated stop included in the chart presented above, there exists a glottalized stop in the same position of articulation:
The glottalized stop /t'/ has been exemplified -- the apico-alveolar release of this stop is of the simple type; however, glottalization also combines with the affricate versions: /ts'/ is exemplified by /ts'ah/ 'sagebrush', /ts'i'i/ 'gnat', /ts'in/ 'bone', and the laterally released /tɬ'/ is exemplified by /tɬ'aakal/ 'skirt', /tɬ'ée'/ 'night', /tɬ'iish/ 'snake', /tɬ'ióól/ 'rope'. The glottalized lamino-alveolar stop /ch'/ appears in /ch'ah/ 'hat', /ch'ééh/ 'futilely', /ch'iil/ 'plant, weed', /ch'ó/ 'spruce'; and the glottalized dorso-velar stop appears in /k'ad/ 'now', /k'ee't'oh/ 'bowguard', /k'ish/ 'alder', /k'os/ 'cloud'.

There are two additional sounds which should be mentioned at this point before I proceed to discuss a class of sounds which is fundamentally distinct in nature from the sounds described above. The two additional sounds are the stop /kw/, as in /kwe'é/ 'here', /dikwiil/ 'how much', and the continuant /hw/, as in /hwééldi/ 'Fort Sumner', /hwiidéeltq'/ 'slippery (of an area)'. Like /k/, /kw/ is an aspirated dorso-velar stop -- it is distinct from /k/ in that the lips are rounded as it is released. Similarly, /hw/, like /h/, is a voiceless dorso-velar continuant -- /hw/ is distinct from /h/ in that it is produced with rounded lips:

<table>
<thead>
<tr>
<th>/k/</th>
<th>/kw/</th>
<th>/h/</th>
<th>/hw/</th>
</tr>
</thead>
<tbody>
<tr>
<td>dorso-velar stop</td>
<td>dorso-velar stop</td>
<td>dorso-velar continuant</td>
<td>dorso-velar continuant</td>
</tr>
<tr>
<td>unrounded</td>
<td>rounded</td>
<td>unrounded</td>
<td>rounded</td>
</tr>
<tr>
<td>aspirated</td>
<td>aspirated</td>
<td>voiceless</td>
<td>voiceless</td>
</tr>
</tbody>
</table>
The completed phonetic chart, incorporating all of the sounds so far discussed (except the glottal stop /\%/), is as follows:

<table>
<thead>
<tr>
<th>bilabial</th>
<th>apico-alveolar</th>
<th>lamino-alveolar</th>
<th>dorso-velar</th>
</tr>
</thead>
<tbody>
<tr>
<td>simple</td>
<td>affricate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>unaspirated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>stop</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>t</td>
<td>s</td>
<td>m</td>
</tr>
<tr>
<td>dz</td>
<td>ts</td>
<td>l</td>
<td>n</td>
</tr>
<tr>
<td>dl</td>
<td>tɁ</td>
<td>sh</td>
<td>—</td>
</tr>
<tr>
<td>j</td>
<td>ch</td>
<td>h (x)</td>
<td>—</td>
</tr>
<tr>
<td>g</td>
<td>k</td>
<td>hw</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>kw</td>
<td></td>
<td></td>
</tr>
<tr>
<td>aspired</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t'</td>
<td>ts'</td>
<td>l</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>tɁ'</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>ch'</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>k'</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>glottalized</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>continuant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>voiceless</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>voiced</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

I will turn now to a fundamental phonological opposition which partitions the sounds of a language into two major classes -- namely, the opposition between consonants and vowels. The sounds included in the above chart are all consonants.

The basic vowel types in Navajo are four in number: /a, e, i, o/ -- they are exemplified in the following words: /gah/ 'rabbit', /'abe'/ 'milk', /tín/ 'ice', /dloñ/ 'laughter'. The principle which distinguishes vowels from consonants can be stated in terms of what happens in the oral cavity during their production. When a vowel is produced, there is no obstruction whatsoever in the oral cavity -- the breath is allowed to pass through the oral cavity with complete freedom. In the pronunciation of vowels, the oral cavity serves as a resonating chamber; its purpose is not to obstruct the flow of breath, but rather to modify in various ways the freely flowing column of air, set into vibration by the action of the vocal bands, in order to produce the acoustic effects which distinguish one vowel
from another. These modifications are accomplished in part by adjusting the size of the oral cavity, by adjusting the overall position of the tongue, and by adjusting the attitude of the lips -- but whatever the vowel, the breath is allowed to pass through the oral cavity without hindrance. By contrast, consonants are produced by creating an obstruction of some sort in the oral cavity -- these obstructions vary in degree and kind: in the case of stops, the obstruction momentarily interrupts the breath flow completely; in the case of nasals, the breath is prevented from passing out through the mouth and is redirected through the nasal cavity; and in the case of continuants, the breath is forced to flow through a constricted passage.

In short, vowels are characterized by an unobstructed oral passage, while consonants are characterized by an obstructed oral passage. This classification of linguistic sounds is fundamental, and it is probably universal for all human language. However, there are other sounds which must also be recognized but which do not fit in any obvious way into either of the two major classes, as they are defined above. For example, the glides /w/ and /y/ have much in common with vowels from an articulatory point of view, since they are pronounced with an unobstructed oral passage; on the other hand, they pattern like consonants in terms of their distribution within words -- like consonants, they can appear word-initially, as in /waa'/ 'beeweed', and /yoo'/ 'beads, necklace'. The bilabial glide /w/ is produced with rounded lips, like the vowel /o/; and the central glide /y/ is produced with the body of the tongue relatively advanced and raised, which, as will be seen presently, is the principle articulatory characteristic of the vowel /i/. The major difference between the glides /w, y/ and their vowel counterparts /o, i/ is the fact that the vowels are syllabic, while the glides are not. It is not a particularly simple matter to define
the notion 'syllabic', but, for Navajo, it is sufficient to say that
the syllabic segments are those which are capable of carrying tone --
that is to say, they appear either with low tone (as /i/ in the word
/ni/ 'you') or with high tone (as /i/ in the word /ni/ 'he said').
According to this definition, the syllabic segments are the vowels;
the glides are, correctly, not syllabic under this definition. The
non-syllabic nature of glides can be illustrated in another way. The
structure of Navajo syllables is such that the first segment in a
syllable is always non-syllabic (a consonant or a glide), and the
second is always syllabic (in fact, it is always a vowel); a syllable
may end in a vowel or in one of a restricted set of non-syllabics.
These patterns are typically represented by the formulae CV and CVC
(where C stands for consonant, V for vowel) -- the pattern CV is
exemplified by such words as /tó/ 'water', /ké/ 'shoe', /ni/ 'you',
and the pattern CVC is exemplified by such words as /lid/ 'smoke',
/kin/ 'house', /k'ish/ 'alder'. The glides /w/ and /y/ appear in
the initial C-position, never in the V-position, in Navajo syllables.
For this reason, it is customary to include the glides in the same
chart with consonants -- in a bottom row labelled glide, with /w/ in
the bilabial column, and /y/ in the lamino-alveolar column.

Another class of sounds not obviously included among vowels
or consonants are the laryngeals -- i.e., those sounds whose de-
fining properties have to do solely with the action of the larynx.
One of these is the glottal stop /ʰ/, produced by bringing the vocal
bands tightly together, thereby stopping the breath flow at the
larynx. The glottal stop is not a consonant under the definition
given above, nor is it a vowel -- the defining characteristics of
vowels and consonants involve the oral cavity in an essential way,
while for the glottal stop, the events taking place in the oral
cavity are irrelevant. Nonetheless, the glottal stop patterns like
a consonant in the syllable structure of Navajo -- i.e., it occurs
in the C-positions. Another laryngeal which occurs in Navajo is the glottal spirant, written /h/ in the usual orthography -- it is not to be confused with the dorso-velar continuant, also written /h/ (but also, and from a phonetic point of view, more appropriately, /x/). The glottal spirant is produced by parting the vocal bands in such a way as to allow the breath to pass through the glottis without setting the vocal bands into vibration; instead, the breath is set into slight turbulence as it passes through the glottis. The Navajo glottal spirant is heard finally in such words as /'e'e'aah/ 'west', /dinééh/ 'young man', /diniih/ 'pain, ache'. It is also heard in other positions in the word, often as a variant pronunciation of the voiceless dorso-velar continuant -- there has, in fact, been some debate among students of Navajo as to whether the glottal spirant and the voiceless dorso-velar spirant are phonologically distinct in the language. Since the laryngeals pattern like consonants in Navajo syllable structure, it is customary to include them in the consonant chart -- in a column at the extreme right labelled laryngeal, with /'/ in the same row as the glottalized stops and with /h/ in the same row as the voiceless continuants.

The usual way to classify vowels is to make reference to the overall position which the tongue assumes when a vowel is being produced; however, since the positioning of the tongue is in part dependent upon the action of the lower jaw, it is relevant also to make reference to the relative degree of mouth opening. Consider first the difference between the vowel /a/ and the vowel /i/. Start by pronouncing /i/ in isolation (or in the syllable /'i/), then follow it immediately by the vowel /a/ -- what one notices is that the lower jaw drops very perceptibly as one changes from /i/ to /a/. Conversely, if one starts by pronouncing /a/ and follows this with
/i/, the jaw rises. The effect of this is to vary the degree of mouth opening -- the mouth is open widest during /a/, and the opening is narrowest during /i/. In addition, the overall vertical positioning of the tongue is effected -- when the jaw is raised, the tongue is also raised, or, to put it another way, the tongue is relatively high in the mouth; and when the jaw is lowered, the tongue is relatively low in the mouth. These observations give rise to one of the dimensions which is fundamental to the classification of vowels from the articulatory point of view -- namely, the dimension of tongue height. Within this dimension, /i/ is classified as a high vowel, /a/ as a low vowel.

Now compare the vowel /e/ with the two just described -- in proceeding from /i/ to /e/ and then to /a/, one observes that the position of the jaw during /e/ is roughly midway between the high position which characterizes /i/ and the low position which characterizes /a/; /e/ is therefore a mid vowel.

Now consider /o/ -- again, in proceeding from /i/ to /o/ and then to /a/, one observes that the jaw is in roughly the mid position relative to the high position of /i/ and the low position of /a/; and this observation is further confirmed by the fact that when one compares /o/ and /e/, by pronouncing one after the other, there is no change in the relative position of the jaw along the dimension of height. That is to say, /e/ and /o/ are both mid vowels. But there is a difference between them, in fact there are two differences. Notice for one thing that when /o/ is pronounced, the lips are rounded, but when /e/ is pronounced, they are unrounded. The other difference has to do with the relative position of the tongue along the horizontal, or front-back dimension -- when /e/ is pronounced, the tongue is relatively advanced, or front, within the mouth; but when /o/ is pronounced, the tongue is relatively retracted, or back. This relative positioning of the tongue can be observed by touching
the tip of the tongue with a small stick while pronouncing /e/ and /o/ in succession; as one proceeds from /e/ to /o/, the tip of the tongue can be felt to retreat slightly into the mouth.

The horizontal dimension is the second principal one used in the classification of vowels -- among the Navajo vowels, /e/ is a front vowel, and /o/ is a back vowel. The vowels /i/ and /a/ participate in this dimension as well. A comparison of /e/ and /i/ reveals that the horizontal positioning of the tongue is the same for both -- i.e., both are front vowels. Similarly, a comparison of /o/ and /a/ reveals the same general horizontal positioning of the tongue -- both are back vowels.

It is possible at this point to present the basic vowel types of Navajo in the form of a chart which incorporates the major articulatory dimensions, together with the feature of lip rounding:

```
    front       back
              \unrounded \rounded
   high      i        o
    mid       e
   low       a
```

Notice that I have failed to indicate whether the front vowels are rounded or unrounded -- they are in fact unrounded; I left this notation out of the chart, because of the fact that there is no distinction between rounded and unrounded among front vowels of Navajo, only the back vowels participate in this opposition.

There are a number of theoretically possible vowels which are not included in the chart. The most important gap is that which appears in the high back rounded position in the chart. It is a fact of the Navajo sound system that there is no high back rounded vowel -- this missing vowel is /u/ (i.e., very roughly, the sound represented by
oo in the English words boot, shoot, too). If Navajo had this vowel as a distinctive phonological segment, then the Navajo vowel system would be of the five-vowel type

\[
\begin{array}{cc}
i & u \\
e & o \\
a \\
\end{array}
\]

so common among the languages of the world -- e.g., the vowel systems of Spanish, Tewa, Yaqui, Hawaiian, and many other languages are of this five-vowel type. But Navajo has a four-vowel system, which is also common among the languages of the world. What this suggests, in relation to the present discussion, is that it is a mistake to chart the Navajo vowels in this roughly triangular fashion, as if they belonged to a five vowel system. It seems more appropriate to represent the system in the form of a rectangular chart which reflects the relative, rather than the absolute, tongue height among the front and back vowels:

\[
\begin{array}{ccc}
\text{front} & & \text{back} \\
\text{high} & i & o \\
\text{low} & e & a \\
\end{array}
\]

Although it is incorrect, from a strictly phonetic point of view, to say that /e/ is low and /o/ is high, it is in fact correct to classify these vowels as low and high from the relative point of view -- /e/ is low relative to its fellow front vowel /i/, and /o/ is high relative to its fellow back vowel /a/. And, in the case of /o/, there is even some phonetic justification for classifying it as high -- it ranges to high, i.e., phonetic [u], when followed by /i/, as in forms like /deesdoi/ (pronounced [deesdui]) 'it is hot'. (Incidentally,
it is the custom to enclose strictly phonetic transcriptions in square brackets []; so-called phonemic transcriptions are enclosed in diagonals / /.)

The feature [rounded] is distributed among the vowels in the following manner: /o/ is [rounded], while all the others are [unrounded]. The feature compositions of the basic Navajo vowel types, in accordance with the revised (or 'rectangular') classification, are as follows:

\[
\begin{array}{cccc}
/i/ & /e/ & /o/ & /a/ \\
\text{vowel} & \text{vowel} & \text{vowel} & \text{vowel} \\
\text{high} & \text{low} & \text{high} & \text{low} \\
\text{front} & \text{front} & \text{back} & \text{back} \\
\text{unrounded} & \text{unrounded} & \text{rounded} & \text{unrounded} \\
\end{array}
\]

The four vowel system provides the basic foundation of the vowel distinctions in Navajo. However, it is not the case that Navajo has only four vowels. Each of the basic vowel types can be modified by the addition of other phonological features which belong to the system as a whole. For example, each of the vowels can be nasal or oral; that is to say, there is a distinction among vowels according to whether they are produced with the velic valve open (allowing the breath to pass through the nasal cavity as well as through the oral cavity) or with the velic valve closed -- the former are nasal (or nasalized) vowels, while the latter are oral. The contrast between /biih/ 'deer', and /biih/ 'into it' (as in /hashtî'îsh biih yîtîizh/ 'I fell into the mud.') consists in the feature of nasalization -- the vowels of /biih/ are nasalized, while those of /biih/ are oral.

In addition, each of the vowel types combines with a tone. By varying the speed of vibrations of the vocal bands, it is possible to vary the perceived pitch of a vowel -- when the vocal bands vibrate at a high frequency, the vowel is perceived as high in pitch.
or tone; and conversely, when the vocal bands vibrate at a low frequency, the vowel is perceived as low in pitch or tone. The most efficient way to perceive this distinction in Navajo is to consider a minimal pair whose members differ solely on the basis of tone. The words /ni/ 'you', and /nî/ 'he said', constitute such a pair -- the vowel of /ni/ is low in tone, while the vowel of /nî/ is high; the same tonal distinction serves to differentiate /'azee'/ 'medicine', with low toned /ee/, and /'azéé'/ 'mouth', with high toned /éé/.

Finally, there is a distinction between long and short vowels in Navajo -- by this is meant that there is a distinction in the Navajo vowel system which depends on the relative duration of a vowel, i.e., the relative length of time it takes to pronounce it. Thus, the vowel of /bááh/ 'bread', is about twice as long in duration as the vowel of /bá/ 'for him'; the /ee/ of /bitsee'/ 'its tail' is about twice as long as the /e/ of /bitse'/ 'his stone'; the /ii/ of /'atiin/ 'road' is about twice as long as the /i/ of /tin/ 'ice'; and the /aa/ of /bitaa'/ 'his father' is about twice as long as the /a/ of /bita'/ 'between them'. Long vowels are indicated by phoneticians by means of diacritic marks, e.g., a macron over the vowel or a colon following it: /ə/ or /a:/.

In the Navajo writing system currently in use, long vowels are indicated by doubling: /aa/. This is extremely convenient, for a variety of reasons. Furthermore, it may be correct from the linguistic point of view to regard the Navajo long vowels as sequences of short vowels -- that is to say, there is some linguistic evidence which supports this analysis. Consider, for example, such words as /hagoónee'/ 'goodbye', with a rising tone /óó/, and /dóola/ with a falling tone /óo/ -- if we analyze long vowels as sequences of short vowels, then it is possible to define falling tone as a high-toned vowel followed by a low-toned vowel (i.e., as /'VV/), and a rising tone as a low-toned vowel followed by a high-toned vowel (/VV/), thereby making it unnecessary to add two additional
tones (falling and rising) to the inventory of phonological features for Navajo. This analysis also correctly predicts the fact that the moving tones (i.e., falling and rising) occur only on long vowels. Since this analysis is supported by linguistic facts of Navajo, I will assume that there is no feature [long] in the Navajo vowel system -- rather, long vowels are sequences of short vowels.

By combining the features of nasalization and tone to the basic vowel types, four distinct sets of vowels are generated:

1. **low toned, oral**: /i, e, o, a/.
2. **high toned, oral**: /i̯, e̯, o̯, a̯/.
3. **low toned, nasal**: /ɬ, ɨ, ø, ø/.
4. **high toned, nasal**: /ɬ̯, ɨ̯, ø̯, ø̯/.

In addition to the vowel features mentioned above, the features [continuant] and [voiced] are relevant to the description of vowels -- all Navajo vowels are continuant and voiced.

This concludes the classification of the sounds of Navajo. I would like to turn now to a consideration of how this aspect of the Navajo language might be used in teaching. In general, I will be concerned with the problem of teaching students to think of the sounds of Navajo in terms of their phonological feature composition. The benefits of having one or more units on this topic are several. It is one way of teaching students to discover the underlying principles which govern certain phenomena with which they have first hand acquaintance. By analysing sounds in terms of their phonological properties, it is possible to reveal the relationships among them and to establish the overall network of relationships which define
the sound system as a whole. The sound system of a given language is not a random collection of possible human sounds; rather, there is a logic and symmetry to it -- the logic and symmetry are defined by the interaction of the phonological features. Thus, for example, once it is realised that a sound like /t'/ has a feature analysis which includes [stop] and [glottalized], it is not surprising to discover that the sound /k'/ also exists in Navajo -- it is not surprising, because it is reasonable to expect that the features [stop] and [glottalized] could cooccur at various positions of articulation. This type of symmetry is generally true among the languages of the world. The symmetry is explainable in terms of a feature analysis of sounds -- if a feature is identified as functional in a given language, then it is reasonable to expect it to be utilized efficiently; the most efficient utilization of a collection of features is that which allows certain features to combine with certain others -- it is because the features of voicing can combine with various positions of articulation that the Navajo continuant consonants form such a symmetrical system:

<table>
<thead>
<tr>
<th>s</th>
<th>ɬ</th>
<th>sh</th>
<th>h</th>
</tr>
</thead>
<tbody>
<tr>
<td>z</td>
<td>l</td>
<td>zh</td>
<td>gh</td>
</tr>
</tbody>
</table>

Absolute symmetry is seldom found in the sound system of a natural language, but by and large, symmetry predominates. Although there are some gaps in the Navajo stop system, it is largely symmetrical:

<table>
<thead>
<tr>
<th>b</th>
<th>d</th>
<th>dz</th>
<th>dl</th>
<th>j</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>ts</td>
<td>tɬ</td>
<td>ch</td>
<td>k</td>
<td>kw</td>
</tr>
<tr>
<td>t'</td>
<td>ts'</td>
<td>tɬ'</td>
<td>ch'</td>
<td>k'</td>
<td></td>
</tr>
</tbody>
</table>

This prevailing symmetry is due precisely to the fact that the
features of aspiration and glottalization can combine with the feature [stop] at the majority of positions of articulation. If sounds were not composed of features, then there would be no reason whatsoever to expect symmetry to prevail in sound systems. Thus, by analysing sounds as bundles of phonological features, it is possible to suggest an explanation of an important linguistic fact. The search for explanations of observed facts is the essential motivation in scientific inquiry.

The subanalysis of individual sounds into their component features is also of use in teaching students to look more deeply into entities with which they are familiar. It is relatively easy to teach people to recognize the segmental nature of speech and to identify the individual sounds of a language. But the discovery of their feature composition involves another sort of activity -- namely, the identification of properties which function within the system independently of the individual sounds; an example is the identification of aspiration as a feature which functions in Navajo independently of, say, the sound /t/; it exists independently of /t/, since it recurs in /ts/, /ch/, /k/, etc. This sort of activity is not limited to linguistics; it plays a role in most, if not all, sciences.

There are other, more pragmatic, educational benefits to be derived from a systematic analysis of linguistic sounds. Once an understanding of phonological features is acquired, it is possible to use this knowledge in coming to grips with the phonology of a new language. In effect, a detailed analysis of Navajo phonological features, quite within the realm of possibility even in the elementary phases of education, provides a secure foundation in general phonetics -- and an elementary understanding of phonetics is of tremendous value, particularly for people whose careers involve them in the study of languages in one way or another; a bilingual education
program, by definition, involves students in the study of at least two languages.

In considering the question of how to introduce the study of Navajo phonetics to Navajo-speaking students, both beginning and advanced, I would like to pursue the idea, briefly suggested in Part I, that the material could be presented initially in the form of games.

I will assume that it makes sense to begin talking about how sounds are produced in the earliest phases of a person's education—perhaps even before the student has learned to represent sounds alphabetically. The first step is to identify, or rather, help the student to identify, the most obvious organs of speech and their Navajo names—i.e., the lips, the tongue, the tip of the tongue, the back of the tongue, and so forth; this, in fact, is the foundation of a Navajo phonetic terminology which could be amplified and perfected as students proceed through their elementary schooling. It is reasonable to involve the students themselves in the creation of this terminology, and it will be of value, as the study proceeds, to let the students become familiar with representational drawings of the speech organs. This involves, at the beginning, teaching them to identify the lips, teeth, tongue, tongue-tip, etc., in 'x-ray' drawings of the type used by phoneticians:
It may take some time to get younger children to the point where they can interpret such drawings quickly, but it can be done; and once this ability is acquired, it will prove to be of tremendous value as their study of phonetics continues.

While this basic foundation is being developed, it is possible at the same time to have students begin to pay attention, and attempt to describe verbally, the movements of the primary articulators (lips and tongue) in speaking. For example, the students could be asked to describe exactly what happens to the lips when one begins to pronounce such words as /mą'ií/ 'coyote', /máazo/ 'marble', /bááh/ 'bread', and other words in their vocabulary which begin with bilabials. Once they are able to describe what happens -- i.e., to observe that the lips articulate against one another (/hadaa' 'ahininílá/, or however they choose to express it), they can be taught to recognize this position of articulation in a drawing:
And similarly for the other positions of articulation -- e.g., the tongue-tip placed behind the upper front teeth, as when one begins to pronounce words like /naadáá'/ 'corn', /dibé/ 'sheep', and so on:
The students should be helped to suggest an appropriate description of the articulation for themselves -- in this way, a phonetic vocabulary with which they feel comfortable will be developed.

I suggest that, in the beginning, particularly with the youngest children, only three basic positions of articulation be presented, together with their x-ray pictures:

**bilabial**
These basic types should be exercised until the students are thoroughly familiar with them and can correctly associate the pictures with the corresponding initial sounds in words like /mɛ'ii/ and /bááh/ for the bilabials, /naadēq'/, /dibé/, and /tín/ for the apico-alveolars, /gah/ and /ké/ for the dorso-velars. After this, the lamino-alveolar position, represented by the initial consonants of such words as /jish/, /chaa'/, can be presented; the corresponding x-ray picture, i.e. 

is only subtly different from that for the apico-alveolars, and it may take some time for young students to recognize the difference. It may be helpful to have the students themselves suggest an appropriate way to draw the x-ray pictures.

Once students are familiar with the four basic positions of articulation, it is possible to construct a simple card game which will help them to become thoroughly comfortable with the idea of thinking of sounds in terms of their production. The game involves two sets of cards -- one set consists of x-ray pictures for each of
the four positions of articulation (say ten cards for each, giving a deck of forty); the other set consists of pictures of objects whose initial consonants represent the positions of articulation (say thirty cards). The players (five or so) sit in a circle; each player is dealt a hand of five x-ray cards from a shuffled deck; the picture cards are placed face-down in a pile at the center of the circle. One of the players is chosen to start the game. This player turns the top picture card face-up and places it beside the pile; he then consults his hand of x-ray cards, and if it contains an x-ray picture corresponding to the position of articulation of the initial consonant in the word which the picture card represents, he takes it from his hand and places it face-up next to the picture card. If there are two x-ray cards which correspond to the initial consonant of the picture word, the player can place both of them down; if three, all three, and so on. When he has done this, the next player goes through the same procedure. The object of the game is to get rid of all of the x-ray cards in one's hand -- the winner of the game is the first player who gets rid of his hand. One can imagine several variations of this game -- the students will undoubtedly think of ways of changing it.

This game (and variations of it) helps not only to teach students to become familiar with the positions of articulation and the role which the articulators play in speech production, but it also helps to teach the fact that sounds belong to classes -- e.g., that /b/ and /m/ belong to the class of 'lip-sounds'; that /t/, /d/, and /n/ all belong to the class of 'tongue-tip sounds'; and so forth. Once these observations are made, it is possible to begin to introduce the idea of manner of articulation. Students can be asked to think about, and to attempt to describe, the differences between sounds belonging to the same position of articulation -- e.g., the difference between /b/ and /m/; the difference between /d/ and /n/,
and between /t/ and /d/, and so on. Their descriptions of these differences will suggest an appropriate Navajo terminology to be used in reference to the manner of articulation. It is possible to represent the manners of articulation in the form of x-ray pictures as well, by using an arrow to represent the flow of breath:

**nasal** (apico-alveolar)

[Diagram of nasal articulation]

**stop** (apico-alveolar)

[Diagram of stop articulation]
When this dimension is added, and students become familiar with its role in speech production, the card game could be appropriately modified to incorporate it. And when the students have learned the alphabetic symbols, and have begun writing, the game can be further modified by replacing the picture cards with letter cards -- the game would proceed as before, but now the players associate an x-ray card with letters. This will help to teach the association between sounds, thought of in terms of how they are produced, and the conventional letters used to represent them.

Once these basic points of the system of phonological features and something of their role in classifying sounds are understood, it is possible to construct another sort of game. Five letter cards can be dealt out to each of the players, the remainder being placed face-down in the center of the circle. Each player consults his hand and attempts to classify the letters into 'families' -- i.e.,
into groups according to shared phonological features. The object of the game is to have the most complete family of sounds possible (i.e., a hand which has all stops wins over a hand which has, say, a dorso-velar stop, an apico-alveolar continuant, a glide, and the two nasals). Each player has two chances to improve his hand by drawing a card from the center deck (and discarding one from his hand). A game of this sort will help to teach the patterns of cross-classification which exist in the sound system. It might also be possible to construct a game which is based on the analogy between the classification of sounds and the classification of people within the kinship system.

By proceeding in this way, from the relatively simple to the more complex, developing a familiarity with the phonological properties which characterize the sounds of Navajo, it is possible to elaborate, in cooperation with the students, an appropriate Navajo usage for speaking about this aspect of the language. Out of this will come an appropriate set of names for the phonological features. When this is available, it is possible to construct more sophisticated games. For example, a set of feature cards could be made -- each card would have the name (in Navajo) of a phonological feature on it; five, or so, cards could be made for each feature. Each player would be dealt a certain number of cards (say seven or ten). The object of the game is, again, to have the most highly valued hand -- the best hand is the one which comes closest to defining one or more complete sounds. Thus, a hand which has cards for the features

1. stop
2. bilabial
3. unaspirated
4. continuant
5. voiceless
6. apico-alveolar
7. lateral
wins over a hand which has the following cards:

1. stop
2. continuant
3. nasal
4. glottalized
5. voiceless
6. glottalized
7. nasal

The first hand wins because it has two nearly complete feature combinations in it -- one for /b/, and another for /õ/:

```
/b/  /õ/
[    [   
  bilabial  apico-alveolar
   stop     continuant
  unaspirated  voiceless
```

The second hand loses because it only has two very incomplete feature combinations:

```
[    [   
  stop     continuant
  glottalized  voiceless
```

The complexity of this game could be increased by allowing certain features to function as 'wild cards' -- e.g., the feature [glottalized] might be allowed to stand as the complete feature combination for a glottalized stop provided the hand also contains a feature combination which represents, say, an aspirated or unaspirated stop. Thus, with [glottalized] as a wild card, the hand
1. consonant
2. stop
3. apico-alveolar
4. lateral
5. unaspirated
6. glottalized
7. nasal

can be judged as having two complete feature combinations in it:

[/dl/][/ti'/]
    [consonant]
    [apico-alveolar]
    [stop]
    [lateral]
    [unaspirated]
    [consonant]
    [apico-alveolar]
    [stop]
    [lateral]
    [glottalized]

The number of possible card games which could be constructed on this model is enormous. Such games help to reinforce the student's understanding of the principles of classification which underly the sound system of Navajo. The same games could, of course, also be applied to English, once the phonological features of that language have been studied.

The familiarity with phonetics which could be gained in this way would also provide an opportunity to explore new linguistic possibilities -- i.e., to introduce sounds which do not occur in Navajo or English; this would be of great value to students who wish to specialize in the study of language, and to investigate languages other than their own. This type of exploration could be begun by combining the features in ways which depart from the principles of combination which are basic to the Navajo system. For example,
a student might be asked to attempt to pronounce the sound characterized by the feature combination

\[
\begin{array}{c}
\text{dorso-velar} \\
\text{nasal}
\end{array}
\]

i.e. /ŋ/ -- the conventional phonetic symbol could be introduced to the student as well. Or a student might try the combination

\[
\begin{array}{c}
\text{bilabial} \\
\text{stop} \\
\text{glottalized}
\end{array}
\]

i.e., the glottalized bilabial stop /p'/, found in such languages as Jemez and Tewa (e.g., Tewa /p'o/ 'water'). And so on. The possibilities here are great.

\[\text{t'áá 'ákódi.}\]