# ISSUES AND EVIDENCE IN SYLLABIC PHONOLOGY

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## 1. Scope

*Syllables and Segments* deals with the properties of speech events that are not satisfactorily accounted for in terms of simple sequences of segments. In most cases, the phenomena discussed in the following articles relate to a unit of phonological organization between the segment and the word, that is, to the syllable, but a number of them also deal with the organization of segments in terms of larger and smaller units. They are mainly studies which concentrate on the evidence for different types of segment organization. Traditionally, much of this evidence is phonological: it is evidence concerning distributional constraints on segment sequences, synchronic and diachronic processes determined by segment position, harmony of features over segment sequences, and the characteristics of tonal, accentual and rhythmic systems. This is the major source of evidence that has shaped the views of segment organization found in current phonological thinking, but there are other sources of evidence that cannot be neglected in the formulation of a general theory. One of these is experimental phonetics, which provides evidence concerning the complex coarticulation of speech segments, the relative timing of articulatory gestures, and the perception of speech. Evidence about the psychological organization of segments can be gained from the study of writing systems, poetic forms, secret languages, speech errors, speech pathologies, and. from experiments that require speakers to manipulate speech samples. Bridging both the psychological and the physical phonetic are the phenomena from child language. This volume includes evidence from most of these sources.

Our purpose in bringing these studies together was to exemplify the range of phenomena that a theory of syllables or of segment organization must account for. They go beyond arguments about the existence of the syllable and its definition that fills so much of past writings. In many cases the work is exploratory; but throughout, the theme of bringing together insights from several sources will be found. We could not at the same time cover the parallel research activity in phonological theory, intimately related as the two areas are. Phonological theory must turn to evidence beyond the strictly phonological to resolve the issues it uncovers; and conversely, further development of phonological theory is essential to the eventual understanding of the relations among the varied phenomena associated with the syllable.

The following discussion can serve as background for the articles included in this volume. In Section 2, we sketch some prominent issues in phonological theory concerning the explicit representation of segment organization. Evidence from the syn-

chrony and diachrony of phonological systems is treated in Sec-
tion 3, and Section 4 covers the evidence from other sources.
In these last two sections, the main findings of the studies
that follow are placed in a general perspective.


2.   The Theoretical Background

The syllable has a long and troubled history in the development
of phonology.[1]  While the evidence for the syllable as a unit
for segment organization exists all around in great abundance,
the various aspects of the syllable that have been investigated
are kaleidoscopic and the pieces have not fallen into place.
The numerous attempts to give the syllable a rigorous phonetic
and/or phonological definition (Stetson, 1951; Hjemslev, 1939;
Haugen, 1956; Hála, 1961; Rosetti, 1962, O'Connor and Trim, 1953;
Pulgram, 1970) have not been entirely successful in accounting
for the wide range of data associated with the syllable.   The
relationships among the phenomena in question are too complex
to admit of explanation by simple schemes, which has sometimes
led phonologists to ignore or avoid the problem altogether and
not recognize any unit of organization between the segment and
the word, e.g. Chomsky and Halle (1968).

A more usual reaction has been to set up the syllable as a (qua-
si-) dependent construct defined in terms of the properties of
segments and words.   This approach is possible because within a
word the same series of segments seem always to have the same
syllabication, differences in style and tempo aside.   Contrast-
ing phonetic syllabications arise only across syntactic boundar-
ies.   For instance, the phonetic contrast between *night rate* and
*nitrate* is accounted for by the presence of the syntactic bound-
ary *(night##rate)* versus the absence of a boundary (in *nitrate*).

There are three types of theories, which differ according to the
relative priority that they accord to the segment and the syl-
lable.  The most usual theory assumes that segments fixed in se-
quence are given.   The basic mechanism in this approach is a
procedure for placing syllable boundaries around words and among
the segments of words.   Proposals of this sort are advanced by
Kuryłowicz (1948), Haugen (1956), Pulgram (1970), Hoard (1971a),
Hooper (1972), Vennemann (1972), Stampe (1973), Anderson and
Jones (1974), Basbøll (1974), and Kahn (1976).  Another type of
theory does not assume that syllables can be defined or located
in terms of existing segments and words, but rather takes the
syllable, like the segment, to be an independent construct which
is a part of the representation of an utterance.   Under this
view syllable structure is basic, and the sequencing of seg-
ments, along with some of the phonetic properties of segments,
are predictable from this basic structure (Fudge, 1969; Hooper,
1976).

A third class of theories of segment organization does not in-
sist upon syllables at all.   It hypothesizes merely that there
are bonds among segments which constitute their organization.
In one sense, this simply turns the syllable model inside out.
Segments with a common bond can be said to belong to the same

syllable; two consecutive unbonded segments can be said to lie
across a syllable boundary.   Schematically, instead of SS or
CVC.CV we might write C V̑ C C̑ V.   For many conceivable states
of language, this could lead to exactly the same conclusions as
a syllabic model.   On the other hand, since there are many con-
ceivable inventories of bonds with different inherent properties,
it allows a wider range of hypotheses.   In particular, it has
more potential for achieving a general account of coherence
across the levels of the segment (where constructs of segment,
complex segment, and transition are now used), the syllable (in-
cluding the phenomena lumped under the rubric of the internal
structure of the syllable), the vocalic or consonantal sequence,
the disyllable, and the word and phrase.   Of current varieties
of phonological theory, autosegmental theory, whose most recent
statement is Goldsmith (1976b), is most compatible with this
point of view.   A segment bond model would allow us to consider
structures such as C̑ V C̑ V as integral, as the contribution of
Lehiste suggests; or to admit the possibility of unbonded con-
sonants, schematically C̑ V̑ C C C for example, as alternatives,
which is related to the proposal of syllabic affixes by Fuji-
mura and Lovins.

However conceptualized, all such phonological theories must re-
solve in one form or another the same fundamental questions
about the representation of syllable structure.   In the remaind-
er of this section, we outline briefly five of these important
questions.

It is now generally agreed that the syllabicity of segments must
be specified in underlying representations by the feature SYLLA-
BIC or an equivalent.[2]   Any segment class may apparently be
[+syllabic] at the phonetic level (Bell, 1978), but it does not
appear to be generally predictable from segment sequences (Sec-
tion 3.1), and the extent of the privilege of syllabicity in
underlying representations is still unknown.   Hoard's discussion
of the syllabic stops of Northwest Coast Indian languages and
Anderson's analysis of the "vowelless" languages of the North-
west Caucasus suggest new and innovative approaches to this is-
sue.

The issues concerning the proper assignment of segments to syl-
lables, or syllabication, are much more hotly debated.   We take
it to be noncontroversial that the input to the phonetically mo-
tivated processes must include syllabication.   Whether or not
underlying representations are syllabified is not so clear.   The
question is addressed by Donegan and Stampe in Chapter 2.

An argument against lexical representation of syllabication is
simply that it is never contrastive.   Of course, if it were
found to be contrastive, that would settle the issue.   As it is,
arguments for lexical representation hinge on whether there are
constraints on the underlying composition of syntactic units
that must be expressed in terms of syllables.   (Donegan and
Stampe's argument against a lexical--or "mental"--representation
of syllables is exceptional in the attempt to move beyond dis-
tributional evidence.)   Fisher-Jørgensen (1952) and Haugen
(1956) proposed that the syllable was the proper domain for dis-

tributional constraints.   For the more abstract representations
of generative phonology, Halle (1959) and Stanley (1967) pro-
posed that the constraints on segment sequences be stated in
terms of morpheme structure conditions which apply to lexical
representations.   Hooper (1975) argues that the morpheme is not
the proper unit for the expression of such phonotactic con-
straints, but rather that the syllable is their proper domain,
since this permits the statement of constraints that on the one
hand are both stronger and more directly represent pronouncabil-
ity.   Similar arguments can be made for combinations of the syl-
lable and the word.   This rules out a lexicon of morphemes to
which sequence structure constraints, and hence syllabication,
apply.   Possible alternatives are to express phonotactic con-
straints at another level (Hooper, 1975) or to list full words
in the lexicon (Vennemann, 1974).

While it is generally accepted that syllabication is not ad hoc
language by language, how and to what extent universal princi-
ples of syllabication are to be incorporated into phonological
descriptions has so far resisted determined attempts at a solu-
tion.   The strongest hypothesis about a descriptive theory is
of course that no language-particular statements are necessary.
There are two principal characteristics of the syllable that
have been used by investigators to implement this hypothesis in
whole or in part.   One much used approach capitalizes on the
striking similarity in any language of word-medial consonant se-
quences and combinations of word-final and word-initial clusters.
Proposals based in some way on this similarity are found in
Kuryłowicz (1948), Pulgram (1970), Hoard (1971), Anderson and
Jones (1974). Basbøll (1974), and Kahn (1976).   Bell (1977a) has
argued that such theories which admit no language-particular
statements unless based on this similarity of distribution, e.g.
the first three above, are unsuccessful when applied beyond
phonotactic criteria.   Their shortcoming is that, in giving in-
terior sequences a derivative status, they do not incorporate
any hypothesis about substance that holds for both interior and
exterior sequences.

The second principle, which was noted by Sievers (1893), is that
the sequence of segments within the syllable depends upon an in-
herent hierarchical scale of sonority or strength, which can be
independently determined by their universal phonological proper-
ties, or, as it now appears necessary, by a combination of uni-
versal and specific ones.   Jespersen (1904), Saussure (1915),
Vennemann (1972), Hooper (1976), and Rudes (1977) are among
those whose theories incorporate this insight.

The difference between these two approaches raises the question
of whether it is their distribution at word boundaries or the
inherent properties of segments that determine their syllabica-
tion (e.g. Basbøll, 1974).   Hooper (1976) argues that the latter
must be taken as fundamental, for sequences across word bound-
aries are not arbitrary, but in general conform to the same con-
straints as sequences within the word across syllable boundaries.
In Section 3 we return to a discussion of the principles upon
which the distributional and sonority approaches are based.

The distinction between a phonetic and a phonological syllable
is a traditional one.  (See Kloster Jensen, 1963, for a survey
of the discussion of this issue.)   In part, this has been a *di-
vorce de convenance*, which permitted one to assume a phonetic
basis for the syllable on one hand, while using it independent-
ly to account for phonological phenomena on the other.  Pike
(1967) exemplifies this pragmatic position.  Within a generative
framework, the question may be phrased as whether different rules
of syllabication can apply at different points in a derivation:
It appears that all such cases that have been proposed assume
the sensitivity to syllabication of rules that are non-produc-
tive, opaque, and/or morphosyntactically restricted, such as
English Velar Softening (Bailey, 1978), Danish Consonant Grada-
tion (Basbøll, 1974), and Seneca Stress Placement and Vowel
Lengthening (Chafe, 1977).   There is no reason to expect such
rules to be phonetically natural, and in fact they are usually
not (Vennemann, 1971; Stampe, 1973; Hooper, 1976).   Thus, while
it is clear, both from such cases and from dialect variation,
that principles of syllabication can change historically, and
that traces of former syllabications are sometimes found in the
alternations of a language, no evidence for different productive
syllabications has been found, except where distinct speech
styles or tempos are involved.

The fourth issue concerns the possibility of syllabications
which assign segments to more than one syllable ("ambisyllabi-
city") or which leave them unassigned ("interludes").  The cru-
cial observation in this regard is that there appear to exist
no cases where *three* distinct assignments of a marginal segment
are needed, i.e. to the preceding syllable, to both syllables,
and to the following syllable (Hoard, pers. comm.).  This sug-
gests that treating the medial consonants in *attic, any, apple,*
which are phonetically quite different from the pre-stress con-
sonants in *attack, anneal,* and *appall,* as ambisyllabic or syl-
lable-final may be equivalent in some sense.  However, see
Hoard (1971) and Bailey (1978) for the syllable-final analysis,
and Pulgram (1970), Anderson and Jones (1974), Kahn (1976),
Rudes (1977), and Stampe (1973) for the ambisyllabic approach.
The problem is more complex for longer intervocalic sequences.
Basbøll (1974:68) suggests that assignment be "partly indeter-
minate" in, for example, the cases where the only relevant dis-
tinction is between open and closed syllables and whether the
syllable is closed by one consonant or more than one does not
matter.

The fifth issue concerns the delimitation of the role of the
syllable as a domain for phonological processes.  We will not
review here the arguments for taking the syllable or larger
units to be the proper domain of stress, accent, and tone; brief
discussions appear in Sections 3.2, 3.3.  There are similar ad-
vantages for treating other features as specified over domains
greater than the segment.  In addition to the numerous "prosod-
ic" analyses of the London School, such analyses are given by
Basbøll (1974) for the Danish stød, Lehn (1963) for emphasis in
Cairo Arabic, Hooper (1977) for nasality in American English,
to name a few.  It is worth noting, in view of the parallel with
Anderson's analysis of Kabardian in Chapter 3, that the differ-

ences between the analyses of Nupe by Hyman (1970), Harms
(1973a), and Hooper (1976) become much less dramatic if Nupe
syllables are taken to be either palatalized, labialized, or
plain. So far, however, the question of whether some features
obligatorily, optionally, or never have a syllabic domain re-
mains to be answered.


3.  Phonological Evidence

Much of this section concerns the most basic and most available
phonological evidence, the phonotactic distribution of segments.
In spite of its relative familiarity, it is misinterpreted sur-
prisingly often. We concentrate, therefore, on identifying what
we feel to be the principal generalizations, attempting to in-
dicate their validity and significance. We have less to say
about phonological processes. This reflects our much less com-
plete knowledge about them, rather than their importance, for
we, like many others, feel that their evidence speaks more dir-
ectly to the heart of theories of segment organization than do
phonological structures. Brief discussions of rhythmic struc-
tures, indeterminacy, and stylistic variation conclude the sec-
tion.

3.1.  Segment Sequences and the Internal Structure of Segments.
It is a common assumption that syllables of the form CV have a
special status. There is less appreciation for the complex bas-
is for this privileged distributional status, which when exa-
mined closely, shows that categorizing the CV syllable type as
"unmarked" is a misleading simplification of a number of more
significant generalizations.

The fundamental pattern of segment sequencing is an alternation
of consonant and vowel. We observe from (1) - (4) that in gen-
eral sequences of consonant and vowel are not constrained, where-
as any sequence of either class may well be constrained. The
following typological facts are stated with reference to the
*section*, which is roughly the phonological word (Pulgram, 1970).

(1)  Within the section, VV sequences ("hiatus") are not permit-
     ted by about one-half of the world's languages, e.g. Ber-
     ber.

(2)  CC sequences are not permitted by about 10 to 15 percent of
     the world's languages,[3] e.g. Fijian.

(3)  No languages *require* that all sections with two or more
     vowels contain a hiatus, nor that those with two or more
     consonants contain a sequence of consonants.

(4)  About 10 to 15 percent of the world's languages that per-
     mit consonant sequences within the section, permit none
     initially nor finally. Almost all of these are limited to
     no more than two consonants, with Kannada, which possesses
     medial -CCC- but no initial clusters nor final consonants,
     being the best known exception.

These generalizations form the basis for the representation of
canonical forms as iterations of vowel-consonant combinations,

for example $(C_0^1 V)^n$, $(C_0^1 V C_0^1)^n$, etc. The first expression repre-
sents the section as an iteration of n CV's or V's; it may con-
tain n vowels which may be separated by one consonant or none.
The section represented by the second expression also has n V's,
which however may be separated by two, one, or no consonants;
the possible iterative elements are CV, V, VC, or CVC. This ex-
pression of the distribution of C and V captures the important
fact that the syllabic portion is obligatory while the C portion
is not. While contoids, even fricatives and stops, may be the
only segments of an utterance, as in the Northwest Coast Indian
languages described in Chapter 3 by Hoard, at least some of them
must be syllabic.

We observe further that the alternating pattern is asymmetrical.
The corresponding vowel-initial expressions such as $(V C_0^1)^n$ and
$(V C_0^2)^n$ are not appropriate because of the following preferences:

(5)  Sections must begin with a consonant in about 20 to 40 per-
     cent of the world's languages, e.g. Hottentot.

(6)  Sections must end in a vowel in about 10 to 25 percent of
     the world's languages, e.g. Luganda.

(7)  There are virtually no languages whose sections obligatori-
     ly begin with a vowel or end with a consonant.[4]

The generalizations (1)-(7) conspire to afford a special status
to the CV sequence. In this regard, note further that the exis-
tence of more complex consonant sequences implies the existence
of simpler ones. If a language possesses forms with CCCC strings
in initial, final or medial position, then it must possess forms
with CCC, CC and C strings in that position. Initial position
is special, however, in that there, forms without C (that is,
forms beginning with V) only occur in languages that also have
forms beginning with C. This follows from (7). Taken together,
the result of these generalizations is that canonical formulas
for syllable structure necessarily contain the sequence CV.[5]
However, the widely accepted claim (e.g. by Jakobson and Halle,
1956) that some languages have *only* CV syllables has not been
substantiated, although there are some near misses, of which
Piro is perhaps the best example (Matteson, 1965).

The asymmetry between initial and final position, which is evi-
dent in (5), (6), and (7), is also a predominant characteristic
of the constraints upon the occurrence of consonant combinations
at the beginnings and ends of sections. In the following dis-
cussion we have largely relied upon Greenberg (1965) and Bell
(1971), to which the reader is referred for further details.
We begin with the two main global differences between initial
and final clusters.

(8)  Languages are more likely to have initial consonant clus-
     ters than final clusters. The world's languages are split
     about evenly between those with initial clusters and those
     without. But less than half, perhaps as few as one-quar-
     ter, have final clusters.[3]

(9)  In final position, the single consonants that may occur are
     a small subset of the total segment inventory in many lan-

guages; this does not appear to occur in initial position.
For example, ʔ is the only final consonant in Burmese, n ŋ l are
the only ones in Mandarin Chinese, p tˢ s are the only ones in
Hottentot (except for loans). It is of course commonplace for
a few segments or a segment class to be forbidden in either fin-
al or initial position; in English ŋ and ʒ are not permitted
initially, but all segments occur finally, for example.

The internal composition of consonant clusters permitted in ini-
tial and final positions has attracted much attention. What ex-
cites the beholder is that segments in both initial and final
clusters tend to be ordered according to increasing sonority
from the outside of the section toward the syllable peak (Siev-
ers, 1893; Jespersen, 1904; Saussure, 1915). The result is cer-
tain regularities of patterning for the segment classes Glides
(G), Liquids (L), Nasals (N), and Obstruents (O):

(10)  Glides (nonsyllabic vocoids) are the most preferred in-
      terior segments.

In many languages, e.g. Luganda and Burmese, the only clusters
are of the type C+y or C+w. No instances are known of clusters
with voiced glides exterior to obstruents. A few cases of ini-
tial glide+resonant clusters do occur, e.g. Pasho *wradz*, *wlar*,
but when they do, the language also has clusters with glides as
interior elements.

(11)  Liquids are preferred over nasals as interior segments.

The strongest pattern reflecting this preference would be for
nasal+liquid clusters to be restricted to initial position, and
for liquid+nasal clusters to be restricted to final position.
But both orders do occur in both positions. However, some lan-
guages have only the preferred orders, whereas languages which
have the reverse orders (initial liquid+nasal, final nasal+
liquid) also possess the preferred ones except for some cases
of voiceless liquids. The preference is also manifested in ob-
struent+resonant clusters. In initial position, for example,
obstruent+liquid clusters are preferred to obstruent+nasal ones,
the latter not known to occur without the former.

(12)  Liquids are preferred over obstruents as interior segments.

Similarly, both obstruent+liquid clusters and liquid+obstruent
clusters occur initially and finally. The first order is highly
favored in initial position. The clusters of a language which
has only one kind of initial cluster are most likely to be ob-
struent+liquid clusters, except perhaps Cw, Cy clusters. Again,
some languages, like English (*plum*, *frog*) have only the preferred
order; the languages which have clusters with the reverse order
also have the preferred clusters. Russian is a typical example:
*pravda*, *xleb*, *rta*, *lba*, *lzi*. A similar preference for final
liquid+obstruent clusters is found.

These patterns of occurrence of cluster types suggest a hierar-
chy of segment classes

(13)  obstruent - nasal - liquid - glide

in order of increasing affinity with the adjacent vowel, which

is of course most sonorant of all.  It should be noted that this
is true even though the occurrence of every combination which
violates this order is attested save one, initial glide+obstru-
ent.

To this point we have discussed only section-initial and section-
final sequences.  Their regularities relate to constraints on
order of medial consonant sequences in two ways.  Each forms the
basis for syllabication theories discussed in Section 2.  First,
even without referring to the intrinsic properties of segments,
most medial sequences of consonants can be analyzed into combina-
tions of permitted final consonants plus permitted initial con-
sonants.  There are a few medial sequences that cannot be broken
up in one or more such ways in most languages, but when they can,
syllable boundaries determined by other criteria almost never
fall at another division.  Known exceptions are Huichol and Ala-
baman, where the syllabication of some medial sequences does
not meet this condition (Bell, 1977a).

The other approach to syllabication also relies on the similar-
ity of sequences within and between words, but considers this
similarity to be due to the fact that section-initial and sec-
tion-final sequences are merely special cases of syllable-ini-
tial and syllable-final sequences, and that the organizing prin-
ciple that determines the order of segments in all positions
depends on the sonority of the segments:

(14)   Segments of a syllable must be arranged in such a way that
       their sonority increases from the onset to the nuclear
       peak, and decreases thereafter.

This principle relies on a ranking of segment types on a scale
of sonority (or its converse, consonant strength), and predicts
not just the organization of the consonantal onset and coda, but
also predicts that the nuclear peak will contain the segment
with the highest degree of sonority.  Since we have already dis-
cussed the consonantal margins of syllables, let us now consider
briefly the nucleus.

It is well known that syllable peaks are not limited to vocoids.
Resonants, obstruents, even stops, are reported as syllabic
peaks in a number of languages.  In fact, syllabic peaks need
not even be necessarily voiced, as shown by the variety of en-
tirely voiceless and vocoidless utterances that occur in some
Northwest Coast Indian languages discussed in Chapter 3 by Hoard.
It is possible, however, to establish an order of preference for
occurrence as syllabic peaks, namely

(15)   stop - fricative - resonant - vowel

See Bell (1978) for further discussion.  It is notable that the
preference for liquids over nasals as interior elements does
not extend to their occurrence as nuclei, a fact remarked by
Sievers (1893).

If we combine (13), the order of vowel affinity, with (15), we
are left with but three categories, obstruent-resonant-vowel.
Even for this reduced set of categories, the scale unfortunately
cannot predict universally whether a syllable peak occurs or not

for all sequences and of course the problem is even more diffi-
cult within the categories.  A vocoid will be syllabic between
obstruents, or preceding an obstruent initially, and obstruents
are always nonsyllabic between two vowels, for example.  But in
most contexts, either syllabic or nonsyllabic segments may ap-
pear, as the following examples illustrate:  Piro perka vs. Eng-
lish parka; Serbocroation krvi vs. Polish krvi, both meaning
'blood'; English kæsl vs. Norwegian avl; Piro riçmika vs. Russ-
ian xlep.

From these facts, and from the implicational, rather than abso-
lute, nature of (10)-(12), we conclude that a universal scope
for (14) is too strong.  There are a number of ways, however,
of further elaborating this general theory so that apparent and
real violations may be explained.

One aspect that needs further elaboration is the basis for son-
ority ranking of segments.  One cannot operate successfully with
general categories such as obstruent, nasal, liquid and glide
without knowing more of the details of the phonetic realization
and phonological properties of the particular segment in the
particular language.  For instance, all *r*-like sounds cannot be
placed at the same point on the scale, since there are so many
varieties of *r*, ranging from sonorous retroflex approximants to
nonsonorous apical and uvular trills and fricatives.  Language-
specific sonority rankings can be partially determined by exa-
mining assimilation processes, as proposed in Vennemann (1972).
Hooper and Vennemann conjectured that with a language-specific
sonority ranking, (14) would apply to all marginal segments and
that their order within the syllable would be determined.  This
now appears to be too strong, particularly with respect to the
order of sequences of obstruents.  (Note that we did not include
a statement about stops and fricatives analogous to (10)-(12).)
Saib's description of the final consonant sequences of Berber
illustrates the point.  If this is so, it amounts to restricting
(14) to sequences of segment classes.  Basbøll (1974) proposes
that principles such as (14) apply to the "hierarchical" fea-
tures SYLLABIC, CONSONANTAL, SONORANT, and VOICE and that all
other features are cross-classificatory with respect to sequence
constraints.  (Rather than language-specific sonority ranks he
suggests that while no language may reverse the order of the
hierarchy, some languages may not apply them.  Thus by relaxa-
tion of the CONSONANTAL constraint, i.e. [+cons] is interior to
[-cons], there occur *wradz, wlar* in Pashto, but initial rw and
lw also occur.)  One last conception of sonority that is so far
little explored is that it is multidimensional rather than uni-
dimensional in nature.

The segment's structure is crucial to (14).  For example, al-
though Basbøll (1974) takes VOICE to be a hierarchical feature,
and Greenberg (1965) shows that voiced segments are by far pre-
ferred as interior elements, there do exist tautosyllabic se-
quences of the sort ##[+voice] [-voice] V.  Most of these are
the common sequences of nasal+unvoiced stop, usually homorganic,
which are sometimes described as clusters and sometimes as sin-
gle segments.  The concept of the complex segment, whose applica-
tion is illustrated here by Anderson and Hoard, obviously sug-

gests itself as a possible explanation, since then the voicing adjustment which takes place would then be seen as a transitional laryngeal adjustment parallel to that which is part of the articulation of some types of "implosive" stops.  The success of such an approach naturally depends on the discovery of general principles for assigning sequences to such structures.

One effect of the complex segment approach is that it restricts the domain of application of (14) to the more central part of the syllable.  This can be done in other ways, too.  We noted above that the hierarchy of preference for interior elements does not coincide exactly with that for syllabic ones, which suggests that somewhat different principles govern the nucleus and its margins.  Basbøll (1974) suggested that CONTINUANT is a hierarchical feature within the sonorant portion of the Danish syllable.  He however did not indicate how the notion might be extended generally.  Such an extension is one of the consequences of Fujimura and Lovins' proposal of "syllable affixes." They suggest that (14) or its equivalent does not apply to affixes, segments which on independent grounds can be shown to be loosely bonded to a syllable.  Further extensions of this notion might reveal that languages fall into various phonological types, and those that allow "affixes" or complex consonant clustering might have other characteristics in common, e.g. widespread vowel deletion between consonants, while languages without affixes might exhibit more vowel insertions.  (Cf. Isačenko's (1939) typology of "consonantal" and "vocalic" languages.)

To recapitulate at this point, a good deal is known about the internal organization of syllables, and from what is known a definite pattern emerges, such that there is a general harmony between the alternation of syllabic and nonsyllabic segments and the alternation of segments with more or less inherent sonority.  But the specific nature of this pattern is complex, and while sonority theory is often useful and revealing, many questions remain to be answered.

3.2.  Phonological Processes Determined by Position.  Another interpretation of the generalizations expressed in the preceding section, including the sonority hypothesis (14), is that the properties of segments and their positions serve as active determiners of phonological processes which shape the syllabic structure of a language.  For example, state (7) is best understood in terms of the equilibrium between the diachronic processes responsible for it.  These are mainly vowel and consonant loss.  Even ignoring the many complexities of the diachronic situation, the reader can see that the common loss of consonants in final positions, which exposes word-final vowels, is counterbalanced by *vowel* loss there, reestablishing closed syllables. But to achieve obligatorily closed syllables, a language must lose *all* its final vowels before losing *any* final consonants, which suggests that such languages are simply very very rare, not impossible, whether or not they are attested.  Similarly, a more detailed knowledge of the diachronic sources of the typological bases of sonority hierarchies will be necessary before their full significance can be understood.  The emphasis of Zwicky (1972), Vennemann (1972), Hooper (1976), and Hankamer

and Aissen (1974) on processual criteria for a language's son-
ority or strength hierarchy expresses the same priority on the
synchronic plane.

It has been a major goal of the last decade's research in pho-
nological theory to achieve a proper representation of the re-
lation between constraints and processes, e.g. Stampe (1973),
Hooper (1976).  The problem in the phonology of children, where
it is even more prominent, is considered in some detail below
by Ingram and by Menn.  As a step toward bridging the consider-
able gulf between adult phonologies and the phonologies of young
children, Menn proposes parallel accounts of the relationships
between constraints and processes in terms of a speech produc-
tion model and a formal representation based on autosegmental
phonology.

The syllable as a unit finds independent justification in a
large number of phonological processes which depend on the seg-
ment's position in the syllable for application.  Some examples
that have been discussed are Spanish nasal assimilation in syl-
lable-final position, and glide obstruentization in syllable-
initial position (Hooper, 1972), and German syllable-final de-
voicing (Vennemann, 1972).  These processes provide evidence
concerning the inherent properties of syllables, since we find
weakening, realized as assimilation, sonorization or deletion,
to be common in syllable-final position, while strengthening,
although never a common process, seems to be restricted to syl-
lable-initial position.  Similarly, vowel insertions usually
break up longer consonant clusters before (or if) they break up
shorter ones, and vowel deletions are often blocked if a com-
plex syllable structure would result (Bell, 1971; Hooper, 1976,
1978).

Segmental processes are often conditioned by the distinction be-
tween an open and a closed syllable, notably those affecting
length and quality of vowel, e.g. open syllable lengthening in
Icelandic (Vennemann, 1972) and retraction of low vowels closed
by velars and labials in Danish (Basbøll, 1974).  Finnic conson-
ant gradation, described by Lehiste below, was conditioned by
closure of the following syllable, although this may have been
part of a more general rhythmic pattern.

The domains of harmonic features, which spread from a segment
inherently marked for the feature to neighboring segments, per-
haps through intervening segments, until it is blocked by some
condition, also reveal segment organization.  The principal do-
mains are strings of segments (characterized by (lack of) cer-
tain features), words, and syllables, with the first two being
the most common.  General principles for the interaction of the
domain types are virtually nonexistent, even for such a common
process as vowel nasalization, which Schourup (1973) claims to
be favored before tautosyllabic nasals, but which Entenman (1977)
argues with some force to be strictly sequence-conditioned, oc-
curring before all nasals or none at all.  We note also that
tone spreading processes seem to be of this type (Hyman, 1973).
Two domain types interact in the spreading of pharyngealization
in Tamazight Berber analyzed by Saib in Chapter 3.  One possible

statement of the process, which differs from Saib's, is this:
The word plays no role; the domain of pharyngealization is never
less than a syllable; it spreads to the preceding and to the
following syllable unless blocked by a sequence of two consonants.

The Otomanguean contrast between ballistic and controlled syllables, which Rensch describes, is a notable instance of a contrast over the domain of syllable. It affects the realization
of a syllable's onset, coda, length, and pitch contour in a systematic way. While it is reminiscent of accentual features, its
possible accentual function is not known, and it is an obvious
candidate for instrumental phonetic study.

Because the domains of segments, syllables, and words interact
and in many cases provide competing explanations of phonological
processes, it would be desirable to obtain a general characterization of the types of segment strings that serve as domains.
The formal attempts advanced so far, e.g. Howard's Crossover
Constraint (1972) and Jensen's (1974) Relevancy Condition, are
not generally satisfactory, but consideration of this question
and that of syllable structure should prove mutually rewarding.
The contributions of Gay and of Fujimura and Lovins in Chapter
4 are also pertinent here.

In this regard, it should be obvious that neither explanation of
a process in terms of segment strings nor in terms of syllables
is desirable a priori. The lenition of voiced stops in Spanish
could be described as occurring in syllable-final position, given syllabications of the type *pad.re, huev.o, al.dea, silb.o.*
Such syllabications are not well-motivated, and the lenition is
better explained by being blocked in phrase-initial position
and following a homorganic sonorant (Harris, 1969). Similarly,
there is no need to assume a shift in syllable boundary to explain the allegro assimilations of the nasal in English *penguin,
concrete* giving -ŋg-, -ŋk- versus lento forms with -ng-, -nk-
(Bailey, 1975). The closer adhesion of segments at faster tempos suffices. A fortiori, to take such processes as the defining basis for the syllable (Skaličková, 1958; Smalley, 1961)
does not seem supportable.

3.3. Rhythmic Structures. Accentual systems are the most obvious examples of linguistic rhythmic structures, marking certain syllables as more prominent by some combination of prosodic
features. Prominent syllables tend to separate one or more nonprominent ones, providing the same sort of alternation at the
level of the syllable is characteristic of vowels and consonants. We also include here tonal and other systems, traditionally classed as prosodic, although their rhythmic function is
not so evident.

Rules for the placement of accent are often sensitive to the
distinction between heavy syllables, which typically are either
closed by a C or contain a long (or full) V, and light syllables,
which are open and contain a short (or reduced) V. This important topic is explored in three of the papers in the following
chapters. Ohsiek, in Chapter 2, discusses the role of the

heavy/light distinction in stress systems and considers the re-
lation between the two kinds of heavy syllables in terms of evi-
dence from both experimental phonetics and typological compari-
son.   I  Chapter 5, Allen and Hawkins, noting that the syllables
of very young children are typically all heavy, report their re-
search on how children acquire light syllables.   Lehiste's de-
scription of the Estonian contrast between short, long, and
overlong syllables in Chapter 3 is also of interest here.

Restricting the domain of prosodic features to the segment(s)
forming the syllable crest (Jakobson and Halle, 1956) is not
tenable.  Leben (1971) has shown that the conjecture that Woo
(1969) drew from this hypothesis, that short vowels may never
bear rising or falling tone, is incorrect.  Rising and falling
tones occur on short vowels in the West African language Mende
(pǎ 'kill', mbû 'owl') and doubtless in many other languages.
One instance of the *distinctive* portion of tone extending over
the initial onset has been reported in Lalana Chinantec, e.g.
[b²i³], by Rensch and Rensch (1966).  For an illuminating view
of the relationship of tonal structures to segmental structures,
see Hyman (1973) and Leben (1973).  It is of course necessary
to admit larger structures than the syllable as domains of pro-
sodic structures; the description of Estonian, in which Lehiste
draws on considerable experimental phonetic study, presents a
compelling case for the disyllable as a rhythmic unit.

3.4.  Indeterminacy.  The preceding discussions imply that syl-
labic divisions and the number of syllables per word are unique-
ly determinable.  Unfortunately, just as with segments, this is
not always the case.  In this section we discuss briefly the
cases of indeterminacy which are likely to be most troublesome.

Many linguists have claimed that native speakers can determine
the number of syllables in any utterance in their language, oft-
en inviting the assumption that this is a fundamental justifica-
tion for the unit.  Most of the claims appear to imply not just
that the utterances are countable but that there is agreement
among speakers, that is, they are uniquely countable.   It is
known that this is not the case for some languages.  Lebrun
(1966) asked bilingual subjects to count the number of syllables
in recorded French and Flemish sentences.  The subjects were in-
deed able to count the number of syllables but they disagreed
about the number.  Furthermore, the disagreements were not re-
solved by discussions among the subjects and re-presentation of
the sentences.  All subjects agreed that the recorded sentences
were perfectly understandable and were pronounced in an ordinary
fashion.  The results were confirmed for English, French, and
Igbo by Bell (1975).

Vovoids in contact with other vocoids are a major source of in-
determinacy.  Two vowels in succession may be pronounced as
clearly as two syllables, or clearly as a single one.  Since
the process V.V > V:, VV̯, or V̯V is likely to be gradual, it will
sometimes be difficult to decide at what point along the con-
tinuum the sequence ceases to be two syllables and becomes one.
Resonants and obstruents, when they are separated from vowels,
may also be indeterminate.  Lebrun found that initial sequences

of French *le temps, le cavalier,* and *de la boue* were perceived
differently by his subjects.  In Kashmiri, the release of final
consonants is indeterminate, being described by Varma (1964) as
a'vowel which "is not heard, though...definitely articulated,"
and by Kachru (1969) as not vocalic.  For some dialects of Ameri-
can English, final /rl/ sequences and glide-liquid sequences,
such as *pearl, squirrel, dire, jewel, towel,* also seem indeter-
minate.  Note that indeterminacy is *not* found where contoids and
vocoids alternate, but occurs where segments of the same class
are in contact.  However, even in these contexts indeterminacy
is *not* the usual case.

A more prevalent kind of indeterminacy is found in the percep-
tion of syllable boundaries.  There are cases in which an inter-
vocalic consonant or consonant cluster appears to belong equally
to the preceding or following syllable, or else judgments of
which one it belongs to vary widely.  A notorious case is that
of English consonants preceding an unstressed vowel, as in *attic*
and *apple,* mentioned earlier.  Although little is known for sure
about the contexts which favor indeterminate perception of syl-
labication, our impression is that they at least include certain
stress-timed rhythms, of which *attic* etc. are one example, and
longer sequences of intervocalic consonants, a factor noted by
Jones (1956) and Harms (1962).

3.5.   Stylistic Variation.   Stylistic and tempo variation inter-
act in interesting ways with syllabic phenomena.  Bailey (1975
[1978]), Stampe (1973), and Rudes (1976) describe differences in
syllabication in English in different speech styles.  The tenden-
cy is for stressed syllables to attract consonants and become
heavier, while unstressed syllables become more and more reduced.
Thus Bailey gives the example of lento syllabications, *as.para-
gus, Wis.consin, hucks.ter, mons.trous,* compared to allegro
*a.sparagus, Wi.sconsin, huckst.er,* and *monst.rous.*  Other chang-
es in syllabication affect syllable boundaries that mark syn-
tactic boundaries in careful speech.  In casual styles, these
boundaries are relieved of their syntactic duties and allowed
to find their natural phonological position.

Resyllabications in casual styles are affected by the rhythmic
type of the language.  Bailey (1978) points out that careful
speech in English is more syllable-timed than the heavily stress-
timed casual speech in which the difference between stressed
and unstressed syllables is exaggerated.  Compare the slow,
careful version of *I'm going to Buffalo* [áe.ěm.góu.ĭŋ.tɨu.bəf.
e.lŏu] to its most casual version [ŋgõə̌ʷn.t'bə́f.lə̀] (Rudes,
1976).   In this extreme version all but the most strongly
stressed syllables are lost.

In a strictly syllable-timed language, such as Spanish, casual
speech processes tend toward the creation of open syllables.
Vowels are not lost except in contact with other vowels, so that
the syllables remain, at least impressionistically, approximate-
ly the same length.  Consider this example of casual Spanish
from Hutchinson (1974:184): *su amante vive en una casa (h)u-
milde* swà.man.te.βi.βe.nu.na.ka.su.mil.de 'her lover lives in
a modest house'.

Casual speech processes present certain problems for synchronic statements of canonical structure. While some casual speech processes simplify syllable structure which thus continues to conform to the canons based on careful speech (e.g. cluster simplification in *contact* and *hand* in English), others produce more complex segment sequences which do not. For example, pre-stress schwa-deletion in English produces consonant clusters such as /pt/ in *potato*, /mk/ in *mechanic*, /ft/ in *fatality*, /tn/ in *tonight* and so on in casual speech. These clusters all violate the syllable structure condition that is applicable in careful speech, but at the same time they are the consequence of the general rhythmic and syllabic structures of English (Hooper, 1978).

## 4. Beyond Phonological Evidence

Phonological evidence for how segments are organized has the disadvantage that the observer must take what is offered him by the language or languages studied. This is often enough inconclusive. Researchers have never given up hope that a key to the mysteries of the syllable might be found outside phonology, a hope that seemed fulfilled with Stetson's (1951) theory of chest-pulses, only to be quelled by later investigation (Ladefoged, 1958). Most researchers today have a more sophisticated appreciation of the unavoidable distortion of speech behavior that is the price of probing it outside its natural setting. Research in this area is thus simultaneously driven by the desire to find research paradigms that expose new or more detailed phenomena to view and by the need to find means to generalize the results beyond the observational context. Both questions are addressed in the following chapters.

The accumulating results of experimental phonetics have already made it clear that purely segmental models are inadequate to account for the processes of speech production and perception (Liberman et al., 1967; Studdert-Kennedy, 1975). It is thus a major task of experimental phonetics to explain the mechanisms for the extensive coarticulation of segments, the smearing of the gestures and the acoustic cues that correspond to their distinctive features over the surrounding segments.

Granting that it cannot be segments that are strung together at the phonetic level raises the following question: Can we account for the properties of the speech string in terms of a concatenation of some other unit? Drawing upon a wide range of evidence, Fujimura and Lovins respond to this question in Chapter 4 with an explicit model of syllable concatenation. They address the problem of coarticulation by distinguishing several types of assimilatory phenomena and proposing constraints on the domains of assimilation. Gay also addresses the issue of the domain of coarticulation, demonstrating the power of well-directed instrumental speech analysis. He obtained an indication of muscle commands by electromyography, observed the movement of articulators by x-ray cinephotography, and was thus able to examine the coarticulation of vowel and consonant gestures in more detail than heretofore. In particular, he is able to

show that in forms such as /kipip/ or /kutup/, where the vowel gestures appear to be more or less continuous through the medial consonant, there are in fact two separate muscle commands, both for the tongue gesture and for the lip rounding gesture. He concludes that the domain of coarticulation in one sense is the string of preceding consonants for inherently vocalic features, and is limited to the neighboring vowels for inherently consonantal ones.

Although it is clear that the timing of articulatory gestures is organized over larger stretches than the segment, with some remarkably strong correlations (Lehiste, 1970a), no satisfactory overall account has emerged. Lisker, also in Chapter 4, examines carefully the effects of consonants on the duration of the vowel preceding them in English. Vowels are longer before voiced obstruents (*cob*) than before unvoiced obstruents (*cop*), a fact of English that has received much attention, at least in word final position. (See Lisker, 1974, and the references therein.) Can this temporal relationship indicate the syllabic allegiance of medial consonants in the "indeterminate" post-stress position as in *cobby* and *copy*? Lisker argues that the similarity of temporal coarticulation between the two positions does not justify this conclusion, when the whole pattern of temporal relations is considered.

At the other pole from the largely unconscious behavior studied in experimental phonetics, the structure of culturally based activities under the headings of language use, language play, and language art consistently show that segments are less accessible than the groups of segments that serve as prosodic domains and rhythmic units. The dominance of syllabaries in the development of writing systems is a celebrated instance. The isosyllabic line is one of the commonest devices of poetic prosody in the world (Lotz, 1960); segment-based poetic forms are quite rare, though attested, e.g. a Somali poetic form described by Greenberg (1960).

Lehiste's description of the meter of Estonian folk songs in Chapter 3 is an example of a poetic form that is syllable-based and provides a valuable complement to the accompanying account of the syllable's role in the language. Secret languages such as English Pig Latin are a potential source of information about a language's organization of its segments. Interpretation of evidence from all of these sources is complicated by the simultaneous involvement of a cultural code and the linguistic code. Distortion of the language code must also be allowed for; for example, Bailey (1978) remarks that secret languages, because they are usually heavily monitored and spoken with a syllable-timed rhythm, are dubious evidence for syllabication of a stress-timed language like English. Similarly, we are not yet in a position to interpret speakers' responses to tasks of marking parts of words or of dividing them in parts, even for the more ingenious tasks that attempt to reduce speakers' self-monitoring.

Occasionally word-formation processes such as reduplication offer a potential insight into segment organization; elicitation of forms beyond the more common ones to determine the conditions

of the process has qualities between secret languages and the
analysis of naturally occurring speech.  A striking example of
this sort in English is expletive infixation.  McCawley demon-
strates in Chapter 6 the value of probing this process to exa-
mine the interrelation between syllable boundaries and morpheme
boundaries.

The role of child phonology in the study of segment organization,
as in phonology generally, seems to be in transition.  There is
an evident tendency to consider it as having the same relation
as diachronic phonology with phonology proper, although it is
usually still classed with speech dysfunctions and speech er-
rors.  However, the deviations from adult speech found in these
three sources differ in nature, not just degree, as Blumstein
points out in Chapter 6.  This indicates that any understanding
of these phenomena as stemming from common mechanisms will re-
quire further development of process models of the sort sketched
by Menn and MacKay.

In the early speech of children, the production constraints de-
scribed by Ingram and Menn seem to be in terms of the utterance
or the word (which may in some cases also be a syllable).  The
child's sensitivity to the number of syllables in adult forms
is nevertheless revealed, as Ingram shows, by the rules that re-
late children's forms to the adult ones.  Sensitivity to the
same parameter is reported in two other processes.  In a kind
of speech error called nonsemantic malapropisms, the inappropri-
ate word that is produced nearly always has the same length as
the word it replaces, where length is not counted in segments
but in $C_0VC_0$ combinations, e.g. *review* for *revise* (Fay and Cut-
ler, 1977).  The "tip-of-the-tongue" study of incomplete lexi-
cal access by Brown and McNeill (1966) also reported number of
syllables of target words to be an accessible parameter by their
subjects.  With regard to the discussion of lexical representa-
tion in Section 2, these facts would be most directly explained
by the lexical representation of words with their syllabic pat-
tern, perhaps as part of their rhythmic pattern, although other
explanations are of course possible.  (Note that there is no
corresponding evidence for lexical representation of syllabica-
tion.)

MacKay (Chapter 6) reports on an experimental paradigm which un-
expectedly induced a large number of speech errors involving
more than one part of a syllable, a type that rarely occurs nor-
mally.  Subjects were asked to repeat monosyllabic words, re-
placing a labial stop by its voiced or unvoiced counterpart,
e.g. *big* → *pig*.  More interesting than the errors in switching
the labial consonants were the many errors that occurred else-
where in the syllable, and their patterns, e.g. shift of voic-
ing of another consonant in harmony with target stop, e.g.
*peaked* → *beaged*.  The task apparently creates production diffi-
culties for adults that are similar to those postulated by Menn
for very young children to explain forms such as /gʌk/ for *duck*,
among other things.  This kind of consonant harmony, which is
not at all common in adult phonology, is also one of the types
of errors in aphasic speech that Blumstein describes in Chapter
6.  She notes that within a word the consonants involved in

such errors seem to obey a distance principle, never being separated by more than one syllable. Among other characteristics of consonant errors in aphasic speech, Blumstein notes that substitutions are rarer in clusters than in single consonants, indicating that they are a more cohesive articulatory sequence. We will have to wait for future research to answer the interesting question, raised by Fujimura and Lovins' proposal of syllable "affixes," whether such consonants behave more like single consonants or like members of a cluster in aphasic speech. One further regularity of aphasic substitutions is that contaminating and affected consonants appear in the same structural position of the word and syllable. As MacKay points out, this is of course one of the major characteristics of spoonerisms: thus we observe *mazagine* for *magazine, fute meeving* for *feet moving, arg of the fewt* for *art of the fugue* (Fromkin, 1971).

Distorted speech also gives evidence for another characteristic of the syllable. Under a variety of conditions, the consonantal onset and the nucleus plus coda have been shown to be more tightly bonded internally than the two parts are to each other, suggesting an internal structure $C_0 + VC_0$. MacKay (1972) found that the most frequent type of transposition in speech errors created a break between onset and core; the distinction forms part of the model he presents in Chapter 6. The same distinction was proposed by Kuryłowicz (1948) on phonological grounds. (Pike and Pike (1947), to whom Hyman (1975) attributes the proposal, did not consider the status of the coda in their argument for an internal structure of the syllable.) The distinction of course conflicts with the view sketched in Kozhevnikov and Chistovich (1965) that the articulatory structure of syllables consists of CV elements. Kuryłowicz cited the heavy/light distinction, which makes no reference to the syllable's onset, and the domain of tonal contrast, which as we remarked earlier almost never extends into the onset. To these phonological facts can be added the asymmetry of co-occurrence constraints, which are far stronger between coda and nucleus than between onset and nucleus. Reduplications which retain the CV portion of a CVC syllable are not necessarily counterevidence, since the inherent weakness of syllable final position is probably a better explanation.

Coarticulation of course extends over the entire syllable and beyond, as the studies in Chapter 4 make clear; but, except for pitch, Lisker's results showing more coarticulation with the syllable of the coda than the onset are typical. The perceptual consequences of an internally structured syllable are not well explored, although the above hypothesis is consonant with the finding that English vowels are more accurately perceived in a VC context than in a CV context (Edman, Strange, and Jenkins, 1976).

It appears that the transposition and insertion rules of secret languages also tend to separate the onset (English *pig → ig-pay, popig, pegig, palfig*), although counterexamples are attested, e.g. Hanunóo *rignuk → nugrik* (Conklin, 1964) and *hänko → konko häntti*, etc. in the Finnish "knapsack" language (Campbell, 1976). The same asymmetry occurs in the metrics of poetry. It appears

that rhyme frequently demands that $VC_0$ sequences be similar, whereas alliteration is rarely based on $C_0V$ sequences. The alliterative meter of the Finnish Kalevala (Kiparsky, 1968b) is the only such case known to us.[6] Conclusions from these two sources remain necessarily tentative in the absence of systematic comparison.

We view this evidence for the $C_0 + VC_0$ structure, converging from many sources, more as signalling an important area for further research than as establishing a fact about the syllable. The example illustrates the power of bringing together diverse sources of evidence to direct us to areas where the search for underlying principles is likely to be fruitful. Other similar examples arise in the following chapters. It is our hope that the discussions we present here, which approach the subject from many different points of view, will provide the perspective necessary to approach a general theory of segment organization and the syllable.

## NOTES

[1]There is no general survey of the syllable and related phenomena that covers the last ten years' work, to our knowledge. Awedyk (1975), Chapter 9 of Pike (1967), and Kloster Jensen (1963) are all useful commentaries on earlier work, and Lotz (1966) is a preliminary bibliography.

[2]O'Connor and Trim (1953) and Greenberg (1962) are attempts to provide a general characterization of syllabic and nonsyllabic segments. See Bell (1977a) for discussion.

[3]This estimate is based on a classification in which consonant+glide combinations, e.g. $t^y$, etc., and consonant+laryngeal combinations, e.g. $k^?$, $p^h$, etc., were counted as single segments, and would be somewhat lower if such sequences were considered to be clusters in some cases.

[4]The Kunjen dialects of Australia are a possible exception to both parts of (7); see Sommer (1969) and Dixon (1970). Fischer-Jørgensen (1952) cites Keresan as a counterexample to the last part, based on Spencer (1946); for another analysis see Miller (1965). The Iroquoian languages Seneca and Mohawk are described by Chafe (1963) and Bonvillain (1973), respectively, to have final syllables that are closed either by an oral consonant or else ? or h. Seneca and Mohawk may indeed be true counterexamples, although in many cases one would rather consider a partial devoicing of a vowel, which the h represents here, as part of the syllable nucleus than its coda.

[5]This condition cannot hold for Kunjen if it violates (7). Even so, it of course does not follow that Kunjen's canonical forms contain no CV.

[6]We thank David Stampe for drawing our attention to the Campbell and Kiparsky reference.