Lexical Morphology and Phonology

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1. Lexical Morphology

The approach to word structure that I shall explore here represents a convergence of several originally independent strands of research. One is the emerging theory of morphology and the lexicon (e.g. Aronoff 1976), and more particularly the idea of a level-ordered morphology elaborated by D. Siegel (1974, 1977), M. Allen (1978) and others. Another centers around the problem of constraining lexical representations and phonological rules, beginning with various versions of the Alternation Condition (Kiparsky 1968, 1973) and continuing with the conception of Cyclic Phonology first proposed by Mascaró (1976) and subsequently pursued in a number of studies of the phonologies of particular languages (most extensively Rubach (1981)). I shall also be drawing on aspects of the recent metrical theory of stress (Liberman and Prince 1977, Hayes 1981) and syllable structure. When these ideas are put together, and developed in a certain direction, they explain a series of properties of phonological rules and their relation to morphology and the lexicon that have so far appeared as unexplained generalizations, or in some cases even defied coherent formulation or escaped notice altogether.
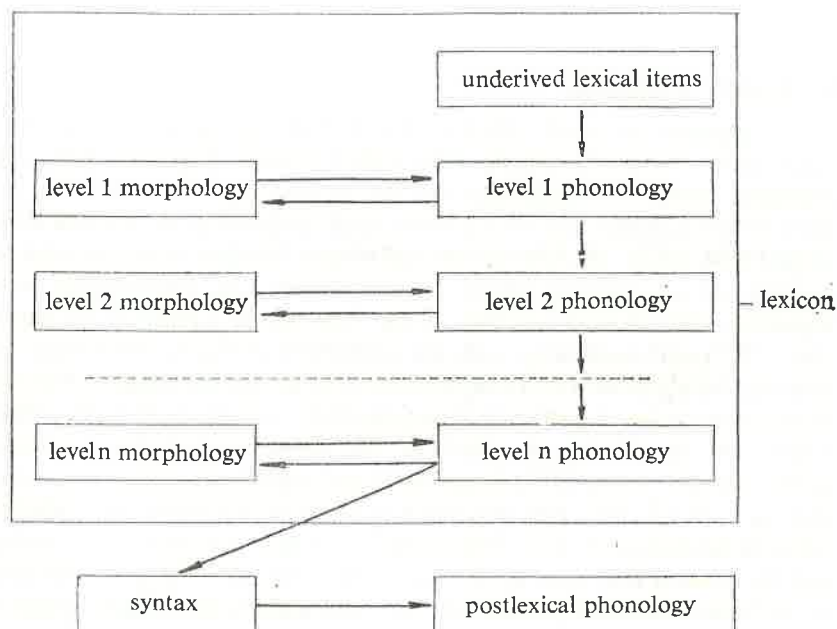
The basic insight of level-ordered morphology is that the derivational and inflectional processes of a language can be organized in a series of levels. Each level is associated with a set of phonological rules for which it defines the domain of application. The ordering of levels moreover defines the possible ordering of morphological processes in word-formation. Following a proposal of Pesetsky (1979) let us assume that the output of each word-formation process is submitted within the lexicon itself to the phonological rules of its level. This establishes a basic division among phonological rules into those which are assigned to one or more levels in the lexicon, and those which operate after words have been combined into sentences in the syntax. The former, the rules of *lexical phonology*, are intrinsically cyclic because they reapply after each step of word-formation at their morphological level.

[3]

The latter, the rules of *postlexical phonology*, are intrinsically noncyclic. The lexicon is accordingly structured in the following way:

(1)

```
                    ┌──────────────────────────┐
                    │   underived lexical items │
                    └──────────────────────────┘
                                 ↓
  ┌──────────────────┐    ┌──────────────────┐
  │ level 1 morphology│──→│ level 1 phonology │
  └──────────────────┘←───└──────────────────┘
                                 ↓
  ┌──────────────────┐    ┌──────────────────┐
  │ level 2 morphology│──→│ level 2 phonology │ ── lexicon
  └──────────────────┘←───└──────────────────┘
                                 ↓
  ┌──────────────────┐    ┌──────────────────┐
  │ level n morphology│──→│ level n phonology │
  └──────────────────┘←───└──────────────────┘

  ┌──────────┐              ┌──────────────────────┐
  │  syntax  │─────────────→│ postlexical phonology │
  └──────────┘              └──────────────────────┘
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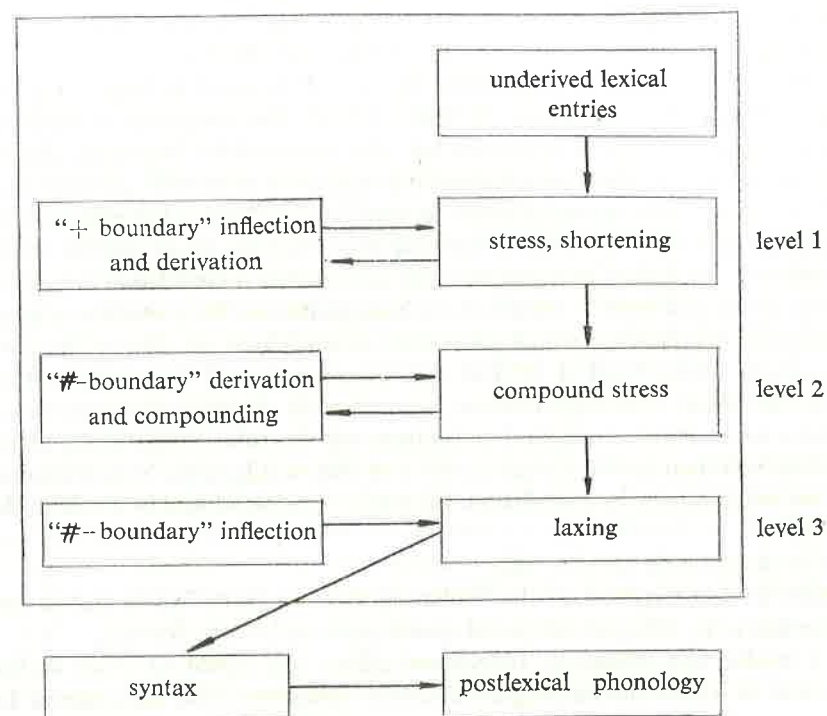
The output of the right-hand boxes collectively constitutes the set of lexical items of the language. The point that the result of every layer of derivation is itself a lexical item will have important consequences later on.

Models of this type have also been investigated by Strauss (1979), Booij (1981), Pulleyblank (1981), and especially by Harris (1982) for Spanish and Mohanan (1981) for Malayalam, the latter also with extensive theoretical justification of the framework.

For concreteness I add a tentative sketch of how the English lexicon might be organized. It draws on previous explorations of English morphology by Siegel (1974), Allen (1978), Selkirk (MS), and Williams (1981), but differs in some respects from each.

(2)

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                                ┌────────────────────────┐
                                │ underived lexical entries│
                                └────────────────────────┘
                                             ↓
  ┌──────────────────────┐    ┌──────────────────┐
  │ "+ boundary" inflection│──→│ stress, shortening │   level 1
  │    and derivation     │←───└──────────────────┘
  └──────────────────────┘
                                             ↓
  ┌──────────────────────┐    ┌──────────────────┐
  │ "#-boundary" derivation│──→│  compound stress  │   level 2
  │    and compounding    │←───└──────────────────┘
  └──────────────────────┘
                                             ↓
  ┌──────────────────────┐    ┌──────────────────┐
  │ "#- boundary" inflection│─→│      laxing       │   level 3
  └──────────────────────┘    └──────────────────┘

  ┌──────────┐              ┌──────────────────────┐
  │  syntax  │─────────────→│ postlexical phonology │
  └──────────┘              └──────────────────────┘
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Of the three levels in (2), the first level comprises the affixes which have usually been associated with the + boundary. They correspond to the "primary suffixes" of traditional descriptions such as that of Sanskrit by Whitney (1889). This level includes derivational suffixes such as *-al, -ous, -ity, -th,* and inflectional suffixes such as those in *kept, met, hidden, children, addenda, indices, foci* as well as "ablaut", "umlaut" and other stem-changing morphology as in *teethe, bleed, bathe, teeth, lice.* To the second level we assign #-boundary ("secondary") derivation and compounding. Such derivational suffixes as *-hood, -ness, -er, -ism, -ist* belong here. The third level takes care of the remaining, "regular" inflection (*leaped, pleated, books, conundrums, indexes, crocuses,* etc.).

Although the division between level 1 and level 2 affixes coincides entirely with the familiar distinction between the "+ boundary" and the "# boundary" affixes, we shall see that it in fact has deeper roots in the morphological system. In what follows I will first motivate (2) on morphological grounds and then proceed to develop some of its consequences on the phonological side.

First let us introduce a specific format for morphological rules in the grammar. Following Lieber (1980) I shall distinguish two basic classes of word-formation processes, compounding and affixation, and assume that all word-formation is endocentric. By this I mean that the category of a derived word is always non-distinct from the category of its head, in English usually the rightmost constituent (cf. Williams 1981).[1] The categories in question include not only lexical categories but also features like Transitive, Agent, etc. In any approach to morphology it is necessary to provide certain kinds of information for any given affix: to what sorts of things the affix may be added, whether it is prefixed or suffixed, and what are the properties of the resulting form. Lieber proposes that this information is encoded in the lexical entry of the affix itself by means of a subcategorization frame and an inherent categorial specification which percolates upward from an affix to the constructions whose head it is. For our purposes it will be convenient to construe these subcategorizations and inherent feature specifications of affixes as so many contextual restrictions on the rules which insert them. Affixes will then not be lexical entries and they will have no lexical features either inherently or by percolation. Each affix A is introduced by a rule of the form

(3)   Insert A in env. $[Y\_\_Z]_X$

where Y, Z correspond to the "subcategorization frame" of A and X corresponds to its inherent categorial specification in Lieber's format.

Consider first inflection. Inflectional affixes are added to stems in the content of lexical and paradigmatic features associated with those stems. To illustrate, let the noun *ox* have been inserted in $[\ \ ]_{\text{Noun}, +\text{Plural}}$. A morphological rule at level 1 then obligatorily inserts the suffix *-en* after it:

(4)   Insert /en/ in env. $[\text{ox}\_\_]_{\text{Noun}, +\text{Plural}}$

The noun *boy* is not subject to (4), but if [+ Plural] it undergoes rule (5) at level 3:

(5)   Insert /z/ in env. $[X\_\_]_{\text{Noun}, +\text{Plural}}$

The morphological processes at different levels are related in certain characteristic ways which recur from language to language.

1. One phenomenon to be accounted for is the "blocking" effect, which has been discussed for derivational morphology by Paul (1896), Esau (1973), Aronoff (1976), Clark and Clark (1979), Toman (1980), and shows up still more clearly in inflection. Words which are inflected at level 1, for example, usually do not receive the general suffixes at level 3. There is no **foots*, **oxes* alongside *feet*, *oxen*, and no **keeped*, **meeted* alongside *kept*, *met*. We shall however have to explain not only why such is the normal case, but also how it is possible for occasional doublets to exist, e.g. *kneeled/knelt, dreamed/dreamt, crocuses/croci, indexes/indices*. In derivational morphology doublets are actually quite common, to the point that blocking there can hardly be

considered more than a general tendency.

The blocking phenomenon follows from obligatoriness of morphological rules. For example, *ox*, if [+ Plural], must undergo (4) and so there is no way to derive **oxes* by the later rule (5). Failure of blocking, resulting in doublets like *crocuses/croci* and *dreamed/dreamt*—which we can take to be the marked case—is obtained by making the special rule optional for those words.

To get the blocking effect for derivational affixes, we treat them also as inserted in the context of the appropriate morphological categories. We shall suppose that lexical items are freely inserted into categorial frames [ ]$_X$, where X is a bundle of features. We illustrate with the derivation of deverbal agent nouns. A restricted set of verbs allow nouns to be made at level 1 by such suffixes as *-ant* or zero derivation (which I take to be a phonologically empty suffix). These suffixes are inserted at level 1 by such rules as (6):

(6)   Insert $/\phi/$ in env. $[V_n\_\_]_{\text{Noun}, +\text{Agent}}$
         where $V_n =$ *guide, bore, gossip . . .*

So from $[[\text{guide}]_V]_{N, +\text{Agent}}$ we derive the noun $[[\text{guide}]_V\phi]_{N, +\text{Agent}}$ which is well-formed because it is endocentric. If V is not in V_n, (6) cannot apply and the resulting structure is filtered out because it is not endocentric. The interesting generalization is that verbs subject to one of these level 1 rules tend not to get the otherwise productive *-er* suffix added by the corresponding rule (7) at level 2:

(7)   Insert *er* in env. $[V\_\_]_{\text{Noun}, +\text{Agent}}$

(8)   spy$_N$: **spier*
         inhabitant: **inhabiter*

And when both do exist, the *-er* noun is mostly restricted to meanings not covered by the level 1 noun:

(9)   cook (person): cooker (device)
         drill (device): driller (person)
         divide (dividing line, ridge, etc.): divider (person, device)
         stimulant, expectorant (substances): stimulator, expectorator
            (devices, persons)
         defendant (of self, in court): defender

If we formulate the appropriate verb-particular meaning conditions on the insertion of level 1 affixes, the distribution and meaning of *-er* can be left basically unrestricted; it will simply appear whenever not pre-empted by some level 1 agent suffix.

2. An absolute constraint, on the other hand, seems to be that a blocking process can only be located at the same level or at an earlier level than the process it blocks. We do not find, for example, cases where word-specific affixes are ordered (on phonological or independent morphological grounds) *after* the general affix for that category. An adequate theory of morphology

must exclude in principle, for example, a language in which the English facts are reversed and it is the level 3 inflections which occur only with specially designated words.

Given the above format for morphology, this simply follows from the ordering of levels. It is impossible for a process to block a process that precedes it because blocking is pre-emption by prior application.

3. From this it follows in turn that among processes in a blocking relationship, those with restricted applicability have to be ordered before those with general applicability. This explains why processes at later levels are also typically more productive than functionally related processes at earlier levels.

4. Derivational processes at later levels are semantically more uniform than those at earlier levels, where various specialized uses are prone to develop. As before, the point generalizes from derivation to inflection, cf. the semantic differentiation *brothers/brethren*. The greater semantic coherence of the general word-formation processes which are ordered at later levels is a consequence of their productivity (as suggested by Aronoff 1976, 45). The fact that they do not require word-by-word specification but apply across the board to a whole category (subject to blocking as discussed above) means that there is no foothold for imposing word-specific semantic conditions on them either. In other words, imposing an additional word-particular semantic restriction adds a relatively small increment of complexity to an early (level 1) process because the words it applies to must be listed anyway, but it adds a large increment of complexity to a late process because its context can otherwise be given categorially.

5. Lexical items which are *inherent* bearers of some morphological feature do not receive the morpheme that marks that feature. Inherently plural nouns like *cattle* and *people* do not receive a plural ending.

Here we shall invoke the Elsewhere Condition (which will play an important role in a quite different aspect of our theory to be discussed below). The formulation in (10) modifies slightly an earlier version proposed in Kiparsky (1973), cf. Koutsoudas, Sanders & Noll (1974).[2]

(10)   Rules A, B in the same component apply disjunctively to a form Φ if and only if

    (i)   The structural description of A (the special rule) properly includes the structural description of B (the general rule).

    (ii) The result of applying A to Φ is distinct from the result of applying B to Φ.

In that case, A is applied first, and if it takes effect, then B is not applied.

Consider now a *plurale tantum* like *people*. Assume its lexical entry is inherently marked [+ Plural]. We would like (10) to block such inherent plurals from being pluralized by rule (5). Suppose then we construe each

lexical entry L as a rule, namely the identity rule L, whose structural description and structural change are both = L. Then the rule corresponding to the lexical entry [people]$_{+Noun, +Plural}$ is disjunctive with (5) by virtue of (10). That is, the structural description of the lexical identity rule (namely [people]$_{+Noun, +Plural}$) properly includes the structural description of the general plural rule (namely [X__]$_{+Noun, +Plural}$) and their outputs are distinct (namely, *people* and *people* + z, respectively). Therefore the special rule, the lexical identity rule, sets aside the general plural rule.

6. Related to the preceding is the exclusion of stacked affixes having the same function. For example, having derived *oxen* at level 1 we cannot add plural suffix at level 3 to get **oxens*. This now follows as in the preceding case given our assumption that the output of each stage of word-formation (with the rules of lexical phonology applied to it) is itself a lexical entry. The lexical entry [oxen]$_{+Noun, +Plural}$ derived at level 1 is then not liable to receive a plural suffix at level 3 for precisely the same reason as the underived lexical entry [people]$_{+Noun, +Plural}$ is not liable to receive it.

We now proceed to some features of English morphology on which the proposed approach sheds light, concentrating on those aspects of (2) that diverge from earlier versions of level-ordered morphology.

The organization of morphological rules depicted in (2) derives inflection at two levels. This predicts that irregular inflection, derived at level 1, should be available to derivational processes at level 2, while regular inflection, derived at level 3, should not. This is confirmed by the occasional appearance of level 1 plurals inside ordinary noun compounds:

(11)   a.   teeth marks   b.   *claws marks
              lice-infested   *rats-infested

Secondly, consider *pluralia tantum* with plural morphology, such as *alms, odds, etc.* These nouns must be marked as inherently [+ Plural] in the lexicon. The theory consequently does not allow them to be entered as underlying /alm/, /odd/ because (10) prohibits the plural affix to be added to them by (5). Therefore the underlying form must be *alms, odds*, etc. (This conclusion would also be forced by word-based morphology, which prohibits bound stems from being lexical entries). Therefore we predict that in such cases the plural suffix should also show up inside compounds, but this time *obligatorily*. This again appears to be correct:[3]

(12)   almsgiving   *almgiving
        oddsmaker   *oddmaker
        painstaking   *paintaking
        Humanities Department   *Humanity Department
        clothesbrush   *clothbrush
        arms race   *arm race

The only other cases where plurals systematically appear inside compounds

in English can (and in most cases must anyway for other reasons) be analyzed as involving phrases embedded in compounds. We must assume some limited recursion from phrase-level syntax back into morphology anyway. The occurrence of level 3 plurals in these cases is predicted:

(13)   a.   a heads-up play, a hands-off policy, a hands-down victory, hands-on training
       b.   (daddy) long-legs, (Judy) blue-eyes[4]
       c.   excess profits tax, the save-the-whales campaign, the Model Cities program, computer systems analyst, systems analyst

In the same way, we predict the formation of *withstood, understood* and similar verb compounds with level 1 inflection on their second members. Since these inflections are formed at level 1, they are available for word-formation at level 2. Moreover, the theory predicts not only that they can but that they *must* appear in past tenses of such compounds. The tensed output of level 2 is [withstand]$_{+Verb,-Past}$ and [withstood]$_{+Verb,+Past}$, neither of which can receive the level 3 past ending *-ed*, the former because of feature conflict, and the latter by virtue of (10) as shown above.

The prediction is particularly interesting in view of the opposite outcome in cases like *grandstanded* (**grandstood*). This too follows from the theory because of the intrinsic ordering of compounding and level 1 inflection imposed by (2). The derivation proceeds as shown in (14):

(14)   level 1:   stand$_V$ → stand$_N$
       level 2:   grand$_A$ + stand$_N$ → grandstand$_N$
                  grandstand$_N$ → grandstand$_V$
       level 3:   grandstand$_V$ → grandstanded

Nouns can only be formed from untensed (in particular, [− Past]) verbs, because tense must agree with a nominative subject (cf. Kiparsky and Kiparsky 1971, 356-7) and nouns do not have nominative subjects. Only when the verb is derived from the compound noun at level 2 can tense be assigned; at that point level 1 inflection is no longer accessible and only the regular inflectional suffixes can be assigned.

More generally, we are now in a position to explain why exocentric (*bahuvrihi*) compounds are characteristically inflected at level 3 even if their second members are by themselves inflected at level 1, whereas endocentric compounds retain the inflection that their second member has by itself. Consider e.g. *milk teeth* (endocentric) vs. *sabertooths* 'sabertooth tigers' (exocentric). As in the verb compound just discussed, endocentric noun compounds are formed at level 2 by combining words, including words derived at level 1 such as *teeth*. Exocentric compounds however, must on our assumptions be assigned zero derivational suffixes since they otherwise would share the properties of their heads, i.e. be endocentric. But as noted in fn. 3, derivational suffixes cannot be added to derived plurals. Therefore exocentric compounds

come out of level 2 with exclusively singular morphology and can receive plural endings only at level 3 where they are adjoined to the whole compound.

The model of lexical phonology directly predicts the correlation between "boundary strength" and affix order which was observed for English by Siegel (1974), and is apparently a general property of languages. The generalization is that affixes of level n are not added to stems which already contain affixes of level $n+1$. For example, consider the two negative prefixes *in-* and *non-*. *In-* assimilates to a following consonant (Singh 1981) but *non-* does not. In standard generative phonology this is dealt with by assigning them + and # boundaries respectively and restricting assimilation to apply across + only:

(15)   in + legible   →   illegible
       non # legible ↛   *nollegible

This phonological difference between *non* and *in* is related to the fact that *non-* can be prefixed to a word with *in-* but *in-* cannot be prefixed to a word with *non-*:

(16)   nonillegible
       *innonlegible

In the present theory both the phonology and the ordering of the two prefixes follows from putting *in* and the assimilation rule on level 1 and *non* on level 2. No boundary is then needed to block the assimilation of *non*. In this way, boundary symbols such as + and # can be entirely eliminated from phonological representations. The requisite information is carried by the appropriate ordering of levels and the morphological bracketing of the string (cf. Strauss (1979), Mohanan (1981)).

The cyclic application of phonological rules has generally been assumed to be subject to the convention that internal brackets are erased at the end of a cycle (Chomsky and Halle 1968, 20). We shall assume here the weaker version (17), equivalent to the "Opacity Condition" of Mohanan (1981).

(17)   Bracketing Erasure:
       Internal brackets are erased at the end of a level.

Hence the use of even the limited boundary information encoded in the morphological bracketing is restricted to the level at which the morphology itself is assigned. Moreover, morphological rules also do not have access to internal morphological structure of earlier levels. Pesetsky (1979) and Allen (1978) have suggested more restrictive conditions but these appear to be difficult to maintain in view of the English example in (22) below, the Malayalam cases cited in Mohanan (1981), and the extensive material discussed, from a different point of view, in Carstairs (1981).

In addition to giving a more restrictive theory of morphological junctures, lexical phonology makes it possible to deal with phenomena where boundary symbols fail. A well-known problem for cyclic assignment of word stress in

English arises in zero derivation. When nouns are formed from verbs they may shift to the nominal stress pattern (18a), but when verbs are formed from nouns they do not shift as expected to the verbal stress pattern (18b):

(18)   a.   tormént$_V$ → tórmènt$_N$
        b.   páttern$_N$ → *pattérn$_V$ (cf. *cavórt, usúrp*)

This difference in stress behavior is directly accounted for by forming nouns from verbs at level 1 and verbs from nouns at level 2, where they escape the level 1 rules of word stress. This correlates in the first instance with the productivity difference that we expect between level 1 and level 2 derivational processes. N to V derivation enjoys great productivity in English (Clark and Clark 1979), while V to N derivation is comparatively restricted in scope. As a broad generalization it can be said that verbs are freely zero-derived from nouns whenever not blocked by a synonymous formation at level 1, such as *systematize* (**to system*), while nouns are zero-derived from verbs in special cases which themselves block the productive agent and action suffixes at level 2 such as *-er* (rule 7) and *-ing*.[5]

Our proposal is borne out by a number of specific morphological facts as well.

1. It predicts that verbs zero-derived from nouns are regular in inflection. The result is that the ablaut rules at level 1 become more general. For example, it becomes a practically exceptionless rule that verbs in *-ing, -ink* are strong (*flung, stung, wrung, swung, rang, sang, shrank, sank, stank* etc.); the weakly inflected verbs (*ringed, winged, inked, linked* etc.) are derived from nouns at level 2 and hence are automatically excluded from level 1 inflection. By contrast, nouns formed from verbs at level 1 will be susceptible to level 1 phonological rules, not only stress as we have seen (*tormént$_V$ → tórmènt$_N$*) but also such rules as ablaut (*sing$_V$ → song$_N$*).

2. As for morphology, since compounds are formed at level 2 we correctly predict that noun compounds can become verbs but verb compounds cannot become nouns. This is entirely correct:[6]

(19)   a.   to grandstand, to wallpaper, to snowball, to quarterback
        b.   *an air-condition, *a stage-manage

3. By assigning V → N and N → V zero derivation to levels 1 and 2 respectively we can also see why verbs formed with suffixes never yield zero-derived nouns:

(20)   *a publicize, *a demonstrate, *a clarify

while nouns may yield zero-derived verbs if they are formed with level 1 suffixes (21a) though not if they are formed with level 2 suffixes (21b):

(21a)   to pressure, to picture, to commission, to proposition, to requisition, to trial, to engineer, to reverence, to reference
(21b)   *to singer, *to beating, *to freedom, *to promptness, *to championship, *to alcoholism, *to nationalist, *to sisterhood

If we stipulate that zero suffixes cannot be added to suffixed forms

(22)   *   ] X] ϕ]

these facts fall out from Bracketing Erasure (17) and the level ordering we have assumed. The nouns in (20) and the verbs in (21b) are excluded by (22) because they are zero-derived from stems which are suffixed at the same level. The verbs in (21a) do not violate (22) because the internal brackets from level 1 are erased by (17) at level 2 where N to V derivation applies.

4. Nouns zero-derived from verbs should be capable of receiving level 1 suffixes, while verbs zero-derived from nouns should not be so capable. The examples in (23) show that zero-derived nouns can indeed get level 1 suffixes:

(23)   contractual, murderous, rebellious

And it does also seem to be true that there are no cases which would involve adding a level 1 deverbal suffix to a zero-derived denominal verb:

(24)   *gesturation, *figurive, *patternance, *crusadatory, *cementant

But, as predicted, level 2 deverbal suffixes can be added to zero-derived denominal verbs:

(25)   placement, commissionable, riveter, masquerading

5. A special case of this relation between level 1 and level 2 derivation is that V → N → V zero derivations are possible, while N → V → N zero derivations are not. Examples of the former type are

(26)   protést$_V$ → prótèst$_N$ → prótèst$_V$ 'stage a prótest'
            (demonstrators may prótèst but a child can only protést)
            discóunt$_V$ → discòunt$_N$ → discòunt$_V$ 'sell at a discount'
            digést$_V$ → dígèst$_N$ → dígèst$_V$ 'make a digest'
            compóund$_V$ → cómpòund$_N$ → cómpòund$_V$ 'join or become joined
                                                          in a compound'

Convincing N → V → N cases, such as a hypothetical triplet *pattern$_N$ → pattern$_V$ → *pattern$_N$* do not exist to my knowledge. Some cases that look like they might be of that type are probably more correctly taken as involving two distinct zero nominalizations from a verb, such as 'act' and either 'effected object' (27a), 'implement' (27b), or 'agent' (27c):

(27) a.	discharge$_V$	discharge$_N$	'act of discharging'	discharge$_N$	'that which is discharged'
	spit$_V$	spit$_N$		spit$_N$	
	shit$_V$	shit$_N$		shit$_N$	
	sweat$_V$	sweat$_N$		sweat$_N$	
	splice$_V$	splice$_N$		splice$_N$	
b.	paddle$_V$	paddle$_N$	'act of paddling'	paddle$_N$	'implement for paddling'
	brush$_V$	brush$_N$		brush$_N$	
c.	scrub$_V$	scrub$_N$	'act of scrubbing'	scrub$_N$	'one who scrubs'

The reason for taking the verbs rather than one of the nouns as basic is that various overt V → N derivations expressing each of these categories must be assumed anyway, e.g. *shavings, spittle* (effected object), *router, mixer* (implement and agent). Also, only on that assumption will level-ordering correctly predict that the verbs may undergo level 1 inflection (cf. *spat, sweat(ed)*), and that verbs which *must* be zero-derived will *not* form zero nouns but express these categories by means of other suffixes, as in (28):[7]

(28)   rivet$_N$ → rivet$_V$ → riveting (act), riveter (implement, agent)
       condition$_N$ → condition$_V$ → conditioning, conditioner
       water$_N$ → water$_V$ → watering, waterer

An essential feature of our approach is that affixation and compounding are interspersed. Here we diverge from Williams (1981), who orders all inflectional and derivational affixation before compounding. We have seen that the interaction of compounding and inflection in English morphology supports our proposal. Additional support for it comes as we now turn to the relationship of compounding and derivational affixation. We shall concentrate on deverbal derivation in English, with particular emphasis on so-called synthetic compounds such as (29):

(29)   typesetter, front-runner, watchmaker, churchgoer, housekeeping, bullfighting

If all affixation precedes compounding, then these words have to be treated as N + N compounds comparable to the type *doghouse*. They have, however, a number of pecularities which have traditionally been taken to motivate a different analysis, namely that they are "derivations from a verbal nexus" (Marchand 1969, 15). This is essentially the approach which we shall pursue here.

The most obvious special feature of synthetic compounds is that their second member does not have to exist as a word in its own right. The nouns *setter, goer* do not occur on their own at least in the senses in which they enter into the compounds *typesetter, theatergoer* etc. As Marchand (1969, 17) remarks, "the lexical independence of the second member is a matter of secondary importance". The point is more obvious for synthetic bahuvrihis, where the second member is routinely bound (*three-legged, moon-faced, fair-minded* etc.). As Bloomfield (1933, 231) observed:

". . . forms like *long-tailed* or *red-bearded* are not aptly described as containing the words *tailed, bearded* (as in *tailed monkey, bearded lady*): the natural starting-point is rather a phrase like *long-tail* or *red beard*, from which they differ by the presence of the suffix *-ed*. This is the same thing as saying that we use compounds of the type *long tailed, red-bearded* regardless of the existence of words like *tailed, bearded*; witness forms like *blue-eyed, four-footed, snub-nosed*. Another modern English synthetic type is that of *three-master, thousand-legger*."

The traditional view, then, is that the special properties of synthetic compounds are due to their being derived from phrasal combinations. To my knowledge, the only generative treatment so far which exploits this idea is that of Roeper and Siegel (1978). They propose that synthetic tatpurushas are derived by "lexical transformations" which operate on subcategorization frames. Their key idea is that in a compound of the form

(30)   X   V $\begin{Bmatrix} \text{er} \\ \text{ing} \\ \text{ed} \end{Bmatrix}$

X has to be the *first sister* of V, that is, the nearest complement of V in the verb phrase.

It is actually not necessary to follow Roeper and Siegel to the extent of deriving synthetic tatpurushas from syntactic representations of any sort. Their essential insight is that the semantic relationship between the members of such compounds is systematically determined by the argument structure of the verb. Their principle encompasses the following generalizations, which as far as I can see are correct:

(1)   X in (30) can never be the subject of V:

(31)   *population-growing, *blood-circulating, *owner-operating

(2)   X can never be an adverbial if V is necessarily transitive:

(32)   *quick-making (*he makes quickly), *home-taking (*he takes home)

(3)   Transitives are compounded with adverbials if they can be used intransitively ("absolutely").

(33)   night-driving   (drives ϕ at night)
       street-trading   (trades ϕ in the street)

(4)   If an object is expressed, this possibility is excluded and (34) therefore becomes ungrammatical:

(34)   *night-driving of cars (vs. car-driving at night)
       *street-selling of drugs (vs. drug-selling in the street)

(5)   The order of adverbials in the base explains such contrasts as (35a), (35b), cf. R & S p. 240:

(35)   a.   well-constructed (by hand)
                  hand-constructed (*well)
            b.   handmade (by Indians)
                  Indian-made (*by hand)

Roeper and Siegel build the "first sister" restriction into their word-formation rules for synthetic compounds. I will assure instead that it should be factored out as a separate interpretive principle which governs verb compounds (continuing to call this reinterpreted version the "First Sister Principle" (FSP)):

(36)   In a word X V Y, if X or Y is a lexical category, interpret it as the first (syntactically unexpressed) argument of V.

On this formulation the FSP correctly generalizes to the reverse type (37):

(37)   pickpocket, catchall, do-nothing, killjoy, stopgap, scofflaw, runaround, diehard, standby, stay-at-home

accounting for the absence of compounds like (38):

(38)   a.   *fallrock, *diesheep, *leaktank (subjects compounded)
            b.   *pickaround, *killhard, *catch-at-home (transitive verbs compounded with adverbs)

An apparent class of systematic exceptions to (36) are compound verbs. Not only are adverbials compounded "across" objects in them:

(39)   hand-pick, machine tool, sun-dry, spotweld, dry-clean, jet-propel, breast-feed, top-dress, guest-conduct, quick-freeze, back-pedal

but compounding of objects is usually precluded:

(40)   *meat-eat, *tax-pay, *flame-throw, *bullfight, *bloodsuck, *evildo, *basketball play

What appears to be interacting with the FSP here is the restriction:

(41)   Compounding cannot affect subcategorization.

This does not have to be stated as a separate constraint, but follows from the principle we already assumed above that compounding (like all word-formation) is endocentric. This precludes (40) and allows (42):

(42)   air-condition (a room), top-dress (a lawn), proofread (an article), stagemanage (a theater company), giftwrap (a parcel)

Because compound verbs, if originally transitive, must have a syntactically expressed overt object, which must be the "first sister" of the V, the first member of the compound is interpreted by the FSP as the *next* sister of the V. Note that the FSP is still needed in order to insure that we derive (42) instead of

(43)   *room-condition (the air), *lawn-dress (the top)

as well as to block subjects from being compounded:

(44)   *Bill head-hurts, *the ceiling house-leaks

The verb compounds of (39), (42) therefore do not refute the FSP but on the contrary support it, given a relativized formulation as in (36).

Allen (1978) has criticized the treatment of Roeper and Siegel on several grounds. First, she points out that if words like *watchmaker* are to be derived by a lexical transformation of the sort they propose, then we must prevent them from being also generated by the compound rule

(45)   N → N N

which is obviously required in the grammar in any case. It will not do to let synthetic compounds come freely by both word-formation processes. This would nullify the effect of the FSP because compounds derived by (45) are manifestly *not* constrained by this principle. If their second member is deverbal, the first member *can* be the subject:

(46)   heart failure, blood circulation, dealer maintenance, population

growth, child marriage, wind pollination, seed dispersal, bowel movement

And if the second member is transitive, its first member *can* be adverbial:

(47)   jury trial (of a defendant), dress rehearsal (of a play), hospital treatment (of a patient), laser transmission (of information), fingerprint identification (of a suspect), surface structure interpretation (of sentences)

Both of these circumstances would be prohibited by the FSP if it were applicable here and are indeed not encountered in synthetic compounds in *-er* and *-ing*. But if the latter could also be derived by (45), the wrong interpretations would be let in as it were through the back door.

Secondly, Allen notes a redundancy which is inherent in the Roeper-Siegel solution. It requires two separate rules introducing the deverbal suffixes *-er* and *-ing*: the above-mentioned lexical transformation for the compounds, plus a separate rule for the simple cases like *singer, singing*. It is true that some verbs undergo only one or the other rule:[8]

(48)   a.   theatergoer   b.   *talk-hearer
                     *goer   hearer

Yet they are related processes, and the grammar should obviously distinguish English from a hypothetical language in which entirely different endings are involved in synthetic compounds and simple derived agent and action nouns.

So we would like our account of English morphology to answer at least the following questions about synthetic compounds:

(1) Why are they formed with the same suffixes that make the productive (level 2) agent and action nouns from simple verbs?

(2) Why are these the only suffixes that occur on bound second members? That is, how come there are no nouns in *-ant, -ation, -al, -th* etc. which are like **-goer, *-growing*$_N$ in that they are restricted to compounds?

(3) Why does the FSP not hold for compounds in *-th, -ation* etc. — cf. (46) and (47)?

(4) Why is the rule forming synthetic compounds disjunctive with rule (45)?

(5) What is the relation of "back-formation" that links synthetic compound nouns and compound verbs like (39, 42), e.g. *air-conditioner, air-conditioning* and *air-condition*?

(6) Why can a speaker at once assign a fixed meaning (in some cases two fixed meanings) to synthetic compounds he has never heard before while other types of compounds such as N + N allow an indefinite number of interpretations?

A modified version of the Roeper-Siegel analysis will allow us to answer these questions. Assume that all English compounds are derived by insertion

of Y Z into a categorial frame X:

(49) $[Y \quad Z]_X$

In principle, X, Y, Z are freely chosen among the lexical categories. We are interested here in the case where Z = Verb. Because of the FSP, Y must then be Noun, Adverb or Adjective, because verbs cannot be interpreted as first arguments of verbs. Consider now the possible values of X. Suppose X = Noun (Agent or Action) or Adjective. Then an appropriately subcategorized affix (*-er, -ing* etc.) will be inserted after it obligatorily by rules such as (50):

(50)   Insert /er/ in env. $[Y \ V\_\_]_{Noun, Agent}$

giving such compounds as *air-conditioner, air-conditioning, outward-facing, strange-sounding*, depending on the rule and the choice of Y. Next, suppose X = V. No rule inserting an affix in that frame exists but the structure is permitted as such (e.g. *air-condition*). Finally, suppose X = Adverb. Again there is no insertable affix, and the structure is rejected because it is exocentric (conflict between the head (V) and the dominating category (Adv)).

We are now ready to answer the questions raised above.

(1)   Rule (50) must obviously be combined by the standard notational convention of parentheses with the rule for simple agent nouns (7 = 51):

(51)   Insert /er/ in env. $[V\_\_]_{Noun, Agent}$

which like (50) belongs on level 2 for phonological reasons and enjoys the same productivity and semantic predictability. The resulting schema is

(52)   Insert /er/ in env. $[(Y) \ V\_\_]_{Noun, Agent}$

A similar generalization obtains for the other suffixes that form synthetic compounds (*-ing* and *-ed*). The identity of suffixes and relationship of processes is reflected formally in a simplification of the grammar which eliminates the redundancy noted by Allen.

(2)   The special status of *-er* and *-ing* is that they are introduced directly into compounds by rule (50). Therefore they can be restricted to particular compounds. The other agent and action suffixes (*-ant, -ation* etc.) are added only to verbs and they cannot therefore be restricted to particular compounds into which the resulting nouns might then enter.

(3)   The reason the FSP does not hold for compounds like (46), (47) is that they are not verb compounds, i.e. they are not formed by taking Z = V in (41). Rather, they are formed by Z = N from two *nouns*. The second noun happens to be derived from a verb at level 1, but that information is lost by Bracketing Erasure at level 2 where the compound is formed, so the FSP has no chance to apply.

(4)   The uniqueness of the correct derivation for synthetic compounds is ensured by the principle (to be justified in a phonological connection below, see p. 57) which selects the shortest derivations among equally simple alternatives. By this principle, we do not derive *watchmaker* in two steps ($[V]_N$ with obligatory insertion of *-er* giving *maker*, followed by $[N \ N]_V$

giving *watchmaker*) because we can have it directly in one step ($[N \ V]_N$ with obligatory insertion of *-er*).

(5)   The process which derives compound verbs like (39, 42), e.g. *air-condition*, is the same which forms all compounds including synthetic compounds. The compound verbs are obtained when X in $[Y \ Z]_X$ is fixed as V.

(6)   Compounds derived from verbs (i.e. where Y or Z = V) are assigned a fixed interpretation by the FSP and the suffixation system. Where a verb has two subcategorization frames, the FSP can correspondingly assign two interpretations to the compound, as with optionally transitive verbs. For example, *house* in *houseseller* might be understood as a locative on the analogy of *streetseller* or as an object on the analogy of *bookseller*, because *sell* can be used both transitively and absolutely. Compounds derived from nouns are assigned a variable interpretation which can be fixed only pragmatically and by convention. For example, the tatpurushas of the form N_1 N_2 (Downing 1977) seem to be interpreted by some open expression of the form "(kind of) N_2 which X's N_1". This includes even the cases like (47) where N_2 is itself derived from a verb.

Beside the productive synthetic Agent and Action compounds in *-er* and *-ing* there are some minor types. We have already discussed the zero suffix which is inserted at level 1 in $[V\_\_]_N$, where N is [+Agent] (e.g. *cook, bore*) or [+Action] (e.g. *escape, ride*). If we generalize this suffix as we did the others:

(53)   Insert ϕ in env. $[(X) \ V\_\_]_N$, [+Agent] or [+Action]

we shall be able to derive as synthetic compounds such nouns as *pastry cook, prison escape*. The expectation then is that there could be verbs which allow *only* the longer subrule, inserting ϕ in the env. $[X \ V\_\_]_N$, i.e. zero-derived analogs to *churchgoer, typesetter*. These do indeed exist. Moreover, they are again subject to the FSP, on account of which their initial constituent must be a noun (see 54) or adverb (see 55) construed as the first argument in the manner previously explained:

(54)   a.   Agent: chimneysweep, barkeep, doorstop
         b.   Action: bloodshed, heartbreak, nosebleed, (bleeding from
                         the nose), housebreak (breaking into a house),
                         rest stop (stop for rest)

(55)   a.   Agent: offshoot, upstart, outlet
         b.   Action: downpour, outbreak, uptake, backlash

Apparent exceptions where the first member has to be understood as a subject are

(56)   bus stop, mudslide, waterfall

They should however not be considered as Agent or Action nouns, but have a local sense ('place where buses stop'). Accordingly they will not be derivable as synthetic compounds by (53). Since their second member is a noun in its

own right, presumably derived from a verb at level 1, it can then be com-
pounded at level 2 by the $[N \ N]_N$ case of schema (49) and escape the FSP like
the compounds (46, 47) as explained above. *Sunrise, sunset* remain difficult
because they denote not only the time but also the act of the sun's rising or
setting.

By allowing the suffix ϕ to be inserted also in the environment $[V \ X\_\_]_N$,
we derive the minor types shown in (57):

(57)   a.   killjoy, cutthroat, pickpocket (cf. (37))
       b.   showdown, blackout, shakeup, pullback, puton (action);
              showoff, pickup, giveaway, runaway, standby, standout
              (agent)

They should also be subject to the FSP; this prediction seems correct (see
38) and explains the limitation of the second members to Nouns and Adverbs.[9]

The remaining major type of synthetic tatpurushas consists of passive
adjectives with the suffixes *-ed, -en*, etc.

(58)   state-owned, moth-eaten, God-given, self-taught, home-cooked,
       pan-fried, sun-dried, hand-built, well-constructed, oft-quoted,
       corn-fed, half-rotten, safety-tested

The first members represent agents and various adverbials. Roeper and
Siegel (1978, 210), note that the FSP predicts this pattern from the argument
structure of the passive verb, and point out the relationship of these com-
pounds to simple passive adjectives. This is precisely as expected from our
point of view.

We shall not here study the other major class of synthetic compounds in
English bahuvrihis like (59):

(59)   a.   paleface, rubberneck, paperback
       b.   pale-faced, moon-faced, long-legged, warm-blooded, heart-
            shaped
       c.   two-seater, triple-decker, quarter-pounder, no-hitter
       d.   three-act, four-star, five-finger, no-fault

The distribution seen in (59) is that if Y = Quantifier Adjective, then the
suffix is *-er* if X = Noun (c) and ϕ if X = Adjective (d). Otherwise, it is
ϕ if X = Noun (a) and *-ed* if X = Adjective (b). In these compounds "X"
must be assigned the meaning "having Y Z". This will also guarantee that
Adverbs and Verbs are excluded from Y, since they cannot qualify nouns.
So we can take hypothetical compounds like **by-faced, *write-faced* to be
uninterpretable.

Possibly the suffixing of *-ed, -er* and zero to [X N] can be combined with
the processes that form words like (60) from simple nouns:

(60)   a.   bearded, domed, forked, hinged, leisured
       b.   potter, commissioner, probationer, trooper, villager
       c.   family, animal, Renaissance (in (quasi-)adjectival use)

The relationship is most plausible for (60a). Type (60b) is rather more
heterogeneous than the well-circumscribed (59c). What speaks for a rela-
tionship between (60c) and (59d) is that they share a preference for pre-
adjunct position, e.g.

(61)   a.   social or family obligations
            more or less animal instincts
            a rather un-MIT paper
            a delightfully Renaissance atmosphere
       b.   a five-act play
            a five-star general

but less readily predicative:

(62)   a.   ?his obligations are family
       b.   ?*Hamlet* is five-act

The aim of the above sketch of English morphology has been to make
plausible the particular version of level-ordered morphology depicted in
(2), a version we must adopt if we are to maintain the intimate connection
between phonology and morphology that lexical phonology requires. We
have focused on the controversial aspects of (2), namely the inclusion of
some inflection at level 1, and the ordering of compounding with affixation
at level 2. What we found is that these aspects are not only compatible
with the morphological facts but positively required by them. That is, even if
the phonological evidence were set aside we should still have to adopt (2) on
morphological grounds alone. The fact that the same disposition of levels
is also necessary for the phonology supports the proposed theory of the
lexicon.

Before leaving the topic of morphology let us underscore some more
general implications of our treatment for the theory of morphology. It would
appear that quite a few of the complex devices that have been attributed to
the word-formation component in previous work are now superfluous. If
true, this would again strengthen the case for the model we have proposed.
Naturally this part of our claim must await testing in other languages and
especially in those with rich morphologies. In the meantime let us pro-
visionally put our conclusions in the form of the following theses as chal-
lenges to further research.

1. There is no synchronic back-formation. Allen (1978, 227) has dis-
cussed and motivated at length the proposal to treat verb compounds such
as *air-condition* as synchronically derived from the corresponding nouns
(*air-conditioner, air-conditioning*). In the present theory such a derivation
is unnecessary, and indeed impossible on both formal and empirical grounds.
Here I subscribe to the position of Marchand (1969) that "the term back-
formation . . . has historical relevance only". From the viewpoint of the
present-day language, there is no reason to treat as anything but basic such

verbs as *beg, mix, injure, sulk, edit, peddle, eavesdrop, partake, syllabify.*
The fact that they are historically derived from nouns and adjectives comes
as a surprise to linguistically unsophisticated speakers, is not accessible to
a learner, and has no structural significance. The historical process is one of
reanalysis, where morphologically simple words come to be perceived as
derived from verbs:

(63)   [beggar]$_N$ reanalyzed as   [[beg]$_V$ ar]$_N$
       [mixt]$_A$ reanalyzed as   [[mix]$_V$ ed]$_A$
       [injury]$_N$ reanalyzed as   [[injur]$_V$ y]$_N$

"Back-formation" of *air-condition* from *air-conditioner, air-conditioning* is
historically a matter of realizing the generalization inherent in schema
(49). Once the compound verb has entered the language, i.e. has become de-
rived by (49), it has no *synchronic* denominal status. However, compound
verbs do constitute a special case among compounds in two respects. First,
English, like other Indo-European languages, originally did not have any
compound verbs. (Cf. Dasgupta (1977) on Bangla.) Verbs derived by (49)
have mostly arisen as back-formations from nouns, i.e. by projecting from
the schema. Cases in which this generalization is in progress or marginally
achieved (e.g. *houseclean, skywrite, joyride, shotput*) give the feeling that
the noun compounds are more basic. Second, as we have seen above, the
potential of verb compounding is severely limited by the requirement that
subcategorization be preserved. Many transitive verbs cannot be com-
pounded simply because there is nothing to put in the required object slot
(see 40). When this is taken into account, verb compounding is seen to be
much more productive than it is usually given credit for.

The conclusion that back-formation as a synchronic process is not needed
is very fortunate because our theory demands it on independent grounds.
Presumably the process would have to be formulated as a rule which de-
letes *-er, -ing* and perhaps other suffixes from nouns such as *air-conditioner*
and recategorizes the residue as a verb. But we do not even allow rules that
delete an affix, let alone the more powerful type of operation which deletes
an affix and simultaneously effects a category change.

Furthermore, we have seen that verbs derived from compound nouns have
level 3 inflection, a fact correctly predicted by our theory (cf. the discussion
of *grandstanded* above). If derived by synchronic back-formation from
nouns, compound verbs would be exceptions to this generalization, cf.
such level 1 past tense forms as *spoonfed, babysat, pinchhit, proofread.* On
our analysis they are predicted as explained above for *withstood* etc.; a
denominal analysis would wrongly predict *spoonfeeded, *pinchhitted* etc.
Back-formation must therefore be rejected on empirical grounds as well.

2. There is no overgenerating morphology. A salient feature of the above
treatment of synthetic compounds is that we never needed to postulate

bound derived lexical items. We did not for example generate *theatergoer*
via intermediate **goer*, flagged as having to enter obligatorily into com-
pounds. Rather, we derived it directly by insertion of *-er* into the frame
[[theater]$_N$ [go]$_V$__]$_N$, an insertion which must be obligatory by endocen-
tricity. Of course we have to block the possible compound verb [[theater]$_N$
[go]$_V$]$_V$ from being derived as an actual word, but this must be done by *any*
grammar that derives compound verbs like *babysit, stagemanage* etc.

In this way we seem to have successfully eliminated Allen's (1978) most
persuasive example of "overgenerating morphology", that is, for the postu-
lation of bound derived lexical items. We shall assume that this device is
not required in morphology at all. Note that no further restrictions need
be imposed on the theory to exclude it. This is done automatically by the
independently necessary stipulation that the output of every cycle is a
lexical item. This is a substantial step towards constraining the power of the
morphological component.

In effect, we are obtaining what seem to be the correct aspects of Aronoff's
"word-based" morphology without stipulating anything to that effect in
the theory. Another area where this appears is the derivation of *pluralia
tantum* like *odds* and generally of words marked inherently for some cate-
gory, where, it will be recalled, the Elsewhere Condition prohibits the pos-
tulations of non-occurring noun like **odd* in the lexicon.

However, we cannot have a fully word-based morphology for two rea-
sons. First, we cannot prevent stems from being bound in the trivial sense
that they always get marked for some paradigmatic feature of the language,
for example if nouns must have some case and every case has an ending.
Secondly, nothing prevents our *basic* lexical entries from being bound, i.e.
"roots" not labeled as lexical categories and therefore not capable of being
used as words in themselves. Both obligatory inflection and root-based
derivation evidently do occur in highly inflected languages, and so this
turns out to be not a defect but a virtue of our approach.

3. There is no truncation. The idea of morphologically controlled de-
letion of affixes was introduced by Isačenko (1969, 1972, 1973) and Aronoff
(1976) also made it his own. It would obviously be desirable to eliminate
this powerful device from the theory, all the more so as we have no need
for rules of affix deletion for back formation. Indeed, it appears that it is
now possible to do so.

Aronoff cites a number of cases from English morphology which are
supposed to motivate the truncation of morphemes. Perhaps his simplest
example is the comparative suffix *-er*, before which the adverb suffix *-ly*
does not show up as might be expected. The comparative of adverbs in *-ly*
is formed from a base without *-ly*:

(64)   quickly   quicker   *quicklier

softly	softer	*softlier
strongly	stronger	*stronglier

This is not a phonological restriction, because the comparative suffix -er can very well be added to *adjectives* in *-ly*:

(65) lovely   lovelier
      sprightly   sprightlier
      comely   comelier

Aronoff therefore proposes a truncation rule which he formulates as

(66) $C_0VC_0 + ly + er$
          1   2 $3 \rightarrow 1 \emptyset 3$

which derives e.g. *quicklier → quicker*. From our point of view there is no case for truncation here because we can simply say that comparatives are formed from adjectives and are themselves both adverbs and adjectives. So the rule for inserting the comparative suffix is

(67) Insert -er in env. $[\text{Adj} \_\_] \{ \begin{smallmatrix} \text{Adj} \\ \text{Adv} \end{smallmatrix} \}_{,+\text{Comparative}}$

This gives (64) directly without the benefit of truncation, for rule (67) does not add -er to adverbs. Note also that the Elsewhere Condition precludes -ly from being added to adjectives in -er (*quickerly, *softerly). That comparatives function intrinsically as both adverbs and adjectives has to be said in any case on account of a form such as *better* which cannot be subject to Aronoff's truncation rule (66), yet still has the double function as adverb and adjective. We enter it in the lexicon inherently specified as $\begin{bmatrix} \text{Adj} \\ \text{Adv} \end{bmatrix}$, + Comparative, and it is thereby exempt (by the Elsewhere Condition) from insertion of -er as well as of -ly.

Aronoff's other examples of truncation in English all concern the verb-forming suffix -ate, which he argues is deleted before suffixes like -ee, -ant, -able on the strength of words like (68):

(68) nominate   nominee
      evacuate   evacuee, evacuant
      negotiate   negotiant, negotiable
      lubricate   lubricant

The alternative is to derive both the nouns and the verbs from roots, i.e. *nomin-*, *(e)vacu-*, *negot-*, *lubric-*. This is a reasonable solution in view of the build of the latinate vocabulary. The roots must be assumed anyway as the base for other level 1 derivatives such as

(69) nominal, vacuous, vacuity, lubricious

And the suffixes -ee, -able, -ant must be allowed to be added to roots anyway in such words as (70):

(70) memorable   lessee   deodorant
      innumerable   conferee   obstruent
      unconscionable   tenant   sonorant

So we may simply allow the suffixes in question to be added to both roots and verbs. As before, the principles of the theory assure that if a derivation from a root is available then the longer derivation from a verb is blocked.[10]

Isačenko himself (1973, 93) has stated an important generalization that emerges from his study of Russian morphology and to my mind renders theory of truncation doubtful:

"It has been demonstrated one more time that the process of truncation without which it is impossible to treat the pertinent facts is a DEEP STRUC-TURE PROCESS. Morphemes are truncated BEFORE they can cause phonemic modifications of the preceding phonemes (e.g. palatalization)".

Internally to our theory, this observation if correct virtually precludes truncation. Consider a morphological structure where a suffix C causes truncation of a preceding suffix B:

(71)   [[A + B] C]

Clearly C cannot truncate B until the *second* cycle, and so it is impossible to prevent cyclic rules from being triggered by B on the *first* cycle. And the "phonemic modifications" such as palatalization to which Isačenko refers are precisely cyclic rules (cf. Rubach 1981).

Theory-externally, we derive support from Isačenko's observation in that, if the allegedly truncated morphemes are never there, as we claim, the absence of the phonological effects triggered by them is predicted.

I must however add that Isačenko does produce one example where cyclic rules are apparently triggered by a truncated morpheme. This is the case of derived verbs beginning in *o-bez-* "to make __ -less', which he derives from adjectives with a deleted morpheme *-n*. I shall have to leave the discussion to the Slavists (cf. Lopatin and Uluxanov 1974, Beard 1978 for some criticism of Isačenko's treatment and alternative suggestions).

Other apparent cases of truncation can simply be considered as deletions of *phonological* material. This may be true of the truncation of -en, -e before German diminutives cited by Kloeke (1981, 233, cf. 223).

(72) Wiege   dim.   Wieg-lein   'cradle'
      Glocke   dim.   Glöck-chen   'bell'
      Leute   dim.   Leut-chen   'people'
      Garten   dim.   Gärt-chen   'garden'
      Knochen   dim.   Knöch-lein   'bone'
      Ofen   dim.   Öf-chen   'stove'

It may then not be necessary to postulate any internal morpheme boundaries at all in words like *Ofen, Garten*.

4. The lexicon is minimally redundant. It has often been suggested that the grammar should contain both a set of rules which enumerate all and only the possible words of the language, and a lexicon, or list, which enu-

merates the actual words of the language (Householder 1959, Halle 1973, Jackendoff 1975). I shall reject this position on the grounds that the class of actual words on one possible interpretation is ill-defined and of no linguistic interest, and on the other possible interpretation cannot in principle be enumerated by a list. Let us see where the line between "actual" and "possible" words might run. Obviously *arrival* is an actual word of English and **derival* is not an actual word, though it is a possible word because it is formed by a morphological process which could apply to the verb *derive* but happens not to apply to it. Now, are such words as *prearrival, book arrival, arrival list* etc. actual words or not? That depends on what we mean by *actual word*. If we mean by it something like a word which "occurs" or "has occurred", or which a particular speaker has heard, or used, then the question is in practice impossible to answer for any given word, and in any case entirely irrelevant for the grammar. A speaker may very well not know whether he has ever heard or used these words and not even an unabridged dictionary would care to list them. Moreover no rule of grammar even depends upon whether a word is "actual" or not in any such sense. If on the other hand an actual word is a word that a fluent speaker knows to be a well-formed word in the language, then these are clearly actual words, and the distinction between them and the non-actual word **derival* is a significant one. But the actual words in this significant sense cannot be listed for the same reason that the sentences of a language cannot be listed, namely because their number is unbounded, witness *preantepenultimate, prepreantepenultimate, prepreprepreantepenultimate . . . , booklover, booklover lover, . . .* and so on. Speakers know what these words mean and use them if necessary but this knowledge is purely rule-governed.[11]

It is possible to take an intermediate position and to say that not all actual words are listed but only those which show some idiosyncrasy. For example, *obesity* might be listed because it is an exception to Trisyllabic Shortening and *curiosity* might be listed because it denotes not only the property of being curious but also a curious thing or property. A priori this is undesirable because it results in considerable redundancy with no compensating gain. It amounts to saying that if a word has one unpredictable feature then everything about it should be treated as unpredictable. The preferable procedure is to list only the unpredictable properties of words. So we may mark *obese* as an exception to Trisyllabic Shortening, and we may register a special meaning for *-ity* when used after *curious, odd, obscene, bestial* and a number of other words.

The position that we shall adopt here is that the set of actual words of a language, in the second, linguistically significant sense where it is an unbounded set, is recursively defined by the lexicon. It consists of the totality of outputs on the right side of (1). The set of "possible words" is obtained

by dropping all idiosyncratic restrictions on the morphological and phonological rules of the lexicon. Underived lexical entries are those which cannot in the simplest grammar be derived from other lexical entries.

By adopting this approach we make the very strong prediction that idiosyncratic marking for susceptibility to morphological processes or lexical phonological rules should be concentrated in *basic* lexical entries. It is possible to account for *derivation* vs. *arrival* by marking the basic lexical entries *derive* and *arrive* as susceptible to the level 1 noun-forming suffixes *-ation* and *-al* respectively. Suppose however, that we had a parallel contrast in the nouns *Americanization* vs. **Africanizal*. We could not mark the verbs *Americanize* and *Africanize* differently for which nominal suffix is added to them because they are themselves derived from *American* and *African,* which in turn are derived from *America* and *Africa.* And if the markings were located in those basic lexical entries, they could not be transmitted through the chain of derivatives because the morphological features of a word are determined by its head, which in English normally is the rightmost constituent, i.e. the suffix.

The approach which lists all "actual" lexical items in the lexicon differs sharply in this respect because it is capable of specifying idiosyncratic morphological properties quite as easily in derived lexical items as in simple ones. If *Americanize* and *Africanize* are going to be listed anyway, then they may be marked for whether they take *-al* or *-ation* with no more trouble than *derive* and *arrive* may be so marked.

In English morphology, at any rate, the overriding generalization is surely that affixation is unpredictable for basic lexical entries (especially of course at level 1) but that for derived lexical items it can be defined generally for a given head, even at level 1. For example, simple verbs have to be marked for whether they allow such suffixes as *-ation, -al, -able,* and ϕ (zero noun derivation), but verbs derived from nouns and adjectives with the suffixes *-ize, -ify* can *never* take *-al* and *-ϕ* (for the latter, see (20) above) and they can almost *always* take *-able* and *-ation* (with *-ify + ation → ification*). The suffix *-ize* itself is idiosyncratic for simple stems (*terrorize* vs. **horrorize*) but productively added to adjectives formed from nouns with the suffixes *-al (-ar),* *-(i)an*: *territorialize, linearize, nationalize, naturalize, optionalize, exceptionalize, scripturalize, globularize, Africanize, republicanize, episcopalianize* etc. Similarly for *-ic* (*rhythmicize, historicize* etc.) except where blocked by a derivative from the noun itself (*alphabetize, satirize* etc.). The suffix *-ity* has essentially the same freedom after denominal *-al (-ar)* and *-ic* (*theatricality, historicity*) but it does not occur after denominal *-(i)an,* such as **Americanity,* except for *Christianity* and the rare *Italianity,* which actually confirms the generalization because speakers who do not know the word

tend to reject it.

The patterning of derivational suffixes requires such closer study but there seems to be no doubt that derived lexical items do not admit morphological idiosyncrasy as freely as basic lexical items do. This can be taken as support for a model in which morphological information can only be associated with basic lexical items and affixes. In such a model, derived lexical items can be assigned idiosyncratic morphological properties only at great cost, namely by entering them as such in the lexicon and so in effect treating them as non-derived.

In addition, the proposed generalization would provide a useful test for what, in the unclear sets of cases, should count as a basic lexical item. We suggested above that a simple exceptional property such as failure of Trisyllabic Shortening does not justify listing an entire item as basic. This now makes the prediction that such exceptional derived items should be subject to the same generalizations as the regular ones. For example, *seasonal* is an exception to Trisyllabic Shortening (vs. *national, natural, titular, globular, jocular, linear*) but it shows the same morphological potentialities as regular derivatives in *-al* do, cf. *seasonalize, seasonality*, confirming our proposal that it should be derived along with them.

5. Lexical semantics is linked to word-formation. The fact that compounds formed from verbs are interpreted in accordance with the First Sister Principle implies that their interpretation must take place in connection with the compounding process itself or at least at the same level. At later levels the internal structure is lost by Bracketing Erasure and we cannot then recover the morphological distinction between e.g. *population growth* ([N [V th]$_N$]$_N$) and *population growing* ([N V ing]$_N$) on which their semanitcs crucially depends.

The contrary position has been aruged extensively by Williams (1981) and Lieber (1980). Both make much of certain cases where the semantically justified bracketing clashes with what the morphology seems to require. Recall that there is an asymmetry between affixes of different boundary classes in that "+" affixes cannot be added to worlds already bearing "#" affixes. For example:

(73)　un#able　　　　*un#abil + ity　　　(in + abil + ity)
　　　un#equal　　　*un#equal + ity　　(in + equal + ity)
　　　un#safe　　　　*un#safe + ty

The absence of the starred words is predicted in that the derivation *able →
unable → *unability* would violate level ordering and the derivation *able →
ability → *unability* would violate the restriction that *un-* is prefixed to adjectives, not to nouns.[12] There are of course various classes of exceptions to this generalization, such as *ungrammaticality, unintelligence, untruth, hydroelectricity,* where level 1 affixes have seemingly been added "outside"

level 2 prefixation and compounding. Lieber and Williams adduce them as evidence that lexical semantics is independent of morphology. However, we have two ways of dealing with such exceptions in our framework. The first would be to make use of limited recursion from level 2 back to level 1. *Ungrammatical, hydroelectric* would be formed at level 2 and then fed back into level 1 where the suffixes can then be added to them. The second hypothesis, which I shall adopt here, is to allow exceptional deferral of Bracketing Erasure for particular words. On this hypothesis, *grammaticality* and *electricity* are formed first at level 1 but idiosyncratically retain their internal bracketing [[grammatical]$_A$ ity]$_N$, [[electric]$_A$ ity]$_N$, so that word-formation processes can apply to the inner constituent at level 2.[13]

There are some factual arguments which favor the second of the two alternatives. The level recursion hypothesis predicts that other suffixes could be added at level 1 to words like *ungrammatical, hydroelectric,* which is not the case: **ungrammaticalize, *hydroelectrician, *hydroelectrify.* The bracket retention hypothesis predicts that other suffixes and compounding processes could apply at level 2 to the internal stems of *grammaticality, electricity,* which is the case: *extra-grammaticality, semi-grammaticality, thermoelectricity.* Moreover, bracket retention is the more restrictive hypothesis. Level recursion could be extended to arbitrary violations of level-ordering, which amounts to a substantial weakening of the theory. Bracket retention could not be invoked in those cases where the inner affixation process feeds or bleeds the outer one. For example, suppose that— contrary to fact—level 1 suffixes such as *-ify* (cf. *óbjèct ~ objéctify*) could be added *outside* of suffixes belonging to level 2, such as *-ism* (cf. *nationalism, particularism*) or *-ite* (cf. *Kennedyite, pre-Raphaelite*). The resulting level-ordering violations such as **nationalismify, *pre-Raphaelitify* obviously could not be derived by deferring Bracketing Erasure, for the required sources, the level 1 words **nationalify, *pre-Raphaelify* do not exist. However, if we instead were to allow recursion from level 2 to level 1, there would be no principled way to block these level-ordering violations from the potential vocabulary of English.[13]

It is however reasonable to separate those aspects of lexical meaning which are not structurally determined.

Suppose, as suggested above, that endocentric N$_1$ + N$_2$ compound nouns are interpreted within the grammar merely by a generalized open expression "(kind of) N$_2$ which X's N$_1$". Downing (1977) points out that the denotatum has to be "nameworthy", which is presumably a special case of the general fact that proper and common nouns denote recognized individuals and recognized kinds of things. On the "kind of" interpretation (i.e. in a common noun), X itself is generically interpreted, e.g. a particular *shorebird* is still a shorebird when it temporarily flies inland or even when it spends its days in

the Las Vegas zoo.

In actual use they are subject to several kinds of specialization. First, as Downing documents, the choice of X is fixed in new compounds by the speaker's and hearer's imagination and knowledge of the world. Secondly, many compounds are institutionalized with a particular sense of X: a *shorebird* is a bird that frequents the shore, a *songbird* is a bird that has a song, a *gamebird* is a bird that constitutes game. I take this institutionalization to represent "encyclopedic" knowledge of the form "there exists a recognized kind of N_2 which X's N_1", rather than a fact about the linguistic system itself. As Marchand (1969, 56) remarks: "In itself there is nothing in the word *water rat* to exclude an analysis such as 'water-producing rat'. With this meaning the word would be quite possible as the name of a toy, for instance. But as a serious word it does not exist in the norm of the language because there is no denotatum for it in the extralingual world. The norm of our language selects only certain patterns from the system of possible realizations according to the denotata of the extralingual world. To a certain extent, therefore, the extralingual denotatum also must be known if our analysis is to be correct." Thirdly, many N_1 N_2 compounds are mere designations of kinds of N_2 which need not have anything to do with N_1, for example *cowbird, lyrebird, leafbird, kingbird, secretary-bird*. So assume that the above rule of interpretation is optional. If it is not applied to a compound, the compound will share the features of its head but the left constitutent will make no contribution to its meaning. By convention, N_1 N_2 is then interpreted as meaning "a kind of N_2".

Certain types of compounds, such as those of the form Adjective + Noun (*whitefish, blackbird, shortcake, greenhouse, longhouse, tightrope*) are virtually restricted to such use as conventional designation of kinds of N_2. We can now account for this fact in the grammar by not allowing those types of compounds to be assigned any compositional interpretation. So the grammar merely says that a *whitefish* as a tatpurusha compound is a kind of fish (the minimal thing which by endocentricity it must say) but does not assign it the meaning "white fish". Adjective + Noun compounds will accordingly have no use except as terminology. From this point of view it is understandable that derivational patterns which have long lost their compositional interpretation in the morphological system may persist as nomenclature and even continue to supply new terms. Finally, like any other kind of expression, compounds may become fully idiomatic. These may be treated by listing or in whatever way is appropriate for idioms in general.

So what this scheme of interpretation says is that one may interpret or coin a new compound such as *tigerbird* in two possible meanings, first to denote a particular bird or kind of bird that is connected to tigers in some way to be pragmatically determined, and secondly for any kind of bird that

needs a designation, for example a newly discovered species. One may not interpret or coin it for example to denote a tiger or a kind of tiger. The advantage is that we delimit the grammatically governed aspect of word-meaning from what is arbitrary and conventional. To be sure, our grammar ends up with a lexicon that does not say how catbirds differ from cowbirds or that tigerbirds do not exist, but in view of the arguments that such information belongs in the encyclopedia anyway that may be more an asset than a liability.

The second advantage is that the points of this section taken together now suggest that lexical relationship reduces to derivational relationship, rendering the ingenious but roundabout definition of Williams (1981) otiose. There is of course no single test that determines in any given case whether two lexical items are derivationally related or not; the decision will in each case rest on the overall grammatical system of the language. We shall therefore want the structure of the morphology to be such that in conjunction with the evaluation measure it predicts the intuitive judgments of lexical relatedness that are shared by fluent speakers of English. For example, we would want the theory to be able to rule out a lexical relationship between such pairs of words as *father* and *paternal*, *ear* and *hear*, and *semen* and *seminary*, in these cases presumably on grounds of phonological, morphological, and semantic complexity respectively. In order to accomplish this we shall have to supply a format for the rules which express the relationships between words in each of these respects. For phonology we may assume the theory of generative phonology provides such a format. For morphology and semantics current work is providing a beginning and we have made some concrete proposals of our own to this end above.

2. Abstractness, Cyclicity, and Lexical Phonology

This organization of the lexion, in conjunction with the proposals developed earlier, has further consequences on the phonological side. It embodies the claim that all and only lexical categories are cyclic domains, and all and only lexical rules are cyclic. The prediction is that there should be no cyclic rule application above the word level. Up to recently this consequence would by itself have sufficed to wreck the theory in view of the fact that sentence stress was one of the castiron arguments for cyclicity. However, Rischel (1964, 1972) and Liberman and Prince (1977) have pointed out that metrical theory eliminates the need for cyclic assignment of sentence stress. In that framework the Nuclear Stress Rule, which assigns prominence to the right branch of a phrasal constituent, can apply in any order or simultaneously to all constituents in the sentence. As far as I know there are *no* rules which have to apply cyclically from the innermost phrasal constituents out and the theory of lexical phonology predicts that.

There are however cases where rules of word phonology seem to apply once at the lowest level of phrase syntax. I have argued (Kiparsky 1979) that the English Rhythm Rule applies both below and above the word level, in cases like *expéct ~ èxpectátion* and *abstráct ~ ábstràct árt* respectively. These applications take place at different stages in the derivation because the destressing of metrically weak initial syllables must crucially intervene between them. A somewhat similar situation has been found in the tonology of Ewe by Clements (1977, 119). In neither case is there evidence of cyclic iteration within the syntax itself: each rule applies once at the phrasal level and does not need to reapply cyclically on successively higher syntactic constituents.

The most straightforward assumption is that these rules belong to both the lexical and postlexical system. However, it is surely significant that they concern what may be called phrase phonology rather than full-fledged sentence phonology. Both rules are subject to a constraint which blocks their application on Verbs followed by object Noun Phrases (*màintáin órder ⇸ *máintàin órder*; for Ewe cf. Clements p. 122 ff.). Both rules have lexical exceptions (e.g. *profóund trúth ⇸ *prófòund trúth*; cf. again Clements p. 137). So one conclusion that could be drawn from this is that the lowest level of phrase structure can in some way be fed back into the lexicon. Quite apart from phonological considerations this would be suggested by the fact that phrasal combination at this level are subject to selectional restrictions and liable to get fixed as idioms and formulas. We already noted above that they can be inputs to word-formation rules, e.g. *American history teacher, to stonewall, a hands-off policy*. A specific example of lexicalization is that *ábstràct* has for many people acquired inherently the specialized technical sense it bears in the phrase *ábstràct árt,* denoting a specific type or school of art.[14] These speakers make a difference between the sentences

(1)   a. This art is ábstràct (not representational)
      b. This art is abstráct (not concrete)

In the light of such facts, the nature of phrase phonology and its relation to word phonology and sentence phonology deserve deeper investigation.

As for a lower bound on cyclicity, there is some evidence that non-lexical categories are not cyclic domains. A quite compelling case has been made by J. Harris (MS) for Spanish on the basis of a study of stress and syllable structure. One of his examples is summarized in (2).

(2)   *desden + es*   'disdains'   (noun plural)
                 desdeñ + es   'you disdain'   (2. sg. subj.)
                 [desdeñ]ₙ es]ₙ   [[desdeñ + a]ᵥ e + s]ᵥ
                       ∨   ∨
   I Syllabification [σ]   [σ]
   ñ → n in coda   n   (inapplicable)

II Truncation   [————]   [∅   ]
   Syllabification   nes   ñes
                         ∨∨   ∨∨
                          σ   σ
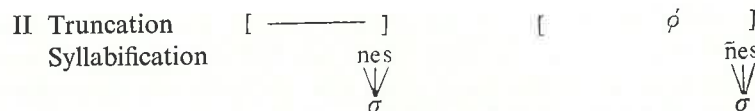
The point concerns the application of a cyclic rule which depalatalizes *ñ* to *n* in the coda of a syllable. The contrast between the noun plural *desden + es* and the subjunctive verb form *desdeñ + es* arises because the underlying palatalized *ñ* is syllable-final in the noun stem /desdeñ/ but syllable-initial in the verb stem /desdeñ + a/. These respective stems constitute the first cyclic domains and the nasal depalatalization finds its correct syllable environment there, not at the word level. Harris demonstrates that the cyclic domains required for both stress and syllabification in Spanish are exactly the lexical categories. There are indications that this is also true for German (Kiparsky 1966, 75–77), French (Bouchard MS.), Tiv (Pulleyblank MS.) and Hebrew (Rapparport MS.). A general condition to this effect was proposed already by Brame (1974) on the basis of Arabic and English data. He noted the Palestinian Arabic contrast *fhimna* 'we understood" vs. *fihimna* 'he understood us', with the same morphemes except that *na* is an ending in the first form and a clitic in the second. As he pointed out, the data can be explained by assuming that the rule syncopating unstressed vowels is ordered cyclically after the rule assigning penult stress on the assumption that the bare verb root is not a cyclic domain:

(3)   [fihim + na]ᵥ   [[fihim + ∅]ᵥ + na]ᵥ
   I Stress   [fihím + na]   [fíhim   ]
      Syncope   fhím + na
   II Stress   —   [fíhím + na   ]ᵥ
      Syncope   —   —

Brame proposed that (1) cycled substrings must occur as independent words, and (2) all and only rules mentioning brackets are cyclic. The first condition taken literally is actually too strong because stems, which must be lexically categorized as N, V or A and which do constitute cyclic domains are not necessarily capable of occurring as independent words in inflectional languages, where they may require an obligatory case ending. Moreover, in many languages word-formation must to all appearances be taken back to roots which in themselves are not necessarily members of any lexical category. If this is true, then it is necessary to stipulate that lexical rules apply only in domains delimited as lexical categories [ ]ₙ,ₐ,ᵥ.

Another previously problematic connection between morphology and phonology is that morphological rules may be sensitive to the output of phonological rules (Siegel 1974, Aronoff 1976). This is naturally accommodated in this theory because phonological rules operate in tandem with morphology in the lexicon. For example, the noun-forming suffix *-al* is

only added to verbs which are stressed on the last syllable, e.g. *arrival, revérsal, acquittal* vs. **depósital, *recóveral*. Therefore the derivational process that adds *-al* to verbs has to apply after the cyclic rule that assigns stress to verbs. If the grammar is organized as in (2) of sec. 1, exactly this ordering is predicted. The claim is that only cyclic rules may be relevant to morphology, more specifically that only cyclic rules of level *n* may be relevant to morphology of level *m*, where n ≤ m.

Perhaps the most significant consequences that the theory has for phonology have to do with the nature of lexical representations. Here it promises to resolve the long-standing issues that have been discussed in terms of constraints in abstractness, the Strict Cycle Condition, morpheme structure rules, and other notions. We shall summarize the problems in histroical perspective and then show how they may be appoached from the perspective of lexical phonology.

The theory worked out in Chomsky and Halle (1968) claims that underlying representations are chosen so as to give the simplest total grammar, where the grammar includes both lexicon and rules. The effect is to guarantee that lexical representations will be at *least* as abstract as the classical phonemic level. But they will be more abstract whenever, and to whatever extent, the simplicity of the system requires it. The simplicity of the system may require more abstract representations for several kinds of reasons. The most important kind of reason for setting up an abstract representation of a morpheme is systematically governed variation in its phonological shape. Underlying representations are set up in such a way as to permit such regular variation to be characterized by the simplest and therefore most general rules possible. Let us illustrate the point with an example from English phonology. The [s] in *dissonant* is to be derived by a degemination rule from /s + s/, on the strength of its component morphemes, which elsewhere appear as /dis/ (cf. *disreputable, discourteous*) and /sɔn + ænt/ (cf. *sonant, consonant*). Moreover, this representation directly explains why the word does not undergo the voicing rule to which single *s* is normally subject in that environmemt (cf. *resonant*). Similarly, the [s] in *criticize* is derived from /k/ by a "Velar Softening" rule, which applies throughout the derivational ("Romance") vocabulary of English, and accounts here for the regular relationship between *criticize, criticism* and *critic, critical*. This does *not* imply that the speaker or hearer need in any way mentally "derive" the words he says or hears by means of such rules as Velar Softening. What it *does* mean is that the alternations they govern belong to the regular phonological pattern of English, while for example a hypothetical *k* ~ *s* alternation in the reverse context, such as **criti[k]ize* ~ **criti[s]al,* would be irregular. The claim made is that someone who knows English implicitly knows that pattern, and will under appropriate circumstances recognize the difference between

regular and irregular alternations, though he may not be able, even after reflection, to verbalize the rules that underlie it.

The system that is set up in order to account for phonological alternations may then in turn permit further abstraction in the underlying representations of non-alternating forms as well. Often it may be positively required by the evaluation measure that selects the simplest grammar. "Abstractness" in this sense cannot be criticized on any legitimate a priori grounds; in the absence of further evidence it would indeed be demanded by sound scientific method. There is, however, evidence, which shows that at precisely this point the theory induces a characteristic type of wrong analysis. Identifying and correcting the source of error in the theory was the focus of the so-called abstractness controversy resulting in various versions of "concrete" phonology and more recently cyclic phonology.

Perhaps the most familiar English example of a rule which causes difficulties of the sort which are at issue here is Trisyllabic Shortening (or Trisyllabic Laxing). This rule shortens a vowel if followed by at least two more vowels, of which the first is unstressed:

(4) $V \rightarrow [-\text{long}]/\_\_C_oV_iC_oV_j$ where V_i is not metrically strong

It applies, for example, to shorten the long vowels in the initial syllables of

(5)   opacity, declarative, tabulate

(cf. *opaque, declare, table*). The rule has to be assigned to level 1 on the evidence of words like

(6)   mightily, bravery, weariness

Clearly all morphologically simple words such as

(7)   ivory, nightingale, stevedore, Goolagong, Averell, Oedipus, Oberon

must somehow be exempted from undergoing it. Standard generative phonology forces their phonological representations to be adjusted, if possible, in such a way that the structural description of the rule is not met. For *ivory* it is possible to postulate a final /y/, which will become *i* by an independently needed rule of English phonology. For *nightingale*, Chomsky and Halle (1968, 234) rather less persuasively suggest underlying /nixtVngǣl/, with *ix → ī → ay* by rules they claim are required on other grounds. The reason this is ultimately unilluminating is that in the bulk of the cases— *stevedore* and so forth—the failure of Trisyllabic Shortening cannot be explained away by changing the underlying form anyway.

Along with the problem that many ordinary words have no regular derivation in the grammar, there is the complementary problem that words like

(8)   alibi, sycamore, camera, pelican, enemy, Amazon, Pamela, calendar

have *two* possible derivations, while only one is ever needed. They could be derived at face value from an underlying representation with a short vowel in the first syllable. But they could also be assigned a *long* vowel in the

first syllable and taken for a "free ride" on the Trisyllabic Shortening rule.

Let us now look at some possible solutions to these problems.

A primitive attempt at solving this problem was the so-called Alternation Condition. In its strong version, it went as follows (Kiparsky 1968–1973, sec. 1):

(9)   Obligatory neutralization rules cannot apply to all occurrences of a morpheme.

The general effect is to limit the "abstractness" of underlying representations to cases motivated by phonological alternations. With regard to our particular example, the Alternation Condition does two things. It resolves the indeterminacy in the underlying representation of (8) by fixing the vowels of the first syllables as short. And it prohibits the possibility of dealing with (7) by such phonological devices as postulating /x/ in *nightingale* and non-syllabic /y/ in *ivory*. Nevertheless, the Alternation Condition as stated in (9) is unquestionably inadequate. Without attempting to do justice to the complex discussion that broke out around it,[15] let us summarize what are perhaps its most damaging flaws.

1. The Alternation Condition is not interpretable as a formal condition on grammars. In order to check whether it is satisfied in a given grammar, it would be necessary to inspect every derivation of that grammar. The only sense that can be made out of it is as a strategy of language acquisition which says that a learner analyzes a form "at face value" unless he has encountered variants of it which justify a more remote underlying representation.

2. The Alternation Condition leaves the theory with an inherent, redundancy. For example, it says that words like *Amazon, calendar, enemy, Emily* cannot be derived from underlying representations with long vowels in the first syllable. That fact ought to be of one piece with the fact that words like *Oberon, nightingale, ivory, Averell, overture* do not undergo Trisyllabic Shortening. Yet we shall still either have to mark the latter as exceptions to the rule, or else restate its environment so that it applies only accorss morpheme boundaries. This is redundant because the theory already tells us, by the Alternation Condition, that these words *could not* be subject to Trisyllabic Shortening. The problem is that the constraint on underlying representations leads to a predictable restriction on the application of rules which cannot, in this formulation, be expressed systematically in the grammar. Apart from the redundancy with the Alternation Condition, neither alternative is satisfactory in its own right. To mark the words as exceptions misses the generalization that *all* non-derived words subject to the Trisyllabic shortening rule fail to undergo it, and it furthermore wrongly claims that such words are irregularities, and should tend to get "regularized" by shortening their first syllable, which does not appear to happen. On the other hand, restricting the rule to apply only across morpheme boundaries

requires in the standard theory of phonology a complex disjunction of pluses in the environment of the rule, viz.

(10)   ___$\langle + \rangle_a$ $C_o\langle + \rangle_b$ $V\langle + \rangle_c$ $C_o\langle + \rangle_d$ V
       Condition: *a* or *b* or *c* or *d*

to allow for shortening in cases such as *tri + meter* (a), *gran + ular* (b), *penal + ty* (c), *omin + ous* (d).

3. The Alternation Condition is too weak in that it imposes no restrictions whatever on possible patterns of alternation. It appears that a certain type of rule, of which Trisyllabic Shortening is an example, could not apply morpheme-internally as in (7, 8) even if alternations did exist. To see what is at stake, consider the condition on Trisyllabic Shortening that the following vowel must be unstressed. It correctly blocks the rule from shortening first vowel in such words as (11):

(11)   a.   quōtátion
            flōtátion
            gȳrátion
            cītátion
            mīgrátion
       b.   fīnálity
            vītálity
            glōbálity
            tōnálity
            tītánic

What does not exist, and arguably could not exist, is a pattern illustrated by the hypothetical cases in (12), where we would have to allow morpheme-internal application of Trisyllabic Shortening, on the strength of the long vowel that shows up in the derivative, where Trisyllabic Shortening is bled by stress.

(12)   órigin: *ōríginal (ŏríginal)
       sýnonym: *sȳnónymous (sўnónymous)

The Alternation Condition is incapable of predicting that such cases do not exist.[16]

4. On the other hand, the Alternation Condition is too strong in that it excludes analyses which are well motivated on internal grounds. That is, it cannot be maintained without unacceptable loss of generalization. It is this failing which attracted the most discussion in the controversy over the Alternation Condition.

For example, while no-one will miss the putative /x/ in *nightingale*, a final /y/ is rather well motivated by the system of English word stress. Words ending in *-ory* and *-ary*, as well as words like *galaxy, industry*, systematically behave as if the final vowel was really a consonant, with respect to several of the stress rules (Chomsky and Halle 1968, 130, Liberman and Prince

1977, Hayes 1981, Ch. 5). The same final /y/ accounts for the failure of Trisyllabic Shortening in derived words like *vacancy, piracy, agency, secrecy*, where the rule would otherwise be expected to apply (Rubach 1981, 1954). Also, the only exception to the generalization noted above that -*al* is added after stressed syllables is *burial*; which can be resolved by taking the final -*y* as nonsyllabic. But the required rule

(13)   y → i/ word-finally

is an obligatory neutralization rule since *i* is a phoneme of English, and so cannot apply in the proposed cases consistent with the Alternation Condition.

An alternative approach is to deny the phonological character of rules such as Trisyllabic Shortening. It is commonly said that rules of this type are to be considered as "morphological" or "morphologized". This claim may actually mean a number of things, since there are several possible ways of treating morphologically conditioned rules in the phonology. But on any of the possible construals, the properties of the rule seem to be obscured rather than explained by the proposal. Let us consider three versions in turn.

The first version would be to simply add to the phonological environment of (4) a morphological environment consisting of the list of formatives before which the shortening process can take place, e.g.:

(14)   *-ous*   :   ōmen   ~ ŏminous
       -ate   :   sēmen   ~ insĕminate
       -ar   :   līne   ~ lĭnear
       -al   :   nātion   ~ nătional
       -ty   :   pēnal   ~ pĕnalty
       -ison   :   compāre   ~ compărison
       -(it)ive   :   compēte   ~ compĕtitive
       -(i)fy   :   vīle   ~ vĭlify
       -ent   :   rēfer   ~ rĕferent

This list is, however, redundant. The suffixes which have to be included in it are simply *all* "+ -boundary" suffixes which can cause the *phonological* conditions of Trisyllabic Shortening to be met. The only suffixes of that class that may be omitted are those which happen never to occur in the appropriate phonological circumstances, for example deverbal -*al*, which is only added to end-stressed words (*arrival, arousal, betrayal*). The correct generalization is that all and only suffix of the + -boundary class may trigger Trisyllabic Shortening in the environment of (4).

A second morphologized version of (4) would omit the phonological conditions entirely and state the rule simply as triggered by the suffixes of (14). It is open to the same objection as the first version and has to be rejected for that reason alone. Moreover, it misses the further generalization embodied in the *phonological* environment of the rule and therefore

enormously adds to the *lexical* arbitrariness of the rule in such cases as:

(15)   ŏmin + ous   vs.   hēin + ous
       pŏllin + ate   vs.   vāc + ate
       līne + ar   vs.   sōl + ar
       nătion + al   vs.   fōc + al
       compĕt + it + ive   vs.   invās + ive
       prepăr + at + ory   vs.   advīs + ory
       prĕfer + ence   vs.   clēar + ance
       rĕfer + ent   vs.   sōn+ ant

The third version is that morphophonemic processes are integral parts of morphological operations. This is the most unfortunate treatment of all because it denies that there is a single process involved, and claims that there are as many "Trisyllabic Shortening" rules as there are suffixes that can trigger the shortening process. Since the shortening is stated separately in connection with each affixation process, there is no way in this theory to distinguish between English and a hypothetical language in which each suffix triggers its own arbitrary set of changes in the stem. It even becomes impossible to relate irregular derivations to regular ones. It seems correct to say that *obēsity* and *oblīquity* are formed from *obēse, oblīque* by the same morphological process as *obscēnity* from *obscēne,* but are exceptions to Trisyllabic Shortening and Vowel Shift, respectively. But if Trisyllabic Shortening and Vowel Shift are integral part of that morphological process, then it is necessary to say that the three derived words are formed by three *different* morphological processes.

Not only is the central regularity underlying a rule such as Trisyllabic Shortening obscured by combining it with the various suffixation processes; the very patterning of exceptions is lost sight of. For example, the morpheme /nōt/ (*note*) is an exception to Trisyllabic Shortening: *cf. denōt + ative* (vs. *compăr + ative*), *nōt + ify* (vs. *cŏd + ify*). On the proposal under consideration it would have to be considered as subject to as many exceptional, otherwise unmotivated morphological operations as happen to give rise to the conditions that ordinarily trigger Trisyllabic Shortening.[17]

The germ of truth in the morphologization idea is that instead of stating a constraint on underlying representations directly, it should be made derivative of a primary constraint on the operation of phonological rules, which limits certain rules to "derived" inputs. If we can state a principle that prohibits Trisyllabic Shortening from operating in underived cases like (7), then the desired underlying representations are at the same time automatically enforced because no others will yield the correct output in conformity with the principle.

The search for a constraint on the application of rules moreover makes more sense in the conceptual framework of generative grammar, and it is

the strategy by which the most interesting discoveries of theoretical linguistics have been achieved.

We can approach the problem by introducing a notion of *derived environment*.

Def: An environment E is *derived* with respect to a rule R if E satisfies the structural description of R crucially by virtue of a combination of morphemes or the application of a rule.

We can then reformulate the Alternation Condition as restricting the corresponding class of rules as follows:

(16) *Revised Alternation Condition (RAC)*

Obligatory neutralization rules apply only in derived environments.

That is, an obligatory neutralization rule can apply only if the input involves crucially a sequence which arises in morpheme combinations or through the earlier application of a phonological rule. Otherwise, that is if the environment is met already in the underlying representation of a single morpheme, the process cannot apply. Requiring that a neutralization process apply only in derived environments guarantees in particular that neutralization will always be contextual (as opposed to absolute).

The RAC, then, does double duty as a constraint on the abstractness of underlying representations and as a principle of rule application allowing us to explain a class of cases which are unstatable in the older theory.

While the Revised Alternation Condition is a substantial improvement, it still retains some of the weaknesses discussed above. In the first place, it is still not a formal condition of the desired sort because the property of being a "neutralization rule" is not determinable from inspection of the grammar. Once again it is in principle necessary to check all the derivations in order to see whether the condition is satisfied. Secondly, there remain problems of empirical adequacy. An example of a loss of generalization entailed by the Revised Alternation Condition in English phonology can be seen in the regularities governed by the Velar Softening rule. This rule, which can be formulated as

(17) $k \rightarrow s / \underline{\quad} \begin{bmatrix} -\text{back} \\ -\text{low} \end{bmatrix}$

(perhaps via an intermediate *c* as in Chomsky and Halle (1968)) is an obligatory neutralization rule, since *s* is phonemic in English. Because of *critic* ∼ *criticize* and similar alternations, (17) must be in the phonology of English in any case. Prohibiting its application in non-derived cases like *conceive, proceed, recite* has several unfortunate consequences. In the first place, the explanation for the distribution of *s, z* and *k* in those stems is lost. We find one set of cases where the root initial consonant is *z* intervocalically and *s* elsewhere, and another set of cases where the root-initial consonant is *s* if a nonlow front vowel follows and *k* elsewhere:

(18) /s/ : re[z]ist   con[s]ist
      /s/ : re[z]ort   con[s]ort
      /k/ : re[s]eive   con[s]eive
      /k/ : re[k]ord   con[k]ord

The problem is explained by assuming underlying /s/ and /k/ respectively. The independently motivated rules of intervocalic voicing of *s* and Velar Softening, applied in that order, account for the observed surface reflexes of /k/ and /s/. The Revised Alternation Condition loses the generalization that /z/ does not appear in roots and sets up a set of exceptions to the intervocalic voicing rule (*receive*). Furthermore, the *k* in the prefix of *accede, succeed, accept* (pronounced with [. . . ks. . .]), should be attributed to the assimilation rule that operates transparently in *afford, support, account* etc., but this cannot be done if the nonalternating initial *s* has to be set up as underlying /s/ as required by the Revised Alternation Condition. Thus many of the convincing aspects of the analysis by Chomsky and Halle (1968) would have to be abandoned along with the less compelling ones.

A major step forward, which puts the whole problem into an entirely new light, was made by Joan Mascaró in his dissertation of (1976). Mascaró proposed that the class of rules which exhibits the "derived-environment-only" behavior is the class of cyclic rules, and that this behavior follows from the definition of "proper application of a cyclic rule". With some simplification, his proposal was:

(19) *Strict Cycle Condition* (SCC):

a. Cyclic rules apply only to derived representations.

b. Def.: A representation Φ is *derived* w.r.t. rule R in cycle j iff Φ meets the structural analysis of R by virtue of a combination of morphemes introduced in cycle j or the application of a phonological rule in cycle j.

The correct mode of application for Trisyllabic Shortening is thus obtained by setting it up as a cyclic rule, and the previously problematic Velar Softening rule has different properties by virtue of being a postcyclic rule.

The most important consequence of the Strict Cycle Condition is that there should be a relationship between the way a rule is *ordered* and the way it *applies*: cyclic ordering should correlate with the restriction to derived environments and postcyclic ordering should correlate with across-the-board application. Naturally, while the evidence from ordering and from application to non-derived forms should in principle coincide, we should not expect to find *both* kinds of evidence for *all* rules. There should however be no conflict between the two criteria and one would hope to find some non-trivial convergence between them. The recent study of Polish phonology by Rubach (1981) is devoted to exploring precisely this hypothesis in a rich body of material. His findings confirm it in rather striking ways.

What the theory entails for English is that Trisyllabic Shortening (and all rules that precede it) apply cyclically, and that Velar Softening (and all rules that follow it) apply postcyclically. This is indeed compatible with what is known about English word phonology. Positive support for it may be given both directly, by evidence for the cyclic or non-cyclic application of the rules, or indirectly by transitivity, by fixing the ordering of the rules in question with respect to other rules whose cyclic or postcyclic status is established on other grounds.

Direct support for the cyclicity of Trisyllabic Shortening can be provided by a slight extension of a line of reasoning begun above. Note the contrast

(20) hy̆pócrisy vs. hȳpóthesis

Why is the first vowel short in *hypocrisy*? This follows if Trisyllabic Shortening is cyclic, since *hypócrisy* is derived from *hýpocrite*, where it is subject to Trisyllabic Shortening:

(21)
	[[hīpo + krit]i]
I TSS	[hipo + krit]
II Stress	[hipókrit + i]
Other rules	[hipókris + i]

Because Trisyllabic Shortening is blocked before a stressed vowel (cf. *hy̆pothesis* and (11) above) it could not apply postcyclically in *hypócrisy*.

The ordering of Trisyllabic Shortening can be pinpointed quite precisely thanks to the condition that it does not apply before a stressed syllable. As the data in (11) show, Trisyllabic Shortening follows the assignment of word stress (more precisely, the "English Stress Rule" of Hayes 1981). The assignment of word stress is followed by several destressing rules which basically serve to eliminate stress clashes under certain conditions. One such rule is Post-stress Destressing. This rule destresses metrically weak open syllables between a stressed and an unstressed syllable. For example, the endings *-ōry*, *-āry* receive a stress by the English Stress Rule, which is retained after an unstressed syllable (22a) but lost directly after a stressed syllable (22b):

(22) a. tránsit + òry   b. advís + ory
          prómiss + òry   cúrs + ory
          plánet + àry   plén + ary

Since Post-stress Destressing applies only to medial syllables (witness *áltò, állỳ*) and the -y in the above words is an underlying /y/ because of the stress considerations mentioned above, then in order to have the proper environment for Post-stress Destressing we must first syllabify the final -y. We already saw that the syllabification of -y itself follows Trisyllabic Shortening because it does not feed it in words like *vācancy, sēcrecy, pōtency.*

(23) Trisyllabic Shortening
          y → i

Post-stress Destressing

By transitivity, Trisyllabic Shortening has to precede Post-stress Destressing. This predicts that vowels destressed by Post-stress Destressing will block Trisyllabic Shortening before them. The prediction is borne out by words like

(24) mīgratory, vībratory, rōtatory, phōnatory

where Trisyllabic Shortening fails on account of the stress on *-at-* inherited from the first cycle, as shown in the derivation of *mīgratory*:

(25)
I Stress		[[mīgrǣt] ōry]

II Stress
TSS
y → i
Post-stress Destr.

inapplicable

i

mīgrǣt   ōri

Another destressing rule eliminates metrically weak stresses medially in open syllables if another stress follows (see 26a). As (26b) shows, it is blocked in closed syllables:

(26) a. èxplanátion   b. cóndènsátion
          cómbination   indèntátion
          ínvitation   infèstátion
          phònetícian   sýntàctícian

This rule has to precede Trisyllabic Shortening since it has to feed it in derivations of words like *prŏclamation, rĕstoration, rĕcitation*, where the prefix vowel is always short (cf. *prŏclaim, rĕstore, rĕcite*, where Trisyllabic Shortening is inapplicable and the prefix consequently can be long). After application of the Rhythm Rule in the second cycle we have

(27)

[prōklǣm]   ǣt + yVn

at which stage Pre-stress Destressing and Trisyllabic Shortening, *in that order*, apply to give

(28)

$$
\begin{array}{ccc}
\mathbf{S} & & \mathbf{W} \\
\mathbf{F} & & \mathbf{F} \\
\mathbf{S}\quad\mathbf{W} & & \mathbf{S}\quad\mathbf{W} \\
\text{prŏklǣm} & & \text{ǣt+yVn}
\end{array}
$$
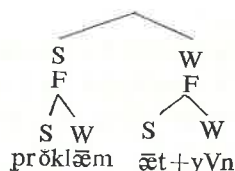
from which the phonetic form is directly derivable.

Because Pre-Stress Destressing precedes the cyclic rule of Trisyllabic Shortening, it must itself be cyclic, and so in turn must every rule that has to be ordered before it. As far as I can see, this is entirely compatible with the theory of English word stress that has been worked out so far.

For comparison, consider the rule which lengthens the vowel in such cases as *Newton* ~ *Newtōnian, Canada* ~ *Canādian, Athens* ~ *Athēnian*:

(29) $\left[\begin{array}{c} V \\ -\text{high} \end{array}\right] \rightarrow \bar{V} / \_C \left[\begin{array}{c} i \\ -\text{stress} \end{array}\right]\left[\begin{array}{c} V \\ -\text{stress} \end{array}\right]$

This rule is ordered after Trisyllabic Shortening (Chomsky and Halle 1968, 181) and in fact it seems to be postcyclic on the basis of examples like *mǎniac* ~ *maníåcal* (not **māníåcal*). Hence the rule is free to apply in nonderived enviornments and an underlying $\breve{V}$:$\bar{V}$ contrast is possible in the environment of (29), cf. *ammōnia: ammōnify, ammōniátion* with /ō/.

The theory of cyclic phonology we have considered so far raises a number of questions. Some are more or less conceptual: Why should there be two types of phonological rules, cyclic and postcyclic? Why should the definition of proper cyclic application have the particular and very complex form it has? What is the *inherent* connection between cyclicity, a property of rule ordering, and the restriction to derived environments? These questions become particularly troublesome if Freidin (1978) is right that the (strict) cyclic application of transformational rules in syntax does not have to be stipulated as an autonomous principle in the theory of grammar, because its effects can be derived from the "Opacity" (Tensed S and Nominative Island) conditions. If cyclicity is indeed derivative in syntax then surely it will not be primitive in phonology. For these reasons one is tempted to look for a reformulation which succeeds in reducing the theory of strict cyclicity in phonology to independently given principles of grammar.

There are also some empirical problems with the theory. For one thing, cyclic rules are known which do not show the expected "strict cyclic" properties, in that they must apply to non-derived environments on the first cycle. We have encountered one such example in the Spanish syllabification rule (see 2). A notorious case is stress in English. Although a metrical treatment eliminates the need for cyclic assignment of sentence stress, it remains true that lexical stress must be assigned cyclically (Kiparsky 1979, Hayes 1981). And it is evidently assigned by exactly the same rules to non-

derived stems as to derived stems. That is, the antepenult stress in *Menómini* is an instance of the same regularity as the antepenult stress in *synónym* + *y*. The formulation of (19) incorrectly entails that this cannot be the case.

A second question that the Strict Cycle Condition leaves unanswered harks back to the original "abstractness" issue. One of the basic observations that the Alternation Condition set out to explain was the tendency for non-derived outputs of obligatory neutralization rules to get lexicalized. Mascaró suggested that this class of rules is necessarily cyclic, but this is evidently untenable for the reasons already discussed in connection with the Revised Alternation Condition. The weaker formulation that obligatory neutralization rules are cyclic in the so-called "unmarked case" is at the very least ad hoc. And finally, if nothing at all is said beyond (19), the theory is simply left with two classes of rules, cyclic and noncyclic, and does not have the leverage required to account for the observed drift into the lexicon. The problem, then, is to develop a theory capable of explaining why, in case after case, obligatory absolute neutralization rules bequeathed to a language by sound changes that merge segments are reanalyzed out of it, and non-derived output of obligatory contextual neutralization rules are lexicalized, so that the actual phonologies of languages are practically always more concrete than history would make one expect.

A third question concerns the relation between the morpheme structure of a language and its cyclic rules. Typically, the output of the cyclic rules (again excluding metrical rules) has the same form as do underlying representations, both as regards the segment inventory and the possible combinations of segments. In other words, cyclic phonology is structure-preserving. The theory as it now stands does not explain why it should be so. Moreover, it saddles grammar with a characteristic redundancy, where phonological rules recapitulate the unmarked structure of morphemes. For example, the theory cannot relate the existence of the (cyclic) Trisyllabic Shortening rule (4) to the fact that non-derived words that violate it, such as (7), are nevertheless much rarer than non-derived words that conform to it, such as (8). In the theory of Chomsky and Halle (1968) the former are outright exceptions, in cyclic phonology they are entirely on a par with the latter and fully as regular; the truth would rather seem to be that morpheme-internal $\bar{V}CVCV$ sequences are "marked" relative to $\breve{V}CVCV$ within English phonology.

In sum, the class of cyclic rules seems to be distinguished from the class of postcyclic rules by a syndrome of properties which define a special mode of rule application, and which have no apparent intrinsic connection either with each other or with rule ordering. Why are cyclic rules structure-preserving? Why do cyclic rules characterize unmarked morpheme structure?

Why do obligatory neutralization rules tend to become cyclic? Why do *metrical* cyclic rules seem to work differently? And more generally, why do these properties go together and what do they have to do with cyclicity?

The answers to these questions are actually already at hand. The Strict Cycle Condition does not have to be stipulated in the theory. A version of it is deducible from the Elsewhere Condition. The version so deduced, unlike the original version, directly predicts the apparently deviant behavior of cyclic metrical rules as well as the relationship we noted between cyclic phonology and the lexicon.

The basic point is that the blocking of cyclic rules in nonderived environments effected by the Strict Cycle Condition follows from the Elsewhere Condition under the assumption, already justified on morphological grounds above, that every lexical entry constitutes an identity rule whose structural description is the same as its structural change. For example, we shall then have the two rules

(30)   a.   /nītVngæl/

   b.   Trisyllabic Shortening (4)

The structural description of (30a) properly includes (30b), i.e. (30a) defines a subset of the contexts of (30b). The outputs of (30a) and (30b) are distinct, with (30a) specifying a long vowel in a position where (30b) specifies a short vowel. So the Elsewhere Condition is applicable and says that only rule (30a) is applied to the string /nītVngæl/, which gives us the desired result that the word is not subject to the Trisyllabic Shortening rule. The rule is, however, free to apply to derived inputs such as [[sæn]$_A$iti]$_N$, because they do not constitute lexical entries.

(31)   [[sæn]$_A$iti]$_N$ [nītVngæl]$_N$

   I [—]   (blocked by E.C.)

   II [[sǽn]$_A$iti]$_N$

   sanity   *nightingale*

We not only derive the special case of blocking on the first cycle, but the full effect of the Strict Cycle Condition, which blocks rules on any cycle *n* from applying to inputs which are not derived (in the sense of (19b)) on cycle *n*. This is by virture of the principle, which we also saw to be necessary on independent morphological grounds above, that the output of every layer of derivation, such as [sǽniti], is itself a lexical entry, and thereby an identity rule which enters into a disjunctive relation with other lexical rules such as Trisyllabic Shortening by the Elsewhere Condition in exactly the same way as underived lexical entries do.

Finally, the reason postlexical rules such as Prevocalic Lengthening are free to apply to nonderived inputs is that being in a different component they cannot be linked disjunctively to a rule in the lexicon by the Elsewhere Condition.

The version of strict cyclicity that we arrive at in this way however differs crucially from (19) in that it blocks conjunctive application only when the outputs are *distinct*. (Cf. Ringen 1980, who proposes that the RAC should be so restricted.) That has been the case in the examples considered so far, but it is not the case in a large class of other cases, most obviously in rules that assign metrical structure to strings not already bearing metrical structure. Consider the lexical entry *parent* and the rule of English word stress that assigns it the stress pattern S͡W. We have two rules whose respective outputs when applied to the string *parent* are *parent* itself (the identity rule)

   F
   S͡W

and *parent* (the stress rule). These outputs are not distinct in that they do not have contradictory feature specifications or contradictory metrical structure. Rather, one has a specified metrical structure where the other is unspecified as to metrical structure. The outputs not being distinct, clause (ii) of the Elsewhere Condition is not met, and both rules accordingly apply, which means that stress is free to apply on the first cycle. In the same way, syllable structure in Spanish is assigned on the first cycle by rules with the effect of (32b) among others because condition (ii) of (10) of sec. 1 is not met and (32a, b) therefore apply conjunctively.

(32)   a.   desdeñ

   b.   VC → V͡C

We also correctly predict that cyclically derived phonological properties can trigger subsequent rules on the same cycle. Thereby even feature-changing rules can apply on the first cycle if they are fed by cyclic rules. This is illustrated in the Spanish example we cited from Harris, where the cyclically assigned syllable-final status of *n* causes depalatalization:
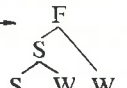
(33)   a.   desdeñ

   b.   V͡ñ → V͡n

Here (10) of sec. 1 is not met and the rules therefore apply conjunctively. Hence we have the correct derivation *desdeñ* (32a = 33a) → *des͡deñ͡* (32b) → *des͡den͡* (33b), all in the first cycle.

A further corollary is that rules which assign metrical structure *will* be blocked on the first cycle to the extent that the input is metrically structured already in the lexicon. In Spanish, cases like *huir* (two syllables), *oiremos* (four) can be simply marked so in the lexicon (as suggested by Harris) and the syllabification rules will not apply.
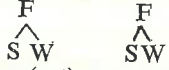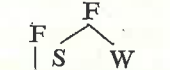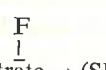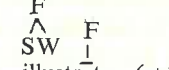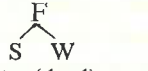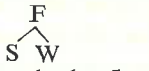
These assumptions afford a series of major simplifications in Hayes' theory of English word stress. Hayes introduces two basic rules of stress assignment (foot formation): the English Stress Rule (ESR) and Strong Retraction Rule

(SRR). The ESR applies at the right edge of the word, assigning maximally binary feet labeled S W, where W may not be a heavy syllable (not counting "extrametrical" material). The SRR applies iteratively from right to left, also assigning maximally binary feet labeled S W, but without restrictions as to syllable weight. As proposed by Selkirk (1980), stress is not a feature but the property of being the strong or only syllable of a foot. Thus, we have such derivations as (34), where parentheses denote extrametricality:

(34) (a) hamamelidanthemum →

(ESR) hamamelidanthe(mum) → (SRR) hamamelidanthemum

(b) Tĭconderōga → Tĭconderō(ga) → Tĭconderōga

The resulting feet are then joined into a word tree, whose right branches are labeled strong unless they consist of single syllables.

Two special sets of assumptions are required in order for the analysis to work out right. The first is that the stress rules, though necessarily cyclic, do *not* observe the principle of strict cyclicity. This is forced by the need to apply stress rules on the first cycle, i.e. in non-derived environments. The second is that the grammar may specify in what manner stress rules apply, specifically whether they may override existing foot structure in the string, or whether they only assign metrical structure to syllables which are not yet organized into feet. The two English rules differ on this score. The ESR belongs to the first type in that it applies regardless of whether the string is already provided with a metrical organization or not. The SRR, on the other hand, strictly respects existing metrical structure. The contrast can be seen in the following examples. Parentheses show extrametricality.

(35) a. parent → (ESR) par(ent) → parent + al → (ESR) parent(+al)

b. illustrāte → (ESR) illustrāte → (SRR) illustrāte (→*illustrāte)

c. standard → (ESR) stan(dard) → standard + īze → (ESR, word tree)

standard + īze (→SRR)   *   standardīze) → standardīze + ātion

→ (ESR, word tree) standardīze + ātion (→(SRR)   *   standardīz +ātion)
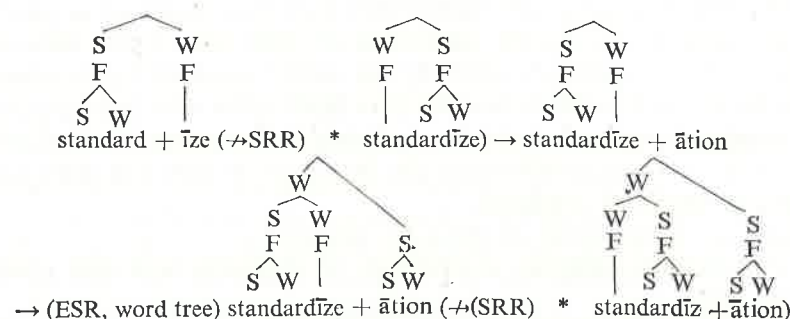
Example (35a) shows how the ESR wipes out the metrical structure assigned by itself on a previous cycle. Example (35b) shows how the SRR respects the metrical structure assigned by the ESR previously on the same cycle. If the SRR were allowed to wipe out the metrical structure assigned by the ESR, we would derive the wrong form *illústràte, and more generally, all evidence that the ESR even existed in the grammar would disappear. Example (35c) shows how, in addition, the SRR respects the metrical structure assigned by the ESR and by itself on a previous cycle. This is why we do not derive the wrong final form as indicated there (*standàrdizátion).[18]

In the present theory, nothing at all need be stipulated in the grammar of English about the mode of application of any of the stress rules. It follows outright from the Elsewhere Condition. In the first place, the ESR and the SRR must be disjunctively ordered. Secondly, being cyclic (i.e. lexical) rules they are blocked from applying in a structure-changing function in non-derived environments. This jointly defines the correct conditions for their operation and interaction. The details are as follows.

The SRR is applicable to any string of syllables and the ESR is applicable to right edges of constituents, i.e. to domains bounded by]. Thus the structural description of the ESR properly contains the structural description of the SRR. By virtue of the Elsewhere Condition, the rules must apply disjunctively, with ESR, as the special rule, taking precedence over the SRR where they conflict. This explains their interaction in (35b). On the rightmost domain, ESR assigns a unary foot, taking precedence over the SRR which would assign a binary foot over the last two syllables to give penult stress. Proceeding leftwards, we come to the string *illu-*. The ESR is not applicable since the string is not at the right edge of a constituent, and so the SRR puts a binary foot on it, stressing the initial syllable. The usual word tree rule labels the left foot strong to complete the derivation.

As for the application of the ESR and the SRR to strings with preexist-

ing foot structure, the theory requires that *both* rules should be subject to the principles that govern the application of cyclic rules. Cyclic rules are subject to "strict cyclicity", which by our earlier argument again reduces to the Elsewhere Condition. Its effect is to block cyclic rules from applying in a structure-changing function in nonderived environments. We shall now take up the various possible cases for both rules in turn and show that everything works as predicted.

There are three kinds of cases to consider:

1. Non-structure-changing applications. As predicted, both rules apply: see e.g. (35b).

2. Structure-changing applications in non-derived environments. Both rules should be blocked.

As far as the SRR is concerned, it is just this blocking which lies behind its failure to erase metrical structure assigned (in whatever way) on earlier cycles. In the derivation of *standardization* (see 35c), the application of the ESR to -*ation* on the third cycle yields the structure (36):

$$
\begin{array}{ccc}
F & F & F \\
\wedge & | & \wedge \\
S\ W & & S\ W
\end{array}
$$

(36)   [[standardīze]$_V$ation]$_N$
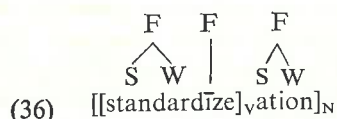
By virtue of our assumption that the output of every cycle is entered into the

$$
\begin{array}{cc}
F & F \\
\wedge & | \\
S\ W &
\end{array}
$$

lexicon, the string to the left of -*ation*, [*standardīze*]$_V$, constitutes a (derived) lexical entry which is fully organized into feet. The Elsewhere Condition prohibits the SRR from overriding the foot structure of this lexical entry.

Now we are committed to the prediction that the ESR too behaves in exactly the same way. Where does the ESR encounter pre-existing foot structure? The case occurs in words like *Attíla, Kentúcky, Mississíppi*, which have a stress on a syllable where it cannot be assigned by the standard stress rules. They are very reasonably treated as being represented prior to the application of the stress rules with a foot on that syllable:

(37)
$$
\begin{array}{cc}
F & F \\
\wedge & \wedge
\end{array}
$$
    Attila   Mississippi

What prevents the ESR from applying to such nouns, eliminating the stress on the second syllable to give the incorrect forms (38)?

$$
\begin{array}{cc}
S & F \\
\wedge & F\ \ S \\
S\ W\ W & |\ \ \ S\ W\ W
\end{array}
$$

(38)   *Atti   (la)   *Mississi (ppi)
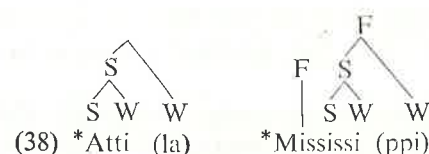
Strict cyclicity, i.e. the Elsewhere Condition. So we must assume that structure-changing applications in non-derived environments are prohibited for the ESR as well as for the SRR. It is thus not true, even in terms of Hayes' own analysis, that the ESR is simply free to erase whatever metrical structure lies in its way. Like the SRR it submits rigorously to the conditions that govern the application of cyclic (lexical) rules.

3. Structure-changing applications in derived environments. Both rules should apply. First consider the ESR. In examples like *parental* (35a) the ESR overrides existing metrical structure because it can apply in a derived environment. That is, the string under consideration in the second cycle (marked off in (39)) is not a substring of a lexical entry which bears a contradictory foot structrue:

$$
\begin{array}{c}
S\ W \\
\wedge
\end{array}
$$

(39)   [[parent]$_N$(al)]$_A$
       |_____|
          ESR
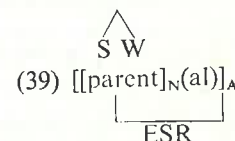
The Elsewhere Condition is inapplicable, and the ESR is free to form a foot at the right edge of the word, giving *paréntal*.

Again we expect to find corresponding cases with the SRR. The reason they were not obvious before is that in most cases, the interior of a word will have been metrically organized in full at any cycle but the first. So observationally the generalization that the SRR never reorganizes existing foot structure approximates the truth fairly closely. But it is only by accident that it seems so nearly true. It breaks down in the crucial cases where more material than can be accomodated by the ESR is introduced on a given cycle. There the SRR completes the foot assignment on the extra syllables to the left and may combine it with new material contained in existing foot structure. Consider *fálsify, solidify*, derived from *false, sólid*. Coming out of the first cycle we have (40):

$$
\begin{array}{cc}
F & F \\
| & \wedge \\
 & SW
\end{array}
$$

(40)   [[fals]$_A$ifȳ]$_V$ [[solid]$_A$ifȳ]$_V$
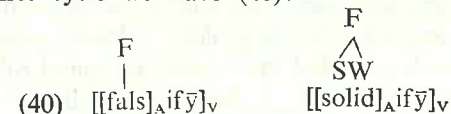
The ESR now assigns a foot to -*fȳ*. If the SRR were now to form a foot solely on that part of the string which does not already belong to a foot, namely the -*i*- which precedes -*fy*, the final outcome would be the wrong forms *fàlsifȳ, *sòlidifȳ. Rather, the SRR must form a foot on *falsi-, -lidi-*,

eventually yielding *fálsifỳ, solidifỳ*. This shows that the SRR too is free to apply to material already contained within feet, provided it does so in a derived environment.

In sum, there is no essential difference in functioning between the ESR and the SRR. Being cyclic, both are restricted by strict cyclicity, and being in an inclusion relationship they apply disjunctively. Both properties are guaranteed by the Elsewhere Condition and nothing need be stipulated about their mode of application in the grammar of English. In addition, two sets of cases which escape even the fine-meshed net of Hayes' analysis are now hauled in along with the rest: the failure of the ESR to apply in non-derived environments, as in *Attíla* (see 37) and the applicability of the SRR in derived environments, as in *solidify* (see 40).

As a result, a further substantial simplification of the stress rules becomes possible. We are free to collapse the ESR and SRR into a single rule in which the ESR appears as a mere condition on the constituent-final environment:

> (41)   Assign maximally binary S W feet from right to left, where W may not branch in env. __].

Finally, under our theory the decision to enter idiosyncratic metrical structure in the lexicon assumes rather more significance than before. At least the following empirical consequences are at stake. First, it predicts, surely correctly, that arbitrary exceptions to stress rules add relatively less complexity to the grammar in basic stems than in derived stems. Furthermore, it follows that such lexical exceptions should be typical of languages with *cyclic* stress assignment, such as English. Postcyclic stress rules, such as the initial stress rule of Finnish, cannot be contravened simply by inherent lexical specification of stress; exceptions to them are costlier in that the lexical items in addition must be marked as not undergoing the stress rules. In languages where word stress is assigned postcyclically it should therefore be characteristically more regular. And this is obviously the case.

This issue arose in an interesting way in the original discussion of the SCC by Mascaró (1976). Mascaró was forced by his version of cyclic phonology to set up phonemic stress in Catalan stems. Yet it is clear that there is an unmarked stress pattern much as in Spanish. This can now be done justice to by assigning it by a cyclic stress rule, with underlying stress restricted to exceptional antepenult or final stress (e.g. *défisit* 'deficit', *papá* 'father'). Support for this alternative is provided by a cyclic segmental rule that depends upon stress. In the environment $\acute{V}$__1, there is devoicing of *b* (and sporadically of other stops also), e.g. *diáplə* 'devil' (cf. *diabólik* 'devilish'). The devoicing rule must apply even if the vowel subsequently loses its stress to a following suffix, e.g. *diapləría*. Hence it is cyclic. But the environment . . . $\acute{V}$bl . . . is always contained within the *first* cycle. Now if stress is

underlying, the environment of devoicing will be non-derived and the rule should not be able to apply (even on our theory, since it is feature-changing). But if stress applies on the first cycle, then it can feed devoicing on the first cycle and there is no difficulty with these derivations.

A further important point is that *vacuous* application creates derived environments in Mascaró's theory but not in ours. Mascaró indeed found an interesting case in his Catalan material which seemed to work crucially as his version predicts, but it yields entirely to the reanalysis just indicated.

Moving now to the problems involving lexical representations, we can resolve them in essentially the same way. We shall simply take the "morpheme structure rules" of a language to be so many rules of its lexical phonology. Then lexical rules, rather than being simply inapplicable on the first cycle, will apply on the first cycle as redundancy rules to fill in lexically unspecified feature specifications, in addition, of course, to applying as before in derived environments in a feature-changing function. For example, the distinction between *nightingale* and *sycamore* is that the first vowel is specified as long in the former—blocking Trisyllabic Shortening as shown above—and *unspecified* for length rather than specified as [−long], in the latter. Then the Elsewhere Condition will not block Trisyllabic Shortening from applying to *sycamore* as its clause (ii) is not met, so that the rule will specify the vowel as [−long], as desired.

A priori the elimination of a special category of "morpheme structure rules" is welcome because the status of these putative rules has almost from the beginning of generative phonology been beset with problems. Kenstowicz and Kisseberth (1977) identify four of them:

1. Condition or rule: are MSRs to be construed as rules that fill in predictable feature specifications left blank in the matrices entered in the lexicon, or are they to be construed as static well-formedness conditions that check the acceptability of fully specified lexical entries?

2. The duplication problem: why are regularities expressed by morpheme structure rules often recapitulated by phonological rules proper, applying to derived forms?

3. The domain problem: on what sorts of entities are lexical constraints defined—morphemes, stems, or finished words?

4. The level problem: to what stage of derivation are lexical constraints applicable—underlying representations, the phonetic output, or some intermediate level?

In the approach proposed here, the answers to these questions must run as follow:

1. Predictable feature specifications are left unspecified in lexical entries and are filled in by the system of universal and language-particular rules of lexical phonology.

2. There is no duplication problem because the rules that apply to non-derived forms in a blank-filling function, governing the structure of primitive lexical entries, are the same lexical rules that apply after the first cycle in a feature-changing function, governing the structure of derived lexical forms.

3. The domains on which lexical constraints are defined are *lexical categories*, i.e. the cyclic constituents N, A, V. Lexical constraints are therefore only indirectly pertinent to morphemes (roots, affixes etc.).

4. Lexical constraints are applicable in lexical (cyclic) phonology as determined by the ordering of the relevant rules. Thus they are not necessarily true either of underlying representations or of the phonetic output. In particular, the application of postlexical rules may totally obscure the canonical structure of lexical items.

From our point of view, "duplication" between morpheme structure rules and rules of lexical phonology, far from being a problem, is actually the predicted normal case. We do not allow rules whose domain is defined as the morpheme; minimally they must belong to level 1 and apply also to such derived forms as meet their structural description. This does not mean that all rules will actually exhibit duplication. It can very well happen that the environment of a level 1 rule occurs only in underived lexical items or only in forms derived at level 1; what is predicted is that *if* it occurs in both then the rule will indeed apply to both.

If we are to allow unspecified feature values in the lexicon, then it becomes incumbent upon us to answer the well-known objections of Stanley (1967) against the procedure. We shall do this by stipulating that no feature can appear marked both + and − in the same environment in the lexicon.

For our starting point we revert to the natural assumption of early generative phonology that phonological features are unspecified in underlying representations if their value can be assigned by a rule. The theory of grammar will provide a set of universal redundancy rules functionally analogous to the markedness principles of Chomsky and Halle (1968), but formally identical to ordinary phonological rules. In particular, assume that for every feature F there is minimally a rule

(42) $[\quad] \rightarrow [\alpha \text{ F}]$

where α (+ or −) is the "unmarked" value. In addition other rules may be applicable in specific syntagmatic or paradigmatic contexts. For example, for voicing we may have the rules

(43)   a. $[\quad] \rightarrow [+\text{voiced}]$
       b. $[+\text{obstr}] \rightarrow [-\text{voiced}]$

putting the unmarked value as [−voiced] for obstruents and [+ voiced] elsewhere. We now say that voiceless obstruents and voiced sonorants are represented as [0 voiced], that is, unspecified for voicing, and that their

respective specifications for voicing are filled in by the application of rule (43). This much is quite in the spirit of traditional markedness theory.

Suppose further that the lexical phonological rules of a language apply to lexical entries together with universal rules such as (43), as part of the system of lexical redundancy rules. For example, the English lexical rule of regressive voicing assimilation applies on the first cycle as a lexical redundancy rule that assigns [α voiced] as the normal value to obstruents in the context __ [α voiced]. This again means that obstruents in that context are [0 voiced] in lexical entries of English.

We thus obtain a hierarchy of successively more specific rules, all but the first rule (43a) applying in domains included in more general rules and superseding them in the shared domain. The portion of the hierarchy that we have seen so far is shown toegether in (44):

(44)   (a) $[\quad] \rightarrow [+ \text{voiced}]$
       (b) $[+ \text{ obstr}] \rightarrow [- \text{ voiced}]$
       (c) $\begin{bmatrix} + \text{ obstr} \\ \alpha \text{ voiced} \end{bmatrix} \rightarrow [\alpha \text{ voiced}] / \underline{\quad} \begin{bmatrix} + \text{ obstr} \\ \alpha \text{ voiced} \end{bmatrix}$

The disjunctive ordering among such sets of rules comes by the Elsewhere Condition.

Clearly, lexical redundancy rules must not be allowed to change lexically specified features. For example, rule (44b) only "fills blanks", and does not apply to segments inherently specified as [+ voiced], such as /z/. This does not have to be specially stipulated in the theory, but falls out directly from the E.C. if we construe each lexical item L as a rule as proposed above. Suppose we have the English words *sip* and *zip*. We then have the rules (45 a-c), where (a) and (b) are disjunctive by the E.C. but (a) and (c) are not disjunctive because their outputs are not distinct (condition (ii) of (10) in sec. 1 is not met).

(45)   a. $[+ \text{ obstr}] \rightarrow [- \text{ voiced}]$
       b. $\begin{bmatrix} + \text{ obstr} \\ + \text{ cor} \\ \text{etc.} \\ + \text{ voiced} \end{bmatrix}$ $ip \text{ # }$ (disjunctive with (a))
       c. $\begin{bmatrix} + \text{ obstr} \\ + \text{ cor} \\ \text{etc.} \\ 0 \text{ voiced} \end{bmatrix}$ $ip \text{ # }$ (conjunctive with (a))

In exactly the same way, the /b/ of *absent*, lexically specified as [+ voiced], does not undergo the voicing assimilation (44c), while the unspecified /b/ of *abdomen* does. Thus the lexical entries themselves are the end points of the above-mentioned hierarchies of successively more specific

rules:

(46)

(44a)
(44b)

(44c)
a[b]sent

[z] ip
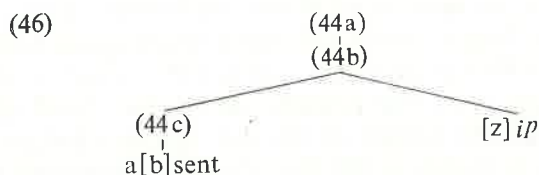
It follows that in every context C, only two lexical specifications will be possible for any feature F, viz. [OF] and [αF], where [αF] is the unpredictable value. Therefore we escape Stanley's (1967) objection that allowing unspecified features in the lexicon amounts to introducing a three-valued feature system.

Not every context allows both possible feature specifications. If only one specification of F occurs in some context C', i.e. if some branch of the hierarchy for F does not terminate in any lexical items but in the rule for C' itself, then we shall say that F is *non-distinctive* in C'. Its lexical specification in C' is then necessarily [OF].

We still have a debt to pay off to the abstractness issue. Although we have been able to derive the "cyclic syndrome", including the properties associated with the Strict Cycle Condition, from independently motivated principles governing the lexicon, we have as yet no explanation for why rules should become lexical in the first place. After all, sound changes enter a language as postlexical rules and there is no a priori reason why they should in time tend to graduate to lexical status, with concomitant reanalysis of their synchronically nonderived outputs. More particularly, as was made explicit in several formulations of the Alternation Condition and the Strict Cycle Condition, obligatory neutralization rules have a special affinity for the cycle/lexicon which still needs to be accounted for.

To begin with this last question, the answer is evidently that obligatory neutralization rules are precisely those rules whose outputs are potentially subject to lexicalization without complicating the grammar. Why neutralization rules? They are rules which merge one set of representations with another:

(47)   A   B

C

where possibly C = A or B. So in this case C derived from A has by definition another possible source in the lexicon, namely B or whatever is the source of B. The lexicalization of the output of a non-neutralization rule (say, aspiration in Enligsh) requires adding some redundant category to underlying representations, which other things being equal will be rejected

on grounds of simplicity. And why just *obligatory* neutralization rules? If the output of an *optional* rule is lexicalized then its relationship to the other variant cannot be accounted for by the rule. This will again be rejected on grounds of simplicity. Imagine, for example, that the Trisyllabic Shortening rule in English was postlexical and optional. Then obviously the shortened variant of *nightingale* would not be lexicalized because it could not then be related to the variant with a long vowel. So if a postlexical rule is non-neutralizing or optional, simplicity considerations will generally require that it continue to apply to non-derived forms, and the Elsewhere Condition then entails that it remain in the postlexical component.

This does *not* mean that there could not be non-neutralizing rules or optional rules in the cyclic phonology. Such cases have certainly been documented in the literature. All that is predicted is that postlexical rules can shift into the lexicon without either overt changes in their non-derived inputs or loss of generality only if they are obligatory non-neutralization rules.

Assuming this account of why it is obligatory non-neutralization rules that may become lexical, we now come to the question why the rules that may become lexical so readily do so. To postulate a principle that the "unmarked" status of a rule is lexical is no more than a restatement of the observation that we wish to explain. Assume instead that the language learner is guided by a principle that selects the simplest available derivation, the criterion of derivational simplicity being length. By "available" I mean "allowed by the evaluation measure." This means that derivational simplicity is strictly subordinated to grammatical simplicity, and only comes into play when the evaluation measure is indeterminate as between alternative grammars. The principle that the shortest derivations are preferred is related to Zwicky's (1970) "No Free Ride" Principle and more distantly to Postal's Naturalness Condition, which is formulated as a condition of adequacy on phonological theories, rather than as a principle for selecting between alternative descriptions within a theory. The idea was actually implicit in some generative treatments of analogical leveling, e.g. the discussion of the loss of final devoicing in Swiss dialects in Kiparsky (1968). We shall call it the Derivational Simplcity Criterion (DSC) and formulate it as follows:

(48)   *Derivational Simplicity Criterion* (DSC)

Among alternative maximally simple grammars select that which has the shortest derivations.

The favored status of lexical phonological rules is derivable from the DSC because putting a rule into the lexical phonology always enables non-derived forms to be derived from the shallowest source, in satisfaction of (48). As a schematic example, consider how Trisyllabic Shortening might have be-

come a lexical rule. Suppose that at a certain period there arose surface exceptions to it such as *nightingale*, from degenerate compounds, vowel lengthening, and other sources. Faced with data such as *nightingale* two analyses are available to the learner. The first possibility is to take the word "at face value" and set up /nītVngæl/, with an underlying long vowel. The second, assuming for the sake of the example that an /x/ deleted with compensatory lengthening can still be motivated for this stage of English, is the more abstract /nixtVngæl/. These two alternatives commit the learner to different assumptions about the phonological rules as well. Underlying /nītVngæl/ entails that Trisyllabic Shortening is lexical. Underlying /nixtVngæl/ entails that the rule deleting /x/ is postlexical. But the DSC fixes the underlying form as /nītVngæl/, in turn forcing Trisyllabic Shortening into the lexical phonology. Such restructuring erodes the support for the /x/-deletion rule and eventually brings about its demise.

To summarize, we have arrived at the conclusion that what is right about the Strict Cycle Condition is derivable from the Elsewhere Condition on the assumption that word phonology is integrated with the morphology in the lexicon. The resulting theory can be considered an advance from both the conceptual and the empirical point of view. Conceptually, it achieves a greater explanatory depth in that various principles that had to be stipulated previously are now derived from the interaction of more elementary principles. Empirically, it marks a step towards overcoming the tension between two goals, each legitimate in themselves but so far curiously difficult to reconcile with each other in generative phonology: maximal generality and elegance of descriptions on the one hand, and maximal realism, naturalness etc. on the other. It no longer seems necessary to make compromises in one in order to achieve the other.

The notable feature of this theory when compared to earlier approaches to the same problems in generative phonology, as well as to current trends in syntax, is that the main explanatory burden is carried by simplicity and the structure of the grammar itself, as opposed to conditions on rules or representations. The only condition we required was the essentially trivial Elsewhere Condition, which may conceivably be reducible to a more general cognitive principle.

3. Morpheme Structure

In this section we shall make an attempt to relate our approach to morpheme structure to previous discussions of the problem and to show that the issues raised there can be satisfactorily answered. The presentation is organized around the four problems that we identified above, namely the condition vs. rule problem, the duplication problem, the domain problem, and the level problem, taken in that order.

3.1. The blank-filling function of lexical rules.

Recall that we have required the assumption that predictable feature values are left unspecified in the lexicon in order to be able to derive the correct form of the SCC as a theorem from the E.C. With this assumption we have reverted to the original and very natural position that was accepted in all the early work in generative phonology, and we have thereby resurrected the explanation for the distinction between systematic and accidental gaps which was achieved in that early version of generative phonology and then lost because of the adoption of fully specified feature matrices in lexical entries.

To know English is to know that *brick* and *slick* are words, and more interestingly, that the non-words **blick* and **snick* are *possible* words while **bnick* and **srick* are *impossible*. We can write rules for English phonotactics that exclude the latter but allow the former and such rules may be found in many structural grammars of English. The deeper insight, due to Halle (1962), was that you not only can but *must* write these rules if your theory has lexical entries with unspecified feature values filled in by redundancy rules and that the simplest possible grammar is chosen. This forces us to formulate a grammar with a rule such as

(1) $[+ \text{cons}] \rightarrow \begin{bmatrix} - \text{nasal} \\ - \text{obstr} \end{bmatrix} / [- \text{cont}]$ ____

which though complicating the rule system by four feature specifications, enables the lexicon to be massively simplified by leaving the nasal and obstruent features unspecified in thousands of entries (*brick, blue, grow, trapeze* etc.). Because /brik/ is excluded by this MSR, it is formally characterized as a systematic gap. Conversely, it also follows from the theory that there *cannot* be a rule that excludes /*blik/ because such a rule would simplify the lexicon by only one feature specification (namely [– lateral] on *r* in *brick*) while itself exceedingly complex to state. So the theory was not merely describing but *explaining* the analogical projection of a speaker from the real words he knows to the possible words.

If we adopt fully specified lexical entries, we lose this straightforward explanation. If all feature values are already specified in underlying representations, then nothing forces us to have a rule (1) in the grammar. Simplicity certainly does not, for the grammar would be simpler if there was no such rule. It is no good to stipulate an evaluation measure "the more rules the better" because then we cannot exclude the spurious "MSR" that excludes **blick*. The evaluation measure that Stanley (1967) proposed for MSR's and the lexicon under the assumption of fully specified entries amounts to a roundabout reconstruction of what the alternative assumption gives directly: assign a value to a MSR in proportion to the number of

feature specifications that *could* be omitted in the lexicon if the MSR *were* actually operating so as to fill in unspecified values. The overall evaluation measure must now be based both on this kind of "pretend" version of simplicity *and* on the straightforward simplicity that is still required for the phonological rules proper. For other attempts to formulate an explanatory theory of phonological admissibility on the "conditions" interpretation of MSRs see Chomsky and Halle (1968, 388), and, in their markedness framework, ibid. p. 415 ff.

The approach with the greatest prima facie appeal is certainly that offered by blank-filling MSRs and the simplicity measure. The reason generative phonology nevertheless moved to the conditions interpretation was that there seemed to be a serious formal problem with the blank-filling interpretation. In addition some empirical problems were pointed out, though they played a relatively minor role in the discussion.

Lightner (1963) and Stanley (1967) argued that if you allow rules to apply to matrices containing unspecified features, then the standard notion of distinctness becomes incoherent and you end up in effect with a ternary feature system. Suppose that we have three segments A, B, and C, specified in the lexicon for the three features F_1, F_2, and F_3 as follows:

(2)

	/A/	/B/	/C/
F_1	+	0	—
F_2	—	—	—
F_3	—	—	—

In a binary feature system, two segments P and Q are distinct if they have opposite values + and — for some feature. This would make A and C distinct in (2) and B non-distinct from both. Yet, if rules are allowed to apply to the matrices in (2) they are inevitably capable of making all three mutually distinct. Suppose we have the rules

(3) a. $[+ F_1] \rightarrow [+ F_2]$
    b. $[- F_1] \rightarrow [+ F_3]$

If we assume the convention that [OF] is not analyzable as [+F] or as [—F], (3) applies to (2) to yield

(4)

	/A/	/B/	/C/
F_1	+	0	—
F_2	+	+	—
F_3	—	+	+

and if we assume the convention that [OF] is analyzable as [+F] and as [—F], (3) applies to (2) to yield

(5)

	/A/	/B/	/C/
F_1	+	0	—
F_2	+	+	—
F_3	—	+	+

In both (4) and (5), all three segments are technically distinct from each other. But we cannot allow rules to apply in such a way as to make non-distinct representations distinct. We then have to recognize "0" as a third feature value, so that B is distinct from A and C in (2). But this is unsatisfactory since we have no use for the extra feature value "0" in the operation of the phonological component. The theory in that form has expressive power which is not utilized in grammars, with resultant loss of explanatory adequacy.

The present theory is of course not open to this formal criticism of the blank-filling interpretation of MSRs because it does not allow a three-way contrast between +, —, and 0 to arise. In any environment, only two lexical specifications are possible for a feature F, namely the marked specification /αF/ and the unmarked specifiction [OF], where the most specific lexical rule applicable in that environment assigns the value $-\alpha$ to [F]. The existence of such a rule is guaranteed by the stipulation that for every F there is minimally a universal markedness rule $[\ ] \rightarrow [\beta F]$ ($\beta = +$ or $-$). Thus the system remains strictly binary while incorporating the built-in asymmetry of markedness theory.

Stanley further drew attention to certain types of constraints on morpheme structure which apparently require static well-formedness conditions rather than feature-specifying rules. He classified MS conditions into three types: if-then conditions, positive conditions, and negative conditions. Only the if-then type of condition is directly interconvertible with the rule format, the "if" clause of the condition corresponding to the structural description of a rule and the "then" clause corresponding to its structural change. The positive and negative type are essentially templates of admissible and inadmissible feature matrices. In these types the translation into rules is open to the charge of arbitrariness as to which feature specifications to take as redundant and which to take as distinctive:

"For example, if, in some environment E, the value [+ f] implies the value [+ g] and the value [+ g] implies the value [+ f], then it would be arbitrary which value we actually choose to indicate in the dictionary" (p. 435).

Apart from arbitrariness, positive and negative conditions also underlay Stanley's more empirical criticisms of the blank-filling interpretation. Namely, he claimed that blank-filling MSRs are capable of describing certain hypothetical types of morpheme structure configurations which are unlike any that could exist in any natural language, and conversely that they are in principle incapable of describing certain types of morpheme structure configurations which *do* exist in natural languages. Stanley's own explanation of these cases relies crucially on the availability of positive and negative conditions and on certain constraints on them that his theory stipulates.

As an impossible type of sequential configuration Stanley cites a putative language with the four types of morphemes

(6)   LCVG   CVGL   VGLC   GLCV

where L = liquid, C = consonant, V = vowel, and G = glide. Noting that it could be easily characterized by the MS rules

(7)   a. $[\quad] \rightarrow [- \text{cons}] / [+ \text{cons}] [\quad]\underline{\quad}$

       b. $[\quad] \rightarrow [- \text{voc}] / [+ \text{voc}]\underline{\quad}$

he suggests that the absence of such cases in real languages could be explained if we accept the conditions interpretation and stipulate that

(8)   a. Positive MS conditions are admissible in the theory.

       b. Restrictions involving syllable structure must be stated by positve MS conditions.

A positive condition in Stanley's sense is a template consisting of an incompletely specified matrix which must be a submatrix of every lexical entry. The four configurations in (6) do not have a unitary characterization in terms of positive conditions; a disjunction of four unrelated conditions would be required. Since the unnatural situation of (6) is easy to describe by MSRs of the traditional blank-filling sort but hard to describe in Stanley's theory, we apparently have an argument in favor of the latter.

It is very much to Stanley's credit that he recognized the special kinship of "positive conditions" to syllable structure at a time when syllable structure had scarcely begun to be explored in generative phonology. As a matter of fact, "positive conditions" are to my knowledge *only* found in connection with restrictions involving syllable structure (or more precisely prosodic structure including feet as well as syllables). This would have to be added as a third postulate.

(8)   c. Only restrictions involving syllable structure [really: prosodic structure] may be stated by positive MS conditions.

From the perspective of 15 years' hindsight and more recent work on syllable structure it is now obvious that no argument against blank-filling MS rules can be had from these observations. Still, because the conclusions themselves continue to be widely accepted it is worth going over briefly how recent work on prosodic structure has undermined their foundations.

A basic inadequacy of the whole argument is that syllable structure clearly is not defined upon morphemes but upon lexical entries (N, Adj, Adv, V). We shall return to this point shortly in the broader context of claiming that the same is really true of *all* lexical redundancy. Let us assume then that the lexical entry is the proper domain of syllabification at least and that "positive MS conditions" in (8 a-c) accordingly should be replaced by "positive word structure conditions". Let us consider whether (8 a-c), so modified, could not themselves be explained, along with the patent impossibility of (6), from more fundamental assumptions about the prosodic organization

of language.

Such an explanation can be achieved if we assume (as proposed in Kiparsky 1979) that universal grammar provides a syllabic parsing algorithm, based on a metrical template which defines a prominence scale to which the segments are matched optimally according to the familiar sonority hierarchy. This assigns an unmarked syllabification to any string of segments. The grammar of a particular language then specifies the maximum permissible syllable structure and such marked syllabification types as may exist in the language, e.g. that *spit* contains one syllable and not two in English. The latter are usually quite limited in scope and in Kiparsky (1981) it is suggested that they are always phonologically motivated (e.g. the monosyllabic valuation of *spit* is forced by stress and other rules of English phonology). The interplay of universal algorithm and language-particular syllabification rules characterizes syllable structure exactly in exactly the same way that the interplay of universal markedness rules and language-particular lexical rules characterizes the segmental inventory of a language, as discussed in sec. 2 above. Assume further the universal condition (McCarthy 1979, Lee 1981):

(9)   Lexical items must be exhaustively syllabifiable.

The explanation for the impossibility of (6) is then that, in accordance with the so-called "logic of markedness", no language will systematically prefer complex syllable structure to simple syllable structure, as this hypothetical language does. In particular, this hypothetical language grossly violates markedness by requiring all syllables to contain clusters (i.e. it has LCVG etc. yet lacks CVC etc.), and by consistently sequencing certain consonant combinations against the sonority hierarchy (LCVG but not CLVG, GLCV but not CLGV etc.).

The upshot is that the theory of syllable structure *forces* the equivalent of "positive conditions" (namely the syllable template) to play the role that Stanley's theory assigned to them by fiat, but it places them (more correctly) at the level of the lexical entry rather than at the level of the morpheme. There is consequently no argument whatsoever to be derived from syllable structure against taking *all* redundant feature values to be specified by blank-filling rules.

Stanley also claimed counterevidence of the converse type, where blank-filling rules are incapable of characterizing actual constraints on morpheme structure. This involves his negative type of MS condition.

A negative MS condition is construed as an incompletely specified matrix N such that all matrices in the lexicon of which N is a submatrix are rejected. Stanley cites an example from Proto-Indo-European, where obstruent stops at the beginning and end of morphemes were subject to certain co-occurrence restrictions involving their manner of articulation. Assuming the

"classical" reconstruction with three series

(10)   voiceless unaspirated: p, t, k', k^w
       voiced unaspirated: (b), d, g', g^w
       voiced aspirated: bh, dh, g'h, g^{w}h

we have the following combinations, with stars indicating the impermissible types:

(11)   *p. . . dh   p. . . d   p. . . t
       b. . . dh   *b. . . d   b. . . t
       bh. . . dh   bh. . . d   *bh. . . t

where p, b, bh represent the initial obstruents and t, d, dh the final obstruents, and ". . ." denotes intervening sonorants. For example, there were morphemes like *perd, dweik', dheug'h* but there were no morphemes like "*perdh*", "*dweig'*", "*dheuk'*". Stanley proposes the negative MS condition (12) to exclude the starred combinations of (11)

(12) $\sim \begin{bmatrix} \alpha \text{ vcd} \\ \beta \text{ asp} \end{bmatrix} \ldots \begin{bmatrix} \beta \text{ vcd} \\ -\alpha \text{ asp} \end{bmatrix}$

and says that "it is in principle impossible to write MS rules to account for these facts" because the generalization involved in [(12)] is that "EITHER one OR another (or possibly but not necessarily both) of two assimilations must take place (that is, that all forms in which neither of the assimilations takes place are ruled out): yet, even if we wrote an MS rule which corresponds to each of these assimilations, we would have no way of stating that at least one but not necessarily both of them must apply" (p. 433).

It will be seen that there is no problem for MS rules here if we proceed from our assumptions about markedness and the form of lexical entries. The theory supplies the universal markedness rules

(13)   a. [   ] → [−asp]
        b. [+obstr] → [−voiced]   (= (45a) of sec. 2)

and the grammar contains in addition a language-particular rule

(14)   [+ asp] → [+voiced]

which takes precedence over (13b) by the E.C. This gives the lexical and derived representations:

(15)

	[voiced]	[asp]		[voiced]	[asp]	
/t/	0	0	→	−	−	(13 a, b)
/d/	+	0	→	+	−	(13 b)
/dh/	0	+	→	+	+	(14)
	lexical repr.			output		

The unwanted combinations of stops in (11) are excluded by adding the rule:

(16)   [+ voiced] → [α asp] $// \begin{bmatrix} - \text{ asp} \\ \alpha \text{ vcd} \end{bmatrix}$ X (mirror-image)

by which */b. . . d/ → /b. . . dh/, */p. . . dh/ → /p. . . d/, and */bh. . .

t/ → /b. . . t/, as shown in (17):

(17)   (a)   /b. . . d/   (b)   /p. . . dh/   (c)   /bh. . .t/

$\begin{bmatrix} + \text{ vcd} \\ 0 \text{ asp} \end{bmatrix} \begin{bmatrix} + \text{ vcd} \\ 0 \text{ asp} \end{bmatrix}$ $\begin{bmatrix} 0 \text{ vcd} \\ 0 \text{ asp} \end{bmatrix} \begin{bmatrix} 0 \text{ vcd} \\ + \text{ asp} \end{bmatrix}$ $\begin{bmatrix} 0 \text{ vcd} \\ + \text{ asp} \end{bmatrix} \begin{bmatrix} 0 \text{ vcd} \\ 0 \text{ asp} \end{bmatrix}$

(13a)   [− asp]   [− asp]   [− asp]   [− asp]

(13b, 14)   [− vcd] [+ vcd]   [+ vcd] [− vcd]

(16)   [+ asp]   [− asp]   [− asp]

output $\begin{bmatrix} + \text{ vcd} \\ - \text{ asp} \end{bmatrix} \begin{bmatrix} + \text{ vcd} \\ + \text{ asp} \end{bmatrix}$ $\begin{bmatrix} - \text{ vcd} \\ - \text{ asp} \end{bmatrix} \begin{bmatrix} + \text{ vcd} \\ - \text{ asp} \end{bmatrix}$ $\begin{bmatrix} + \text{ vcd} \\ - \text{ asp} \end{bmatrix} \begin{bmatrix} - \text{ vcd} \\ - \text{ asp} \end{bmatrix}$

The outputs will coincide with those derived from the respective lexical representations

(18)   (a) $\begin{bmatrix} + \text{ vcd} \\ 0 \text{ asp} \end{bmatrix} \begin{bmatrix} 0 \text{ vcd} \\ + \text{ asp} \end{bmatrix}$ (b) $\begin{bmatrix} 0 \text{ vcd} \\ 0 \text{ asp} \end{bmatrix} \begin{bmatrix} + \text{ vcd} \\ 0 \text{ asp} \end{bmatrix}$ (c) $\begin{bmatrix} + \text{ vcd} \\ 0 \text{ asp} \end{bmatrix} \begin{bmatrix} - \text{ vcd} \\ - \text{ asp} \end{bmatrix}$

and the DSC chooses the lexical reprsentation (18a) over (17a) for /b. . . dh/, (18 b) over (17 b) for /p. . . d/, and (18c) over (17 c) for /b. . . t/. Therefore blank-filling rules *are* capable of representing these constraints and they moreover do so without any arbitrariness in the choice of lexical representations because the independently motivated DSC locates the gap in a specific set of feature combinations.

Cases such as the restriction of Alur mentioned by Kenstowicz and Kisseberth (1977, 153), where alveolar and dental stops are mutually exclusive in CVC roots, are treated most naturally as instances of harmony. The constraint is that all coronals must be [α F], where F is the feature distinguishing alveolars and dentals. This can be done by assigning the marked feature value to morphemes rather than individual segments, so that the (universal) lexical rule assigning the unmarked value of [F] will apply to *all* the coronals in the morpheme or (in the marked case) to none.

While I do not know of true cases where an arbitrary choice has to be made in lexical representations, it would not be surprising to find that they do exist, as they no doubt exist with respect to other areas in phonology and elsewhere in grammar too. What I do think can be concluded from my review of the material cited in the literature is that arbitrariness is not an inherent consequence of the blank-filling interpretation of MSRs any more than it is of the conditions interpretation. Nor do the arguments from excessive and insufficient power go through, as we have seen. Most importantly, the charge of formal incoherence, while it holds for the version of MSR theory it was directed at, cannot touch the version advocated here because it preserves the strictly binary character of the feature system. So we can conclude that the blank-filling interpretation of MSRs is correct and take this as further evidence in favor of lexical phonology.

3.2. The duplication problem

In the case of the problems just discussed the phonological literature for the most part gives the impression that the matter is more or less under control. This is not so when we turn to the duplication problem. Within standard generative phonology there have been virtually no leads on how to deal with the undeniable fact that much of morpheme structure is recapitulated in word structure, so that there is substantial overlap between MSRs and phonological rules on the common understanding of how the grammar is organized.

The subcase of the duplication problem which has received the most attention is the problem of where segment structure rules (which may be construed as context-free MSRs) are to apply. Stanley (1967, 404) first called attention to the basic paradox: "For some purposes we want the segment structure rules to state their redundancies EARLY in the P rules [or in the MSRs P.K.], so that these redundant features can be used by other P [and MSR] rules. But for other purposes we want the segment structure rules to state their redundancies LATE in the P rules so that they can state the redundancies in segments introduced or changed by the P rules. Because of this conflict, neither the usual practice of letting the segment structure rules be scattered through the P rules, nor the practice we advocated earlier of letting the segment structure rules appear only in the MS rules, can be accepted as it stands". Stanley's proposal was to adopt the convention "that the output of each P rule is automatically subjected to the segment structure rules." As Stanley notes, this accounts for the structure-preservation typical of P rules, but is too strong: "It seems certain that we do not want all P rules, especially the late ones, to have their output subjected to the segment structure rules. It is still an open question how we are to identify, in a non-ad-hoc manner, just which P rules are so subjected."

A stab at solving that problem was made by Chomsky and Halle (1968, Ch. 9). Their theory of markedness incorporates the "linking convention" that markedness conventions are applied to the output of phonological rules if and only if they are applicable to *all* the segments in that output. This departs from Stanley's conjecture in putting the burden on a kind of principle of symmetry rather than on the ordering of the rules, and in allowing only *universal* segment-structure rules (i.e. markedness conventions) to reapply in the course of phonological derivations. Neither position addresses the more general question of duplication in context-sensitive rules.

Lexical phonology entails that "*duplication" should be the normal case for any lexical (i.e. "cyclic") rule*, whether context-free or context-sensitive, and whether universal or language-particular. (In a sense this agrees with Stanley's conjecture that it has to do with "early" rules). The predicted

relationship between the structure of simple and derived lexical items is therefore as follows:

(a) If a rule holds for lexically derived items, it holds for nonderived items in the unmarked case. This follows from the fact that underived forms are subject to lexical rules only with respect to unspecified feature specifications.

(b) If a rule holds for lexically underived items, it should hold also for lexically derived items. This follows because we have no special category of rule that is applicable only to nonderived forms and no general principles that block rules from applying to derived forms. Of course, *post-lexically* derived forms are *not* subject to lexical rules. It may happen that lexical rules are *vacuous* for derived forms: the theory commits us to the claim that the rules governing the structure of nonderived forms be applicable to lexically derived forms, not that they be independently motivated by them.

A review of English "MSRs" shows however that many, perhaps most of them, *must on independent grounds* be assigned to the lexical phonology. The motivation is either that they themselves have the properties of lexical rules (such as "cyclic" application or restriction to derived forms) or that they must follow other rules which have those properties. We shall now illustrate this point with some familiar instances of apparent "MSRs".

Consider the constraint that blocks adjacent obstruents that differ in voicing (e.g. *a[tz], *ma[zt]a, *ca[sb]ah, *hu[gzt]er). It can be seen that a regressive voicing assimilation rule applies in any case to morpheme combinations that arise in level 1 morphology, e.g. /loz + t/ → lo[s]t, /wid + θ/ → wi[t]th. We conclude that it is this rule which also fills in the voicing specification in the non-final obstruents of *adze* etc.

A parallel argument holds for nasal assimilation: *linp, *I[nk]a etc. are excluded by an obligatory lexical rule that also applies to lexical morpheme concatenations. Another reason why the constraint must be governed by a lexical rule is that it is limited to the metrical span of a foot: across a foot boundary the place of articulation may disagree, cf. *có[ng]ruent* vs. *co[ng]-rúent*. The latter is *optionally* assimilated to *co[ng]rúent* by a post-lexical rule that, beside its optionality, differs from the lexical rule also in requiring simple string-adjacency (rather than foot-boundedness), cf. *i[n/ŋ] Cuba*, and in assimilating at an *articulatory* level (rather than just the major place features as the lexical rule does). Thus, in *symphony* we derive first /n + f/ → [mf] by the lexical rule and then optionally [mf] → [ɱf] (labiodental nasal) by the postlexical rule. Note that this correctly predicts that we have two rather than three pronunciations of *in France*: *i[n] France/ i[m] France*, depending on whether the post-lexical assimilation applies, not *i[m] France*, since lexical assimilation is inapplicable.[19]

More complicated is the distribution of [θ] and [ð]. In stem-final position they contrast in nouns but verbs end in the voiced spirant:

(19)   a. wrath, wreath, booth, moth, heath, sheath, death, path, faith
        ([θ]), vs. scythe, lathe, blithe, spathe ([ð]).
        b. writhe, seethe, tithe, soothe, smoothe ([ð]).

But again this is not a regularity of morphemes but of stems, because it
holds also for verbs derived from nouns:

(20)   *tooth/teethe, bath/bathe, mouth/mouthe, breath/breathe*

For initial position the distribution is: [θ] in lexical categories (nouns,
verbs, adjectives) and [ð] in non-lexical categoires (conjunctions, pronouns,
etc.):

(21)   a. throw, think, thick, thorough, thong, thigh
        b. the, this, that, then, there, thus, though, thou, thy, thee

The rule *could* be formulated as stated, in which case it could be a lexical
rule but equally well a MSR of the traditional type. Perhaps however,
exploiting the fact that only lexical categories receive stress in the lexical
(cyclic) phonology (emphatic and contrastive stress being assigned post-
lexically at the sentence level) the rule is better formulated as (22):

(22)   θ → ð in the onset of an unstressed syllable

in which case the voiced [ð] of *the, this* etc. falls together with the voiced [ð]
of *father, mother, brother, heathen, farthing, feather, lather, gather, bother,*
either, neither, fathom, (with exceptions in the "Greek" vocabulary, e.g.
catholic, method, ether, Athens). Rule (22) is necessarily lexical both be-
cause it refers to the output of lexical stress and because it governs lexical
θ:ð alternations like *south:southern, north:northern, earth:earthen, smith:*
smithy, cloth:clothing.

A particularly interesting case involves the constraints on consonant
clusters and vowel length. There are two relevant lexical rules to consider
here: shortening and syllabification. Long vowels are shortened before de-
rived consonant cluster in level 1 lexical phonology:

(23)   /kēp + t/   →   kept
        /swēp + t/   →   swept
        /mēt + t/   →   met + t → met
        /fēd + t/   →   fed + t → fed
        /drēm + t/   →   dr[e]mt
        /fēl + t/   →   felt
        /mēn + t/   →   m[e]nt
        /lōs + t/   →   lost
        /wīd + θ/   →   width

Inside morphemes, long vowels do occur before clusters ending in coronals,
e.g. *child, beast, faint, count, coax, strange.* The Elsewhere Condition will
correctly block the Shortening rule from applying to the lexically specified
long vowels in these words. The question then is why long vowels are
barred altogether before non-coronal clusters, i.e. why there are no such

nouns or verbs as *chimp, *beang, *faipk.* The answer is that such lexical
items are barred because they cannot be assigned a syllable structure. The
syllable structure rules in English allow a peak followed by a coda
consisting of at most two segments in order of descending sonority, and,
in final position, by any number of extrametrical coronal consonants: That
is, the rhyme must be of the form

(24) $[+ \text{seg}]^3$ $[+ \text{cor}]^n$

where the elements of the core ($[+ \text{seg}]^3$) appear in order of decreasing
sonority, as defined by the well-known scale: vowels, glides *r, l,* nasals,
obstruents. I take it that vowels and glides differ prosodically rather than
segmentally and so the apex of the hierarchy should really be $\begin{bmatrix} - \text{cons} \\ - \text{high} \end{bmatrix}$,
$\begin{bmatrix} - \text{cons} \\ + \text{high} \end{bmatrix}$. We can represent the sonority hierarchy in terms of a feature
hierarchy $F_1, F_2 \ldots F_n$ with the interpretation that position k in the
hierarchy can be filled by segments nondistinct from $[+ F_k]$ but distinct from
$[+ F_{k+1}] \ldots [+ F_n]$. Then the hierarchy can be designated as

(25)   [   ], [+ high], [+ cons], [+ lateral], [+ nasal], [+ obstr]

For example, we get the sequence

(26)   a, i, r, l, m, p

from which any three items in the right order can be selected to form the
core of a rhyme (with an ad hoc restriction that the initial segment must
be chosen from the first two positions—or if syllabic *r* is admitted into
lexical representations, from the first three). Thus, examples of the maximal
rhyme cores are:

(27)   ayr   (*fire*)
        ayl   (*isle*)
        aym   (*time*)
        ayp   (*type*)
        arl   (*snarl*)
        arm   (*arm*)
        arp   (*harp*)
        elm   (*elm*)
        elp   (*help*)
        emp   (*hemp*)

In addition, the syllable may contain extrametrical coronals tacked on to
the end, e.g. *cats, fires, sixths, (thou) believed'st.*[20]

These rules of syllabification are in the grammar anyway to account for
such facts as that *color* is disyllabic but *curl* is monosyllabic, that *Kreml*
is disyllabic but that *realm* is monosyllabic, etc. Thus they have nothing
to do with the "morpheme structure" or sequential constraints on segments
in words *directly.* Yet they are *indirectly* the most important determinants

of those constraints by virtue of the general principle (9) mentioned earlier that *lexical items must be exhaustively syllabifiable*. A putative word which cannot be parsed into syllables by the above procedure is rejected by (9) and is therefore inadmissible.

Constraints on suffixes are likewise derivative of (9) and the syllabification rules. The reason why consonantal suffixes are all coronal in English is that non-coronal consonantal suffixes would form words that could not be parsed by (24). For example, the noun-forming suffix *-th* could not be *-f* instead because a word **warmf* would be inadmissible in English syllable structure.

I reiterate that not all regularities of morpheme structure have to reappear as alternations in derived forms in this theory. It could very well happen that derived forms accidentally do not provide a chance for the lexical rule to apply. What should be true on the present theory is however that no rules *must* be restricted to apply *only* within morphemes. I do not in fact know of any "morpheme structure rules" in English which need to be so restricted.

I conclude that at least English confirms the prediction that systematic constraints on morphemes are a function of lexical rules. An apparent counterexample to it is cited by Kenstowicz and Kisseberth (1977, 148) from Hindi. Nasals agree in place with a following stop within morphemes and yet heterorganic combinations remain unassimilated across morpheme boundaries, e.g. *an + jān* 'unknown', *cūm + kar* 'having kissed', *cūm + nā* 'kiss', *kām + dār* 'manager', and when they arise by a vowel syncope rule, e.g. *camak* 'shine', *camk + a* 'shined'. In fact, however, nasals do undergo assimilation in some kinds of morpheme combinations, cf. the prefix *sam-*:

(28) *sam + bandhī* 'connected' (cf. *bãdh + nā*, /bāndh-/ 'tie')

  san + deś 'command' (cf. *ā + deś* 'rule, instruction')

  saŋ + gīt 'music' (cf. *gīt* 'song')

I conjecture that the suffixes *-kar, -nā* etc. before which assimilation does not take place belong in the level 2 morphology (i.e. they are the counterparts of the English "#-boundary" suffixes). If that can be maintained, then Hindi is quite compatible with the theory. This account requires that vowel syncope be ordered after nasal assimilation. As far as I know, this can be so, and if vowel syncope turns out to be postlexical, it actually must be so.

In opposition to the view that "morpheme structure rules" can be assigned to the phonological component (which they term the "ordering solution" to the duplication problem) Kenstowicz and Kisseberth offer the following argument:

"Suppose a language has a rule assimilating the voicing of an obstruent to a following obstruent and that this rule both describes alternations and at the same time expresses a constraint on lexical representations. According to the ordering solution, the noninitial members of an obstruent cluster will be 0 for voice and the voicing assimilation rule will simultaneously fill

in 0's and alter distinctive plus and minus values. Now suppose this language has a rule lengthening vowels before voiced obstruents, but that this rule must be ordered before the voicing assimilation rule. Thus, we might find forms like the following: *pa, pa-ta,* but *pa:-da;* and *map, map-ta, mab-da,* but *ma:b, ma:p-ta, ma:b-da.* Now if we were to find a form like *ma:zg* (and *ma:sk-ta, ma:zg-da),* there would be no way in which the length rule could correctly assign [+long] to the *a*, since at the point where this rule applies (i. e., before voicing assimilation), the *z* will be [0 voice]. Although this is only a hypothetical example, we would not be at all surprised to find a language with similar properties."

It is quite true that such a configuration of data could not be derived if the grammar is organized as I propose. If voicing assimilation and lengthening apply as lexical rules in that order, as required to derive /mab + ta/ → *ma:pta* and /maSg + ta/ → *ma:skta*, then we would predict that /map + da/ becomes *ma:bda* instead of *mabda*.

(29)

		[[map] da]	[[mab] ta]	[maSg]	[[maSg] ta]
I. 1.	Voicing Ass.	[—]	[—]	[mazg]	[mazg]
2.	Lengthening	[—]	[ma:b]	ma:zg	ma:zg
II. 1.	Voicing Ass.	[mabda]	ma:pta	–	ma:skta
2.	Lengthening	[ma:bda]	–	–	–
		ma:bda	ma:pta	ma:zg	ma:skta

But it would be unreasonably defeatist to reject a theory on the basis of *hypothetical* counterexamples. If real ones cannot be found, we rather have a prima facie argument *for* the theory which predicts that they do not exist.

K & K further note that rules which both fill in zeroes and change pluses and minuses "will often fail to correctly state the constraints on underlying morpheme shapes". They cite a case in point from Klamath. The contrast between voiceless aspirated stops (written *p, t, č, k, g*) and voiced unaspirated stops (*b, d, ǰ, g, g̣*) is neutralized preconsonantally into voiceless unaspirated stops (*P, T, Č, K, Q*):

(30) /mbody'/ 'wrinkle'   mbodi: + tk (sic)   mboTy' + a

  /lo:čw'/ 'covet'   lo:čo + t   lo:Čw' + a

While aspiration is contrastive in underlying representations in preconsonantal position, as these examples illustrate, there are morphemes whose underlying preconsonantal stops are indeterminate as to aspiration because they never come to stand before a vowel in any alternant, e.g. *paPg + as* 'board'. These stops should be left unspecified for aspiration in the lexicon and receive their proper specification by the neutralization rule. As the example shows, "given that a phonological rule both supplies unspecified feature values and also alters feature values, one can discover whether that rule expresses a constraint on underlying morpheme shapes only by ex-

amining each lexical representation to see whether there are any that violate the rule. Thus, . . . the proper MS constraints would never be directly expressed" (K & K, p. 142).

The point of the example is that the neutralization rule applies in a blank-filling function in non-derived environments and in a feature-changing function in derived environments. Assume that syllabification applies at the word level and that the neutralization rule applies to syllable-final stops, and that aspiration is distinctive. We then have the rules (31 a-e):

(31) a. [   ] → [+ asp]
      b. [+ obstr] → [− vcd]
      c. $\begin{bmatrix} + \text{ obstr} \\ − \text{ asp} \end{bmatrix}$ → [+ vcd]
      d. syllabification
      e. [+ obstr] → $\begin{bmatrix} − \text{ asp} \\ − \text{ vcd} \end{bmatrix}$ syllable-finally

where (a, b) are universal and (c, e) are Klamath-particular. By the E,C, disjunctive ordering holds between (b) and (c). See (32):

(32)   paPgas   mbodi:+tk   mboTy'+a   lo:čo+t   lo:Čw'+a

	P	T	T	č	č
	0 asp	0 asp	0 asp	+ asp	+ asp
	0 vcd	0 vcd	0 vcd	0 vcd	0 vcd
(31a)	[− asp]	[− asp]	[− asp]	–	–
(31b, 31c)	[+ vcd]	[+ vcd]	[+ vcd]	[− vcd]	[− vcd]

(31d)   a $\begin{bmatrix} − \text{ asp} \\ + \text{ vcd} \end{bmatrix}$ $\begin{bmatrix} − \text{ asp} \\ + \text{ vcd} \end{bmatrix}$i: o$\begin{bmatrix} − \text{ asp} \\ + \text{ vcd} \end{bmatrix}$ $\begin{bmatrix} + \text{ asp} \\ − \text{ vcd} \end{bmatrix}$o   o:$\begin{bmatrix} + \text{ asp} \\ − \text{ vcd} \end{bmatrix}$

(31e) $\begin{bmatrix} − \text{ asp} \\ − \text{ vcd} \end{bmatrix}$ — $\begin{bmatrix} − \text{ asp} \\ − \text{ vcd} \end{bmatrix}$ — $\begin{bmatrix} − \text{ asp} \\ − \text{ asp} \end{bmatrix}$

From our point of view, to say that a feature F is distinctive in a given context C is to say that the specification +F or −F occurs in C in the lexicon. Otherwise (i.e. if only 0F occurs), F is nondistinctive. In Klamath, aspiration is distinctive in prevocalic and in preconsonantal position because [+ asp] occurs in the lexicon in both those contexts, while voicing is not distinctive because everything is [0 vcd] in the lexicon.

A third general argument against having morpheme structure governed by rules in the phonological component—which K & K take to be perhaps their strongest—is that the "duplication problem" "is really just a special subcase of the more general problem of "conspiracies": "It is reasonable to suppose that any adequate theory of conspiracies will naturally extend itself to the duplication problem as a special subcase. On the other hand, there is simply no way in which the ordering solution can be generalized

to handle conspiracies" (p. 142).

Recent developments in phonology have done little to support the idea that "conspiracies" are a unitary category of phenomena requiring some basic theory of their own. On the contrary, the various puzzles that have been consigned to that category have proved to be of a rather heterogenous sort. Some "conspiracies" have found a principled explanation in autosegmental theory (see e.g. Goldsmith 1976 on "tone stability" in reference to a "conspiracy" in Lomongo). Others such as the Yawelmani case analyzed in Kisseberth (1970) and cited—together with a similar Tonkawa case—in the present context by Kenstowicz and Kisseberth (1977, 142–144) yield to the theory of syllabic phonology in now obvious ways. The real unity in these phenomena seems to be that they involve prosodic organization of the type that earlier generative phonology was ill equipped to handle and which therefore appeared particularly problematic.

In sum, lexical phonology entails a principled and general form of the "ordering solution" to the duplication problem. It is well supported empirically; the apparent weaknesses attributed to it in the earlier phonological literature are partly misapprehensions and the remainder is defused by recent prosodic theory.

3.3. The domain problem

Kenstowicz and Kisseberth observe that there are cases in which the domain of a constraint is "the word" rather than the morpheme (1977, 145). Tunica (Haas 1940) requires all words to begin with CV, and root morphemes, which ordinarily can occur in word-initial position, naturally conform to the same constraint. That the word constraint is primary and morpheme structure is derivative from it is shown by the fact that precisely those root morphemes which happen never to occur word-initially are *not* subject to it: inalienably possessed nouns, which *must* occur with a possessive prefix, may begin with a consonant cluster or with a vowel. An exactly analogous situation is found in Odawa (Kaye 1974).

Like bound roots, affixes may also be exempt from the constraints on ordinary stems. Thus, they need not be syllabifiable in themselves; what is required is rather that when they are added to stems the result should be syllabifiable. For example, English has consonantal suffixes but they are all coronal. This restriction is derivative of the syllable canon described above: such hypothetical words as *warm + k, *help + f would be unsyllabifiable while the coronal suffixes in warm + th, help + s can be parsed as extrametrical. Therefore the restriction on the place of articulation of English consonantal suffixes need not be stated as a "morpheme structure constraint".

The literature is of course full of proposed morpheme structure con-

straints. I have not made a systematic investigation of them to see whether they can, to the extent that they are correct, all be formulated as lexical rules, as would be implied by the present theory. But I do think that those examples which have appeared in theoretical discussions as specific evidence for morpheme structure conditions can be taken to be lexical rules, and indeed in many interesting cases *must* be so taken. A number of such examples were already cited in the preceding section in connection with the "duplication problem". Some additional ones will be taken up now.

Kaye and Nykiel (MS) note that loanwords in Polish have adapted to the underlying phonotactics of the native vocabulary, which in their view is defined in terms of morpheme structure. The basic constraint which they propose excludes noun stems ending in -CR, where R is a sonorant consonant (excepting masculines ending in nasals, and -*Rw* clusters). Foreign words are brought into line with this constraint by breaking up the -CR cluster with a "jer" (which they write as E), an underlying vowel which is lowered to *e* before another E and otherwise deleted. For example, *trefl* 'club' (in cards), borrowed from French *trèfle*, is analyzed as /trefEl/, as evidenced by the diminutive *trefelek* /trefEl + Ek + E/. Isačenko (1971) had earlier made a very similar proposal for Russian, involving a rule breaking up stem-final CR clusters:

$$(32) \qquad \phi \rightarrow \text{jer} \ / \ [+ \text{obstr}] \underline{\qquad} \begin{bmatrix} - \text{obstr} \\ - \text{syll} \end{bmatrix}$$

where the quality of the *jer* is also predictable (back *jer* next to velars and *v* /w/, front *jer* elsewhere). He too pointed out that loans have adapted to this pattern, citing the examples

(33) váflja   'wafer'   váfel,nyj
      sáblja   'saber'   sábel,nyj, sábel,ka
      túflja   'slipper'   tufel,túfel, ka

I am not in a position to comment on either the Polish or the Russian material with authority, but a few observations lie close at hand which seem to support the position that a rule such as (32) can and must be a rule of lexical phonology. The reason it *can* be a rule of lexical phonology is that the *jers* must be present throughout the "cyclic" derivation and are only deleted postcyclically, as shown by Pesetsky (MS) and Rubach (1981). The reason it *must* be a rule of lexical phonology is that it applies also to *derived* C + R clusters that arise by suffixation. Russian has for example an adjective forming suffix /l/, seen in *otstályj* 'left behind, retarded' (*otstat*, 'to get left behind'), *žilój* 'lived in'. A lexical "truncation" rule deletes *v* (as well as *j*) before consonants, cf. *živ + ú* 'I live', /živ + t,/ → *žit*, 'to live'. This rule also applies before *l* in /živ + l + ój/ → *žilój*. Because truncation precedes *jer*-deletion, which is in any case postlexical, this derivation shows

that the suffix is a bare /l/ without a preceding *jer*. Now consider the adjective *svétlyj* 'shining, bright', from the root /svet/ seen in *svetit*, to shine'. From the argument just given we know that the underlying form of the stem must be /svet + l/. But the genitive plural is *svetel*, , from /svet + El + E/, with a *jer* inserted before the *l*. The source of this *jer* can only be rule (32), applying in this case to a *derived* form. This, then, gives an independent basis for assigning rule (32) to the lexical phonology, at least in Russian.

Kaye (1974) also adduces the case of harmonic processes, where the harmonic feature is characteristically a property of a whole morpheme but not necessarily (because of "opaque" morphemes which block the spread of harmony) of the entire word. These cases are however accounted for by the approach to the description of harmony that was briefly mentioned above where lexical marking for the harmonic feature is done at the level of the morpheme.

The contrast between *s* and retroflex *ṣ* in Sanskrit offers a particularly clear case of the domain and duplication problems. The rule that neutralizes it—the so-called "ruki" rule—shows some complications of exceptional interest, and figured prominently in the arguments for the original RAC and later for the SCC (Kiparsky 1973, Mascaró 1976); therefore it will be an appropriate test case for lexical phonology.

The "ruki" rule retroflexes *s* to *ṣ* after *r*, velars, and nonlow vowels. Though the actual formulation of the rule in terms of features is not important for our purposes, I shall assume that retroflex consonants are defined by the feature combination [+coronal, +high, +back]. Since the mid vowels *e*, *o* are represented as *ai*, *au* at the stage at which the ruki rule applies, and *r* belongs phonologically to the class of retroflex consonants (whatever its phonetics may have been exactly), the environment can be stated as [+high]:

$$(34) \qquad \begin{bmatrix} + \text{cont} \\ + \text{obstr} \end{bmatrix} \rightarrow \begin{bmatrix} + \text{high} \\ + \text{back} \end{bmatrix} \Big/ [+ \text{high}] \underline{\qquad}$$

The *ruki* rule applies regularly to the many inflectional and derivational suffixes beginning with *s*; it also applies in compounds and to clitics, albeit with lexical exceptions and some variation (Wackernagel 1896, 233 ff., Hock 1980).

(35) 2.s. suffix: da+dā+si   'you give'   bi+bhar+ ṣi   'you carry'
      aorist suffix: a+yā+s+am   'I went'   a+bhār+ṣ+am   'I carried'
      future suffix: kram+sya+ti   'he will go' vak+ṣya+ti   'he will say'
      desiderative: di+dā+sa+ti   'he wants to give'   ni+nī+ ṣa+ti   'he wants to lead'
      dat. pl. suffix: senā+su   'armies'   agni+ṣu   'fires'

compound: sad 'sitting' pari#ṣad 'convention'
clitic: sma 'indeed' gacchanti ṣma 'they do (did) go'

The *ruki* rule exhibits the classic syndrome of lexical properties.

1. In many morphemes, unretroflexed *s* appears in non-derived "ruki" environments, e.g. *kisalaya* 'sprout', *barsa* 'tip', *barsva* 'socket of a tooth', *kusuma* 'flower', *pustaka* 'book', some already in the Rigveda, e.g., *bisa* 'lotus', *busa* 'mist', *brsaya* 'a demon'.

2. The *ruki* rule applies in derived environments. Word-internally, it is virtually exception-free, both across morpheme boundaries as in (35), and morpheme-internally when the environment is created in various ways by the application of zero grade ablaut. For example, in the root *śās* 'instruct' *ā* is weakened to *i* in the weak grade environments. This puts the *s* into the *ruki* environment, and we get e.g. *śiṣ + ṭa* 'taught' from /*śās + ta*/. Similarly, the root *ghas* 'eat' loses its *a* vowel in certain forms, for example in the reduplicated 3. pl. /*ja + ghas + anti*/ → *jakṣati*. As a result of the loss of the vowel, the root-initial velar (assimilated to *k*) causes the root-final *s* to turn into *ṣ*. The root *vas* 'shine' and the homophonous root meaning 'dwell' reduce to *uṣ* in the weak grade, e.g. 3.pl. perf. /*va + vas + us*/ →*ūṣus* 'shone, dwelt'. Similarly, the suffix -*vas* is weakened to -*uṣ*-, e.g. gen. sg. /*vid + vas + as*/ → *viduṣas* 'knowing'.

3. The output of the *ruki* rule is phonemic. Nominal stems and verb roots (though not affixes) can have *ṣ* in environments where it cannot be derived from the *ruki* rule, e.g. *ṣaṣ* 'six', *kāṣṭha* 'piece of wood', *bāṣpa* 'fear', *bhāṣ* 'speak', *ṣṭhīv* 'spit', *laṣ* 'desire', *kaṣ* 'scratch'. In these lexical items it is necessary to set up underlying /ṣ/.

4. The *ruki* rule must be ordered in the cycle because of its interaction with other rules in the phonology and morphology. One reason for this has to do with the fact that the *ruki* rule seemingly applies "across" an augment or a reduplicating syllable. The case that interests us here is the combination of a preverb ending in *i* with a root beginning in *s*. In this case, retroflexion is general in Vedic and gradually acquires lexical exceptions as the language develops towards its classical state. In past tense forms where the augment *a* is inserted before the root, retroflexion *still* takes place, even though its conditions are not overtly met. For example, the root *siñc* 'sprinkle' forms the compound verb root *abhiṣiñc-*'anoint'. Its imperfect is *abhy + a + ṣiñcat* (3. sg.). In order to derive *ṣ* in that case, the *ruki* rule cannot apply at the word level or post-cyclically, since its environment would not then be met. The correct output can be derived, however, if the *ruki* rule applies cyclically, given the further (independently justified) assumption that the preverb + root combination is a constituent. The derivation (assuming again that cyclic nodes are those labeled with the lexical categories N, V, Adj, Adv) will proceed as follows:

(36) Cycle 2: Morphology: compounding [[abhi]$_{Adv}$ [siñc a]$_v$]$_v$
            Phonology: *ruki* rule   ṣ
      Cycle 3: Morphology: inflection   [[abhi aṣiñca]$_v$t]$_v$

A similar situation arises in the reduplicated forms of these compound verbs. Usually, both the root and the reduplication have *ṣ*, e.g. 3.sg. perfect *abhiṣaṣañja* 'cursed' (from abhi#ṣañj). Reduplication and augment can also occur together, e.g., *abhyaṣaṣañjat*.

A further indication that the *ruki* rule is cyclic is based on the fact its application across a clitic boundary in Vedic is blocked by another *ṣ* in the preceding or following syllable (Hejib and Sharma 1979). This *ṣ* is usually itself derived by word-internal application of the *ruki* rule. Therefore, *which ṣ* in a string /. . . IsIs. . . / is retroflexed is predictable if the *ruki* is applied cyclically, and only then.

(37) (a) sūri + su#syāma → sūriṣu syāma (*ṣyāma) Rv. 7.19.7.
      (b) tam#u#stu + se → tam u stuṣe (*ṣṭuṣe) Rv. 2.20.4

Having provisionally established the cyclicity of the *ruki* rule, we can take a closer look at the representations to which it must apply. Given that there are both underlying /ṣ/ and /s/, the question arises as to how surface [ṣ] should be analyzed in those morphemes in which it always stands in the *ruki* environment, and so never alternates with [s]. In classical generative phonology, the right output would be produced from either underlying form. The RAC, as well as the SCC which replaced it, both prohibit the *ruki* rule from applying in non-derived environments, and thereby entail that the underlying form in such cases *must* have /ṣ/. For example, such lexical items as *viṣa* 'poison', *śīrṣan* 'head', *doṣa* 'evening', *juṣ* 'enjoy' *karṣ* 'drag, plow', *suṣ* 'dry', *dviṣ* 'hate', *śiṣ* 'remain', *piṣ* 'crush' should, accordingly, all be entered in the lexicon with /ṣ/.

The attractive aspect of this analysis is that words like *bisa, kusuma* do not have to be marked as exceptions to the *ruki* rule, but retain surfaces simply by virtue of being entered with /s/ in the lexicon. By the same token, the drawback is that the existence of the *ruki* rule then cannot explain why *ṣ* is the normal case in the *ruki* environment even in non-derived environments, so that we are left without any account of the marginal, "marked" status for words like *bisa, kusuma* in the Sanskrit lexicon.

With the theory of lexical phonology we have the best of both worlds. Taking "R" as an abbreviation for the features defining retroflexion (let us say [+ back, +high] as suggested above), *bisa* is enterd with [−R] and so does not undergo the *ruki* rule, while *viṣa* is entered with [0R] (unspecified for R) and gets specified as [+R] by the *ruki* rule. In general, we have the following cases.

1. unmarked cases: entered as [0R] specified, as [+R] by *ruki* rule if applicable (*viṣa*), otherwise as [−R] (*rasa*)

2. marked cases: entered as [−R] or [+R] rules cannot apply (*bisa, ṣaṣ*)
3. exceptions: marked as not undergoing *ruki* rule (certain compounds).
   We must now show that our new analysis accounts equally well for the evidence previously cited in favor of taking non-alternating [ṣ] in the *ruki* environment as underlying /ṣ/. Three arguments were given for doing so, which we shall now re-examine in turn.

One argument was based upon the fact that the *ruki* rule does not apply if the following segment is an *r*. For example, when *uṣar* 'dawn' (from *vas* 'shine') loses its *a* in the weak cases, we get no retroflexion, e.g. gen. sg. *usras*. Forms like 3.pl. aor. *ajuṣ + ran* would then seem to indicate that the ṣ of *juṣ* is underlying, since underlying /jus/ would give **ajusran*. This argument is compelling from the viewpoint of the SCC. To get ṣ in *ajuṣ + ran* the *ruki* rule would have to apply in the first cycle, but the SCC prohibits it from applying there. However, lexical phonology entails precisely that the *ruki* rule does apply to unspecified *juS* in the first cycle, which gives the desired result. The first cycle is the verb stem, formed athematically directly from the root. Henceforth we shall use capital *S* to denote *s* unspecified for retroflexion, i.e. [0R]:

(38)   Cycle 1: Morphology   [[jauS]]ᵥ
           ruki rule   ṣ
      Cycle 2: Morphology   [[ájauṣ]ᵥ rán]ᵥ
           Ablaut   ájuṣ   rán
      Other rules   ájuṣran

The only question is: why do we not similarly get retroflexion in the cyclic derivation of *usras*? Because the *ruki* environment here is derived by zero grade ablaut, caused by the accented inflectional suffix in the last cycle. Therefore the trigger *u* and blocker *r* of the *ruki* rule both come up simultaneously (*vasar + ás → usrás*) and so the *ruki* rule never has a chance to apply. Derivations of the gen. sg. and acc. sg. forms and the denominal adjective are given below:

(39)   Cycle 1: Morphology   [[vaS]ar]ɴ   [[vaS]ar]ɴ   [[vaS]ar]ɴ
      Cycle 2: Morphology   [[vaSar]ɴ+áS]ɴ [[vaSár]ɴam]ɴ [[vaSar]ɴá]ɴ
           Cyclic phonology:
           Ablaut   [[uSr]ɴáS]   [[uSár]ɴam]ɴ   [[vāSar]ɴá]ɴ
           ruki   —   [[uṣár]ɴam]ɴ   —
               usrás   uṣáram   vāsara

The explanation thus turns crucially on the fact that the (inherently unaccented) stem of the noun 'dawn' is /vaS + ar/, although the first syllable is always reduced to *uS* by zero grade in the declension. This in turn *has* to be the case if zero grade is triggered (in certain morphological conditions) by a following accent, as in the theory sketched out e.g. in Halle and Kiparsky (1981). Moreover, the full grade underlying form predicts the correct

form in the adjective derived with the suffix *-á*, with strengthening of the first syllable: /vaS + ar + á/ → *vāsará* 'relating to dawn, matutinal'. From a putative stem /uṣ + ar/ we would wrongly derive **auṣara*. I conclude that the contrast between *usras* and *ajuṣran* is explained entirely on independent grounds even if both are given underlying forms unspecified for retroflexion.

In sum, the cases where *r* blocks retroflexion can very well be distinguished from the cases where it does not, even if the *ruki* rule applies on the first cycle as required by lexical phonology. This answers the first argument for the RAC/SCC theory.

The other two apparent pieces of evidence for underlying /ṣ/ in the *ruki* environments concern *ṣ* in suffixes. The facts are quite interesting and deserve another look.

The effects of the *ruki* rule can be observed in the nominative singular ending *-s* in the appropriate environments. Before a following voiced segment, final /-/ in *ruki* environments surfaces as *r*, e.g. *agnir gacchati, viṣnur gacchati*. The *r* is derived via *ṣ* by a postcyclic voicing assimilation rule applicable to all obstruents, followed by an obligatory rule which converts the output *ẓ* (nonexistent in Sanskrit) to *r* (which we already know belongs phonologically among the retroflex consonants). When a voiced segment does not follow, we get *ḥ* in both *ruki* and non-*ruki* environments, e.g. *agniḥ, visnuḥ, devaḥ*, which assimilates in place of articulation to a following voiceless consonant, obligatorily if this is coronal, optionally otherwise, e.g. *agnis tatra, agniḥ/agnix karoti*. In certain close combinations, however, *ḥ* is blocked and there *s* and *ṣ* again appear as per the *ruki* rule, e.g. *divas putraḥ* 'the son of Heaven', *dyauṣ pitā* 'father Heaven'. We conclude that final *-s* is subject to the *ruki* rule, although this is only detectable in certain environments because both *-s* and *-ṣ* are liable to turn into *-ḥ* or its assimilated variants before voiceless segments and pause.

Now we note that the deverbal suffixes *-iṣ, -uṣ* have exactly the same sandhi behavior as the sequences *i+s, u+s*, e.g. /hav + is/ 'oblation', /yaj + us/ 'sacrificial formula': cf. (nom. sg.) *yajuṣ + s → yajuḥ* and (close combination) *yajuṣ karoti* 'he makes a s.f.'. It follows that these suffixes must be represented as *iṣ, uṣ* at least at the point at which the postcyclic sandhi rules apply.

There is compelling evidence that these suffixes are nevertheless underlyingly unspecified /iS/, /uS/. In the first place, the outcome of underlying /ṣ/ before *s* is different from that seen in these suffixes, e.g. nom.sg. /ṣaṣ + s/ → *ṣaṭ* with external sandhi forms based on *-ṭ*, while nom.sg. /hav + iS + S/ and /caks + uS + S/ have external sandhi forms based on *-ṣ*, as shown above. The only basis for understanding this difference is to have, at the relevant point, a distinction between /S/ and /ṣ/, and to have a rule with the

effect

(40)   ṣ → ṭ / __ S

ordered *before* the *ruki* rule, and thus applying to *ṣaṣ* but missing *haviS*, *cakṣuS*. Moreover, underlying /iS/, /uS/ allow us to sustain the otherwise exceptionless generalization that there are no retroflex consonants in affixes:

(41)   [   ] → [0R] /] X ____

In lexical phonology, there is no problem. The contrast between *dviṭ* and *cakṣuḥ* follows automatically from (41) and the conventions on the cyclic application of rules. The crucial point is that the *ruki* rule will apply on the *first* cycle to the final *s* of [dviS] but not to the final *s* of [[cakS]uS], because *uS* is at that point still identifiable as an affix and Rule (41) blocks retroflexion in affixes. The Bracketing Erasure Convention erases the internal structure at the end of the cycle, i.e. when the output is entered into the lexicon, allowing the final *s* of [cakṣuS] then to be retroflexed in the *second* cycle. This particular timing of the *ruki* rule is what underlies the Janus-faced behavior of the -*S* in *cakṣuṣ*.

The following derivations illustrate this and other aspects of the phonology of *s* and *ṣ* in Sanskrit. We take as examples the non-derived nouns *musala* 'pestle' and *uṣṇīṣa* 'turban', the suffixed nouns *iṣ + u* 'arrow', *cakṣ + uṣ* 'eye', the deverbal noun *dviṣ* 'hate' (derived from the root /dvaiS/ 'hate') and the numeral *ṣaṣ* 'six'. The underlying fricatives are unspecified for retroflexion except that the *s* of *musala* is specified as [−R] and both *ṣ*'s of /ṣaṣ/ are specified as [+R], as shown in (42). All forms are nominative singular (suffix -*S*). The cyclic lexical nodes are Noun and Adjective in these examples; the roots [cakS], [dviS] are not cyclic nodes.

(42) [[musala]ₙS]ₙ [[uSnĪSa]ₙS]ₙ [[iSu]ₙS]ₙ [[[cakS]uS]ₙS]ₙ [[[dviS]]ₙS]ₙ [[ṣaṣ]ₐS]ₐ

I (40)	−	−	−	−	−	−
ruki, (41)	−	[uṣṇīṣa]ₙ	[iṣu]ₙ	[[cakṣ]uS]ₙ	[dviṣ]ₙ	−
II (40)	−	−	−	−	[[dviṭ]ₙS]ₙ	[[ṣaṭ]ₐS]ₐ
ruki, (41)	−	−	−	[[cakṣuṣ]S]ₙ	−	−
Other rules	*musalaḥ*	*uṣṇīṣaḥ*	*iṣuḥ*	*cakṣuḥ*	*dviṭ*	*ṣaṭ*

And so, when all particulars are worked out, the second apparent argument reverses itself and turns out to speak *against* the RAC and SCC and *for* lexical phonology.

The third argument that /ṣ/ is underlying in non-alternating *ruki* contexts was that roots in -*ṣ* retain the *ṣ* when -*na*- is infixed before it in the present tense, e.g. *pinaṣ + ṭi*, *śinas + ṭi* from *piṣ* 'crush', *śiṣ* 'remain'. If *ṣ* is phonemic in these roots, that is the only possible outcome. On the contrary assumption that /S/ is underlying, we might just as well expect **pinasti*, **śinasti*. In fact, if morphological processes like infixation should normally precede a phonological rule such as the *ruki* rule, it is just these wrong forms that might be expected.

Given our new analysis in the framework of lexical phonology, however, nasal infixation must on independent grounds apply as a cyclic process and follow the *ruki* rule, just as required for these verb forms. We saw above that the noun-forming suffixes *iṣ, uṣ* are underlying /iS/, /uS/ and are subject to the *ruki* rule, which the theory of lexical phonology that we adopted allows to apply to them. In the nominative/accusative neuter plural, they too receive a nasal infix, by a rule which can be formulated as follows:

(43)   ø → n / ____(C) + i[Neuter Plural]

In the resulting forms, e.g. *havīṃṣi, cakṣūṃṣi*, the *ṣ* still shows up [a]fter the inserted nasal. Now we know from the previous discussion that the *ruki* rule will not apply to the suffixal *S* until the *second* cycle. But it is in this cycle that rule (43) applies to insert the nasal infix. It follows that the *ruki* rule must precede nasal infixation in this class of derivations too.

Let us immediately settle that these forms can on no account be derived by relaxing the *ruki* rule so as to apply across a nasal. Whenever the nasal is *not* infixed but present underlyingly, it blocks the *ruki* rule absolutely. For example, there is never any retroflexion in the verb root *hiṃs* 'harm', which has a nasal in its underlying form, as shown by the fact that it remains fixed throughout its paradigm, i.e. not only in the present tense (*hinasti* 'harms') but also where there can be question of any infixation, e.g. *ahiṃsā* 'innocuousness', *hiṃsana* 'harming', *hiṃsyate* 'is harmed', etc. (contrast *peṣa, peṣana* 'crushing', *piṣyate* 'is crushed', from *piṣ*). Another such case arises in the weak forms of the noun *pumans* (nom.sg. *pumān*) 'male'. When the vowel of the second syllable is lost and the nasals simplified to one there is still no retroflexion, e.g. instr.sg. *pumans + ā́ → pumns + ā́ → pumṣ + ā́*.

Since the *ruki* rule cannot apply across a nasal, it must apply in *piṃṣanti* before the nasal is infixed. This will take place in the first cycle when the present stem /painaS/ is formed from the root /paiS/. The same order is required on the *second* cycle where rule (43) applies to the noun stem /cakṣuS/. The following derivations illustrate how the correct distribution of retroflexion in all cases is obtained when the rules are ordered in this way.

(44)   [[[cákS]uS]ₙi]ₙ [[[paiS]]ᵥánti]ᵥ [[[hinS]]ᵥánti]ᵥ [[pumanS]ₙā́]ₙ

Cycle 1: *ruki*,(41)	[[cákṣ] uS]ₙ	[[paiṣ]]ᵥ	—	—
infixation	—	[[painaṣ]ᵥ]ᵥ	—	—
Cycle 2: ablaut	—	[[piṇṣ]ᵥánti]ᵥ	—	[[pumnS]ₙā́]ₙ
ruki, (41)	[[cákṣ uṣ]ₙi]ₙ	—	—	—
infixation	[[cákṣ uṇṣ]ₙi]ₙ	—	—	—
Other rules:	*cakṣūṃṣi*	*piṃṣánti*	*hiṃsánti*	*puṃsā́*

It can be seen that here too the facts are entirely consistent with the prediction of lexical phonology that cyclic rules do apply in non-derived environments, so that *ṣ* in particular is derivable by the *ruki* rule if it occurs underlyingly in the appropriate environment. The prediction that the *ruki* rule does get blocked in suffixes on the first cycle by (41) but applies to them on the second cycle when brackets have been erased is also borne out; it succeeds in explaining the asymmetry between retroflexion in roots and suffixes on which all versions of the RAC and SCC founder. The *ruki* rule not only exhibits all the basic features of the "cyclic syndrome", but offers clearcut support for the particular theory of lexical phonology defended here.

3.4. The level problem

The previous discussion has already brought out the point that constraints on lexical entries cannot be defined exclusively on underlying representations, for the constraints must sometimes be formulated with reference to properties such as stress and syllable structure which themselves are assigned by rules of lexical phonology. Still less can they be defined on phonetic representations, which notoriously may diverge from lexical representations in their canonical structure. For example, /iV/ sequences underlyingly specified as disyllabic are marginal in lexical representations of English morphemes, but they are common in the output because underlying /yV/ eventuates in phonetic *iV* in a great many contexts (Hayes 1981, Ch.5). In short, the rules that determine "morpheme structure" must be ordered among the rules of lexical phonology and so cannot apply at any single level of representation. Hence we conclude again that lexical redundancy can be a function of lexical phonological rules.

Pushing the matter a bit further, a case can be made for the claim that phonological redundancy can depend on *post-lexical* rules also. This will become apparent when we recall the role of markedness rules in the theory and pursue its implications in more detail.

We have been assuming that the universal phonological rules which specify the unmarked feature values are part of the phonology of every language. For example, the rule

(45) $[+ \text{obstr}] \rightarrow [-\text{voiced}]$

is part of English lexical phonology. Voiceless obstruents are left unspecified in the lexicon and (45) assigns them the feature specification [−voiced], while voiced obstruents are specified as [+voiced] and (45) is blocked from applying to them by the Elsewhere Condition as shown above. We shall say that a feature F is *distinctive* in a language if and only if it appears as specified ([+F] or [−F]) in basic lexical entries. Marked values may also be specified by language-particular phonological rules. The theory of markedness is thus

incorporated into lexical phonology in a straightforward way.

The fact that lexical rules do not *change* feature specifications on the first cycle (a special case of the Elsewhere Condition as we have seen) is what allows the markedness rules to subsist in the phonology without reducing all feature specifications to the unmarked value. But clearly not all features occur lexically marked in a language. For example, while voicing happens to be distinctive in English in that the feature specification [+voiced] appears in basic lexical entries, it is non-distinctive in such languages as Menomini, Hawaiian, and Warlpiri. In these languages, the feature [voiced] plays no role in the lexical phonology and all obstruents are assigned the value [−voiced] by rule (45) (and perhaps [+voiced] in particular contexts). So the question is: if *all* languages have rule (45), then what grammatical property distinguishes those languages in which rule (45) applies across the board?

The theory actually already predicts exactly this case also. Since the universal markedness rules are in the phonology of every language, they must be either in the lexical phonology or in the postlexical phonology. If they are in the lexical phonology they are countermanded by inherent feature specifications of lexical entries and only supply the unmarked value for the unspecified cases (e.g. voicing in English). If they are in the postlexical phonology, the Elsewhere Condition is inapplicable (as it holds only of rules in the *same* component) and so they apply across the board. In that case they effect complete feature neutralization. For example, if (45) is assumed to apply postlexically in Warlpiri it will account for the voicelessness of all obstruents in that language. Of course this does not preclude the possibility of other postlexical rules in the grammar for voicing in specific environments. What it does mean is that there can be no voicing contrast in any environment in such a language. Simplicity considerations then preclude voicing from being distinctively specified in lexical entries also.

The upshot is that we have *degrees* of lexical idiosyncrasy. The mildest kind consists of marked feature specifications, which suffice to block lexical rules in non-derived environments. The more costly device of outright lexical exception features is required to block lexical rules in derived environments, and in postlexical rules if the theory is to allow these to have exceptions at all. For example, *nightingale* escapes Trisyllabic Shortening just by virtue of its specified long vowel in the first syllable, while the derived word *obēs + ity* requires an exception feature on *obese*. In the worst case, finally, it may simply be necessary to list the whole exceptional item in the lexicon. Simplicity considerations force this when the total cost of specifying the lexical exceptionality of a word outweighs the cost of listing the word itself.

An interesting aspect of the theory is that the derived environments which allow feature-changing applications of a rule on the first cycle may be created by the application of an earlier rule or rules on that cycle, of which the first must necessarily be non-feature-changing. For example, stress and syllable structure assignment may feed feature-changing segmental rules on the first cycle, as in (2) of section 2. The consequence is that lexical rules conditioned by previously assigned stress or syllable structure apply across the board like postlexical rules. Lexical entries therefore cannot be exempted from them just by assigning them the appropriate marked feature specification, because that feature specification will be wiped out by the rule. Exceptions to metrically conditioned rules are consequently of the costlier sort; like any exceptions to lexical rules in derived environments they have to be marked by exception features. This explains the oft-noted fact that the integrity of prosodic domains such as syllables and feet tends to be marked by phonological processes of considerable regularity.

Notes

1.   Marchand (1969, p. 228) accurately points out that " . . . a prefix is the determinant of a syntagma whereas a suffix is the determinatum." "A prefixal derivative joins the category the unprefixed word belongs to. In a suffixal derivative, however, the suffix is the grammatically and semantically dominant element. In combinations such as *father-hood*, *father-ly*, the word *father* merely determines what is essentially a '-hood' or '-ly' respectively." He further observes that the order of determinant and determinatum (modifier and head) is reversed in "combinations based on the underlying theme of appreciation": diminutives and hypocoristics (*booklet*, *daddy*), approximatives (*yellowish*), frequentatives (*crackle*).

Our assumption that word-formation is evelocentric implies that apparent exocentric cases (such as bahuvrihi compounds) must involve zero suffixes. Partial justification for this will be given below (p. 10).

2.   The formulation of (10) is generalized from that of Kiparsky (1973) in that it need specify only that the structural changes effected by the rules be incompatible (condition ii). The earlier version had to apply also to cases where the structural changes are identical. But, as pointed out by Howard (1975), the case where the changes are identical was only necessary for stress rules. For example, the two rules collapsed in the schema

$$V \rightarrow \acute{V} \ / \ - C_0 \ (V \ C_0) \#$$

must apply disjunctively so that a stress is assigned to the final syllable only if there is no penult (i.e. in monosyllables). However, if we adopt metrical phonology, the two

stress patterns (. . . S̆ W# and . . . #) are distinct if we construe distinctness for metrical structure in the obvious way as incompatibility of labeling or bracketing. And in any case, the metrical version of the rule simply assigns a maximally binary

foot to the right edge of a word, and so does not properly constitute a schema abbreviating two rules. We therefore need only specify distinctness of outputs as in (ii) of (10).

3.   The model predicts that level 1 plurals should not only be inputs to compounding, but also to level 2 affixation. This possibility is to my knowledge not realized. We therefore require an ad hoc constraint that blocks it. Interestingly, this constraint does *not* apply to *inherent* plurals, cf. *to people, to dice, dicey, sudsy, woodsy.*

Another point is that nouns which denote things that are classified as coming in pairs, e.g. *a pair of trousers*, systematically deviate from the pattern of (12) in that they do not require plural endings in compounds:

trouser pockets	(trousers)
scissor tail	(scissors)
spectacle case	(spectacles)
pincer movement	(pincers)

They must therefore be considered as morphologically derived plurals, however this is to be done. This is independently required because the stems *trouser* etc. that we are forced to set up in the lexicon are indeed *not* bound to the plural morpheme, for they show up also in derivatives like *trousered, bespectacled, to scissor.*

4.   These examples were called to my attention by Nigel Fabb.
5.   For discussion of zero derivation see Marchand (1969), Rardin (1975), Clark and Clark (1979), Allen (1978, 271 ff.), as well as the criticism by Lieber (1980, ch. 3) and Carlson and Roeper (1981).
6.   *Breakin, showoff* etc. are not zero-derived from verbs but compounds formed at level 2, as we shall see below.
7.   Actual words which appear to be N → V → N zero derivatives are *feed$_N$* 'food for feeding livestock; (← *feed$_V$* ← *food$_N$*) and perhaps *breed$_N$*, 'genetic type produced by breeding' (← *breed$_V$* ← *brood$_N$*, if the latter is really the synchronic base). The first step of the derivation, N → V, would have to be at level 1 in order to feed V → N, which itself is a level 1 rule. But this conclusion is forced independently on phonological grounds. One reason the verb has to be derived at level 1 is in order to undergo the vowel change (umlaut), which must be confined to level 1 because it is never triggered by any level 2 or level 3 affixes. Second, the verb has to be derived at level 1 because its past tense and participle forms have level 1 morphology (*fed, bred*, derived by the level 1 rule of shortening from /fēd + t/, /brēd + t/). Therefore these words do not refute the theory but on the contrary confirm it.
8.   Allen questions the existence of the (48b) type of symmetry.
9.   The FSP forces the analysis of ambiguous forms like *washcloth, scrubwoman, flowchart, overflow valve, exhaust pipe* as N + N rather than V + N. This is confirmed by the fact that the first member nearly always occurs as a noun in its own right, and by more complex words like *acid wash filter, upward flow tower* (Burgschmidt 1973, 271).
10. Also, if *migratory, rotatory* are from *migrate + atory, rotate + atory* by truncation of the first *-ate*, we lose the explanation of the failure of Trisyllabic Shortening pointed out below. If the *-at* of the putative suffix is truncated, we cannot at any rate have a unitary truncation rule. So we may as well assume simply *migrat + ory, rotat + ory.*
11. In this respect, words are not essentially different from sentences (Jackendoff 1975). Although speakers obviously have committed to memory numerous sentences or texts, such as proverbs, prayers, slogans and poems, there would be no point in listing these in even the most complete generative grammar. We consider the fact that a given sentence is remembered verbatim by a given speaker to be not a fact about his grammar but a fact about his knowledge of the culture, folklore, literature etc.

12. Since there is no *inable, the noun *inability* is presumably to be derived by prefixing *in-* to *ability*, cf. *inaction, inconsideration, infidelity, ingratitude.*

13. I do not wish to claim that every apparent mismatch between morphology and syntax is to be treated in that way. In Williams' example *transformational grammarian* it seems to me that not even the semantics requires the bracketing [*transformational grammar*]*ian*. The expression can be interpreted directly like *transformational linguist, medieval scholar,* or *macrobiotic cook*. Cases like *Middle Americanist, nuclear physicist* are no problem either if we grant Williams' assumption that they are compounds, since *-ist* is a level 2 suffix (cf. *relativist, comparativist*) and so should be capable of being added to compounds, cf. *Indo-Europeanist, trade-unionist, hand-organist.*

There remain a number of apparent level-ordering violations in English morphology that have a different etiology. Consider an example discussed by Aronoff (1976, 53–55) and others. The suffix *-ment* belongs to level 2 since it is stress-neutral (**management*) and the suffix *-al* belongs to level 1 since it is stress-changing (*díphthong ∼ diphthóngal, envíronment ∼ environméntal*) and can be followed by a variety of level 1 suffixes (*musicality, proceduralize*). So why do they appear in the wrong order in words like *experimental, incremental, environmental?* An examination of *-ment* at once suggests the solution. Words ending in *-ment* fall into two types, those whose base is a verb and those whose base is a root. Only the *-ment* that goes on roots may (though it need not) form verbs as well as nouns (*to compliment, to experiment, to regiment*). Because it is added to roots we have to assign it to level 1. For this *-ment* to take the level 1 suffix *-al* would be actually expected. And indeed, as Aronoff notes, the base of *-ment-al* is practically always a root rather than a verb. Hence such words as **embarrassmental, *confinemental, *involvemental* etc. do not exist and make a more or less deviant impression. The exceptions are *developmental* and *governmental*, where a good case can be made for distinguishing between a level 2 [[govern]$_V$ ment]$_N$ '(act of) governing' and level 1 [govern+ment]$_N$ 'ruling authority', of which only the second underlies *governmental.*

We shall say that the suffix *-ment* at level 1 may form both nouns and verbs. Our theory actually forces this solution. We cannot derive the noun *expériment* from the verb *experimènt* because we have no way of getting the stress off the final syllable, and because the derivation would violate (22) anyway. We cannot derive the verb from the noun at level 2 because of the stress change, and because the verb has to be an input to level 1 derivation, e.g. *experimentation.*

Basically the same kind of solution can be suggested for cases like *editorial, burglarious, computerize.* We postulate the minor level 1 suffixes *-ar, -or* in these words as against the productive level 2 agent suffix whose underlying form can simply be /r/. The prediction is that these suffixes, unlike *-er*, should be stress-changing, cf. *díctate ∼ dictátor.*

14. I owe this observation to Richard Oehrle.

15. See e.g. Kenstowicz and Kisseberth (1977, Ch. 1) for a review of the issue.

16. The pronunciations cited here and below follow the norm given by Webster's Dictionary (Third Edition). It should be noted that many speakers show some variation in quantity in initial open syllables, apparently involving both shortening of long vowels (*tōnálity → tŏnálity*) and lengthening of short vowels (*prŏgress → prōgress, pŏlíce → pōlíce, rĕsídual → rēsídual*).

17. Taken literally, this is what Linell (1979) must be advocating when he says that "phonotactic rules" and "morphophonological rules proper" are not "separate rules" but "aspects of certain morphological operations" (p. 131, 142). For example (p. 133) Trisyllabic Shortening and Vowel Shift are both considered by him as a part of the

morphological operation by which the suffix *-ity* is added to adjectives (and, presumably, of the many other morphological operations that can cause the relevant alternations to come into play). Similarly, epenthesis of [I] between sibilants and devoicing of *z* after voiceless obstruents are considered by him part of plural suffixation (and, presumably, duplicates of these rules are part of genitive and 3.sg. suffixation as well as applying somehow to the reduced forms of *is* and *has*).

18. Apparent exceptions like *demócratize, oríginate* (vs. the regular *álphabetize, cápitalize, sýcophantize, rélativize, óxygenate, mýelinate* etc.) should be taken as instances of derivation not from nouns but from roots. The first cycle is then [democrat + ize]$_V$, [origin + ate]$_V$. Since there is no internal cycle, the ESR and SR apply to give the correct stress pattern.

19. It can be seen that the clusters to which the lexical rule does not apply are also admissible morpheme internally, e.g. *m* followed by dentals: *dream + t, lambda* [md], *Camden.*

20. Cf. Kiparsky (1981). The idea of extrametrical segments terminating a syllable is an adaptation of the "syllable affix" of Fujimura and Lovins (1978, Fujimura 1979). A related proposal, closer to mine than to theirs, was made by Halle and Vergnaud (MS), apparently independently of both.

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