

AKAN VOWEL HARMONY:
THE WORD STRUCTURE CONDITIONS AND THE FLOATING VOWELS*

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Clements, in an account of Akan vowel harmony [1981b], has a separate autosegmental tier for the harmonic feature category [Advanced Tongue Root]. He claims to demonstrate the superiority of his autosegmental framework over the segmental framework adopted in an earlier account of Akan vowel harmony by Schachter and Fromkin [1968], namely that of Stanley [1967] and Chomsky and Halle [1968]. However, although the segmental framework in question is indeed unsatisfactory in certain respects as it stands, it can be readily modified to meet Clement's objections without recourse to the autosegmentalization of the harmonic feature category.

1. Introduction

Clements [1981b] objects to certain aspects of two linear accounts of Akan (tongue root) advancing harmony which he examines, namely mine of 1967 and Schachter and Fromkin's (hereafter S&F) of 1968, and presents a non-linear account of his own in which the features [+Advanced] and [-Advanced], like the tones, are on a separate autosegmental tier, and in which some of the [+Advanced] autosegments on that tier remain unassociated, or floating, in surface representation.

*This is a revised and expanded version of an article entitled "Akan vowel harmony: the word structure conditions" which was published only in Dutch translation [Stewart 1982]. I am indebted to Nick Clements not only for the challenge which his 1981 article represented but also for his comments on the 1982 version of this article; these played a large part in inspiring the extensive changes in the present version. I am also indebted to those who attended the seminar of the Department of African Linguistics of the University of Leiden on 9 March 1982, at which I presented the original paper, and in particular to Harry van der Hulst and Maarten Mous. Naturally, however, the responsibility for the shortcomings which remain is entirely mine. Republication in English is by kind permission of Foris Publications.

In this paper I strongly support his initiative in attempting to apply to vowel harmony principles that have emerged from the study of tone. I show that his separate tier for the features of the category [Advanced] is unjustified, but find that it does indeed appear appropriate to posit floating segments of some kind to account for what have been called the "zero vowels".

I begin by presenting a revised version of my 1967 account, leaving the "zero vowels" out; this time, however, I deal not only with the Asante (As) dialect but also with the Akuapem (Am) and Fante (Fa) dialects, and this time I adopt the general (linear) framework of Stanley [1967] and Chomsky and Halle [1968] as applied to Akan by S&F [1968]. I show by practical demonstration that the S&F framework is basically satisfactory, and that it can be readily developed in a natural way, namely by extending the scope of Stanley's structure conditions from the morpheme to the word, to meet the following objection by Clements [1981b:125]:

"[S&F] adopt a rule-based model of vowel harmony which accounts for vowel harmony in terms of two independent types of statements: morpheme structure conditions determining co-occurrence restrictions in roots, and phonological rules determining the harmonic category of affixes. Within this framework, it is entirely accidental that the same set of restrictions on vowel co-occurrence should apply internally in roots and externally across morpheme boundaries."

A central feature of this revised account is the formulation of word structure conditions of a particular type which I call *disharmony conditions*; these capture the concept of the *harmony span* which I use in the earlier account: the word is divided into harmony spans within which the vowels are necessarily in harmony, and the disharmony condition for a particular dialect defines the harmony spans in that dialect by stating the circumstances under which disharmony between two successive vowels is possible.

After examining Clements's two main objections to my own earlier account I turn to the "zero vowels" which I disregarded in the first instance. I show that a more satisfactory nonlinear analysis than

Clements's is one with two tiers only, one tonal and one nontonal; by this analysis we have floating vowels in place of Clements's floating [+Advanced] autosegments.

Finally I show that once we admit floating vowels, the features of the category [Advanced] are not only not on a separate tier, but are arguably not even distinctive.

2. Proto-Akan and Akuapem

Although both Stewart [1967] and Clements [1981b] focus on the Asante dialect, I begin here not with Asante but with Akuapem as described by Christaller [1875:8-10], which, apart from one very minor complication which is peculiar to Akuapem and which I disregard in the first instance, appears to have preserved proto-Akan vowel harmony virtually unchanged.

Five vocalic binary feature categories distinguish 15 vowels, as in (1):

(1)	ɛ	e	ɔ	o	ɪ	ĩ	i	ĩ	ɔ	õ	u	ũ	a	ã	ə
Low	-	-	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	(-)	+	(+)	+
High	-	-	-	-	+	+	+	(+)	+	(+)	+	(+)	(-)	-	(-)
Round	-	-	+	+	-	-	-	-	+	+	+	+	(-)	(-)	(-)
Advanced	-	+	-	+	-	-	+	+	-	-	+	+	-	(-)	+
Nasal	(-)	(-)	(-)	(-)	-	+	-	+	-	+	-	+	-	+	(-)

The categories [Round] and [Advanced] correspond for this purpose to S&F's [Back] and [Tense] respectively. A specification which is enclosed in parentheses is redundant in that it is not required for the specification of the vowel in question, but is itself provided by a segment structure condition (SgSC); the three SgSCs in (2) provide all the redundant specifications in (1):¹

¹All three conditions are given in if-then form, and it is important that the reader should not be misled by their superficial resemblance to phonological rules. Take the first condition, for instance, which says that a low vowel is nonhigh and nonround; it says also, by implication, both that a high vowel is nonlow and that a round vowel is nonlow, and

- (2) a. SgSC1(10v): b. SgSC2: c. SgSC3:
- $$\Rightarrow \begin{bmatrix} V \\ +Low \\ -High \\ -Round \end{bmatrix} \quad \Rightarrow \begin{bmatrix} V \\ -Low \\ -High \\ -Nasal \end{bmatrix} \quad \Rightarrow \begin{bmatrix} V \\ +Low \\ +Advanced \\ -Nasal \end{bmatrix}$$

The first condition says that a low vowel is nonhigh and nonround; the second that a nonlow nonhigh (i.e. mid) vowel is oral; and the third that a low advanced vowel is oral.

The specification of a low vowel for advancing is provided by the sequence structure condition (SqSC) in (3):

- (3) SqSC1:
- $$\Rightarrow \begin{bmatrix} V \\ +Low \\ \alpha Advanced \end{bmatrix} / \alpha \left[\begin{array}{c} C_0 \\ \left[\begin{array}{c} V \\ +Advanced \\ -Low \end{array} \right] \end{array} \right]$$

This says that a low vowel is advanced if and only if it is followed by an advanced nonlow vowel.

The simple phonological word, which will be defined presently, is subject to the SqSC in (4):

- (4) SqSC2:
- $$\Rightarrow \begin{bmatrix} V \\ \alpha Advanced \end{bmatrix} C_0 \begin{bmatrix} V \\ -\alpha Advanced \\ +Low \end{bmatrix}$$

This is a disharmony condition which says that a noninitial vowel may be in disharmony with the preceding vowel only if it is itself low; and which implies, of course, that any succession of vowels in which all apart from

there is thus no need to formulate these conditions separately, however important the part they play in the provision of redundant specifications. It will be seen that the second condition, which says that a nonlow non-high vowel is oral, similarly implies both that a nonhigh nasal vowel is low and that a nonlow nasal vowel is high; and that the third condition, which says that a low advanced vowel is oral, similarly implies both that a low nasal vowel is nonadvanced and that an advanced nasal vowel is nonlow.

the first are nonlow is either nonadvanced throughout or advanced throughout, however many vowels there may be.²

The simple phonological word consists of a single root morpheme together with its affixes, if any, but includes no nonharmonizing affixes. Affixes include clitics; the most important clitics are the subject prefixes and the object suffixes. The nonharmonizing affixes referred to are all clitic suffixes; examples are *ho* 'there', *yi* 'this', *mu* [m] 'inside'. Words with suffixes were in fact excluded altogether from my earlier account [Stewart 1967], just as were words with more than one stem morpheme; my object there was not to give anything approaching an overall statement of the harmony but simply to establish the position of the root of the tongue as its articulatory basis.

Words containing the nonharmonizing clitic suffixes just mentioned resemble words with compound stems in that where the first vowel of the suffix or of the second part of the compound is both nonlow and advanced, the preceding vowel is also advanced, e.g. *ɔ* + *bɛ* + *ba* + *mu* → *ɔbɛba-mu* [ɔbɛbɛm] 'he will come in', *a* + *fɔ* + *tu* → *afɔ-tu* [afutu] 'advice' (from *tu fɔ* 'give advice'). In each case the problem arises that the advanced vowel to the left of the morpheme boundary may be in disharmony with the vowel before it (if any) even if it is itself nonlow, and that the word then fails to conform to SqSC2. The second of the two examples just given is a case in point; to conform, it would have to be **əfutu* or **afoto*. In principle both types of nonsimple phonological words are outside the scope of this paper, but I shall return briefly to these words in the final section.

²An equivalent formulation of SqSC2 is as follows:

$$\begin{array}{ccc} V & C_0 & \left[\begin{array}{c} V \\ -\text{Low} \end{array} \right] \\ \Rightarrow [\alpha\text{Advanced}] & & [\alpha\text{Advanced}] \end{array}$$

This says that any noninitial nonlow vowel is in harmony with the preceding vowel; which, of course, amounts to the same thing. See the observations in footnote 1 on implied conditions and their redundant status.

Wherever the well-formedness condition (WFC; all SgSCs and SqSCs are WFCs, as Clements correctly points out on p. 121) in (4) would otherwise be violated (for instance, where a prefix with a nonlow nonadvanced vowel in its base form is followed by a root with a nonlow advanced vowel in its base form), the WFC is met by the application of the associated automatic phonological rule (A-rule) in (5):

(5) SqSC2A: V → [+Advanced]

The device of the A-rule, the function of which is to show what happens where a WFC would otherwise be violated, is an original feature of the present treatment and is explained below in the section on the development of the S&F framework. The A-rule in (5) tells us that its associated WFC, namely SqSC2, is met by the replacement of nonadvanced vowels by advanced vowels wherever there would otherwise be an inadmissible combination of nonadvanced and advanced vowels.

The examples in (6) illustrate the effect of SqSC2A on the prefix

ɔ- 'he', the past tense suffix -ɪ, and the perfect tense prefix a-.

- (6) a. ɔ + kasa + ɪ → ɔkasaɪ 'he spoke'
 b. ɔ + fiɪ + ɪ → ofiɪɪ 'he pierced it'
 c. ɔ + bisa + ɪ → obisaɪ 'he asked'
 d. ɔ + kəri + ɪ → ɔkəriɪ 'he weighed it'
 e. a + kasa → akasa 'has spoken'
 f. a + fiɪ → əfiɪ 'has pierced it'
 g. a + bisa → əbisa 'has asked'
 h. a + kəri → akəri 'has weighed it'

It will be seen that while in most cases the affix vowel displays harmony with the nearest root vowel, a prefix vowel displays disharmony where the nearest root vowel is ə. It will be recalled that SqSC2 allows disharmony between two vowels where the second vowel is low; as a consequence of this, there is of course no reason for SqSC2A to apply to the prefix vowel in (6d) or (6h). The disharmonic sequences in (6d) and (6h), in which the second vowel is [+Low, +Advanced] may be compared with that in

(6c), in which the second vowel is [+Low, -Advanced].

Since, in a simple phonological word, the only morpheme which can possibly have an advanced vowel in its base form by the present analysis (or by that of Stewart [1967] or by that of S&F [1968]) is the stem morpheme, the A-rule affects only affix vowels. The reason for analysing the harmonizing affixes as having nonadvanced vowels in their base forms is that, as we have just seen, the specification of these vowels for the category [Advanced], though often determined by SqSC2, is not always thus determined, and that when it is not thus determined it is always minus. As we shall see in the final section, however, it may eventually turn out to be more satisfactory to analyse nonlow prefix vowels as underlyingly advanced; we would then need (at least) two A-rules, one for the advancing of low vowels and one for the disadvancing of nonlow vowels.

As was noted earlier, the above account ignores a minor complication which is peculiar to Akuapem. This is the occurrence of the nasal vowel sequences $\tilde{\imath}\tilde{\epsilon}$, $\tilde{\omega}\tilde{\epsilon}$, $\tilde{\imath}\tilde{\epsilon}$, $\tilde{\imath}\tilde{\epsilon}$, all of which violate SgSC2 which says that a mid vowel is oral, and the last two of which violate SqSC2 which says that a vowel can be in disharmony with a preceding vowel only if it is itself low; an example is the verb root $\tilde{\imath}\tilde{\epsilon}$ 'open' (cf. As $\tilde{\imath}\tilde{\imath}\tilde{\imath}$). The nasal vowel sequences in question, which contrast with the oral sequences $\imath\epsilon$, $\omega\epsilon$, $\imath\epsilon$, $\imath\epsilon$, have usually been presumed to be derived from underlying $\tilde{\imath}\epsilon$, $\tilde{\omega}\epsilon$, $\tilde{\imath}\epsilon$, $\tilde{\imath}\epsilon$ by a phonological rule which nasalizes a mid vowel after a nasal vowel and makes it nonadvanced if it is not nonadvanced already. The phonological rule is suspect, however, as it does not operate across morpheme boundaries (see the section on the question of floating segments below), and it would appear desirable to amend SgSC2 so as to allow $\tilde{\epsilon}$ in underlying representation and to split SqSC2 into two separate conditions, one saying that an oral vowel can be in disharmony with a preceding vowel only if it is itself low, and the other saying that a nasal vowel can be in disharmony with a preceding vowel only if it is itself nonhigh. The amended version of SgSC2 would say that a nonlow nonhigh nasal vowel is nonround and nonadvanced. An extra SqSC would be needed to state that $\tilde{\epsilon}$ occurs only after high nasal vowels.

3. Fante

Apparently as a result of a merger of ə with e , the Fante dialect has only one oral low vowel, and has consequently not ten but nine oral vowels altogether. The two low vowels are classified as in (7a) (cf. (1) above), and SgSCL(10v) in (2a) above is replaced by SgSCL(9v) in (7b):

(7) a.	a ã	b. SgSCL(9v):	
Low	+ (+)	\Rightarrow	$\left[\begin{array}{c} \text{V} \\ +\text{Low} \end{array} \right]$
High	(-) (-)		$\left[\begin{array}{c} -\text{High} \\ -\text{Round} \\ -\text{Advanced} \end{array} \right]$
Round	(-) (-)		
Advanced	(-) (-)		
Nasal	- +		

Whereas SgSCL(10v) says that a low vowel is nonhigh and nonround, SgSCL(9v) says that a low vowel is nonhigh, nonround, and nonadvanced. SgSC3 in (2c) above, which says that there is no nasal advanced low vowel, and SqSCL in (3) above, which states the complementary distribution of nonadvanced and advanced low vowels, are eliminated as a consequence of the loss of the advanced low vowel.

The disharmony condition SqSC2 in (4) above and its associated A-rule SqSC2A in (5) above are both retained, but whereas in Akuapem they account unaided for the $\text{a} \sim \text{ə}$ alternation in prefixes, in Fante they do not account unaided for the $\text{a} \sim \text{e}$ alternation; for this alternation we need in addition the A-rule in (8), which is associated with SgSCL both in its ten-vowel variant in (2a) above and in its nine-vowel variant in (7b) above.

(8) SgSCL1A: $\text{V} \rightarrow [-\text{Low}]$

This A-rule says that the associated WFC, namely SgSCL(10v) or SgSCL(9v), is met by the replacement of the feature [+Low] by the feature [-Low] wherever there would otherwise be an inadmissible feature combination; the inadmissible combinations are of course [+High, +Low] and [+Round, +Low] in the case of SgSCL(10v), and both of these together with [+Advanced, +Low] in the case of SgSCL(9v).

In Fante, then, where the specification [-Advanced, +Low] in prefixes is changed to [+Advanced, +Low] by the A-rule associated with the disharmony condition SqSC2 an inadmissible combination arises, which is changed in its turn to [+Advanced, -Low] by the A-rule associated with SgSCL.

It will be recalled that in Akuapem the disharmony condition is met by disharmonic sequences both of the advanced-nonadvanced type specified in (9a) and of the nonadvanced-advanced type specified in (9b):

- (9) a. $\begin{bmatrix} V \\ +Advanced \end{bmatrix} C_0 \begin{bmatrix} V \\ -Advanced \end{bmatrix}$ b. $\begin{bmatrix} V \\ -Advanced \end{bmatrix} C_0 \begin{bmatrix} V \\ +Advanced \end{bmatrix}$

It will be seen, however, that in Fante, as [+Advanced, +Low] vowels are disallowed by SgSCL(9v), disharmonic sequences of the nonadvanced-advanced type are impossible, and consequently all disharmonic sequences are of the advanced-nonadvanced type.

What, then, was the fate of the nonadvanced-advanced type in Fante? Compare the two Fante examples in (10) with the two Akuapem examples in (6) above which illustrate the nonadvanced-advanced type, namely (d) and (h). It will be seen that whereas *kəri*, with its [+Advanced, +Low] first vowel, does not trigger the advancing of prefix vowels, *keri*, with its [+Advanced, -Low] first vowel, does.

- (10) d. Fa ɔ + *kəri* + ɔ → o*kəri*
 cf. Am ɔ + *kəri* + ɔ → ɔ*kəri*
- h. Fa a + *kəri* → e*ker*
 cf. Am a + *kəri* → a*kəri*

Now not only in these examples but in all examples of nonadvanced-advanced disharmony in Akuapem the advanced (low) vowel is the first vowel of a root and the nonadvanced vowel forms part of or constitutes a prefix, and consequently the replacement of *ə* by *e* in Fante has the effect of totally eliminating nonadvanced-advanced disharmony within the simple phonological word.

It is appropriate to mention the reason why, in Akuapem, the advanced low vowel in a nonadvanced-advanced sequence is never a prefix vowel: a

prefix with a low vowel never has an initial consonant and is never preceded by more than one other prefix, and the vowel of any preceding prefix is totally assimilated to the low vowel which it precedes, e.g. Fa
 $ye + a + ba \rightarrow yaaba$ 'we have come'.

4. Asante

In the Asante dialect the advanced low vowel ϵ has a more restricted distribution than in Akuapem, the SqSC in (11) taking the place of the one in (3):

(11) SqSC1(As):

$$\Rightarrow \begin{bmatrix} V \\ +Low \\ \alpha Advanced \end{bmatrix} / \alpha \left[\begin{array}{c} C_0 \\ \begin{bmatrix} V \\ +Advanced \\ +High \end{bmatrix} \end{array} \right]$$

This says that a low vowel is advanced if and only if it is followed by an advanced high vowel. We saw that in Akuapem, ϵ occurred before all advanced nonlow vowels.

Correspondingly, the less restrictive disharmony condition in (12a) takes the place of the one in (4):

$$\begin{aligned} (12) \text{ a. SqSC2(As):} & \begin{bmatrix} V \\ \alpha Advanced \end{bmatrix} C_0 \begin{bmatrix} V \\ -\alpha Advanced \\ -High \end{bmatrix} \\ & \Rightarrow \\ \text{b. SqSC2(As)A1:} & \begin{bmatrix} V \\ -High \\ -Advanced \end{bmatrix} / \begin{array}{c} C_0 \\ \begin{bmatrix} V \\ +High \\ -Advanced \end{bmatrix} \end{array} \\ \text{c. SqSC2(As)A2:} & V \rightarrow [+Advanced] \end{aligned}$$

(12a) says that a noninitial vowel may be in disharmony with the preceding vowel only if it is itself nonhigh. We saw that in Akuapem the disharmonic vowel had to be low. In addition, the two ordered A-rules in (12b-c) take the place of the one in (5), though the one in (12c) is in fact identical to the one in (5); they say in effect that wherever possible, SqSC2(As) is met by the replacement of e , o by ϵ , \circ before

ɪ , ɔ , and that elsewhere it is met in the usual way by the replacement of nonadvanced vowels by advanced vowels. The examples in (13) illustrate the disharmonic mid vowels that are admissible in Asante but not in Akuapem:

- (13) a. As a + bɛ + tu → abetu 'has come and pulled it out'
 cf. Am a + bɛ + tu → əbetu
- b. As a + kɔ + tu → akotu 'has gone and pulled it out'
 cf. Am a + kɔ + tu → əkɔtu
- c. As ɔ + tie + ɪ → otieɪ 'he listened'
 cf. Am ɔ + tie + ɪ → otiei
- d. As mi + w̃ie + ɪ → miw̃ieɪ 'I finished'
 cf. Am mi + w̃ie + ɪ → miw̃iei

In (a) and (b) the disharmonic mid vowel is advanced, and the vowel with which it is in disharmony is a low vowel which constitutes a prefix. In (c) and (d) the disharmonic mid vowel is nonadvanced, having become so by SqSC2(As)A1, and both it and the vowel with which it is in disharmony form part of the root.

Nonlow prefix vowels appear to harmonize with mid vowels in Asante as in Akuapem, e.g. ɔ + bɛ + tu → obetu 'he comes and pulls it out',
 ye + bɛ + tu → yebetu 'we come and pull it out'. Whereas in Akuapem the harmonization is demanded by SqSC2, however, in Asante it is not demanded by the Asante counterpart of SqSC2, namely SqSC2(As), and a nonautomatic phonological rule on the lines of (14) seems to be needed to account for it:

- (14)
$$\left[\begin{array}{c} \text{V} \\ \text{-Low} \end{array} \right] / \text{---}]_{\text{px}} \text{C}_0 \left[\begin{array}{c} \text{V} \\ \text{+Advanced} \\ \text{-Low} \end{array} \right] \quad (\text{px: prefix})$$

$$\rightarrow \left[\text{+Advanced} \right]$$

This says that a nonlow prefix-final vowel becomes advanced before any advanced nonlow vowel.

It will be seen that the Asante A-rule SqSC2(As)A1 introduces alter-

nation into the root, e.g. *tiɛ* ~ *tiɛ* 'listen'. There is one root, namely *ɲĩnseɲ* 'become pregnant', which would appear to have had the alternation in the past (**ɲĩnseɲ* (unsuffixed form) ~ *ɲĩnseɲ* (suffixed form)) but to have got rid of it by generalizing the suffixed form. There are good reasons for believing that the proto-Akan form was **ɲĩnseɲ*, as will be seen in the section on Clements's "disharmonic roots" below; and this form, when combined with the past tense suffix, would of course have met the structural description of the Asante A-rule in question. The generalization of the suffixed form should perhaps be seen partly as a move in the direction of the restoration of the principle of root control, which is of course violated by SqSC2(As)A1.

5. Word Structure Conditions and Their Associated Automatic Rules

It will be recalled that I have made two changes in the S&F framework; first, I have extended the scope of the SqSCs from the morpheme to the word, and second, I have introduced a new kind of phonological rule, the automatic rule (A-rule), the function of which is to show what happens where a well-formedness condition (WFC) would otherwise be violated.

S&F did in fact consider the possibility of the first of these two changes themselves; they write as follows (p. 56):

"While it might have been possible to extend SqSC5 [their counterpart of my SqSC2; J.M.S] to apply to such tenseness-harmony constraints within the word, we have preferred to characterize the latter by means of a phonological rule."

The second of the two changes, namely the introduction of the A-rule, meets a need which arises as a result of the first: to show how SqSC2 is met in those cases in which it would be violated if each of the constituent morphemes of the word retained its base form.

The A-rule is designed to capture Hockett's concept of *automatic alternation*; he writes as follows [1958:279-80]:

"Some alternations are such that if they did not take place, the phonemic pattern of the language would be different from what in fact it is."

"Alternations of this kind are called *automatic*. One of the alternate shapes is the *base form*, and the other or others are said to replace the base form under specific conditions where, otherwise, there would be an arrangement of phonemes contrary to the phonemic pattern of the language. It is to be noted that the term "automatic" refers to the fact that the base form is replaced, but not to the particular replacement which is made. . .there is nothing about the *phonemic* system of the language which renders the actually-used device any more natural than [the theoretically possible] alternatives."

It will be seen that his concept of the *phonemic pattern of the language* is already captured by the WFCs.

Although in the present context the need for the A-rule arises in the first instance from the extension of the scope of the SqSC from the morpheme to the word, it is important to note that this is by no means the only type of situation in which the A-rule is needed, and that S&F's framework is defective without it in any case. This is evident from those situations in which S&F posit the application of morpheme structure (MS) conditions to the output of phonological rules (P-rules); they write as follows (p. 18):

"Some of the MS conditions apply to strings which are the output of P-rules, as well as to those which are the input to this component of the grammar. To repeat these conditions as P-rules, or to specify the redundant features in P-rules, would not only be uneconomical but would obscure the generality concerning the redundancies which persist. We therefore include the convention that when a feature is specified as redundant in the MS rules, it remains redundant with the application of the P-rules, if the non-redundant feature is changed and the redundant feature is not mentioned. For example, at the systematic-phonemic level all [-Back] vowels in Akan are redundantly [-Round], and are so specified in the MS Segment Structure Conditions. If a P-rule changes the feature specification of a vowel from [+Back] to [-Back] and does not mention the feature [Round], this implies that the segment which was redundantly [+Round] becomes [-Round] simultaneously with the change of the backness feature."

Their example hardly fits the present analysis, which makes no use of the distinction between [Back] and [Round], but another example can be readily substituted. In Fante, as we have seen, [+Low] vowels are redundantly

[-High, -Round, -Advanced], and are so specified by SgSC1(9v) in (7b) above. When the A-rule SqSC2A in (5) above changes the specification of a low vowel to [+Advanced] (which it does without specifying a feature of the category [Low] for that vowel), this has the consequence that the vowel which was [+Low] becomes [-Low] simultaneously with the change from [-Advanced] to [+Advanced]. Now whereas S&F would say that this consequence was implied by SgSC1(9v), I maintain that it is not implied, but has to be stated in an A-rule associated with the SgSC. As Hockett points out, there is nothing about the phonological pattern of the language which makes the actually used device any more natural than the theoretically possible alternatives; in Turkana, for instance, a is replaced in comparable circumstances not by e but by o [Dimmendaal 1982:23], and a different A-rule is therefore required.

As I have already noted, S&F acknowledge their indebtedness to Stanley [1967]; Stanley is in fact the author of the distinction between P-rules and MS conditions as they conceive it, and also of "the convention that the output of each P-rule is automatically subjected to the segment structure rules [i.e. the SgSCs; J.M.S.]" [1967:404]. I shall now show that both of the weaknesses in the S&F framework with which I am concerned in this section are in fact traceable to weaknesses in Stanley [1967].

Let us look first at the difficulty that I resolve by introducing the A-rule. Stanley writes as follows (p. 397):

"Essentially, this proposal amounts to demanding that redundancy rules [i.e. MS conditions; J.M.S.] be clearly distinguished from rules which change feature values [i.e. P-rules; J.M.S.]."

If, however, the MS conditions apply to the output of each P-rule in the way he proposes then the MS conditions do change feature values. My own proposal, namely that in such circumstances the feature values are changed not by the structure conditions themselves but by associated A-rules, avoids this difficulty.

Now let us look at the question of the scope of the structure conditions. Stanley writes as follows (p. 397):

"The fact that MS rules apply to individual morphemes, and not to strings of morphemes in a sentence, reflects the easily verified empirical fact that the constraints holding within single morphemes are more restrictive than the constraints which characterize larger units."

The error here is to compare the claims of the morpheme with those of the sentence without considering the claims of the word.

Ultimately, then, it is this latter error of Stanley's that gives rise to Clements's objection ([1981b:125-6]; quoted in the introduction above) to the S&F framework. As I have shown in this section, however, the error is by no means crucial, and we can readily adjust the Stanley/S&F framework in a natural way without resorting to the autosegmentalization of the harmonic feature category.

6. Clements's "Disharmonic Roots"

Clements explicitly criticizes my 1967 framework on two counts: first, that it "provides no straightforward treatment of [the two] disharmonic roots [*piŋce* 'to come close' and *piŋseŋ* 'to be pregnant']" (p. 132), and second that it is characterized by "a considerable amount of indeterminacy with respect to the choice of where [the harmonic/prosodic features] are to be located in linear strings of phonemes" (p. 133). I devote this section to the first criticism and the following section to the second.

It is important to note that Clements (p. 119) distinguishes between two types of roots which display internal disharmony: "mixed vowel roots" such as *bisa* 'to ask' which conform to the structure conditions and are in fact very common, and "disharmonic roots" which do not conform to the structure conditions and of which he knows no examples apart from the two just quoted.

The first point to be made is that the present account is the first to recognize that the Asante disharmony condition is not the same as that of Akuapem, and that whereas in Akuapem a noninitial harmony span can generally be initiated only by a low vowel (see SqSC2 in (4) above), in Asante a non-initial harmony span can be initiated by any nonhigh vowel (see SqSC2(As) in

The Fante phonetic form in the second column of (16c) is exactly what one would expect if the form in the first column was compounded with *sen*, though if it were a straightforward compound it would be phonologically **n̄n-sen* and it would not take advanced vowels in prefixes as in fact it does. It is plausible to suggest that it is a compound in origin but that it has come to be treated as a single morpheme; this is something that happens sometimes even in the case of more transparent compounds such as the stem in *ebufuw* (not **abo-fuw* [*abufuw*]) 'anger' from *bɔ fuw* 'get angry' (*bɔ:* 'breast'; *fuw:* 'shoot up').

It will be seen that (Fa) *n̄nsen* is not in fact a "disharmonic root" at all, and that it is plausible to reconstruct the proto-Akan form as **n̄nsen* as we can explain the advanced vowel in (Am) *n̄nsen* only if we posit an earlier **n̄nsen*. We have already explained the change of the second vowel from advanced to nonadvanced in (As) *n̄nsen*; see the section on Asante above. Perhaps (Am) *n̄nsen* is to be explained as a borrowing from Asante. Compare Christaller's (Am) dictionary entry *o-tuo* 'musket, gun'; the final *o* represents a nominal suffix which, as S&F [1968:67] note, has a segmental realization after high vowels in Asante but has no segmental realization in any context in Akuapem or Fante. On being borrowed into Akuapem, (As) *n̄nsen* would presumably be reinterpreted as a compound parallel in structure to *pince*.

7. The Representation of the Harmonic Feature

Clements writes as follows on the above topic (p. 133):

"Another problematical aspect of [Stewart's] account concerns the placement of the feature H in underlying representation. Any theory making use of prosodic features of this sort within the general framework of linear representation will be faced with a considerable amount of indeterminacy with respect to the choice of where they are to be located in linear strings of phonemes. For instance, in the case of Akan the following set of representations would all be consistent with the phonetic shape and phonological behavior of the noun root [*kotoj^{wɛ}*] 'knee': a. *Hkotoj^{wɛ}* ; b. *kHotoj^{wɛ}* ; c. *kɔHto^jwɛ* ; d. *kɔtHɔj^{wɛ}* ; e. *kɔtoHj^{wɛ}* ; f. *kɔto^jwHɛ* ; g. *kɔto^jwɛH* .

Given this fact, the rule requiring H to occur to the right of the rightmost nonlow vowel, which uniquely selects (g) as the underlying representation of 'knee', is a linguistically arbitrary one."

My answer here is that how one marks the harmonic feature of a harmony span is of no theoretical significance. What is significant is the division of the word into harmony spans; this is captured in the present account by the disharmony conditions in (4) and (12).

My position on the question of marking is essentially the same as that of S&F, who write as follows (p. 13):

"We will mark the first vowel for this feature in the dictionary matrices, but it should be understood that this is an arbitrary decision, and that we could just as easily have chosen to mark the last vowel instead. It is the [structure] condition itself which makes the generalization and not the dictionary matrices, and therefore we need not be concerned about which segment is marked."

8. The Question of Floating Segments

One of Clements's objections to S&F's account remains unanswered. S&F write as follows (p. 97; [U] is [u] or [ɔ], and [I] is [i] or [ɪ]):

"Apparent exceptions to the claim that it is only nonlow tense vowels that tense preceding vowels in grammatical morphemes are provided by words such as A[m]-Fa obegua [obegwəʔ] /As obedwa [obedjɔʔ] 'he comes to skin', okogyam [okodjəmʔ] 'he goes to condole', etc. However, if we investigate the derivation of the root morphemes in such words, we find that, at some point in the derivation, there is always a [u] or [i] - i.e. a nonlow tense vowel - before the low tense [ə] that occurs as the first vowel in the final phonetic form. Thus the underlying form of the root A[m]-Fa [gwəʔ] /As [djɔʔ] is /guək/, and the [u] of the root is present in the derivation until it is deleted by the [U]-deletion rule. . . In the case of the root [djəmʔ], while the underlying form is /gəb/, the [I]-insertion rule. . . obligatorily inserts an [i] between the [g] and the [ə], and this [i] remains present in the derivation until it is deleted by [the [I]-deletion rule]."

(For ə read a in every case; see Clements [1981b:116-7, 123.] Clements

has reservations about the synchronic motivation of this analysis; he writes as follows (p. 148):

"Most writers on the subject have assumed that [these] stems had their historical source in forms containing [+Advanced] high vowels between the initial consonant and the low vowel, which dropped out after having conditioned the palatalization (occasionally accompanied by rounding) of the consonant. While no synchronic alternations remain to provide a strong source of motivation for such an analysis in the present-day language (though see S&F [1968] for an attempt to support such an analysis with language-internal evidence), there is a certain amount of comparative evidence suggesting that it is not implausible as a diachronic analysis, at least for some forms."

S&F's P-rules of [U]- and [ɪ]-deletion are certainly open to the objection that they never operate across a morpheme boundary and thus never generate alternant forms of morphemes. Before we seek a solution, however, let us look at another of S&F's [1968:72] P-rules, namely regressive non-vowel nasalization, a less complex rule which is open to the same objection.

By S&F's analysis Akan has nasal consonants at the systematic-phonetic level but not at the systematic-phonemic level, and a large proportion of the surface nasal consonants result from the application of the regressive nonvowel nasalization rule, the main part of which is essentially as in (17):

$$(17) \quad \begin{bmatrix} C \\ +Voiced \end{bmatrix} / \text{---} \begin{bmatrix} V \\ +Nasal \end{bmatrix} \\ \rightarrow \begin{bmatrix} +Nasal \end{bmatrix}$$

This P-rule says that a voiced consonant becomes nasal before a nasal vowel; examples are /bã/ → [mã] 'give', /dã/ → [nã] 'and'.

We can avoid this problematic P-rule if we admit underlying /m,n/ and introduce a SqSC of nasality agreement, somewhat as in (18):

$$(18) \quad \begin{bmatrix} C \\ +Voiced \end{bmatrix} V \\ \Rightarrow \begin{bmatrix} \alpha Nasal \end{bmatrix} \begin{bmatrix} \alpha Nasal \end{bmatrix}$$

This says that any CV sequence in which the C is voiced is either oral throughout or nasal throughout.

We can avoid S&F's P-rules of [U]- and [l]-deletion in a similar way if we are prepared to admit floating vowels comparable in status to floating tones, distinguished from their nonfloating counterparts in terms of the feature category [Segmental] proposed by Voorhoeve, Meeussen and De Blois [1969]. Let us however call it [Durational] in order to avoid the apparent contradiction of talking of nonsegmental segments. The SqSC would then be somewhat as in (19):

$$(19) \quad [C_0 \quad (V_1 \quad \quad \quad) \quad v \quad \quad \quad]_{\text{syllable}}$$

$$\Rightarrow \quad [-\text{Durational}] \quad [+ \text{Durational}]$$

This says that if a syllable contains at least one vowel, then the final or only vowel is durational and any nonfinal vowels are nondurational; it is assumed that another condition excludes VC-final syllables. The near-minimal monosyllabic/disyllabic pairs of Asante verb roots in (20) illustrate:

(20)	jja	[ja]	'accompany'	ci=a	[cia]	'greet'
	ɲã	[ɲã]	'get'	ɲĩ=ã	[ɲĩã]	'need'
	ɟɟja	[ɟwa]	'skin'	dɟi=a	[dɰɰia]	'plant'
	sɟja	[sɰɰa]	'be small'	tɟi=a	[tɰɰia]	'pay'

(j , ɟ : nondurational i , u ; = : syllable boundary.)

The roots tɟi=a , dɟi=a , ɟɟja are assumed to be derived from earlier *tu=a [tua] , *du=a [dua] , *gɟa [gwa] ; compare the official spellings 'tua' , 'dua' , (Fa, Am) 'gua' (As 'dwa'). The remaining root with ɟ , namely sɟja , is similarly spelt 'sua' , though its historical origin is less obvious.

It is perhaps not without interest that the "zero tone-bearing units" which I posited in my early work on Akan tone [Stewart 1962, 1965] for what were later to become known as floating tones were inspired by Welmers' [1946:18-19] treatment of the floating vowels illustrated in (20) above as "zero variants" of the vowels in question.

Clearly, if we admit floating whole vowels, there is no need for floating [+Advanced] autosegments. This does not mean, of course, that

there is no need at all for autosegmental phonology, and I shall try presently to work out some of the implications of the floating vowels for an Akan phonology with two tiers, one tonal and one nontonal, basically on the lines of Clements [1981a]. First, however, I must draw attention to a crucial difference between Clements's model and that of Goldsmith [1976].

Clements and Ford [1979] refer to Goldsmith's [1976] view that "associations among [tones and tone-bearing units] are governed by a set of principles of *well-formedness* [with] the following effect: every tone is associated with at least one tone-bearing unit; every tone-bearing unit is associated with at least one tone; and no association lines cross" [1979:182]. By this view free (= unassociated) tones are of course disallowed in surface representations. Clements and Ford themselves, however, propose to admit surface free tones, claiming that they are motivated by tonal downstep; they write as follows (pp. 204-5):

"Throughout the synchronic phonology of Kikuyu, phonological and phonetic evidence converge to demonstrate that the free extra-low tones created by the operation of tone shift correspond precisely to the downstep elements operated upon by the tone rules. Throughout this set of rules, the downstep element functions as if it were a phonological entity on a par with tones. This fact follows naturally from the assumption that it *is* a tone: namely, the floating extra-low tone that our rules have independently generated.

"From the point of view of Kikuyu phonology alone, this is the simplest position that we can take. Our rules have generated a number of extra-low tones that are subject to the operation of certain phrase-level rules. Subsequent to the operation of these rules, these free tones are interpreted by the rules of pitch assignment as *operators* triggering pitch lowering. Such rules have the effect of lowering the register within which subsequent tones in the tone group are realized. No further entities such as special "drop tone" features or unanalysable "pitch change markers" need be introduced. Any rules that might be proposed to trade in free tones for such entities would be descriptively superfluous.

"If we adopt this view, it appears possible to do away entirely with the theoretically suspect entity "!", replacing it with a known quantity. Floating tones are well documented in the languages of Africa, and it appears

likely that the downsteps identified in other languages can be assigned a similar status. Thus, to take an example, it would be advantageous to consider the downsteps occurring between low tones in Dschang-Bamileke (see Hyman and Tadadjeu [1976]) as consisting of free high tones; since free high tones must be generated in just the places where downstep appears phonetically, there is no need to introduce further rules whose only function is to exchange the free high tones for some type of downstep entity. A free high tone is formally distinct from an associated high tone, and can therefore serve as the unambiguous operator conditioning register-lowering [i.e. key lowering; J.M.S.]."

Subsequent work suggests the possibility that the surface free tones which account for downstep are always low. Clements [1981a:90] sees them as low and no longer as extra-low in Kikuyu. Stewart [1981:138] shows that there is no need "to consider the downsteps occurring between low tones in Dschang-Bamileke. . .as consisting of free high tones" as Clements and Ford (passage just quoted) suggest, as even these downsteps are analysable as free low tones, and Clements [personal communication] "do[es] not know offhand of any other instances of languages in which downstep could be attributed to floating high tones."

In the light of this I suggested, in the Dutch version of this article [Stewart 1982:339], that a floating vowel was perhaps a vowel not associated with any tone just as a floating tone was a tone not associated with any vowel. (I followed S&F [1968:47] in identifying the tone-bearing units as the final vowels of syllables at the systematic-phonemic level. This raises problems, particularly as the tone-bearing units at the systematic-phonetic level are quite often sonorant consonants, but these problems need not concern us here.) I saw this as having the advantage of avoiding recourse to the feature category [Zero] ([α Durational] = [$-\alpha$ Zero]) which I discuss there).

It now appears, however, that this must be rejected on the grounds that the category [Durational] is needed in underlying representations to distinguish between nondurational floating tones and durational floating tones. Clements [personal communication] claims that "two types of floating low tones must be recognized for Kikuyu; those that act as downstep operators, and those that don't," and Thomas L. Cook [personal communication] draws

attention to what appears to be essentially the same situation in Efik, while I myself now believe that my own analysis of the tones of the associative construction in Dschang-Bamileke [Stewart 1981] would be improved if the high-tone and low-tone associative markers were analysed as floating tones at some nonsurface stage in the derivation (as originally proposed by Tadadjeu [1974:286]) even though the floating low tone did not act as a downstep operator in this case.

It seems, then, that we should retain the category [Durational] in both tiers and revise the principles of well-formedness governing associations among tones and vowels so that they have the following effect: every durational tone is associated with at least one durational vowel; every durational vowel is associated with at least one durational tone; and no association lines cross.

So far my position has been purely defensive; I have argued merely that although the segmental framework used by S&F in their treatment of Akan vowel harmony is indeed unsatisfactory, it can be readily modified to meet Clements's objections without recourse to a separate harmonic tier. I now proceed to give three reasons why the floating [+Advanced] whole vowels posited here are in fact to be preferred to the floating [+Advanced] auto-segments posited by Clements.

First, sporadic cases of rightward vowel shift such as those illustrated in the right-hand column in (21) show that the floating [+Advanced] whole vowels sometimes become nonfloating:

(21)	Am	gyarɔ	[gʷarɔ]	Fa.Abura	gura	[gura]	'wash'
	(As	ɟɟjarɔ	[ɟɟʷarɔ])			
	As	syjaɔ	[sʷɟaɔ]	Am, Fa	syia	[sʷɟia]	'swear'

(Fa.Abura: the Abura subdialect of Fante.)

Second, the floating vowels account not only for the otherwise unexplained advancing of prefix vowels before nonadvanced low vowels but also for other otherwise unexplained phenomena: consonant "palatalization" before low vowels [S&F 1968:89-91], consonant rounding before nonround

vowels [S&F 1968:87-8], and, in Fante, rounding of prefix vowels before nonround vowels [S&F 1968:102-4]. Clements says nothing about the implications of his autosegmentalization for what remains of the traditional zero vowels.

Third, there would appear to be no objection to regarding the floating vowels as being fully specified; as being specified, that is, for all the vocalic feature categories without exception. An important factor favouring the synchronic recovery of the specifications is the fact that, as the pairs in (20) above illustrate, monosyllabic CV₁V sequences and disyllabic CV₁V sequences have a number of SqSCs in common.

9. Floating Low Vowels?

The recognition of floating advanced vowels which condition advanced prefix vowels opens up an extremely interesting possibility: might there not also be floating nonadvanced vowels which condition nonadvanced prefix vowels? The symmetry commonly displayed by floating high tones and floating low tones makes this a very natural question to ask; consider for instance the Asante sentences (retranscribed from Stewart [forthcoming]) in (22):

- (22) a. cʷè -nǎ̃ → cʷènǎ̃ 'look at him'
 b. kǒfí fìrɛ́ -nǎ̃ → kǒfí fìrɛ́nǎ̃ 'Kofi calls him'
 c. mà kǒfí mǎ́fíɛ́ -nǎ̃ → mà kǒfí mǎ́fíɛ́nǎ̃ 'Kofi should call him'
 d. ɔ́- ñɕʷè' -nǎ̃ → ñɕʷènǎ̃ 'he does not look at him'

(Acute accent: high tone; Grave accent: low tone.)

As the difference between (a) and (b) illustrates, a prepausal low-tone object pronoun (which, as we saw earlier, constitutes a clitic suffix) becomes high after a high tone. In (c) a floating low tone conditions a low suffix tone after a high tone, and in (d) a floating high tone conditions a high suffix tone after a low tone.

Now consider the Asante verbs in (23), which illustrates an analysis that admits not only floating advanced nonlow vowels but also floating

nonadvanced low vowels:

- (23) a. a + ba → aba 'has come'
 b. a + di → ədi 'has eaten'
 c. a + tɔ̃ɔ → atɔ 'has picked'
 d. a + pɔ̃ã → əpã 'has got'

As the difference between (a) and (b) illustrates, a nonadvanced low prefix vowel becomes advanced before an advanced nonlow root vowel. In (d) a floating advanced nonlow vowel conditions an advanced prefix vowel before a nonadvanced low root vowel, and in (c) a floating nonadvanced low vowel conditions a nonadvanced prefix vowel before a nonlow root vowel which would be advanced but for the presence of the floating nonadvanced low vowel, which conditions nonadvanced vowels after it as well as before it.

It would appear that by this analysis *i*, *u*, *e*, *o* are in complementary distribution with *ɪ*, *ʊ*, *ɛ*, *ɔ* not only in harmonizing affixes but also in roots, as roots in which the first durational vowel is *ɪ*, *ʊ*, *ɛ*, *ɔ* are always analysable as having a floating nonadvanced low vowel before that vowel, thus: *əɪ*, *əʊ*, *əɛ*, *əɔ*; compare (c) with (b) in (23) above. Then, of course, the features [-Advanced] and [+Advanced] are redundant and the number of contrasting oral vowels is reduced from nine to five, and we no longer have the anomaly that whereas the nonadvanced nonlow vowels *ɪ*, *ʊ*, *ɛ*, *ɔ* contrast with their advanced counterparts *i*, *u*, *e*, *o*, the nonadvanced low vowel *a* does not contrast with its advanced counterpart *ə*; nonlow vowels are redundantly advanced except in specified contexts, just as all along low vowels have been redundantly nonadvanced except in specified contexts.

Then, of course, the floating vowels are more appropriately specified simply in terms of the feature category [Low], so that we have floating nonlow vowels and floating low vowels instead of floating advanced nonlow vowels and floating nonadvanced low vowels. This immediately eliminates the much-debated anomaly that the advancing of prefix vowels is conditioned not by all advanced vowels but only by nonlow advanced vowels: we can now say that the advancing of prefix vowels is conditioned simply by nonlow vowels.

It looks as if this approach might open up the possibility of a more satisfactory account than has yet been achieved of one aspect of Akan vowel harmony which has been excluded from the present treatment, namely harmony across boundaries other than those which occur within the simple phonological word as defined in the section on proto-Akan and Akuapem: word boundaries, boundaries between root morphemes in compounds, and boundaries preceding nonharmonizing clitic suffixes. We saw above, in the same section, the compound $a + f\omega + tu \rightarrow af\omega-tu$ [afutu] 'advice' from $tu f\omega$ 'give advice'; by the analysis now suggested this becomes $a + f\omega + tu \rightarrow af\omega tu$ [afutu], in which what appears to be an inadmissible occurrence of a nonadvanced vowel before a nonlow advanced vowel is explained by the floating low vowel that has already been posited on other grounds. A floating low vowel then accounts for apparent exceptions to SqSC2 or SqSC2(As) in much the same way as a floating low tone accounts for downstep between adjacent high tones; downstep in this context, of course, constitutes an apparent exception to the rule that two adjacent high tones are on the same level.

It should be noted that here we are forced to regard the floating vowel as low rather than as nonadvanced, as it has to be advanced to conform to SqSC2/SqSC2(As).

It should also be noted that by this approach to harmony across word boundaries and other comparable boundaries, it may prove possible to do away entirely with the allegedly postbinary phonetic process of "vowel raising" posited by Clements [1981b:154-60], following Berry [1957], to account for these and other phenomena. Clements notes that the sentences in (24a-b) are distinct in normal speech:

- (24) a. mi-i-bu bɔɔ bi 'I'm breaking a stone'
 b. mi-i-bu buo bi 'I'm breaking a nest'
 c. (ɛ)bɔɔ 'stone'
 d. (e)buo 'nest'

(ω , φ : ω , φ affected by "vowel raising.")

By the approach I am suggesting we would have $\varepsilon b\alpha\omega\omega -bi \rightarrow \varepsilon b\alpha\omega\omega bi$ [ɛboobi] 'a stone'; since, by condition SqSC2(As), any nonhigh vowel can initiate a harmony span, that condition is satisfied by the harmonization of the ω alone, and the contrast with $\varepsilon bu\omega -bi \rightarrow \varepsilon bu\omega bi$ 'a nest' thus survives even where the initial ε or e is absent.

I am well aware that there are many questions which I have left unanswered, such as whether we can continue to regard nonlow prefix vowels as being nonadvanced in the base forms of the prefixes, and if not, what the implications are. My purpose here, however, is merely to show that the features [-Advanced] and [+Advanced], for which Clements proposes a separate autosegmental tier, are arguably not even distinctive, and to point to what appears to be a more promising way ahead in the attempt to capture just what it is that tonal phenomena and vowel harmony phenomena have in common.

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