CLS 19 (1983)

ASPIRATION TO ROOTS
REMARKS ON THE SANSKRIT DIASPIRATES*

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0. Although diaspirate roots were found in Proto-Indo-European, in Classical Sanskrit no root ever appears with two aspirates. Aspiration appears on either consonant, depending upon environment. The alternations are shown in (1).

(1)	(a)	bodhati	3rd sg pres ind	√budh "to know"
	(b)	bubodha	3rd sg perf	
	(c)	bhotsyati	3rd sg fut	
	(d)	abhutsi	1st sg aorist	
	(e)	bhut	root noun, nom sg	
	(f)	bhudbhis	root noun, instr pl	
	(g)	bhuddhvam	2nd pl pres imp	
	(h)	buddhi	2nd sg pres imp	
	(i)	buddha	past participle	

The data suggests two possible explanations; one posits diaspirate roots and deaspirates one of the consonants of the root. We will refer to this as the Grassmannian analysis. The second, the Pāṇinian analysis, analyzes roots as monoaspirate and moves the aspiration when necessary.

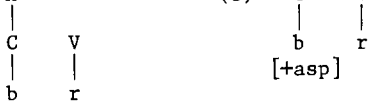
In this paper, we argue that these facts are best treated autosegmentally, assuming the autonomy of the aspiration feature from the segmental matrix of the root. In addition, we assume an autosegmental version of the Pāṇinian view and argue that it is superior to the Grassmannian view.

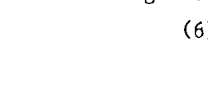
1. Sanskrit has the following voiced aspirates:

(2) bh, dh, ḍh, jh, gh, h

We will present arguments in support of our claim that the aspiration element[1] in these sounds should be represented autosegmentally. We assume that aspiration is a laryngeal feature on a tier separate from the segmental melody which is mapped onto positions of the CV skeleton.

There are a number of phonological processes in Sanskrit which are more easily statable if we represent voiced aspiration as an autosegment (henceforth "H") and not as one of the features of the segmental matrix. The root bhṛ "to bear", then, is represented as in (3a) and not as in (3b).

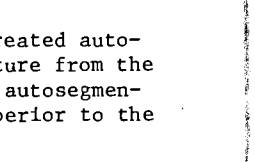
(3) (a)


(b)


The representation (3a) posits the consonantal melody (the feature complex abbreviated as b) and the laryngeal feature H as two independent units. Rules can apply to either one of them without having any effects on the other. We assume that the autosegment H is associated to the CV tier by some version of the association conventions as presented by McCarthy (1979) or Clements and Ford (1979). Dissociation of the H can result in reassociation of the autosegment to a possibly non-contiguous position in the CV skeleton, thus creating the illusion that we are dealing with a non-local process. We will briefly present arguments for the autonomy of H and the segmental melody before returning to the analysis of the diaspirate alternations illustrated in (1).

The phonotactic properties and the phonological behavior of h [ɦ], which alternates with various different segments, can be most easily explained if we assume that the aspiration is independent of the segmental melody. Consider the examples in (4) and the suggested representation in (5):

(4)	(a)	/g ∿ h/		
		dohmi ∿ dogdhi ∿ dhokṣi		√duh
	(b)	/dhi ∿ hi/	Imperative suffix	
		sagdhi	/sak - hi/	
		ihi	/i - hi/	
	(c)	/bh ∿ h/		
		grahiṣyati ∿ agrabhiṣta		√gra(b)h

(5)


Due to lack of space we make no attempt to explain these alternations here. We wish simply to point out that although the melody may be deleted, the aspiration is unaffected, thus rendering support for the representations in (5).

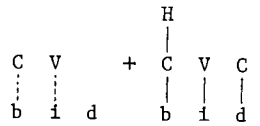
A process which affects only the segmental melody, without affecting the autosegment H, can be observed in reduplication. Reduplicated consonants in Sanskrit are never aspirated.[2] Following Marantz (1982), we will assume reduplication to be the prefixation of a morphological template (which can be partially specified, or wholly unspecified) to the root. The melodic specification of this template is accomplished by copying the root melody and associating it by means of the association conventions.

Let us consider as an example the formation of the perfect which is derived by prefixing a template CV- to the root and copying and associating the segmental melody as shown in (6).

(6) (a)

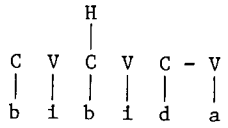

"to split"

(b)



by CV prefixation, copying of root melody and L - R association

(c)

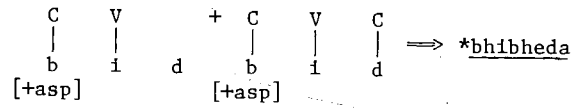


bibheda
"I have split"

by guṇa strengthening of the root

Only the material on the segmental tier is copied, so the reduplicated C is never aspirated. If aspiration were represented as part of the segmental matrix, however, the reduplication operation would derive the ill-formed (7), thus requiring another rule to account for the deaspiration.

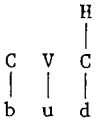
(7)



⟹ *bhibheda

2. We analyze those roots which show alternation as underlying monoaspirate, as shown in (8).

(8)



√budh "to know"

How then do we account for the alternations shown in (1)? Let us first take up the cases in which aspiration appears on the initial C of the root ((1)(c) - (g), repeated here in (9)).

(9) bhot + sya + ti
abhut + si
bhut #
bhud # bhis[3]
bhud + dhvam

Aspiration is thrown back in the following environments: before -s; word finally; and before the 2nd person pl. endings -dhve and -dhvam. In segmental terms the rule can be stated as follows (this formulation is a somewhat simplified form of the rule as presented in Sag 1974:604):

(10) $[^{-son}_{+voice}] \rightarrow [+asp] / [_{Root}\text{\_\_}[+seg]_0[+asp]] \begin{Bmatrix} s \\ dhve \\ dhvam \\ \# \end{Bmatrix}$

The process as described by this rule copies the aspiration of the root final C onto the initial C when followed by one of the relevant suffixes, or if it is word final. Thus a rule deaspirating the root final C must follow (10). In effect the rule makes diaspirates out of monoaspirates where the second C of the root will later become deaspirated. The generalization, however, seems rather to be that aspiration is dissociated in these environments and reassociated to the root-initial obstruent.

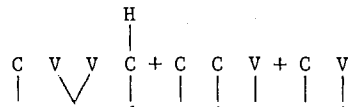
It was noted by Phelps (1975) and Hoard (1975) that the collection of environments in (10) seems to be somewhat ad hoc. However it is not the case that this is an arbitrary collection of environments. In fact it is the set of all and only those environments which cause devoicing of the root-final consonants. The fact that the suffixes -dhve and -dhvam condition throwback is an idiosyncratic fact about these morphemes and on any account will have to be stated as such (see Schindler (1976) p. 634-5 for discussion).

On our analysis, aspiration is reassociated to the root-initial consonant when the consonant to which it is associated underlyingly is devoiced.

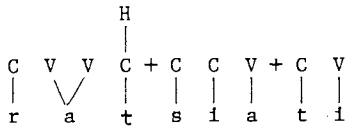
Notice furthermore that the rule in (10) has global properties in that it applies just in case an environment which is going to deaspirate the final C follows that segment. Crucially the rule must apply before this segment is deaspirated because the root-final aspiration is part of its environment. Deaspiration would bleed the rule. This is precisely the weakness of the linear treatment and the strength of the autosegmental one. Removing the aspiration from the segmental tier eliminates both the globality and the need to postulate an intervening diaspirate form in the course of the phonological derivation.

It is a characteristic property of autosegments that they don't appear on arbitrary segments: they can only be associated with 'legitimate bearers'. What counts as a legitimate bearer for Sanskrit H are the voiced stops.[4] An autosegment which during the course of a derivation finds itself associated to a segment which is no longer a legitimate bearer for it is automatically dissociated. For example, the verbal root rādh "to succeed", which we represent as in (11a), forms its future by affixing -sya to the root. A general rule of Regressive Voicing Assimilation (RVA) devoices the final consonant of the root. The result is (11b), where H is associated to a voiceless stop, which is not a legitimate bearer for H. Automatic dissociation changes (11b) into (11c).

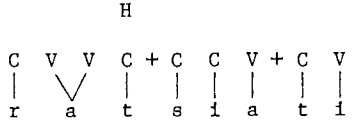
(11) (a)



(11) (b)



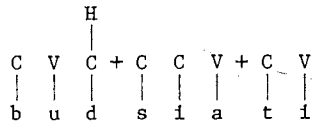
(c)



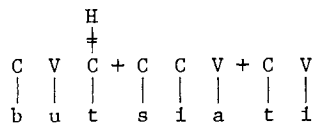
Unassociated autosegments are finally deleted, and (11c) is realized as rātsyati, which shows no trace of the underlying aspiration of the root-final consonant.

In those cases under discussion, the autosegment H does not remain unassociated after devoicing of its original bearer, but is reassociated to another consonant of the root which is a possible bearer. Consider the future of budh which is derived by RVA and subsequent dissociation and reassociation of H. The derivation is shown in (12).

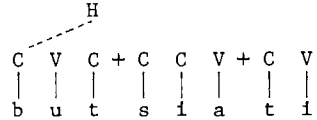
(12) (a)



(b) by RVA



(c) Reassociation



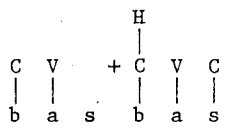
bhotsyati by guṇa strengthening of the root

The complex process of deaspiration of the final C and concomitant aspiration of the initial C is captured in this analysis by the usual procedures assumed in autosegmental phonology of dissociation from illegitimate and reassociation to legitimate bearers. The extent to which adopting the autosegmental treatment simplifies the analysis is in itself further justification for assuming the aspiration being an autosegment.

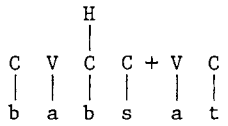
The aspiration alternation is restricted to voiced stops which are part of the root. This constraint precludes aspiration ever being thrown back on any other voiced stop, e.g. a reduplicated one.

Consider the form of the 3rd pers pl ind act of the root bhas "to devour": bapsati, *bhapsati. The derivation is as follows:

(13) (a)

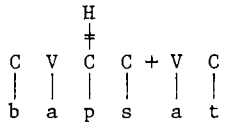


(b)



by a → Ø (Root Reduction)

(c)



by RVA

bapsati

The impossible form *bhapsati shows that H may not be reassociated to the initial consonant which is not part of the root. This seems problematic. Since we claim that (re)association is automatic, how can it be blocked in this case? (Notice that the constraint is built into the environment of rule (10). Following a suggestion made by Sag (1976:617), which we translate into autosegmental terms, we might assume that the consonant slot in the reduplication template is partially prespecified as [-H].[5] This move is not implausible, given the fact that partial prespecification of the reduplication template is independently necessary. Since velars change to palatals in reduplication (cf. jagāma, perfect from gam "to go", and cakāra, perfect from kr "to scatter"), we have to specify the C slot of the template as [-back].

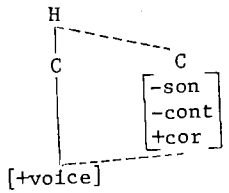
3. The last set of facts in (1) to be accounted for are the cases in which there is apparent deaspiration of the root-final consonant without accompanying throwback - (11), cf. also (14).

(14)

buddha	/budh + ta/
dugdha	/dugh + ta/
subdha	/subh + ta/

These cases show the application of Bartholomae's Law (BL) which assimilates coronal stops to a root-final voiced aspirate. We formulate BL in (15) below.[6]

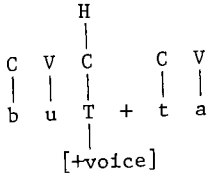
(15)



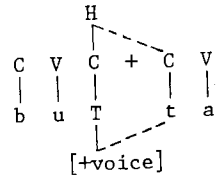
Traditionally, the process illustrated by the forms in (14) was conceived of as consisting of two rules: first, a segmental analogue of (15), followed by deaspiration of the first C in the environment of the second, thus: Ch + C → Ch + Ch → C + Ch. The interaction of this deaspiration with that of Grassmann's Law created an ordering paradox.

In our interpretation of this process, there is no deaspiration. Clusters to which BL has applied are, we claim, aspirated throughout, i.e. murmured (see footnote 1). We assume that deaspiration is only apparent and that the written form reflects orthographic convention and not phonetic fact. Since there is no dissociation of H, the lack of throwback is not surprising. Thus the form in (1i) is derived as follows:[7]

(16) (a)



(b)



BL

buddha

This reinterpretation of Bartholomae's Law resolves the ordering paradox which has been an intractable problem for most traditional Grassmannian solutions. These have generally involved deaspiration by Grassmann's Law (GL) crucially interacting with BL and the Deaspiration which accompanies it (see Sag 1974 for a full discussion). Since in our interpretation there is no deaspiration accompanying Bartholomae's law, there can't be any ordering paradox arising with respect to it!

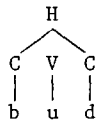
This ordering paradox, however, was Sag's main argument against the Grassmannian solution and for the throwback analysis.

Having avoided the ordering paradox, we reintroduce the Grassmannian solution as a viable alternative.

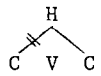
In what follows, we will briefly compare an autosegmental version of the Grassmannian solution to ours. We will present a diachronic argument in favor of the Pāṇinian solution which leads us to the conclusion that even without the ordering paradox the Grassmannian solution is inferior to the Pāṇinian solution.

4. In the Grassmannian analysis, roots are underlyingly diaspirate (see (17)); GL (18) applies to deaspirate the first aspirate if the H has not previously been dissociated from the second consonant by the same processes we referred to above.

(17)

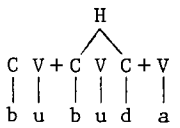


(18) GL

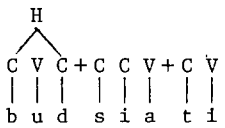


In (19) we illustrate how this analysis derives the two forms bubodha and bhotsyati.

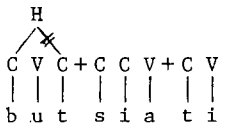
(19) (a)



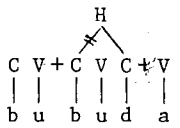
(b)



N/A



by RVA



N/A

by GL

bubodha

bhotsyati

other rules

In a comparison of the two analyses on the grounds of simplicity the Pāṇinian analysis would come out better since only one rule (RVA) accounts for dissociation of H. Throwback is done by convention. There is in our solution no analogue of GL.

If we accept the Grassmannian solution, we claim that the historical process is recapitulated as part of the synchronic grammar of Classical Sanskrit. We, on the other hand, assume that GL

correctly describes the sound change and its operation resulted in reanalysis.

What could be said in favor of this hypothesized reanalysis? In the Pāṇinian solution, a merger of roots of the form (20a) with roots of the form (20b) is predicted (see Schindler (1976) for details), whereas roots which had the form (20c) should remain distinct.

(20) (a) * H / C V C (b) * H / C V C (c) * H / C V C

The Grassmannian solution makes no such claim - diaspirate roots remain diaspirate. Therefore on the Pāṇinian analysis we expect throwback of aspiration to occur even on those roots which were never diaspirate. This is exactly the case. Consider the facts in (21) which show throwback in roots of the form (20b).

(21) √gah √grah
aghāksi jighrksati

The Grassmannian analysis would have to explain this merger by spreading the H:

(22) * H / C V C H C V C
* H / C V C

This is not implausible. However, if the change is to be explained by spreading, why was there no spreading in roots of the form (20c) as well, resulting in a total merger of all types of aspirate roots? There is no obvious explanation of this.

The Pāṇinian solution predicts only the actually occurring mergers, making no claims about initially aspirate roots.

FOOTNOTES

* We are indebted for helpful comments to Roger Higgins, Junko Ito, Paul Kiparsky and Alan Prince. The usual exculpations apply.

1. It seems reasonably clear that the voiced aspirates in Sanskrit were actually murmured sounds (see Ladefoged 1975: 122-124). Allen (1953:34) gives the following quotation from an ancient phonetic treatise (RP xiii.2. and 4-6).): "When the glottis is in an

intermediate condition (between closed and open) both breath and voice are produced. [...] Breath is emitted for the voiceless sounds and voice for others, except for the voiced fricative (h) and the voiced aspirates, where both breath and voice are emitted."

2. In Vedic Sanskrit, the intensive reduplication of some roots shows initial aspiration, e.g. bharibhrat, intens. part. of the root bhṛ "to bear" (see Wackernagel 1896:124). These facts are compatible with the treatment of reduplication proposed below if we assume that these intensive forms involve reduplication of the entire root morpheme. Under this assumption, the preservation of the aspiration is in fact predicted.

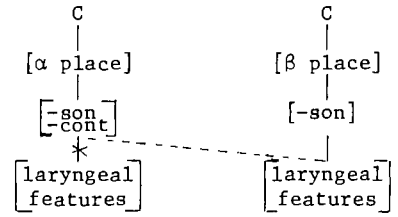
3. The position before the instr pl ending -bhis counts as word final in Sanskrit (see Sag 1974). Thus bhudbhis is a case of final devoicing. A later external sandhi rule assimilates t to the following bh in voicing.

4. Note that we are not dealing in this paper with the voiceless aspirates in Sanskrit. The voiceless aspirates do not take part in the alternations which we are discussing. In the future forms of the root prach "to ask", e.g., the root-final consonant is deaspirated (and changed to a velar), but there is no throwback of the aspiration to the initial consonant: praksyati, *phraksyati. To account for the different behavior of voiced and voiceless aspirates, we have to represent them in different ways. Moreover, since our analysis relies on the assumption that only voiced stops are possible bearers for the autosegment H, we cannot represent voiceless aspirates by positing the same autosegment H, now associated to a voiceless stop. We propose to draw the distinction by treating voiceless aspiration as a component of the segmental matrix, and not as an autosegment. Following Steriade (1982) (after Halle and Vergnaud 1980), who motivates a similar distinction for the representation of aspiration in classical Greek, we assume that the segmental matrix has some internal structure, as indicated in (i) (see Steriade 1982:45).

(i) C
[place features]
[manner features]
[laryngeal features (voicing, aspiration)]

Voiceless aspiration in Sanskrit is one of the laryngeal features in (i). The deaspiration of voiceless aspirates before obstruents is the result of rule (ii), which is needed anyhow for the Regressive Voicing Assimilation in obstruent clusters. Something like this delinking of laryngeal features must take place in Final Devoicing/Deaspiration, too.

(ii)

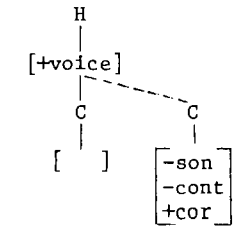


Note that it is possible to use one and the same feature H (or [+asp]) for both voiced and voiceless aspiration, the different status of this feature in the representations draws the correct distinction. If we adopt the treatment of deaspiration in reduplication suggested below, this identity in feature content is highly desirable: both voiced and voiceless aspirates are deaspirated in reduplication, and by prespecifying the initial C of the reduplication template as [-H], we can account for both cases of deaspiration.

5. We should point out that if we adopt this treatment, we lose the argument from reduplication for the independence of the autosegment H from the segmental melody. This is not devastating since we feel there is enough independent support for our analysis.

6. An alternative solution would be to map the H directly into the voice feature. This would imply that the voicing features are on a tier separate from the rest of the melody features (see Steriade 1982). This would simplify BL (it could be stated as in (i)) as well as other aspects of the analysis, and it is an attractive idea in its phonetic naturalness.

(i)



However it has associated problems as well which we have not yet been able to overcome. Thus we leave it as a suggestion at present.

7. For the sake of simplicity, we have avoided giving fully specified feature columns. In this case, however, it is clear that we must divorce the voicing feature from the rest of the segmental matrix. The archiphoneme T stands for the melody matrix minus the voicing feature.

REFERENCES

Allen, W.S. (1951) "Some Prosodic Aspects of Retroflexion and Aspiration in Sanskrit," BSO(A)S 13, 939-946.

Allen, W.S. (1953) Phonetics in Ancient India, Oxford University Press, London.

Borowsky, T. (1979) "An Autosegmental Account of the Sanskrit Diaspirates," Unpublished manuscript, University of Massachusetts at Amherst.

Clements, G. N. and K. Ford (1979) "Kikuyu Tone Shift and its Synchronic Consequences," Linguistic Inquiry 10, 173-210.

Hoard, J. (1975) "On Incorporating Grassmann's Law into Sanskrit Phonology," in Cogen et al., eds., Proceedings of the First Annual Meeting of the Berkeley Linguistics Society, University of California, Berkeley, CA, 207-220.

Ladefoged, P. (1975) A Course in Phonetics, Harcourt Brace Jovanovich, Inc., New York etc.

Marantz, A. (1982) "Re Reduplication," Linguistic Inquiry 13, 435-482.

McCarthy, J. (1979) Formal Problems in Semitic Phonology and Morphology, Doctoral dissertation, MIT, Cambridge, MA.

Mester, A. (1982) "Some Notes on Sanskrit Phonology," Unpublished manuscript, University of Massachusetts at Amherst.

Phelps, E. (1975) "Sanskrit Diaspirates," Linguistic Inquiry 6, 447-464.

Sag, I. (1974) "The Grassmann's Law Ordering Pseudoparadox," Linguistic Inquiry 5, 591-607.

Sag, I. (1976) "Pseudosolutions to the Pseudoparadox: Sanskrit Diaspirates Revisited," Linguistic Inquiry 7, 609-622.

Schindler, J. (1976) "Diachronic and Synchronic Remarks on Bartholomae's and Grassmann's Laws" Linguistic Inquiry 7, 622-637.

Steriade, D. (1982) Greek Prosodies and the Nature of Syllabification, Doctoral dissertation, MIT, Cambridge, MA.

Wackernagel, J. (1896) Altindische Grammatik I. Lautlehre, Vandenhoeck & Ruprecht, Göttingen.

Whitney, W.D. (1896) A Sanskrit Grammar, Third edition, Breitkopf und Härtel, Leipzig.