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On the Phonology of Icelandic Preaspiration¹

Höskuldur Thráinsson

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This paper presents a new phonological analysis of preaspiration in Icelandic. Its purpose is to get as close to the phonetic facts as possible while capturing at the same time the regular phonological character of Icelandic preaspiration.

The paper is organized as follows: Section 1 briefly reviews some phonetic descriptions of preaspiration. Section 2 shows why preaspiration must be considered an active phonological rule in Modern Icelandic. Section 3 presents an informal description of what the preaspiration rule has to do. Section 4 gives both an autosegmental and a more conventional generative phonological statement of the rule. Section 5 gives arguments for the autosegmental analysis. Section 6 is a Conclusion, followed by an Appendix on preaspiration in other languages.

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1. INTRODUCTION

1.1 Phonetic descriptions of preaspiration

The term *preaspiration* implies an association of the phenomenon with the succeeding rather than the preceding segment. Thus it is common to say that stops can be preaspirated as well as being postaspirated (or simply aspirated). The following descriptions are quite characteristic: "Some languages have aspiration, or a short [h] which comes before stops rather than after." (Smalley 1973: 397). "An alternative method of timing the laryngeal movements to signal the spread arytenoid configuration and the stiffened vocal folds is to actualize these gestures in advance of the supralaryngeal closure. This type of temporal adjustment will result in a preaspirated stop consonant rather than a postaspirated version." (Stevens 1975: 19). Other phoneticians talk about preaspiration in terms of the offset or cessation of the voicing of the preceding vowel, parallel to the lag in voice onset time which they consider characteristic of postaspiration. The following descriptions illustrate this view: "Another variable to be considered here is the distinction between *unaspirated* sounds (chiefly stops) on the one hand and *aspirated* or *preaspirated* sounds on the other.

This is essentially a matter of the time relations between the closed phase of the articulation and the time of *onset* (aspiration) or *cessation* (preaspiration) of voicing." (Catford 1968: 332). "We must also note that in some languages (e.g. Gaelic and Icelandic) consonants may be pre-aspirated; there may be a period of voicelessness at the end of a vowel before the articulatory stricture is made." (Ladefoged 1973: 77).

It is very likely that all these descriptions are essentially correct, since what is referred to as preaspiration is characteristically voiceless and similar to an [h], and it must be produced with a spread glottis (see Pétursson 1976: 186 for some instrumental evidence). But if preaspiration is to be viewed as being on a par with postaspiration, the difference being simply one of relative timing of laryngeal and supralaryngeal articulatory gestures, one might wonder why postaspiration is a very common phenomenon while preaspiration seems to be very rare. The only way to provide any insight into that problem is to investigate the phonology of preaspiration in some detail. In this paper I shall undertake such an investigation of Icelandic preaspiration, hoping to shed some light on the nature of the phenomenon and provide a model for similar investigations of preaspiration in other languages.

1.2 Preaspiration in Icelandic

Although there is now fairly general agreement that preaspiration in Icelandic normally has the phonetic quality of an [h], there has been some controversy about this in the past. Thus Liberman has claimed that "Icelandic preaspiration is realized not only as [h], but also as [x], [ç], and perhaps even as [f], depending on the preceding vowel and the following consonant" (Liberman 1971: 271; see also Liberman 1970 and 1972). This claim is based, however, on an old and inaccurate description (Goodwin 1905 and 1908). Icelandic phoneticians have in general not agreed with this claim (cf. e.g. Ófeigsson 1920–24: XVII, Einarsson 1927: 13, Guðfinnsson 1946: 36 ff.), and recent instrumental studies have failed to support it (Pétursson 1972a: 65–67, Garnes 1974, Thráinsson 1975). It is quite possible that Goodwin has in some instances been confused by words like *bágt* 'poor'(neuter), which can either keep its velar fricative and thus be pronounced [pauxt],² or, more normally, lose the fricative and be pronounced [pauht].³ But it should also be mentioned that the phonetic quality of preaspiration varies somewhat, depending on the preceding vowel, as Einarsson, for instance, pointed out (1927: 13, 1945: 2). This is usually quite clear on spectrograms, where the formant

structure of the preceding vowel is partially reflected in the preaspiration segment (cf. e.g. Garnes 1974: 432). This is, in fact, what one would expect if the articulation of preaspiration is essentially that of an [h], i.e. a spreading of the glottis with no inherent supralaryngeal configuration. One characteristically finds the same phenomenon in the case of a pre- and postvocalic /h/. In addition, there are bound to be somewhat different formant transitions in the preaspiration, depending on the succeeding consonant, but that follows from general laws of coarticulation. Hence I shall transcribe preaspiration as [h] in this paper.

This way of indicating preaspiration in phonetic transcription is also meant to imply that preaspiration typically has a normal segment length in Icelandic, whereas postaspiration is generally much shorter (cf. Pétursson 1972a, Garnes 1974). This suggests that preaspiration is not simply the inverse of postaspiration, as its name and some phonetic descriptions might lead us to believe. I shall indicate this difference by transcribing postaspiration by an [ʰ] above the line. This implies the giving of a segment status to preaspiration and not to postaspiration, and a rejection of the view sometimes advanced that preaspiration is to be considered a component or a phonetic feature of the succeeding stop (cf. e.g. Haugen 1958: 72). The reason for this will become clearer below.

2. ARGUMENTS FOR THE EXISTENCE OF A PREASPIRATION RULE

2.0 The alternatives

Having established that Icelandic preaspiration is normally best represented by an [h] on the phonetic level, our next task is to determine how it should be represented in underlying or lexical representation.

First, one might want to claim that the preaspiration segment simply represents an underlying /h/ in every case. I shall refer to this as the strong /h/ analysis. Second, one could claim that the preaspiration segment only sometimes represents underlying /h/ and is derived by a phonological rule in other cases. I shall refer to this as the weak /h/ analysis. The third possibility is to maintain that preaspiration is derived by a rule in every case. I shall refer to this as the rule analysis. Below I shall compare variants of these analyses, and I shall argue that the rule analysis is the only tenable alternative. I shall occasionally refer to the other alternatives collectively as the /h/ analysis when further distinctions are irrelevant.

It should be made clear that the /h/ analysis is not simply a strawman

set up here for expository purposes. First, it is clear that some version of the /h/ analysis would be imposed by the so-called biuniqueness condition (Chomsky 1964: 80–81). It seems to be an analysis of this sort that Pétursson has in mind when he says that “La conclusion qui semble s’imposer c’est qu’en islandais il n’y a pas de consonnes préaspirées, mais qu’il y a la consonne *h* suivie d’une consonne occlusive.” (Pétursson 1972a: 67, 1974: 186). Such an analysis is also discussed in Haugen (1941: 102, 1958: 72), who rejects it on phonological grounds. It is also considered from a phonological point of view in a recent study by Árnason (to appear), and although it is rejected there, the author does not seem to find it totally implausible.

Secondly, it will become clear below that certain recent schools of “concrete phonology”, such as Hooper’s or Vennemann’s “natural generative phonology” (cf. e.g. Hooper 1976, Vennemann 1974) would not allow the rule analysis but would be forced to adopt at least the weak /h/ analysis. Hence it is of considerable theoretical interest if we can show that only the most abstract analysis, namely the rule analysis, is able to account for all the facts in a satisfactory way.

In the following comparison I shall take the weak /h/ analysis to imply that the preaspiration segment [h] only represents an underlying /h/ in cases where there is no alternation. In other cases I shall assume that it would be derived by a rule under the weak /h/ analysis.

2.1 The first class of examples

2.1.1 Words with no alternation

First, let us consider a common type of examples of words where preaspiration occurs:

- | | | | | | | |
|-----|-------|-----------------------|---------|--------|----------|-------|
| (1) | kappi | [k ^h ahpI] | ‘hero’ | hattur | [hahtYr] | ‘hat’ |
| | þakka | [θahka] | ‘thank’ | | | |

In examples of the kind exemplified in (1) we get preaspiration plus a short stop where the orthography has *-pp-*, *-tt-*, *-kk-*. These sequences belong to the stem in each case, and the forms do not alternate with forms without preaspiration. Consequently, we would be forced to set up underlying stem forms like /kahp-/, /haht-/, /pahk-/, if we adopted a constraint on abstractness like the following one, proposed by Vennemann (1974: 347): “Lexical representations of non-alternating parts of morphemes are identical to their phonetic representations.” This constraint forms a part of

Vennemann's "Strong Naturalness Condition", which is accepted with minor revisions by for instance Hooper (1976).

It is clear that words of this sort represent the best case for the /h/ analysis. It should be pointed out, however, that it is not an accident that we get preaspiration in words spelled with *-pp-*, *-tt-*, *-kk-*. This spelling undoubtedly reflects historically long (or geminate) /p,t,k/ respectively (in most cases at least). Hence there must have been a diachronic rule at some stage, changing /pp/, /tt/, /kk/ to [hp], [ht], [hk]. Proponents of the /h/ analysis could, of course, accept this and claim that this historical change has led to a restructuring such that words with historically long /pp/, /tt/, /kk/ are now interpreted synchronically as containing the sequences /hp/, /ht/, /hk/, respectively. The question is then simply this: Is the preaspiration rule still operative in the synchronic phonological system of Modern Icelandic or have the words where it applied historically been restructured as containing an underlying /h/?

If no such restructuring has taken place, it is probably possible to state a very simple morpheme structure constraint for Icelandic that limits the occurrence of underlying /h/ to word-initial position. From that point of view it would be preferable to analyze even nonalternating words like *kappi*, *hattur*, *þakka* as containing underlying geminate stops rather than a preconsonantal /h/. This seems to be one of Haugen's reasons for rejecting the /h/ analysis (Haugen 1958: 72), although he is, of course, working within a different theoretical framework. Árnason (to appear) also gives a similar argument against the /h/ analysis. We shall see below, especially in 2.1.3, that there are other and more compelling reasons for analyzing nonalternating words as containing underlying long or geminate stops. We must first, however, argue for the necessity of a preaspiration rule to account for synchronic alternations.

2.1.2 Some synchronic alternations

2.1.2.1 Simple alternations

It should be emphasized at the beginning that by assuming that the preaspiration rule mentioned above is still operative in Icelandic, the simplest and strongest version of the rule analysis predicts that this rule will apply whenever the sequences /pp/, /tt/, /kk/ arise through morphological or phonological processes⁴ and hence that such sequences will never be pronounced as [p:], [t:], [k:] in Icelandic. The strong /h/ analysis makes no such prediction at all, and the weak /h/ analysis will only derive [hp], [ht], [hk] from underlying /pp/, /tt/, /kk/ if there are synchronic alterna-

tions to be accounted for. It is very important to keep these distinctions in mind.

Our first argument for the existence of a preaspiration rule in Modern Icelandic is based on the formation of the neuter of adjectives (see also Árnason, to appear):

(2)	Fem. sg.	Neut. sg.
rík	'rich'	rík-t
sæl	'happy'	sæl-t
aum	'miserable'	aum-t
græn	'green'	græn-t
djúp	'deep'	djúp-t

As the examples in (2) illustrate, the stem of adjectives shows up in the fem. sg. and the neuter is quite regularly formed by adding a /t/ to the stem. Hence we would expect the neuter of adjectives with a stem-final /t/ to be formed the same way, giving rise to the sequence /tt/. If there were no synchronic rule of preaspiration in Icelandic, we would expect such forms to be pronounced with a long [t:], whereas the rule analysis predicts that the preaspiration rule should apply here and give [ht]. That is the correct prediction, as shown in (3):⁵

(3)	Fem. sg.	Neut. sg.
feit	[fei:t ^h] 'fat'	feitt [feiht] ⁶
ljót	[ljou:t ^h] 'ugly'	ljótt [ljouht]
sæt	[sai:t ^h] 'sweet'	sætt [saiht]

Here the strong /h/ analysis immediately runs into trouble. There seem to be three alternatives that its proponents could resort to. First, they could claim that the neuter forms in (3) are synchronically irregular and have a different stem form from the feminine (and masculine), namely /feih-/ , /ljóh-/ , /sæh-/ . Secondly, they could claim that the stem is regular but there is a different morphological rule at work, namely one infixing a neuter marker /h/, as suggested by Árnason (to appear). Thirdly, those who believe in the separation of morphophonemics and phonology (or phonemics) could claim that the alternations observed in (3) are morphophonemic, i.e. that the stems have a morphophonemic base form like //feit// , //ljót// , //sæt// , for instance, and there are alternations between the phonemes /t/ and /h/ in stemfinal position that are governed by a morphophonemic rule rather than being a part of the phonology.

Although the first two alternatives would seem to "work" in the sense

that they are compatible with the phonetic facts, they make wrong predictions about the phonology and morphology of Icelandic. First, there is no evidence at all that native speakers of Icelandic feel that neuter forms like *feitt*, *ljótt*, *sætt* are not perfectly regularly formed. If they had different stems or were formed by a special morphological rule (infixation), one would expect that speakers would occasionally make mistakes and create “regular” neuter forms by adding a /t/ to the stem as it appears in the fem. and pronounce the result with a long [t:]. The fact that no such thing happens strongly supports the rule analysis.

The morphophonemic alternative is clearly more plausible, since it admits that there is a regularity here, although it relegates it to morphophonemics rather than considering it an integral part of the phonology. The weak /h/ analysis, being almost identical to the morphophonemic variant just described except for terminology, could capture the phonological regularity of these forms, but it claims that the occurrence of [ht] in words of this type is synchronically a very different phenomenon from the [ht] we get in *hattur*, for instance, since the former sequence is derived by a synchronic rule from an underlying /tt/ while the latter goes back to underlying /ht/. In the following sections we shall see that this double origin hypothesis makes it impossible to capture a number of interesting generalizations about Icelandic phonology.

2.1.2.2 Preaspiration following assimilation

The rule analysis predicts that the preaspiration rule should apply to instances of /pp/, /tt/, /kk/ that are created by assimilation. There are a number of such cases, especially with /tt/, and the prediction is borne out in every case. We shall now look at some of these examples.

Weak verbs form past tense by adding a dental suffix which can show up in various forms. On the basis of forms like *ná* past *náði* [nau:ði] ‘attain’, *heyra* past *heyrði* [heirði] ‘hear’, etc., one might want to argue that the underlying form of the past tense morpheme is /ð/. If that is the case, we would have to assume a phonological rule changing underlying /ð/ to a /t/ in cases where the stem ends in /s,p,k/, for instance, as evidenced by the forms in (4):

(4)	Inf.	Past
	leys-a	‘untie’
	gláp-a	‘stare’
	vak-a	‘wake’
		leys-t-i
		gláp-t-i
		vak-t-i

Now if the stem should end in a /t/, we might expect the same to hold there. That would give rise to the sequence /tt/, and the preaspiration rule should apply, according to the rule analysis, giving [ht]. This is exactly what happens, as shown in (5):

(5)	Inf.		Past
	mæta	[mai:t ^h a] 'meet'	mætti [maihtɪ]
	veita	[vei:t ^h a] 'grant'	veitti [veihtɪ]
	nýta	[ni:t ^h a] 'utilize'	nýtti [nihtɪ]

It is obviously difficult for the strong /h/ analysis to account for this in any reasonable way. The implausible alternatives of postulating irregular stems or a special morphological infixation rule were discussed in 2.1.2.1 above, and the discussion need not be repeated here. In fact, if one were to analyze the past tense morpheme as underlyingly /t/, the two cases would be exactly parallel (cf. Árnason, to appear). The morphophonemic analysis is less plausible here than it was before, because the assimilation of /tð/ to /tt/ would presumably have to be considered morphophonemic and the preaspiration rule has to follow assimilation here (be "sub-phonemic"). Hence the cases involving assimilation present an even stronger argument for the existence of a phonological rule of preaspiration.

A very similar situation arises in the formation of imperatives, as shown in (6):

(6)	Formal style	Colloquial style
	leys þú 'you untie!'	leys-tu
	gláp þú 'you stare!'	gláp-tu
	vak þú 'you wake!'	vak-tu

In these examples we see that whereas the formal style has the stem form of the verb plus the 2nd pers. pronoun *þú*, the informal style has an enclitic form *-tu* of the 2nd pers. pronoun as a suffix on the stem in case it ends in /s,p,k/. This enclitic also shows up in other forms (cf. *ná-ð* 'attain!', *heyr-ðu* 'hear!'), but we would a priori expect it to show up in the *-tu* form in case the stem ends in a /t/, since that is the form it takes on following the phonologically similar /s,p,k/. The rule analysis of preaspiration would then obviously predict that the colloquial imperative of verbs with stemfinal /t/ should be pronounced with a [ht], and this prediction is correct, as shown in (7):

(7)	Formal			Colloquial	
mæt	[mai:t ^h]	þú [θu:]	mættu	[maihtY]	
veit	[vei:t ^h]	þú	veittu	[veihtY]	
nýt	[ni:t ^h]	þú	nýttu	[nihtY]	

Assimilation can also be found in the formation of the neuter of adjectives ending in a dental spirant, as shown in (8):

(8)	Fem. sg.			Neut. sg.	
væð	[vai:ð]	'wadeable'	vætt	[vaiht]	
óð	[ou:ð]	'crazy'	ótt	[ouht]	
leið	[lei:ð]	'bored'	leitt	[leiht]	

Here we have preaspiration in the neuter again. It is quite obvious that we have to assume underlying stem forms like /væð-/ , /óð-/ , /leið-/ (cf. the fem. forms above and the masc. forms *væð-ur*, *óð-ur*, *leið-ur*). A regular neuter formation would then give underlying /væð+t/, /óð+t/, /leið+t/. The most plausible way to account for the phonetic realization of these forms is to assume an assimilation rule, giving intermediate /væt+t/, /ót+t/, /leit+t/, and then the preaspiration rule would automatically give the correct phonetic output. This assimilation rule could also account for forms like past part. *rætt* 'discussed' from underlying /ræð+ð+t/ (cf. inf. *ræða* 'discuss'). The less attractive alternative would be to claim that these cases are not instances of preaspiration but rather the result of a separate rule changing /ð/ to [h].

Still another case of assimilation is shown in (9):

(9)	þófta	[θoufta]	or	[θouhta]	'a thwart'
	aftur	[aftYr]	or	[ahtYr]	'again'

In careful pronunciation one can keep the labiovelar spirant, as shown above. Alternatively, the spirant can be assimilated to the following /t/, giving an intermediate /tt/ which is then realized phonetically as [ht] as the rule analysis of preaspiration predicts. This case is different from the ones discussed above in that here the assimilation is optional (cf. that it is not reflected in the orthography).

As a final case of assimilation feeding preaspiration, one can mention the verb meaning 'to become more handsome', which is either spelled *fríðka*, which reflects a pronunciation like [friðk^ha], or, more commonly, *frikka*, reflecting the usual pronunciation [frihka]. The verb is obviously related to the adj. *fríður* 'handsome', and it seems natural to express this relation by postulating an underlying /friðka/. The most common pronunciation would then be derived by applying an assimilation rule /ðk/ →

/kk/ plus the general preaspiration rule we have been assuming. This derivation is partially reflected in the spelling *fríkka*.

All the cases involving assimilation obviously support the rule analysis and constitute evidence against the strong /h/ analysis. Note, for instance, that it would not be possible to derive neuter forms like [vaiht] from the stem /væð-/ by a morphological infixation rule inserting an /h/. And in cases like *pófta*, *fríkka*, etc., the strong /h/ analysis has no way of synchronically relating the preaspiration in these words to the other cases of preaspiration discussed above. Hence it clearly misses a generalization that we would like our grammar to capture. But since all the cases discussed in this section involve some kind of alternation, they are not counterexamples to the weak /h/ analysis as described above. But, as before, the weak /h/ analysis would claim that these instances of preaspiration are of a different nature synchronically from the ones discussed in Section 2.1.1, these being derived by a synchronic rule, the others not.

2.1.3 Neologisms, loanwords, and Icelandic accent

The rule analysis of preaspiration makes an explicit claim about the system of phonological rules that every fluent speaker of Icelandic has internalized. Hence it predicts that Icelanders will apply the preaspiration rule to new words or neologisms that meet its structural description. In its simplest form it also predicts that the rule will be applied to loanwords. It is also well known that speakers often tend to apply phonological rules from their own language when learning a foreign language. Hence we predict that Icelanders learning foreign languages will tend to pronounce certain foreign words with preaspiration, if there is a “psychologically real” preaspiration rule in Modern Icelandic. Such a pronunciation would then constitute a part of the “Icelandic accent”.

The strong /h/ analysis does not make any of these predictions. If all instances of preaspiration in Icelandic were simply residues of a historical change, we would not expect preaspiration to figure regularly in new words, we would not expect it to show up in loanwords, and we would not expect it to characterize the Icelandic accent. We shall return to the morphophonemic alternative and the weak /h/ analysis below.

All predictions of the rule analysis about new words, loanwords, and the Icelandic accent are correct, and the facts thus constitute a new and interesting type of argument for the rule analysis. Let us first look at some examples of Icelandic accent. The following set of German and English words is characteristically pronounced roughly as indicated in the phonetic transcription by not-so-fluent Icelandic speakers of these languages:

(10)	Lippe	[lɪhpɛ]	‘lip’	Mitte	[mɪhtɛ]	‘middle’
	mit	[mɪht]	‘with’	Acker	[ahkɛr]	‘field’
	copper	[k ^h ɔhpɛr]		rip	[rɪhp]	
	litter	[lɪhtɛr]		met	[mɛht]	
	soccer	[sɔhkɛr]		bloc	[plɔhk]	

The important thing to notice here is the preaspiration of the /p,t,k/. Note in particular that it even occurs in words like *mit* ‘with’, *rip*, *met*, *bloc*, as originally pointed out by Haugen (1958: 72n). The explanation for this interesting fact about the Icelandic accent seems to be the following: There are no words in Icelandic that contain a stressed short vowel followed by a single short consonant. If the vowel is short, a long consonant (or two or more consonants) must follow (see 3.1.1 below). When Icelanders are faced with stressed VC sequences in foreign languages, they will therefore tend to interpret them as either V:C or VC:. Which of these two possibilities is chosen seems to depend on the vowel (see also 3.1.3 below). In the case of German, where there are relatively clear differences between short and long vowels, the matter is quite simple: Words with short vowels like *Lippe*, *Mitte*, *Acker*, etc., are analyzed as containing a vowel followed by a phonologically long or geminate consonant, i.e. /pp/, /tt/, /kk/ in the cases above. But then the preaspiration rule takes over and gives the [hp], [ht], [hk] pronunciation. When the vowel is long, on the other hand, as in *Mut* ‘courage’, *Miete* ‘rent’, etc., the succeeding consonant is (correctly) analyzed as short, because such words fit perfectly into the Icelandic quantity system (which has a rule lengthening stressed vowels before single consonants, cf. 3.1.1 below).

In English, the quantity differences between vowels are perhaps less clear. It seems, however, that “lax” vowels such as [ɪ, ɛ, ɔ], are generally interpreted as short by Icelandic students of English, at least in words of the type cited above. Hence the following consonant is analyzed as phonologically long, and we get phonological /ripp/, /mett/, /blokk/ for *rip*, *met*, *bloc*, and because there is a rule of preaspiration in Icelandic, these words are pronounced with preaspiration. Words with tense or diphthongal vowels, on the other hand, such as *deep*, *beat*, *coke*, *fate*, are interpreted as containing phonetically long vowels and hence (correctly) analyzed as containing short /p,t,k/.⁷

Facts of this sort constitute quite powerful evidence for the rule nature of preaspiration. If there were no such rule in Modern Icelandic, there would be no reason for Icelandic speakers to pronounce foreign words of the sort discussed above with an [h]. They are not so pronounced by the

speakers of the languages in question, so it cannot be a case of simple imitation. And if Icelanders were simply trying not to violate a surface constraint that prohibits short stressed vowels followed by single short consonants, it is not at all clear why they should choose to do so by inserting an [h]. In particular, it would seem simpler just to lengthen the stop phonetically and pronounce the words in question with [p:], [t:], [k:], e.g. [mIt:], [rIp:], [mæt:], [pløk:]. That way the words would not violate this constraint, and they would actually sound more like the correct pronunciation, if anything. Furthermore, comparable words exist in Icelandic, cf. *grobba* [krɔp:] 'bragging', *odd* [ɔt:] 'point'(acc.), *dogg* [tɔk:] 'cone'(?), etc. The fact that preaspiration rather than simple phonetic lengthening characterizes the pronunciation of these words by Icelanders indicates that phonological (re-)interpretation rather than simple surface adjustment takes place.

It is instructive to consider the implications of the [h]-insertion alternative more closely. Note, in particular, that such a solution has no way of relating the phenomenon under discussion to the existence of a preaspiration rule in Icelandic. Its proponents would either have to claim that the insertion of [h] into foreign words of the sort exemplified above is an isolated phenomenon, unrelated to anything else, or that it is a general strategy of speakers of Icelandic to insert an [h] into foreign words that do not seem to fit into the Icelandic quantity system. Our analysis, on the other hand, predicts that VC sequences in foreign words are analyzed by Icelanders as containing either a phonologically long or a phonologically short consonant, depending on the quantity and perhaps also the quality of the vowel. If the consonant in question is analyzed as /pp/, /tt/, /kk/, this analysis leads to preaspiration according to our preaspiration rule, but in other cases a phonologically long or geminate consonant should give rise to a long consonant on the phonetic level. This prediction is borne out by the frequent pronunciation of English words like *rib*, *bed*, *dog*, *fine*, *fun*, *dim*, etc. as [rIp:], [pæt:], [tɔk:], [fIn:], [fæn:], [tIm:]. Although the (lax) vowels of these words are generally somewhat longer than those preceding /p,t,k/ (cf. e.g. Peterson and Lehiste 1960), they seem to be interpreted as short by Icelanders, and hence the succeeding consonant is analyzed as phonologically long or geminate, i.e. /bb/, /dd/, /gg/, /nn/, /mm/, which gives [p:], [t:], [k:], [n:], [m:] preceded by a short vowel by the rules of Icelandic phonology (cf. 3.1.1 below). Again, the reverse happens in the case of tense or diphthongal vowels, such as in *bead*, *cloud*, *fine*, *dime*, which are pronounced with long vowels and short consonants by Icelanders.

The facts just reviewed show clearly that it is not a general strategy of Icelandic speakers to insert an [h] between a short (lax) vowel and a short consonant in foreign words to make them fit into the Icelandic quantity system. The general strategy is to analyze the consonant as phonologically long. That explains the occurrence of preaspiration in certain foreign words, because preaspiration consonants are the phonetic realization of long /pp/, /tt/, /kk/ in Icelandic, according to our analysis. Any attempt to explain the occurrence of preaspiration in the Icelandic accent in terms of some kind of [h] insertion will fail to capture this important generalization.

It is also worth pointing out that this phonological analysis of foreign words is reflected in the way loanwords are adapted to the Icelandic system. One good example is Icelandic *sjoppa* [sjɔhpɑ] ‘kiosk’, pronounced with a preaspirated *p* and written with a *-pp-*, which reflects the analysis suggested above.⁸

It is important to notice that the morphophonemic alternative would not work in any of the examples discussed in this section because there are no morphophonemic alternations. It is also very difficult to see how these facts could be satisfactorily accounted for by the weak /h/ analysis. The foreign words, the loanword *sjoppa*, and such loanwords as *lotteri* [lɔhteri] ‘lottery’, *rokk* [rɔhk] ‘rock’, do not show any alternations that would allow proponents of this analysis to set up underlying forms with /pp/, /tt/, /kk/ and derive the phonetic representation via the preaspiration rule. They would therefore have to say that these words are interpreted by Icelanders as containing an underlying /h/. But why should that be the case? The rule analysis clearly offers a much more plausible explanation here, as described above. As a desperate effort to save the weak /h/ analysis, one could perhaps claim that the loanwords and foreign words discussed above are actually first interpreted as containing underlying /pp/, /tt/, /kk/, and hence they undergo the preaspiration rule, but then they are immediately restructured as containing underlying /hp/, /ht/, /hk/. It is very difficult to see any motivation for such a move other than the desire to save Vennemann’s “Strong Naturalness Condition” mentioned above, or similar constraints on abstractness, at any cost. We shall see more evidence against such conditions below (e.g. in 2.2.3).

2.2 The second class of examples

2.2.1 Words with no alternation

Another class of instances of preaspiration in Icelandic is usually de-

scribed as preaspiration occurring before /p,t,k/ + /l,n/. Some examples are given in (11):

- | | | | | | | |
|------|------|----------|----------|-------|----------|------------|
| (11) | epli | [ehplɪ] | ‘apple’ | opna | [ɔhpna] | ‘open’ |
| | ætla | [aihtla] | ‘intend’ | vetni | [vɛhtnɪ] | ‘hydrogen’ |
| | ekla | [ɛhkla] | ‘lack’ | vakna | [vahkna] | ‘wake up’ |

In these examples there are no alternations between forms with and without preaspiration, so the /h/ analysis would claim that the preaspiration segment here simply represents an underlying /h/. As before, it is generally assumed that historically there was no /h/ in these words, so the question is basically whether the rule creating the [h] is still active in Icelandic or whether the words have been restructured. We could again advance the argument about simpler rules for the distribution of underlying /h/, if a preaspiration rule were assumed, but we would like to find some synchronic phonological evidence.

2.2.2 Some synchronic alternations

2.2.2.1 Simple alternations

The simplest argument comes again from the formation of morphological categories. The gen.pl. of a large class of weak feminine nouns ends in *-na*, which is added to the stem. If we assume a phonological rule of preaspiration, which is sensitive to the above-mentioned sequences /p,t,k/ + /l,n/, we would predict that preaspiration should show up in the gen.pl. of weak fem. nouns that are formed by adding *na* to stems ending in /p,t,k/. This prediction is borne out by the facts, as exemplified in (12):

- | | | | |
|------|----------|-------------------------------------|----------|
| (12) | Nom. sg. | | Gen. pl. |
| | pípa | [p ^{hi} :p ^h a] | ‘pipe’ |
| | gata | [ka:t ^h a] | ‘street’ |
| | kaka | [k ^h a:k ^h a] | ‘cake’ |
| | pípna | [p ^h ihpna] | |
| | gatna | [kahtna] | |
| | kakna | [k ^h ahkna] | |

The strong /h/ analysis cannot account for these alternations in a regular phonological fashion. It cannot even resort to the morphological solution of /h/ infixation here, because the [h] does not replace the regular gen.pl. ending but is instead completely dependent on the occurrence of the /n/, as can be seen from the following: Not all weak fem. nouns take this *-na* ending as a gen.pl. marker. Some only take *-a* (e.g. *lilja* ‘lily’), in others there is idiolectal variation or some vacillation with respect to the gen.pl. One such word is *kaka*, which has either the gen.pl. form *kakna* [k^hahkna] given above or *kaka* [k^ha:k^ha] without the /n/ and without the preaspira-

tion segment. Forms with the preaspiration segment and without the /n/, or without the preaspiration segment and with the /n/ – i.e. *[k^hahka] or *[k^hakna] – are totally impossible for any speaker. This is, of course, what we would expect, if preaspiration is governed by a rule that is sensitive to the presence of the /n/, but it is very hard to see why this should be the case if the preaspiration segment were an independent genitive morpheme in underlying representation, especially since there is nothing phonetically wrong with the starred sequences above – cf. that *sakka* [sahka] is a perfectly acceptable gen.pl. of *sakka* ‘plummet’, and *sagna* [sakna] is a perfect gen.pl. of *saga* ‘story’. What is wrong with the starred examples is just that they cannot be gen.pl. forms of *kaka* for phonological reasons.

It is presumably possible to work out a morphophonemic solution here, but it will become increasingly difficult and finally impossible in the following sections.

2.2.2.2 Preaspiration following syncope

There are numerous cases where the sequences /p,t,k/ + /l,n/ are created by the application of a syncope rule. Whenever such sequences arise, we get preaspiration as predicted by the rule analysis. The exact formulation of the rule governing this syncope need not concern us here (for discussion see Benediktsson 1969: 393–396, Orešnik 1972: 18–21, Anderson 1974: 142). The instances of syncope that concern us occur in unstressed syllables of nouns and adjectives, if an inflectional ending that begins with a vowel is added. This is illustrated in (13):

(13)		Dat. sg.	Nom. pl.
depill	‘dot’	/depil+i/	/depil+ar/
	syncope:	depl+i	depl+ar
		[təhplɪ]	[təhplar]
jökull	‘glacier’	/jökul+i/	/jökul+ar/
	syncope:	jökl+i	jökl+ar
		[jœhklɪ]	[jœhklar]
jötunn	‘giant’	/jötun+i/	/jötun+ar/
	syncope:	jötn+i	jötn+ar
		[jœhtnɪ]	[jœhtnar]

Exactly the same occurs in adjectives like *opinn* ‘open’, *lotinn* ‘stooping’, *mikill* ‘great’. Preaspiration always and only shows up when syncope has taken place and created the proper phonological environment. It is obvi-

ously impossible to capture this regularity under the strongest forms of the /h/ analysis (cf. Árnason to appear). And since a (phonological) rule precedes the preaspiration rule here, the morphophonemic alternative loses its appeal.

A rather similar situation arises in the case of certain masculine nouns, when the definite article is suffixed, as shown in (14):

(14)			Dat. sg.
kópurinn	'the young seal'	kópinum	or kópnum
báturinn	'the boat'	bátinum	or bátnum
hrókurinn	'the rook'	hrókinum	or hróknum ⁹

The stems of these words end in /p,t,k/. They sometimes have an *-i-* as a dative marker. When they do, there is no preaspiration in the dat.sg. with the suffixed article (or in any other form of the noun), but when they do not have this dative marker and the dat.sg. form of the article *-num* is added directly to the stem, sequences of the type /p,t,k/ + /n/ arise and preaspiration occurs. This is completely without exception – i.e. preaspiration is impossible when the *-i-* intervenes between /p,t,k/ and the /n/, and it is obligatory when no *-i-* intervenes. This is, of course, exactly what we would expect if preaspiration is rule-governed. But if we were to adopt the strong /h/ analysis, it is very hard to see why this should be the case. Again, it has nothing to do with admissible vs. inadmissible phonetic sequences, because there are instances of [hp], [ht], [hk] (derived from /pp/, /tt/, /kk/ according to our rule) followed by an *-i-*, such as in dat.sg. *koppinum* [k^hɔhpInYm] 'the chamber pot', and there are also sequences of phonetic [p,t,k] followed by [l,n] and not preceded by preaspiration, such as in the dat.sg. *stafnum* [stapnYm] 'the cane' (see sections 3.3 and 4.3 below).

2.2.3 Neologisms, loanwords, and Icelandic accent

As before, the rule analysis predicts that new words and loanwords should undergo the preaspiration rule. This prediction is borne out by the facts. The recently coined word *bota* 'jet' is a case in point. It is a weak feminine noun, and its stem ends in a /t/. Hence the rule analysis predicts that it should be pronounced with preaspiration if the gen.pl. marker *-na* is added, and this is correct: *botna* [θɔhtna]. Again, however, there is some vacillation about the gen.pl., so some only add an *-a*, giving *þota* [θɔ:t^ha]. These are the only possible gen.pl. forms, as predicted by the

rule analysis – i.e. if there is no *-n-* in the gen. marker, no preaspiration is possible, and if there is an *-n-*, preaspiration is obligatory.

Although alternations are involved here, it is not clear that this treatment of new words is predicted by the morphophonemic variant of the /h/ analysis, unless its proponents would be willing to ascribe a “psychological reality” to morphophonemic rules governing such alternations. If they are, the morphophonemic alternative becomes suspiciously similar to our rule analysis.

Another interesting piece of evidence comes from the loanword *rytmi* ‘rhythm’. A priori one might have expected that /m/ would behave the same way as /l,n/ with respect to preceding /p,t,k/ – i.e. that preaspiration should occur if sequences like /p,t,k/ + /m/ arise. I do not, however, know of any simplex native words in Icelandic that have such sequences. The pronunciation of the loanword *rytmi* [rɪhtmi] shows, however, that /m/ has this property (cf. Árnason (to appear)). It should also be noted that since *rytmi* does not show any alternations, no variant of the /h/ analysis would allow the [h] to be derived synchronically from anything other than an underlying /h/. Hence even the weak /h/ analysis would be faced with similar problems here as in the case of the loanwords discussed in 2.1.3 above.

It should also be mentioned that syncope can occur in loanwords and create sequences of the proper type for preaspiration to apply. The recent loanword *bítill* ‘Beetle’ is a case in point, as illustrated in (15):

(15)	Dat. sg.	Nom. pl.
bítill	/bítill+i/	/bítill+ar/
syncope:	bítill+i	bítill+ar
	[pihtlɪ]	[pihtlar]

Finally, one could mention the Icelandic accent pronunciation of such English words as *poplar* [pʰɔhplar], *butler* [pœhtlər], *utmost* [œhtmost], *Cockney* [kʰɔhkni], etc., which show that the preaspiration rule is also applied to foreign words that are analyzed as containing sequences of the type /p,t,k/ + /l,m,n/. This presents one more problem for even the weak version of the /h/ analysis, since there seems to be no reason to interpret these words as containing an underlying /h/, and they do not show any alternations that would allow a synchronic derivation of the [h] from anything other than an underlying /h/. Note also that these words would seem to fit perfectly well into the Icelandic quantity system without any [h] intervening between the vowel and the stop, because more than one

consonant follows the short vowel anyway. Hence these cases are somewhat different from the ones discussed in 2.1.3 above.

2.3 Conclusion of section 2

We must conclude that there is overwhelming evidence for the existence of a synchronic phonological rule of preaspiration in Modern Icelandic. The strong /h/ analysis is clearly untenable. The reason is not only that it leads to a more complicated morphology and makes it more difficult to relate morphology and phonology, as argued by Árnason (to appear). It is much more important to realize that it makes very different claims about the phonological structure of Modern Icelandic than does the rule analysis. The rule analysis claims that preaspiration is a completely regular and rule-governed phenomenon in Modern Icelandic. It predicts that preaspiration will only and always show up under certain phonological conditions. Hence it predicts among other things that new words and loanwords should be subjected to this rule, if they satisfy the phonological conditions for its application. Furthermore, it predicts that Icelanders will be likely to apply this rule to foreign language material in the early stages of learning a foreign language. All these predictions are borne out by the facts, and that is what constitutes the most compelling argument for the rule analysis of preaspiration. At the same time the /h/ analysis becomes untenable, since it does not make these predictions. In so far as the strong /h/ analysis makes any predictions at all, it would seem to predict the opposite in all cases, whereas the weak /h/ analysis could account for regular alternations but not for the facts about loanwords and Icelandic accent discussed above.

Now recall that by adopting the rule analysis of preaspiration, we can probably claim that underlying /h/ is restricted to word-initial position in Icelandic. In other words, the Icelandic preaspiration rule is completely transparent in the sense used by Kiparsky (1973: 79), since there will be no cases where its structural description is met and the rule does not apply (see section 4.3), and there will be no cases of non-word-initial [h] other than those created by the preaspiration rule.¹⁰ It is possible that this state of affairs contributes to the strength of the rule and has made it survive as a synchronic rule even in the cases where there is no alternation to be accounted for.

For the rest of the paper I shall therefore take it as established beyond doubt that there is a synchronic phonological rule of preaspiration in

Modern Icelandic, and that all cases of preaspiration in Icelandic are derived by a rule.

3. WHAT THE RULE DOES

3.0 Three alternatives

Having established the existence of a phonological rule of preaspiration, we now need to determine what this rule does. There has been some controversy about this. We shall now go through the various proposals and try to determine on the basis of the facts already discussed and some additional ones which alternative is the most adequate.

The phonetic and phonological facts discussed so far do actually rule out a number of conceivable proposals. Thus we have already mentioned that phonetic considerations and quantity relations seem to make it unavoidable to consider preaspiration a segment. Hence it is phonologically insufficient to say that preaspiration is just a feature of the stop, or the inverse of postaspiration due to some kind of a “lack” of synchronization or coordination of the laryngeal and supralaryngeal articulatory gestures. Although this may be close to the phonetic truth, the phonological rule has to go further and state the environment where this occurs, since this is a regular phonological phenomenon in Icelandic and not just random instances of failure of coordination. Furthermore, the rule has to express the segment status of preaspiration as opposed to postaspiration. This rules out Liberman’s theory, which claims that Icelandic preaspiration is suprasegmental and “is an acute syllable accent opposed to no preaspiration (which is a grave accent: cf. *stød* vs. *ikke-stød* [in Danish])” (Liberman 1970: 39). It is very difficult to make any sense of such a claim in the light of the phonetic and phonological facts. While it may be correct that the rule of preaspiration in Icelandic originally developed because of certain facts about the accentual system of Icelandic or its syllable structure, it is clear that preaspiration has a segmental realization, namely [h], and hence it cannot *be* a syllable accent or any other suprasegmental phenomenon (see also Garnes 1974: 383, and Pétursson 1972b).

Basically, then, we seem to be left with three alternatives. First, we could look at the preaspiration rule as a rule devoicing the second half of the vowel preceding the (preaspirated) stop. Secondly, we could look at it as an epenthesis rule inserting an [h] in the particular environment. Thirdly, we could, at least in some cases, say that the rule takes the first part of a geminate (or long) stop and turns it into an [h]. These alternatives will

be considered one by one in the following subsections, and it will be explained in detail why the third is the most adequate.

3.1 Vowel devoicing

This possibility is mentioned in Ófeigsson (1920–24: XVII); it has recently been advocated by Anderson (1974: 266), and Garnes (1974: 379–383) seems to favor it too.¹¹ We shall now consider in some detail what such an analysis would imply.

3.1.1 Quantity relations

If the preaspiration segment were derived by a devoicing of the second half of a long vowel, we would expect the result to be a short voiced vowel plus a short voiceless vowel (preaspiration segment), since it should be possible to split a long vowel into two halves of normal (short) segment length. If the preaspiration segment were derived by a devoicing of the second half of a short vowel, we would expect the result to be a shorter voiced segment plus a shorter voiceless segment, since a short vowel split in two should give two extra short halves. Hence it would clearly constitute an interesting argument for the vowel devoicing hypothesis if we could find such differences between pairs of vowels and preaspiration segments ([Vh]), depending on the length of the vowel that had been devoiced by the preaspiration rule. This is actually Anderson's main argument for a vowel devoicing analysis of Icelandic preaspiration, if I understand him correctly. He claims that if the vowel preceding the preaspirated stop is "long (or diphthongal) preaspiration consists in the devoicing of the second element of the vowel", e.g. [au̥] in the case of the diphthong /á/, whereas if the vowel is "short" we get "a very short voiceless vowel preceded by a very short voiced vowel", e.g. [ǣ̥] in the case of the monophthong /a/. "It is clear what the generalization is here: a preaspirated consonant has the effect of devoicing exactly one-half of the preceding syllabic element. If there are two moras in that element, one is devoiced; if there is only one, half of it is devoiced." (Anderson 1974: 266).

Unfortunately, however, there is no reason to believe that this is true of Icelandic preaspiration. There is no evidence for a quantity distinction like "[au̥]" vs. "[ǣ̥]", which depends on the vowel that has allegedly been devoiced. The vowel (voiced segment) preceding the preaspiration segment seems in all cases just to be a normal short vowel on the phonetic

level, and the preaspiration segment seems in all cases just to be a normal short segment. It does not seem to be true that they are any shorter in the case of monophthongs than diphthongs, as Anderson claims. Objective measurements typically look like the figures in (16) (Garnes 1974):

(16)							
Monophthongs				Diphthongs			
	hitt		'met'		heitt		'hot'
V 108		H 120		V 123		H 91	
	sett		'put'		sótt		'sickness'
V 123		H 103		V 112		H 112	
	setti		'put'		sóttá		(gen.pl.)
V 115		H 93		V 105		H 105	
<hr/>				<hr/>			
Mean	115	105		113		103	

Here V refers to the vowel (or the voiced portion) preceding the preaspiration segment, and H refers to the preaspiration segment itself (or the devoiced portion). The figures represent duration in ms. Garnes's results basically agree with my own measurements (Thráinsson 1975), and Pétursson's results (1972a) also fail to support Anderson's claim. It would also be very surprising if it were true, since there is no significant difference in length between monophthongs and diphthongs in Icelandic in general. Both types can be either short or long, depending on the number of consonants that follow (cf. below).

Since the voiced and voiceless parts of the [Vh] sequences are apparently never "extra short", the vowel devoicing hypothesis could still be supported if one could argue that what is devoiced is in every case the second half of a long vowel. But this cannot be maintained for the following reason: Icelandic vowel length can most simply be accounted for by assuming that all vowels are underlyingly short and that there is a lengthening rule that lengthens vowels in certain environments (cf. e.g. Benediktsson 1963, Árnason 1975, and see also Garnes 1974: 134). The basic rule can be stated as in (17) as a first approximation:

$$(17) \quad \left[\begin{array}{l} +\text{syll} \\ +\text{stress} \end{array} \right] \rightarrow [+long] / -C_0^1$$

This means that stressed vowels are lengthened if no consonant or only one consonant follows. This rule cannot feed the preaspiration rule, however, since what follows the vowel in the input to the preaspiration rule is never less than a geminate (long) consonant or two consonants, as illustrated by examples like *hattur*, *veitti*, *epli*, etc., discussed in section 2

above. There are even cases where we must apparently assume three consonants following the vowel, cf. *dökkna* [tœhkna] 'become dark'. In addition, long vowels apparently only occur in stressed syllables in Icelandic (i.e. basically in initial syllables), but there are some instances of preaspiration in unstressed syllables, such as in *holóttur* [hɔ:louhtYr] 'full of holes', *fráleitt* [frau:leiht] 'absurd'.

The vowel devoicing hypothesis also runs into quantity problems of a different kind. It seems that we characteristically get preaspiration when we have a geminate (long) /pp/, /tt/, /kk/. What we end up with, however, is not a long stop but a short one preceded by a preaspiration segment of approximately equal length. The quantity relations can be illustrated as in (18) (cf. Garnes 1974: 31):

(18)	V:		P	hatur	/hatur/	[ha:t ^h Yr]	'hate'
	V	H	P	hattur	/hattur/	[hahtYr]	'hat'
	V	P:		haddur	/haddur/	[hat:Yr]	'hair'

Here V stands for vowel, P for plosive, and H for the preaspiration segment. In *hatur* we get a long vowel, as expected since only one (short) consonant follows. In *hattur* we get a short vowel, short preaspiration segment, and a short stop. This would require some extra explanation under the vowel devoicing hypothesis, because we would have expected the geminate stop to be long, just as the geminate stop is long in *haddur*.

We can conclude, therefore, that none of the facts about quantity relations in preaspiration words can be used to support the vowel devoicing hypothesis.

3.1.2 Vowel quality

One could think of an argument for the vowel devoicing hypothesis based on vowel quality. Suppose it turned out that there were quality differences between long and short variants of vowels in Icelandic, and the quality of the vowel preceding the preaspiration segment were that of a long variant in every case, and the preaspiration segment always reflected the formant structure of a long vowel. Such a state of affairs would clearly constitute an argument for the claim that the preaspiration segment had indeed been derived by the devoicing of the second half of a long vowel. It has actually been claimed by Garnes (1974) that this is the case in Icelandic: "Spectrographic evidence shows that the spectral structure of vowels before preaspiration share [sic!] many similarities with long vowels ... The structure of the higher formants is preserved in preaspiration. That

structure is similar to the last portion of a long allophone of the vowel.” (Garnes 1974: 380). This does not agree with Pétursson’s findings, who has maintained that “Nous avons prouvé que pour notre sujet Ó.P. les voyelles devant -t- (type: /V:t/) et devant -tt- (type: /Vht/) ont les positions articulatoires différentes et constituent deux systèmes cohérents qui ne sont pas identiques” (Pétursson 1972a: 70). In other words, Pétursson is claiming that the vowel we get in sequences like [Vht] is qualitatively different from the long vowel in [V:t].¹² The evidence Garnes (1974) gives for her claim is very scant (she refers to one unclear spectrogram), and Pétursson’s claim (1972a) is also rather difficult to evaluate. Hence it seems worthwhile to try to clear this up.

Garnes (1974:19) and Pétursson (1975: 38) give formant frequencies for Icelandic vowels. Although there are some differences, they agree on a number of points. They agree, for instance, that long /e/ normally has lower F_1 values and higher F_2 values than the short variant. The average figures are shown in (19):

(19)	F_1/F_2	Garnes	Pétursson
	short /e/	640/1710	555/1869
	long /e/	558/1808 ¹³	442/2043

Now if Garnes’s argument for the devoicing analysis were to go through, an /e/ in preaspiration words should show formant structure more similar to that of the long variant than the short one. Spectrographic measurements I have made indicate that the opposite is true, as shown in (20):¹⁴

(20)	F_1/F_2					
		V:		VH		V
	dekra (4)	513/1838	dekkra	550/1650		
			epli (2)	550/1675	efli	550/1625
	þekja (2)	525/1950	þekja	600/1700		
	setra (4)	500/1813	settra	550/1575		
	vera (3)	467/1834			verra	567/1683
	Mean:	501/1859		563/1650		559/1654

These figures indicate that the formant structure of the vowel in preaspiration words is that of a short vowel and not that of a long variant. Hence they support Pétursson’s findings (1972a) referred to above, and actually constitute an argument against the vowel devoicing hypothesis rather than being arguments for it, as Garnes (1974) implies.

In addition, one could mention that the long variant of /e/ often shows a

tendency to diphthongize (cf. Garnes 1974: 19), but this tendency is not observed in preaspiration words. The formant structure that is carried over into the preaspiration segment is a reflection of the formant structure of a preceding short vowel and does not show the gliding formants characteristic of a diphthongized vowel (see Thráinsson (in preparation)).

Finally, there is the Icelandic dialectal variant *flámæli*. Its characteristics are roughly that /i/ and /u/ are lowered whereas /e/ and /ö/ are raised. This dialectal rule tends to affect long vowels rather than short ones (cf. Guðfinnsson 1947: 24). Hence it would clearly constitute an argument for the vowel devoicing hypothesis as described above if this rule typically affected vowels in preaspiration words along with long vowels. The fact that preaspiration words are generally not cited as examples of *flámæli* in works on Icelandic dialectology (Guðfinnsson 1946: 109, passim, 1947: 24 ff., 1964: 82, 205, Dahlstedt 1958a, b, Benediktsson 1961–62) thus constitutes evidence against the claim that such words really contain long vowels the latter half of which have been devoiced.

We can conclude, therefore, that none of the observed facts about vowel quality support the vowel devoicing hypothesis.

3.1.3 Garnes's other arguments

Garnes (1974: 381) claims that "Evidence that preaspiration is due to the application of a process of devoicing comes from at least three sources, pronunciation of words in a foreign language, perception, and vowel plus resonant sequences." It turns out that none of these arguments are arguments for the devoicing hypothesis as such, although some of them constitute arguments for the existence of a preaspiration rule in Icelandic.¹⁵ Some of them actually turn out to be arguments against the devoicing hypothesis. We can consider them one by one.

The one based on "pronunciation of words in a foreign language" is basically the argument given in 2.1.3 above for the existence of a preaspiration rule in Icelandic, and it is not an argument for the devoicing hypothesis at all. Why should "Icelanders respond to the short vowels in *met* and *got* and apply the devoicing process" (Garnes 1974: 381)? This "devoicing process", i.e. the preaspiration rule, normally applies to words containing phonologically long or geminate /t/, as shown above, and not to words containing phonologically short /t/. Hence if Icelanders were applying this rule to words analyzed as containing a short /t/, they would be applying it in a totally new environment. The application of the preaspiration rule to words like these must therefore imply that they are

analyzed as containing a long stop, because the vowel is interpreted as short and hence the stop must be long to make the words fit into the Icelandic quantity system, as explained in 2.1.3 above. The vowel devoicing hypothesis would work better if it could be maintained that the preaspiration segment was derived by a devoicing of the second half of a long vowel. But if these words were interpreted as containing a long vowel phonologically and a short consonant, there would be no reason at all to apply the “devoicing rule”, since such words do not contain preaspiration in Icelandic and fit perfectly well into the quantity system of the language as they are, as evidenced by the Icelandic words *met* [mɛ:tʰ] ‘record’ and *got* [kɔ:tʰ] ‘spawning’.

Garnes’s second argument has to do with the perception of preaspiration and goes like this: “Icelandic subjects indicated their responses to stimuli with short vowels which were followed by voiceless vowel resonances as preaspiration. It was crucial in perception for the vowel/consonant ratio in the stimulus to be low for the subjects to be able to ‘hear’ preaspiration.” (Garnes 1974: 382). I fail to see how this is specifically an argument for the devoicing analysis of preaspiration. What Garnes claimed to have shown by her perception experiments was that “vowel length is the primary cue in perception of the quantity opposition in Icelandic. Consonant length contributes somewhat, but only secondarily, in perception.” (op. cit. 209–210, see also 312). This may be true, and actually it fits quite well into the explanation of the analysis of foreign words by Icelandic speakers given in 2.1.3 above. But I must admit that I do not understand how this provides an argument for the vowel devoicing hypothesis, and Garnes does not explain further why she takes that to be the case.

The third argument goes like this: “similarities in the distribution of voiceless resonants and preaspiration also indicate that devoicing is a process.” (Garnes 1974: 382). Here she is referring to the (partly dialectal) devoicing of /l,m,n,r/ before /p,t,k/ in Icelandic (cf. Thráinsson (in press)). But there are crucial differences here. We have seen that preaspiration occurs in the case of underlying or derived /pp/, /tt/, /kk/ and not at all before short /p,t,k/ (on the sequences /p,t,k/ + /l,m,n/ see 3.3 below). The devoicing of /l,m,n,r/, on the other hand, occurs before short /p,t,k/. Hence the two rules are in fact not comparable at all in this respect.

3.1.4 Conclusion of section 3.1

On the basis of the evidence discussed above, we can safely conclude that

there are no real arguments for the devoicing hypothesis. On the contrary, there are a number of arguments against it. The only thing that gives it some initial plausibility is the reflection of the formant structure of the vowel in the formant structure of the preaspiration segment, but this can equally well be accounted for by assuming that the preaspiration segment is an [h], as explained in 1.2 above.

3.2 [h] insertion

Although [h] insertion does not seem an implausible hypothesis a priori, I do not know of anyone who has explicitly proposed it or argued for it. This hypothesis would obviously account for the phonetic quality of the preaspiration segment, and it would not run into any trouble in accounting for the quantity and quality of the vowel. Hence the most serious difficulties with the devoicing hypothesis do not arise here. Furthermore, the cases of preaspiration before /p,t,k/ + /l,m,n/ would seem to be quite plausibly accounted for by an insertion rule, since what we start out with seems to be a /Vpl/, /Vpn/, /Vtl/, etc., and what we end up with is a [Vhpl], [Vhpn], [Vhtl], respectively.

There are some difficulties with this hypothesis, though. First, even if we assume a simple [h] insertion rule for the /p,t,k/ + /l,m,n/ cases, we would still want to relate these cases to the preaspiration we find in words with clearly phonologically long (or geminate) /pp/, /tt/, /kk/. The most straightforward way to do so is to assume a lengthening rule that operates on /p,t,k/ preceding /l,m,n/, if such a rule can be independently motivated (see 3.3 below). Then both sets of examples of preaspiration could be handled by a rule of [h] insertion before long /pp/, /tt/, /kk/. But whereas this approach would succeed in relating the two sets of occurrences of preaspiration, it would make the [h] insertion analysis lose most of its initial plausibility. The reason is, of course, that now we would need to assume two rules in every case of preaspiration, i.e. an [h] insertion rule before /pp/, /tt/, /kk/ plus a rule shortening the stops, since they appear as short stops on the surface in every case. This makes the [h] insertion rule rather suspicious, although still much more plausible than the vowel devoicing hypothesis. The nagging question is: why should the stops be lengthened and [h] inserted only for the stops to be subsequently shortened? This question makes one want to look for alternatives that account for the quantity of the stops in a more straightforward way. The only remaining alternative is a rule that takes /p,t,k/ directly to [h] before /p,t,k/, respectively. We shall now turn to this alternative.

3.3 Preaspiration derived from stops

A rule turning the first half of a long or geminate stop into a preaspiration segment would obviously fit rather nicely with all of the facts about preaspiration in /pp/, /tt/, /kk/ words discussed above. The only problem would seem to be preaspiration in /p,t,k/ + /l,m,n/ words. But as already pointed out, we would like to account for both sets of occurrences of preaspiration by the same rule if possible, because it seems quite unlikely that Icelandic has two different rules of preaspiration. The simplest way to do so is to postulate a rule that lengthens /p,t,k/ before /l,m,n/, and have a general preaspiration rule operate on the output of this lengthening rule. To assess the plausibility of such a move, it is necessary to compare this analysis of preaspiration as derived by the same rule in all cases to the two rule alternative which maintains that while the preaspiration in words like *kappi*, *feitt*, *fríkka*, etc. is indeed derived by a rule turning the first half of a long /pp/, /tt/, /kk/ into an [h], there is no rule that lengthens /p,t,k/ before /l,m,n/ and hence the preaspiration in words like *epli*, *rytmi*, *vakna*, etc. is derived by a different preaspiration rule, e.g. one that inserts an [h] before /p,t,k/ if they are followed by /l,m,n/. It would clearly constitute an argument for the two-rule hypothesis, and against our hypothesis, if there were any differences between the preaspiration plus stop sequences depending on the rule that had applied. It is possible to find some near minimal pairs that are instructive to compare in this respect.

First, there are cases where we apparently have to assume an underlying /pp/, /tt/, /kk/ preceding an /l/ or /n/. This is generally reflected in the largely phonological Icelandic spelling. These cases include the nouns *heppni* 'luck' (cf. *heppinn* 'lucky' with underlying /pp/), *hittni* 'marksmanship' (cf. *hitta* 'hit' and *hittinn* 'clever at hitting'), and the verb *þykkna* 'become thick' (cf. *þykkur* 'thick'). All these words have preaspiration, and both theories would claim that it is derived by the same rule as in e.g. *kappi*. Now we can compare these words to words like *vopna* 'to arm', *vatna* 'to water', and *vakna* 'wake up', where there is no reason to assume underlying long stops preceding the /n/,¹⁶ but where our hypothesis claims that the stops are lengthened and then the same preaspiration rule applies as in the previous set of examples, whereas the two-rule analysis would postulate a different preaspiration rule for the late set. Since our hypothesis claims that the same preaspiration rule is at work in all cases, it predicts that the phonetic realization of the stop plus /n/ should be parallel in all instances. This has, in fact, been traditionally assumed (cf. e.g. Einarsson 1945: 16, 20, 21–22), and it has recently

been confirmed by objective measurements. The figures in (21) are taken from Garnes (1974):

(21)	Underl. long stop				Underl. short stop		
	H	P	H+P		H	P	H+P
heppni	74	120	194	vopna	104	124	228
hittni	112	133	245	vatna	90	123	213
þykkna	100	117	217	vakna	117	80	197
Mean:	95	123	219		104	109	213

The results are clearly consistent with our hypothesis that preaspiration is derived by the same rule in all cases.

Secondly, we can compare the quantity relations in words like *vatna*, *vakna*, where our analysis claims that a phonological lengthening has taken place, to words like *settra* 'placed' (gen. pl. masc.), *dekkra* 'darker' (neut.), where there are phonological arguments for underlying long /t/, /kk/ (cf. nom. sg. masc. *settur*, *dökkur*), and, in addition, a contrast with short /t/, /k/ in words like *setra* 'residences' (gen. pl.), *dekra* 'pamper'. Our hypothesis predicts that the length of the preaspiration segment plus the stop should be similar in *vatna*, *vakna*, *settra*, *dekkra*, and this prediction is borne out by objective measurements as shown in (22).¹⁷

(22)	Preasp. + stop			Preasp. + stop			Short stop	
	/__n			/__r			/__r	
vatna	213		settra	205		setra	120	
vakna	197		dekkra	205		dekra	95	
Mean:	205			205			108	

We can conclude, then, that the quantity relations exemplified in (21) and (22) are consistent with our analysis, and there is no evidence that preaspiration in words like *epli*, *vopna*, *rytmi*, *vatna*, *vakna*, etc. is derived by a preaspiration rule that is different from the one operating in *kappi*, *heppni*, *feitt*, *hittni*, *fríkka*, *þykkna*, etc.

It would constitute an argument more directly in favor of our lengthening rule if it turned out that it is in fact a more general rule that lengthens all stops before /l,m,n/ - i.e. if we could find evidence for lengthened /b,d,g/ in the same environment. It is somewhat problematic to test this because the occurrence of /b,d,g/ is quite restricted in underlying forms. There are, however, forms that can be assumed to contain underlying /ddr/, /ggr/, and /ggv/, such as *saddra* 'full' (gen.pl. of *saddur*), *sneggra* 'faster' (neuter of *snöggur*), *glöggva* (sig) 'make clear (to oneself)' (cf.

glöggur 'clear'), and the quantity relations in these can be compared to those of forms where our lengthening rule should apply, if it does in fact apply to all stops. Relevant examples are shown in (23) (measurements taken from Garnes 1974 (S), and Thráinsson (in preparation) (H), cf. note 17):

(23)	Underl. long stop		Lengthened (?) stop	
	/___r,v		/___l,n	
			tefla	184 (S)
saddra	150 (H)		neinna	203 (S)
sneggra	125 (H)		ragna	124 (S)
glöggva	115 (H)		mygla	117 (H)
Mean:	130			157 ¹⁸

This picture is obviously not as clear as one would like. The variation is too great, and more research is needed to pin down the facts. Note, however, that the stops in the words where our lengthening rule should have applied seem to be just as long as the stops that are underlyingly long (and in some cases even longer). Hence these phonetic facts must be considered compatible with our lengthening hypothesis. It should be mentioned that our hypothesis also receives some support from earlier measurements (Einarsson 1927), and Kress (1937) even transcribes words like *tefla* phonetically as if they contained a long *b*.

If our lengthening hypothesis is correct, we would expect lengthened /b,d,g/ to be longer than short preconsonantal /p,t,k/. This seems indeed to be the case, as the comparison in (24) shows:

(24)	Lengthened /b,d,g/		Short /p,t,k/	
	/___l,n		/___r,v	
tefla	184 (S)		dapra	121 (S)
neinna	203 (S)		titra	97 (S)
			setra	120 (H)
ragna	124 (S)		dekra	95 (H)
			vakra	110 (S)
mygla	117 (H)		vökva	82 (S)
Mean:	157			104

The difference is perhaps not as great as one might have expected. The reason is possibly that /p,t,k/ are inherently somewhat longer than /b,d,g/, as the measurements in (25) would seem to indicate:¹⁹

(25)	Preasp. + stop		Long /b,d,g/
happa	300	habba	250
hatta	300	hadda	240
koppar	200	kobbar	160
veittu	250	veiddu	280
vítt	200	vídd	180
	315		280
hakka	220	hagga	180
	180		160
Mean:	<hr/> 246		<hr/> 216

It should be obvious from the data presented in (21)–(25) that the phonetic quantity relations in words of this sort are quite complex and need to be investigated in much greater detail. Garnes's (1974) research indicates, for instance, that the objective phonetic length of segments in Icelandic depends among other things on the number of segments in the word. She found that disyllabic words tend to be of similar duration, and hence there will be less time for each segment the more segments a disyllabic word has (Garnes 1974: 388). This might provide an explanation for the fact that long intervocalic stops seem to be longer in general than long preconsonantal stops (*cf.* (21) and (22) above vs. the first column in (25), or the second column in (23) vs. the second column in (25), for instance). I believe, however, that phenomena of this sort should either be accounted for by general phonetic principles or by rules of phonetic detail rather than by rules of phonology proper. In other words, I am claiming that as far as the categorial rules of Icelandic phonology are concerned, there are only two quantity values, i.e. short and long (or geminate). I conclude, therefore, that the available facts seem perfectly consistent with our hypothesis that there is a phonological rule which lengthens /p,t,k/ (and possibly /b,d,g/) before /l,m,n/, and this rule feeds a general preaspiration rule that operates on long or geminate /pp/, /tt/, /kk/, underlyingly or derived.²⁰

3.4 Conclusion of section 3

The general conclusion is, then, that it seems natural to assume that all instances of Icelandic preaspiration are derived from long /pp/, /tt/, /kk/, even those that are spelled with *p*, *t*, *k*, + *l*, *m*, *n*. The simplest way to derive the phonetic sequences [hp], [ht], [hk] from these more remote /pp/, /tt/, /kk/, respectively, is clearly to turn the first half of the long or

geminate stop into a preaspiration segment which is phonetically an [h]. I shall take it as established for the rest of this paper that this is what the Icelandic preaspiration rule has to do.

4. HOW THE PREASPIRATION RULE WORKS

4.1 A conventional generative description

It is, of course, possible to write a conventional generative rule that turns a /p,t,k/ into an [h] when preceding a /p,t,k/, respectively. A first semiformal approximation to such a rule could be stated as in (26) (assuming for the moment that /p,t,k/ are classified as [+tense] and /b,d,g/ as [-tense]):

$$(26) \quad \begin{bmatrix} -\text{son} \\ -\text{cont} \\ +\text{tense} \\ \alpha\text{labial} \\ \beta\text{cor} \\ \gamma\text{high} \end{bmatrix} \rightarrow [\text{h}] / \text{---} \begin{bmatrix} -\text{son} \\ -\text{cont} \\ +\text{tense} \\ \alpha\text{labial} \\ \beta\text{cor} \\ \gamma\text{high} \end{bmatrix}$$

This rule says that a tense stop is turned into an [h] if it precedes an identical stop. Stated this way, the preaspiration rule looks like any other phonological rule. If we disregard certain inadequacies of detail, such as the lacking feature specification of [h], this rule is in fact very probably correct in a certain sense. Yet people have hesitated to propose an account of this sort for preaspiration in Icelandic. Some have even complained that “generative phonology, with all the machinery it has been equipped with, is unable to state this [i.e. the preaspiration rule] in a natural fashion” (Árnason, to appear).

The problem we are faced with is that of providing a formulation of the rule that is both intuitively meaningful and descriptively adequate. To determine what this would require, we need to review the articulatory description of a preaspirated stop. First, however, a short description of the Icelandic stop system is in order.

4.2 An excursus about the Icelandic stop system

There are two series of stops in Icelandic, normally represented as /p,t,k/ vs. /b,d,g/. We have been following this tradition here. It is important to keep in mind, however, that /b,d,g/ are generally voiceless. This has been indicated in the present paper by transcribing them phonetically as

[p,t,k]. What distinguishes /p,t,k/ from /b,d,g/ in initial position, for instances, is thus not a difference in voicing but primarily (and perhaps exclusively) a difference in aspiration, i.e. /p,t,k/ are aspirated and voiceless whereas /b,d,g/ are unaspirated and voiceless.

It is often claimed that there is an additional difference in 'hardness', 'tenseness', 'force of articulation', or something similar, but it has proven to be very difficult to find any articulatory correlates to these alleged phonological features. Hence it would seem very tempting to assume that the important or distinctive feature here is aspiration, i.e. [+spread glottis] ([+SG]) in the Halle and Stevens feature system (1971). In fact, I have argued elsewhere in some detail that by making this assumption it is possible to account for certain dialectal differences in Icelandic in a quite natural way (Thráinsson, in press). I shall therefore assume that the distinction between /p,t,k/ on the one hand and /b,d,g/ on the other can be represented in terms of laryngeal features as shown in (27):

(27)	/p,t,k/	/b,d,g/
	$\left[\begin{array}{l} +\text{spread glottis} \\ -\text{constricted glottis} \\ +\text{stiff vocal cords} \\ -\text{slack vocal cords} \end{array} \right]$	$\left[\begin{array}{l} -\text{spread glottis} \\ -\text{constricted glottis} \\ +\text{stiff vocal cords} \\ -\text{slack vocal cords} \end{array} \right]$

If one wanted to maintain that there was an additional difference in tenseness between /p,t,k/ and /b,d,g/, the latter series could perhaps be specified as [−stiff v.c.]. Note that the feature [−spread glottis] does not imply that /b,d,g/ are produced with a closed glottis. The claim is rather that the production of /p,t,k/ involves an active spreading of the vocal folds and hence a wide open glottis, whereas the production of /b,d,g/ does not. Consequently we would expect experimental studies to reveal a difference in the degree of glottal opening between /p,t,k/ and /b,d,g/. Pétursson (1976: 179–180) has recently confirmed this prediction.

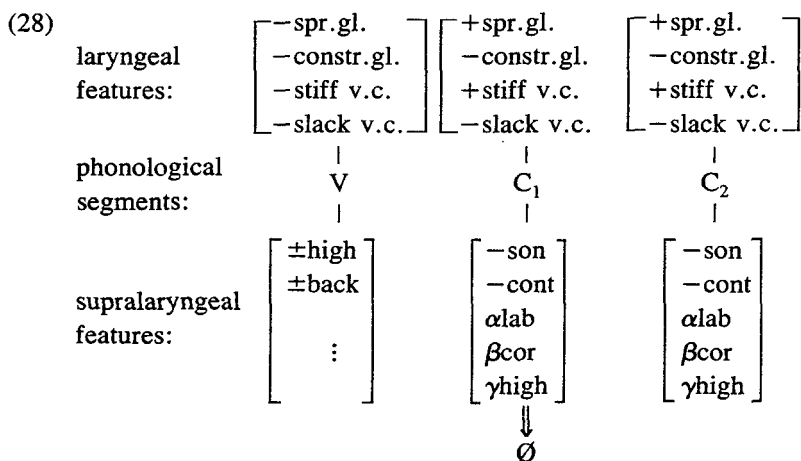
Having clarified this, we are ready to return to the articulatory description of a preaspirated stop and how the preaspiration rule can best be formulated.

4.3 An autosegmental description

We saw above that preaspiration is sometimes described articulatorily as

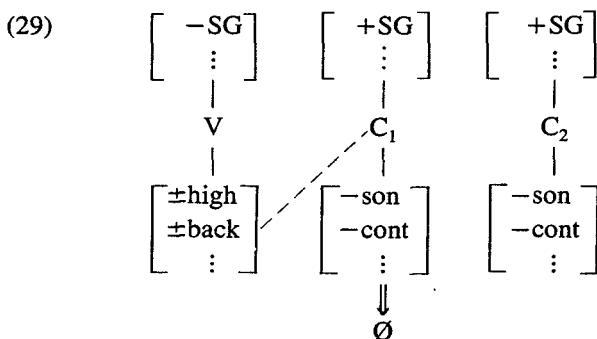
a "lack of coordination" between laryngeal and supralaryngeal articulatory gestures. In other words, one could look at a preaspirated stop as a stop where the supralaryngeal articulatory gesture is made "too late", as it were. In the case of Icelandic preaspiration, we could then say that the laryngeal articulatory gesture for the phonologically long or geminate stop is made at the "correct" point in time, i.e. when the first half of the stop is to begin, whereas the supralaryngeal gesture, namely the oral closure, is not made until the second half of the geminate stop begins. In other words, we have to get from a phonological sequence of two specified stops, as it were, to a sequence where the first member is only specified for the appropriate laryngeal features. What this means, then, is that the phonological rule of preaspiration has to wipe out or delete the set of supralaryngeal features for the first half of the stop and leave only the laryngeal feature specifications. Such a rule would adequately describe preaspiration as a phenomenon where the laryngeal and supralaryngeal configurations for a geminate stop do not coincide on the phonetic level, and at the same time capture the essential fact that this is perfectly regular or phonologized in Icelandic and not some kind of accidental or sporadic lack of coordination.

But is there any way of adequately formulating a rule of this kind within a generative framework? The answer is yes. The theory of autosegmental phonology as developed primarily by Goldsmith (1976a,b) offers a rather neat way of doing this. As Goldsmith points out, "autosegmental phonology is a theory of how the various components of the articulatory apparatus, i.e. the tongue, the lips, the larynx, the velum, are coordinated." (Goldsmith 1976a: 23). At the phonological level, this coordination is usually total in the sense that the phonological features that constitute a phoneme behave as a unit. Deleting a phonological segment, then, means deleting or wiping out all the phonological features it is composed of. But there are cases where deletion is incomplete. Certain tone languages, for instance, have phonological rules deleting a vowel without deleting the tone that goes with it. If we assume that a particular configuration of laryngeal features specifies high tone, for instance, we can look at this kind of deletion as a deletion of all the features that the vowel is composed of except the laryngeal features that specify high tone (cf. Goldsmith 1976a,b). Hence it seems that in some cases a certain subset of the phonological features composing a phoneme can behave as a unit. I want to argue that preaspiration in Icelandic is just such a case. To try to capture this, we can formulate the Icelandic preaspiration rule as in (28) as a first approximation:



(28) is intended to show that each segment (V, C₁, C₂) has associated with it a set of laryngeal features and a set of supralaryngeal features. What the preaspiration rule does is indicated by the double-shafted arrow at the bottom of the picture, i.e. given a sequence of two identical stops from the series /p,t,k/ the rule deletes the supralaryngeal features of the first. What is left, then, is simply a segment that has no supralaryngeal feature specification of its own but has the laryngeal specification [+spr.gl., -constr.gl., +stiff v.c., -slack v.c.], and such a segment is an [h] in the Halle and Stevens feature system (1971: 203)!

This should suffice to illustrate the basic idea. To account for the fact that this [h] created by the preaspiration rule reflects the formant structure of the preceding vowel, we can either assume that this holds universally for an [h] that is adjacent to a vowel (cf. e.g. Harms 1972:2) and hence need not be mentioned in the Icelandic preaspiration rule, or we can express it directly in our rule by adding an association line from the set of supralaryngeal features of the vowel to C₁ as shown in (29) (cf. also the discussion in Goldsmith 1976b: 161 ff.):



Now that we have described the mechanics of this account of Icelandic preaspiration, we can return to the question of plausibility and adequacy. Since this account looks rather different from the more conventional description given in 4.1 above, it is important to try to determine to what extent these differences are simply notational and to what extent they are of any explanatory importance. We shall try to do this in the next section.

5. SOME ARGUMENTS FOR THE AUTOSEGMENTAL ANALYSIS

5.1 Descriptive adequacy

First, it would seem that the autosegmental analysis of preaspiration reflects more adequately what is going on in phonetic or articulatory terms than a conventional rule of the sort given in 4.1 would do. The conventional rule does not really reflect the "lack of coordination" between the laryngeal and supralaryngeal articulatory gestures that we have taken to be the phonetic nature of preaspiration. The conventional rule could just as well have turned a /p,t,k/ into any other segment. In fact, a conventional rule changing, say, a /p/ into an [h] is not a particularly natural one, since it has to change quite a number of feature specifications. The autosegmental approach gives us a way of doing this by actually deleting rather than changing feature specifications.

It is worth emphasizing that the autosegmental approach to preaspiration assumes that the features of the segments in question split up into two well defined subsets, i.e. laryngeal and supralaryngeal. One would expect that in cases where subsets of feature specifications behave as a unit, these subsets will be well defined rather than just some arbitrary combination of features. Laryngeal/supralaryngeal, nasal/nonnasal, etc., would seem natural candidates, and features do, in fact, often seem to group in this natural way (cf. Goldsmith 1976a,b. See also Anderson 1974, Chapter 14).

It could be added here that certain dialects of Spanish have a rule deriving [h] from /s/ in certain environments, and this rule could be analyzed in a similar way as a deletion of supralaryngeal features (cf. Goldsmith, to appear). This, together with some of the facts to be discussed below, shows that Icelandic preaspiration is not an isolated phenomenon in the languages of the world, and there are probably a number of phonological processes that could profitably be analyzed in a similar way.²¹

5.2. Predictive power

In addition to being descriptively adequate, we would like our theory to be restricted enough to make specific predictions. It should predict that certain things are possible and others are not possible, or at least much less likely. Our analysis does in fact have these properties. Note, for instance, that the prerequisite for getting an [h] as a result of the operation of our rule is that the stop in question be specified as [+SG]. This predicts, of course, that we could not get preaspiration in the case of /b,d,g/, and we do not. The conventional analysis does not make such a prediction. Even if we would change the rule in (26) in a way that would make the feature [+SG] figure in its formulation, this would still not change the fact that a rule changing, say, a /b/ to [h] would be just as possible to write in that kind of framework, although feature counting would perhaps make it one notch more expensive. In contrast, an autosegmental rule deleting the supralaryngeal features of a /b/ *could not* give an [h] because /b/ is not specified as [+SG]. This is a very important difference.

5.3 Relating preaspiration and devoicing

If our hypothesis is correct that the laryngeal features of Icelandic stops can behave as units or independently in the case of preaspiration, i.e. if the existence of preaspiration in Icelandic is taken as evidence for the autosegmentality of laryngeal features of Icelandic stops, we might expect this independence to show up elsewhere too. In other words, if laryngeal features like [+SG] can behave independently in the case of preaspiration, we might expect this independence to show up elsewhere in the form of independent movement or floating of the feature [+SG]. We do in fact find such behavior.

Let us first consider what such a movement would imply in phonetic terms. As pointed out above, the feature [+SG] specifies aspiration in the case of stops. In phonetic terms this means that the glottis is wide open at the time of the oral release of the stops, and consequently it takes some time for it to get into a position normal for voicing of, for instance, the succeeding vowel. This is essentially Kim's (1970) theory of aspiration expressed in terms of phonological features. Now if we could think of the feature [+SG] of Icelandic stops as being autosegmental and capable of such behavior as moving or floating from the stop where it originated in phonological specification and to the left into the preceding segment, this sort of movement should have two consequences: First, it should make

the stop unaspirated, since it would no longer be specified as [+SG]. Secondly, if the preceding segment were voiced, we would expect it to become voiceless, since the feature [+SG] refers to a wide open glottis, and a laryngeal configuration of that sort will not result in voicing, i.e. spontaneous vibrations of the vocal cords, unless the vocal cords are very slack (cf. Halle and Stevens 1971: 203).

What has just been described here in autosegmental terms is articulatorily an anticipation of the spreading of the glottis. In the case of a stop that is phonologically specified as [+SG], the active articulatory gesture of the laryngeal mechanism is supposed to be a wide spreading of the glottis. This has the effect that the glottis is still wide open at the time of the oral release of the stop. If this spreading gesture is executed earlier, the glottis will have had some time to close down before the oral closure of the stop is released, and hence the stop will not be aspirated. If this spreading gesture is made already in the preceding segment, this segment will become voiceless. I have argued elsewhere in some detail (Thráinsson, in press) that this is exactly what happens in the case of the extensive (but partially dialectal) devoicing of Icelandic liquids and nasals before /p,t,k/. The facts are like this: The most widespread Icelandic dialect devoices /l,m,n/ before /p,t,k/. As a consequence, /p,t,k/ are deaspirated. Other dialects vary in the extent to which this devoicing takes place. The most restrictive dialect only devoices /l/ before certain /t/'s, but has otherwise no devoicing of /l,m,n/ before /p,t,k/ (for some discussion see Einarsson 1928). Most importantly, however, there is no dialect that has devoicing without a concomitant deaspiration, or deaspiration of /p,t,k/ after /l,m,n/ without a concomitant devoicing of the /l,m,n/. This correlation is illustrated in (30):

(30)

úlpa	'coat'	[ulpa]	[ul ^h pa]	*[ul ^h p ^h a]	*[ulpa]
heimta	'demand'	[heimta]	[heim ^h ta]	*[heim ^h t ^h a]	*[heimta]
vanta	'lack'	[vanta]	[vant ^h a]	*[vant ^h t ^h a]	*[vanta]
vinka	'wave'	[vinka]	[vin ^h k ^h a]	*[vin ^h k ^h t ^h a]	*[vinka]

Data of this sort indicate that the phonological rule of devoicing has to move the feature specification [+SG] from the stop and to the preceding liquid or nasal. The fact that there are no intermediate stages possible (cf. the starred examples in (30)) seems to make it natural to look at this as one rule. The rule character of the phenomenon (as opposed to simply different underlying forms) is further supported by the fact that Icelanders speaking the devoicing dialects will tend to apply the devoicing rule when

speaking foreign languages. Thus they will pronounce English *help*, *Delta*, *milk*, for instance, as [hɛɭp], [tɛɭta], [mɪɭk].

As mentioned above, this analysis of devoicing is argued for in some detail elsewhere (Thráinsson, in press). Since that paper was written, it has received some support from instrumental phonetic experiments, which have shown that in the case of sequences like [ɭt] and [ɱp] that arise by devoicing of this sort, the glottis is already wide open during the production of the devoiced /l/ and /m/, but it has begun to close down by the time the stop is produced (cf. Pétursson 1976: 198).

5.4 Preaspiration and deaspiration

We have already indicated that preaspirated stops are not postaspirated. This has sometimes been used as an argument for considering preaspiration an “inverse aspiration”. We have seen, however, that preaspiration in Icelandic is not exactly comparable to postaspiration, since the former has regular segment length but the latter has not. Hence the latter is best considered a feature of the stop, or, rather, a consequence of a particular feature of the stop, namely [+SG].²² To account for the fact that preaspirated stops are not postaspirated, we could propose a similar feature moving analysis as above, i.e. assume that the feature [+SG] of the stop moves into the preaspiration segment. Such a rule would express that the spreading of the glottis that one would expect to go with the stop is absorbed by the preaspiration segment in much the same way as it is absorbed or anticipated by a liquid or nasal that precedes /p,t,k/ and gets devoiced as a result. In the case of the preaspiration segment [h], however, this would not make any difference in the production of the segment, since it is voiceless and specified as [+SG] anyway.

This analysis of the relationship between preaspiration and deaspiration is supported by the fact that the deaspiration phenomenon is actually more widespread than we have seen so far. An /r/, for instance, is always devoiced before /p,t,k/ in all dialects, and as a result the stops are deaspirated. An adjective like *sár* ‘painful’ is a case in point. The neuter is formed by adding a /t/, and consequently the /r/ is devoiced and the /t/ deaspirated, as shown in (31):

- (31) sár [sau:r] sárt [sauɾt]²³

Similarly, the dental spirant is dialectally devoiced before /k/, and the /k/ is always deaspirated in such cases. The dialects that do not devoice the /ð/ consequently do not devoice the stop. This is shown in (32):

- (32) maðkur 'worm' [maθkYr] [maðk^hYr] *[maθk^hYr] *[maðkYr]

Other spirants, on the other hand, are always voiceless before /p,t,k/ in all dialects and the stops are always deaspirated. This is exemplified in (33):

- (33)
- | | | | | |
|--------|-----------|--------------------------|---------|-----------|
| leysa | 'untie' | past: | leysti | [leistɪ] |
| hreyfa | 'move' | past part.: | hreyft | [ɾeyft] |
| gleypa | 'swallow' | past: | gleypti | |
| | | spirantization: p→f/___t | | [kleiftɪ] |
| rakur | 'moist' | neuter: | rakt | |
| | | spirantization: k→x/___t | | [raxt] |

The simplest account of the deaspiration and devoicing phenomena discussed in this section and in 5.3 above is then to assume a general rule moving the autosegmental laryngeal feature [+SG] from the stop and into the preceding consonant. In the most widespread dialect, this rule is very general and the feature can move into any nonsyllabic segment, thereby causing a devoicing of the segment if it is underlying voiced, such as /l,m,n,r,ð/. Other dialects are more restrictive and do not allow this feature movement in cases where it would cause devoicing of /l,m,n,ð/. Disregarding such special restrictions for the moment, we could state a first approximation to a general rule that accounts for all the above discussed instances of deaspiration of /p,t,k/, together with the devoicing that occurs before /p,t,k/ in the most widespread Icelandic dialect, in the way shown in (34):

- (34) [-syll] [+SG] ⇒ [+SG] [-SG]²⁴

This rule also receives some support from the instrumental data of Pétursson (1976: 186), which indicates that the glottis is widest open on the *s* in sequences like [sp], [st], [sc], on the *r* in [rk], and on the [h] in preaspiration sequences like [hp], [hc].

6. CONCLUSION

This paper has presented a new phonological analysis of Icelandic preaspiration. The aim has been to work out an analysis that gets as close to the phonetic facts as possible while at the same time satisfying phonological requirements about restrictiveness and predictive power. I have argued that the autosegmental approach offers the best way to achieve these

goals. I believe that I have shown that by adopting such an analysis we can both account for the phonetic facts in a fairly neutral fashion, make a number of correct predictions about preaspiration in Icelandic, and make it possible to relate preaspiration, devoicing, and deaspiration.

The question remains, however, why a language should develop a rule like preaspiration. I believe that the fact that Icelandic no longer has voiced stops must have something to do with it. When all Icelandic stops became voiceless, it became necessary to find a clear way of distinguishing long /pp/, /tt/, /kk/ from long /bb/, /dd/, /gg/. If this is the correct functional or teleological explanation, we might expect to find preaspirated stops of the same sort only in languages that do not have a clear voiced/voiceless distinction in their stop systems. This theory could actually make such a prediction by claiming that for a preaspiration rule of the Icelandic sort to be possible, it is necessary that /p,t,k/ be specified underlyingly as [+SG], i.e. that the feature [+SG] function distinctively. The following Appendix contains a few preliminary notes about this prediction.

APPENDIX

A.0 Many languages have two series of stops that are distinguished essentially by voicing. English is usually considered to be among these. Thus it has been argued that English /p,t,k/ are not underlyingly specified as [+SG] but that there is a rule that introduces the feature [+SG] only in the cases where /p,t,k/ are postaspirated, i.e. in syllable-initial position (cf. Kahn 1976: 45, *passim*). If we are correct in hypothesizing that languages do not develop a preaspiration rule for stops unless the feature [+SG] functions distinctively in their stop series, English should not have such a rule of preaspiration. This is, of course, the correct prediction.

Now let us assume for the moment that stops corresponding to /p,t,k,/ are only specified [+SG] underlyingly when this feature is needed to distinguish them from another series of voiceless stops, such as /b,d,g/ in Icelandic. In other words, let us assume that when there is a voiced/voiceless distinction between stops, the feature [+SG] does not figure distinctively and stops are not marked underlyingly as [+SG] (unless, of course, there are more than two distinctive stop series). If this were true, our formulation of the preaspiration rule would predict that such preaspiration should only be found in languages where there is no voiced/voiceless distinction between stop series. It would be very interesting if this were true. One can take a first step towards testing this hypothesis by simply looking at descriptions of languages that have been reported to have

preaspiration and seeing whether they have any voiced stops. Most descriptions mention whether the language in question has voiced stops or not, and such judgments are probably fairly reliable in most cases. Unfortunately, however, it is usually very difficult to tell from phonetic/phonological descriptions whether the alleged preaspiration is of the same nature as Icelandic preaspiration. There is usually not enough phonetic detail to determine the actual quantity relations, not even the phonetic realization of the preaspiration, and the investigators do not give enough phonological detail to make it possible to determine whether the alleged preaspiration is a living synchronic phonological rule, or just underlying /h/, for instance, which does not alternate with anything, although it may be historically derived from something else.

Having pointed out these difficulties, it is interesting to look briefly at some languages and dialects that have been reported to have preaspiration. The purpose of this Appendix is to do just that in order to point out a few interesting facts that seem to merit a closer investigation.

A.1 Preaspiration in other languages

A.1.1 First, Faroese is usually reported to have preaspiration. If we look for the distinction between the two series of stops, it does not seem to be voicing. Thus Rischel (1972: 484) says that "there may or may not be vocal cord vibration in /b,d,g/". And although it has been argued that there is a difference in 'force of articulation' or a fortis/lenis difference between the two series of stops in Faroese, it is tempting to attribute the basic distinction to the feature [\pm SG]. This is consistent with Werner's claim that "Fortis-lenis ist . . . irrelevant, der Hauch [i.e. aspiration] ist entscheidend; der Fortis-Lenis-Unterschied Stützt den des Hauchs, kann ihn aber nicht ersetzen." (Werner 1963: 86–87).

Unfortunately, however, the details about the phonetics and phonology of Faroese preaspiration are not so clear. Thus it is difficult to determine what the actual quantity relations are between the preaspiration and the following stop (cf. Werner 1963: 87–88). That preaspiration occurs in the case of apparently underlying /pp/, /tt/, /kk/ (Werner 1963: 80–81) as well as in cases where the sequence /t+t/, for instance, arises through the application of a morphological rule (Rischel 1972: 484) is very suggestive, as is the fact that sequences like /p,t,k/+l,n/ seem to give rise to preaspiration in Faroese as in Icelandic (Werner 1963: 82, 93). But we still need to know whether there is similar evidence for the lengthening of stops before /l,n/ in Faroese as in Icelandic, what the story is about alleged instances of preaspiration before /p,t,k/+r,s/ (Werner 1963: 93),

between a diphthong and an /s/ (Werner 1963: 100, Pétursson 1972b: 97), etc. There are also reports of preaspiration before such sequences as /p/+t/ and /k/+t/ (Werner 1963: 82, 93, Rischel 1972: 484, Pétursson 1972b: 97). In such cases, Icelandic has spirantization of the first stop (cf. 5.4 above). It would be interesting to see whether the Faroese examples could perhaps involve such spirantization, or, alternatively, be interpreted as the result of a rule lengthening the first stop and feeding the preaspiration rule.

A.1.2 Preaspiration is also reported to occur in certain Norwegian dialects (cf. e.g. Chapman 1962: 61). Oftedal's descriptions of the dialect of Jæren (Oftedal 1947, 1972) are often cited in this connection. Here again there seems to be a lack of voiced stops, and the distinction between the two series of stops is possibly best represented by the feature [\pm SG]. Oftedal remarks on this: "Det gjeld altså her [i.e. in the speech of his informant] om lag det same som for nyislandsk, der 'all stops are more or less voiceless'" (Oftedal 1947: 231). As in the case of Icelandic and Faroese, people have tried to define the difference between /p,t,k/ and /b,d,g/ in terms of fortis (or *tenuis*) vs. lenis (or *mediae*), but found it rather unsatisfactory (cf. Oftedal 1947: 232–233). The statement that "/p/ /t/ /k/ ... are always 'aspirated' in one way or another" (Oftedal 1972: 430) is highly suggestive.

But the descriptions leave a lot to be desired in terms of phonetic and phonological detail. Wolter's (1965) report on some instrumental measurements is of rather limited help. He is apparently not describing exactly the same dialect as Oftedal (Wolter 1965: 594), and hence his exclusively phonetic data are rather difficult to complement by the phonological information Oftedal's studies contain. Wolter's percentage figures are sometimes rather confusing, since he never gives any examples of the words he has measured, but only divides them into monosyllabic and polysyllabic. The absolute length of the preaspiration seems quite compatible with its being a segment, if one compares it with Icelandic preaspiration (Wolter's averages are about 91 ms for preaspiration in monosyllabic words and 85 ms in polysyllabic words). Yet Wolter remarks that it only "amounts to an average of 28.61% of the whole stop phase in polysyllables and 31.73% in monosyllables" (op.cit. 595). Although there is no reason to expect a preaspiration segment to be exactly equal in length to a succeeding stop, even if it is of the same nature as Icelandic preaspiration, this is a somewhat lower percentage than one would expect, and it makes one want to know more about the words measured,

whether the speakers exclusively spoke this preaspiration dialect, etc., but no such information is given. It would also be useful to know more about the alleged preaspiration of stops before an /s/, which Oftedal reports on (1947: 233) but which Wolter did not find (1965: 596), more about preaspiration before stops preceding /l,n,r/, mentioned by both (Oftedal 1947: 232, Wolter 1965: 596), more about the existence and length of preaspiration after long vowels, which Oftedal mentions (1947: 233) and about which Wolter says that it has been "registered by the ear ... but no measurements have been made, the material not being representative of the words known and used by some of the informants." (Wolter 1965: 595). Furthermore, Wolter claims that preaspiration "in connexion with [t] ... may sound like an [f]" (*op.cit.* 233), but Oftedal maintains that it never becomes a fricative in the dialect he describes, although it may do so in others (Oftedal 1947: 232). The phonetics of all this needs to be investigated further. In addition, there is no way to tell from these descriptions whether there is a synchronic phonological rule of preaspiration in these dialects or whether a historical change has created the segment [h] in certain environments and it has subsequently been phonemicized. Although this has not happened in Icelandic, it might well happen in other languages, especially if there is a low number of alternations to keep the rule alive.

A.1.3 The situation is even less clear in the Swedish dialects that have been reported to have preaspiration. One should not take it for granted that all the things that have been referred to as preaspiration, or voiceless vowel (Lundell 1879: 86, Westin 1897: 32, Reitan 1930), or epenthetic consonants (Millardet 1911, Verrier 1912, Rositzke 1940) do in fact constitute a homogeneous class, as some investigators have tended to assume. It is true that some of Lundell's examples of "den 'aspiration' som förekommer i Sveg i Härj[edalen] före *tt ttj kk*, samt i Särna i Dal[arna] före *tt*" (Lundell 1879: 86) look pretty much like Icelandic preaspiration examples as far as their origin is concerned. Lundell's original remarks are also very interesting, although quite brief. His reason for referring to this "aspiration" as a voiceless vowel rather than an [h] is his impression that the airflow is less than in the case of an [h] in general (*ibid.*). He also remarks that the phonetic quality is determined by the quality of the preceding vowel, and that has presumably also influenced his decision to refer to this as a voiceless vowel. Unfortunately, the instrumental investigation of Millardet (1911) introduced a great deal of confusion here, since he seems to have thrown together a lot of phonologically different phenomena. Some of this is cleared up by Rositzke (1940:

480), who points out that words with phonologically long /pp/, /tt/, /kk/ such as *kuppar*, *pyttor*, *bockar* are never pronounced with a spirant, as Millardet's work might have led one to believe. Millardet's study has nevertheless led to the claim that Swedish preaspiration has a phonetic realization very different from Icelandic and Faroese preaspiration, for instance (cf. Pétursson 1972b: 97–98). This needs to be looked into much more closely.

In addition, there is some evidence that preaspiration in certain Swedish dialects may not be a regular synchronic rule but may figure as an independent phoneme. Thus Marstrand (1932: 295–296) reports that in Vemdalen only historically long /p,t,k/ are preaspirated and not secondarily lengthened /p,t,k/. Similarly, it seems that loanwords may fail to undergo preaspiration (Reitan 1930: 70). Yet it is also reported that the sequence /t+t/ created by a morphological rule will undergo preaspiration (op.cit. 69). On the whole it is not clear how regular preaspiration is in those Swedish dialects that seem to show instances of it. It seems that dialects may even vary as to which of the stops from the /p,t,k/ series can be preaspirated – i.e. some dialects may have preaspirated /pp/, /tt/, /kk/, others only /tt/ (op.cit. 72). It is not even clear whether /b,d,g/ are voiced or voiceless in these dialects. They are usually referred to in these studies as being voiced (“tonad”), but since some of the studies are actually more concerned with establishing orthographic conventions than reporting on phonetic detail, it is not entirely clear whether the distinction voiced/voiceless actually means what it says or whether it is just a convenient terminology for distinguishing between the two series of stops.

A.1.4 Outside the Nordic language group the neighboring Lappish is sometimes said to have preaspiration or voiceless vowels. It seems to be generally agreed that Lappish does not have voiced stops (cf. Wagner 1964: 234, 258, Liberman 1971: 272). Phonetic descriptions of Lappish preaspiration seem to describe a phenomenon rather similar to Icelandic preaspiration, although some have remarked that Lappish preaspiration may sometimes lack the friction noise normally present in an [h] (cf. Kylastra 1972: 374), and others wish to emphasize the differences in realization from case to case (Liberman 1971: 272). Phonologically it is also related to long stops, but the situation is quite complicated since it enters into the Lappish gradation system (cf. e.g. Liberman 1971: 273, Ravila 1956). Among the phonetic details it would be helpful to know more about are the quantity relations: whether, for instance, there is such a thing as “überlange Präaspiration” (Wagner 1964: 242), etc. And it is,

of course, necessary to determine whether there is a synchronic rule of preaspiration in Lappish or just phonemicized relics of a historical change.

A.1.5 On the other side of the Nordic language area there is Scottish Gaelic (ScGael.), which also seems to have preaspiration. Interestingly enough, ScGael. does not have voiced stops (Marstrander 1932: 297, Wagner 1964: 285, Jackson 1951: 90–91). There is also some evidence that there is – or at least was at the beginning of this century – an active synchronic rule of preaspiration in ScGael. The evidence is that speakers of ScGael. tended to pronounce certain English words with preaspiration (Marstrander 1932: 294). It is not entirely clear to me, however, what the phonological prerequisites for preaspiration are in ScGael – i.e. whether one can, for instance, assume a lengthening of /p,t,k/ as a necessary condition for preaspiration. It has been claimed that such a lengthening took place (Wagner 1964: 286, Oftedal 1968: 254). Then the ScGael. pronunciation [mahk] for *mac* ‘son’ would be derived from a long stop – cf. the Old Irish spelling *macc* (Oftedal 1968: 254). But, as usual, not enough is known about the objective quantity relations, the extent to which the preaspiration segment can be spirantized (e.g. become [x] before [k] – cf. Wagner 1964: 286, Marstrander 1932: 294, Borgstrøm 1974: 92), etc.

A.1.6 Finally, preaspiration is sometimes said to exist in certain American Indian languages, such as Fox, Hopi, Papago, Malecite/Passamaquoddy. But one should not jump to the conclusion that this terminology means that this phenomenon is phonologically the same as or similar to preaspiration in Icelandic. While it seems true that Fox, for instance, does not have clearly voiced stops (cf. e.g. Jones 1911: 741), it seems that the [hp], [ht], [hk] combinations in Fox have a rather different historical origin from corresponding Icelandic sequences (cf. Bloomfield 1963: 88–89). Trubetzkoy (1958: 140n) claims that the preaspiration in Hopi must function as a segment, but I have been unable to find enough phonological details about it, so its nature is still unclear to me. Finally, it has been claimed that the so-called preaspiration in Papago is really a devoicing of the second half of the preceding vowel (cf. Anderson 1974: 266n), and I am in no position to evaluate this claim. I note, however, that Papago does not seem to have any voiced stops. What distinguishes the “sharp” and “mellow” stops in initial position, for instance, seems to be aspiration (cf. Alvarez and Hale 1970: 94–95).

A.2 Devoicing in other languages

It is also quite interesting to note that most of the languages and dialects mentioned above as having preaspiration (and no voiced stops) also seem to have devoicing of sonorants before /p,t,k/. This fits quite nicely into our theory of such devoicing as being a movement (or spreading) [+SG] from the stop over to the sonorant. Marstrander (1932: 298) mentions the existence of this devoicing in Icelandic, Faroese, the preaspiration dialects in Norway and Sweden, and in ScGael. Rischel (1972: 484) also mentions this for Faroese, and Werner's data (1963: 93) indicates that this devoicing also results in deaspiration in Faroese. The same apparently holds for the Norwegian preaspiration dialects (Oftedal 1972: 431). Similarly, Reitan (1930: 67) mentions devoicing of /l,m,n/ before /p,t,k/, which apparently varies in extension among dialects, some dialects only devoicing /l/ before /t/ just as some Icelandic dialects do. Lappish is also reported to have devoicing of /l,m,n,r/ before /p,t,k/, and Wagner's claim that it "hängt systematisch mit der Präaspiration zusammen" (1964: 260) is quite suggestive, although his explanation of this relation may be wrong. The same is true of his attempts to relate the devoicing of sonorants before /p,t,k/ in ScGael. to the preaspiration also found there (op.cit. 292).

NOTES

- 1 This work was supported in part by the Icelandic Science Foundation and the Thor Thors Fund of the American Scandinavian Foundation. I am indebted to a number of people for help and suggestions, but most of all to Nick Clements, whose ideas and suggestions have greatly influenced my thinking about this topic, and to Hreinn Benediktsson for his encouragement and very valuable comments on earlier versions of this paper. I have also benefited from comments by Kristján Árnason, John Goldsmith, Einar Haugen, Janez Orešnik, Magnús Pétursson, Alan Prince, the participants in the phonological seminar at Harvard, Spring 1977, and the workshop on autosegmental phonology at Harvard, May 21, 1977. I may soon regret that I did not always follow the advice of these people. Thanks are also due to Dennis Klatt for making it possible for me to do the phonetic measurements, to Helgi Guðmundsson for referring me to a number of studies on preaspiration in other languages, and to Karl Teeter and Philip LeSourd for information on Malecite/Passamaquoddy. – An earlier version of this paper appeared in *Harvard Studies in Phonology*, I, 1977.
- 2 For an explanation of the phonetic transcription of Icelandic stops used here see Section 4.2 below. See also notes 6 and 23.
- 3 I owe this point to Hreinn Benediktsson (personal communication).

- 4 From here on I shall frequently use the // notation to refer to any nonphonetic stage in the derivation, not only to the underlying or "deepest" synchronic level.
- 5 Not all speakers pronounce the feminine forms with an aspirated /t/ – cf. note 24 below.
- 6 It is sometimes claimed that all stops are postaspirated in final position in Icelandic. The reason for this claim is that it is very difficult to perceive any difference in postaspiration between words like *ljót* and *ljótt*, for instance, in utterance-final position. But such differences are clear if a vowel-initial word follows, cf. *ljót á litinn* 'of ugly color' with postaspiration vs. *ljótt á litinn* with preaspiration and no postaspiration. Hence I shall mark postaspiration on words like *ljót*, *sæt*, *feit*, etc., but not on *ljótt*, *sætt*, *feitt* or the like. See also note 23.
- 7 This quantity interpretation of English vowels corresponds at least partly to the inherent length of the nuclei of these words – cf. e.g. Peterson and Lehiste 1960, Lehiste and Peterson 1961, Klatt 1975. It would, of course, be interesting to investigate this correspondence in greater detail to determine what it is exactly that governs the quantity interpretation of these vowels by speakers of Icelandic, but that is outside the scope of this paper.
- 8 I owe this example to Benediktsson (1959: 67), whose phonological analysis completely agrees with mine on this point.
- 9 Here the *-ur-* is a *nom.* marker, *-i-* is a *dat.* marker, *-inn* the *nom.* form and *-num* the *dat.* form of the suffixed definite article.
- 10 With the exception of compound forms like *íshús* lit. 'ice-house', and words with a prefix like *óhóf* 'excess'.
- 11 For an overview of a number of related ideas about preaspiration in Nordic languages and Lappish, broad in scope but lacking in phonetic and phonological detail, see Kylstra 1972.
- 12 I find Garnes's remark on this finding rather hard to understand: "The differences which Pétursson observes are most likely due to the allophonic length of vowels, not with [sic] the effect of preaspiration on the preceding vowel." (Garnes 1974: 380). But this is exactly the point. The long vowel before a single /t/ must be the long variant, and if the vowel that appears in preaspiration words is not the same variant, and if the difference is not due to the effect of the preaspiration segment, then it must be "due to the allophonic length of vowels". But this means, then, that the vowel in preaspiration words does not "share many similarities with long vowels", as Garnes claims, and hence its quality does not support the vowel-devoicing analysis, as she apparently wants it to do.
- 13 Garnes's figures for long /e/ are actually 505-610/1735-1880, reflecting the tendency of long /e/ to diphthongize. I have simply taken the averages here to make the figures more comparable to Pétursson's. I shall return to the diphthongization question below.
- 14 The figures for each pair represent averages, and the number in parentheses is the number of speakers for each pair. All the words were spoken in the carrier sentence 'Eg segi orðið____núna' 'I say the word____now'. V: stands for long vowel, VH for vowel before preaspiration, and V for short vowel. For further details see Thráinsson (in preparation).
- 15 Garnes is, in fact, partly arguing that preaspiration is a "process that cannot be suppressed" in Stampe's sense (1972). Nothing hinges on this distinction here, as far as I can see.

- 16 In the case of *vakna*, there is some synchronic evidence for short stop – cf. *vaka* ‘wake’. In the case of *vatna* and *vopna* there are no synchronic alternations that bear on this question.
- 17 The figures for *vatna*, *vakna* are again from Garnes (1974), the others are based on my own measurements and are averages for two speakers.
- 18 What is written here as *f* before *l* in *tefla* ‘play chess’ is pronounced as the Icelandic phoneme /b/, i.e. as an unaspirated (lax?) voiceless stop. What is written as *nn* in *neinna* ‘not anyone’(gen.pl.) is pronounced as the Icelandic phoneme /d/ plus /n/, i.e. as an unaspirated (lax?) voiceless stop plus a nasal. The phonology of this need not concern us here, but it might be pointed out that words like *tefla* are occasionally misspelled by Icelandic children with a *b* instead of *f*.
- 19 All these measurements are from my own material on the phonetics of Icelandic preaspiration. Each pair of figures represents a single speaker. The words *happa*, *habba*, *hatta*, *hadda* were spoken one by one in the reading of a word list. The others were spoken in a carrier sentence – cf. note 14.
- 20 One could also mention here that much of the traditional literature on Icelandic phonetics assumes an even more general lengthening of consonants preceding consonants. Ófeigsson (1920-24: XIX, passim) and Einarsson (1945), for instance, generally denote “half length” in such cases. This does not, however, hold for /p,t,k,s/ preceding /v,j,r/. In such cases the preceding vowel is long. It is likely that these facts have something to do with syllabication rules in Icelandic, but it would take us too far afield to go into these here.
- 21 For an autosegmental analysis of vowel harmony see Clements 1976.
- 22 It has also been claimed that there are some articulatory differences between the production of preaspiration and postaspiration (Pétursson 1972a: 66), but it is rather difficult to evaluate this claim.
- 23 That the final /t/ is phonologically deaspirated can be seen if a vowel-initial word follows, cf. (*betta var*) *sárt í gær* ‘(this was) painful yesterday’.
- 24 It should be mentioned, however, that a large subset of the speakers who have this extensive devoicing and deaspiration rule also deaspirate /p,t,k/ when they follow a long vowel, without, however, devoicing any part of the vowel. Since apparently no speakers do so without having the most extensive variant of the devoicing rule, i.e. something like (34), one would like to be able to express this relation somehow. I suspect that this may be possible by postulating different syllable structure rules for the dialects in question, and I believe that there are some independent reasons for doing so. We cannot, however, go into this question here.

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