

Aspects of Brittonic spirantisation under Laryngeal Realism



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ASPECTS OF BRITTONIC SPIRANTISATION UNDER LARYNGEAL REALISM

ABSTRACT

This paper examines the three principal environments in which spirantisation occurs in all of the Brittonic languages: (a) as fricatives which ultimately continue geminate aspirated voiceless plosives; (b) as the result of various triggering forms that cause the spirant mutation; and (c) after liquids. It is argued that these changes – long a vexed problem of Brittonic diachronic phonology – fall out naturally when one adopts a Laryngeal Realism view of Celtic phonology, under which the plosive series are not contrasted via the laryngeal feature [voice] but via the feature [spread glottis], i.e. the phonological contrast between the plosive series is /p^h t^h k^h/ vs. /p t k/.¹

PRELUDE

§1. Conventional wisdom is that the Celtic languages, throughout their history, contrasted their plosive series via the laryngeal feature [voice], thus /p t k/ vs. /b d g/ (e.g. Pedersen 1909: 90–140; Thurneysen 1946: 134–40; Evans 1964: 7; Ó Siadhail 1989: 82; Thorne 1993: 7; Lambert 2003: 45; Jordán Cólera 2019: 108–34).²

§2. This is certainly not true, however, for the modern Celtic languages. Jones (1984: 41) notes, for Welsh, that:³

- (1) [t]he series /p, t, k/ are aspirated and voiceless, whilst the series /b, d, g/ are unaspirated, and although frequently referred to as voiced, voicing is not a constant feature of their articulation. They are regularly unvoiced in word initial and final positions: [b̥is] ‘finger’, [d̥ið] ‘day’, [kiɡ̊] ‘meat’, [m̥aβ] ‘son’, and frequently so in a medial fully voiced environment, e.g. intervocally: [seβon] ‘soap’, [bloðɛ] ‘flowers’, [deɡ̊ɛ] ‘tens’. They may be partially voiced in all these environments, but fully voiced occasionally in medial fully voiced environments only. Since aspiration/non-aspiration is the constant feature distinguishing the two series of stops, voicing may be considered redundant, and the contrast operates on the voice-onset axis, i.e. on the duration of the release stage of the plosives. The delay is consistently longer for /p, t, k/ than for /b, d, g/.

¹I should like to thank the anonymous reviewer for helpful comments. All usual disclaimers apply.

²The material presented here in §§1–2 recapitulates that in Eska (2019a: 5–7; 2020: 237–9).

³I bring the employment of phonetic characters into compliance with the current usage of the International Phonetic Alphabet. For Modern Irish, cf. Ní Chasaide (1999: 113).

This is verified by Voice Onset Time (VOT) values for plosives in initial position (measured in milliseconds; data cited after Ball 1984: 15):

(2)	/p/	/b/	/t/	/d/	/k/	/g/
	62	15	82	33	97	32

A VOT value of 0 would indicate that voicing of a following segment commences precisely at the release of the occlusion. The positive values in Welsh demonstrate that voicing is not present, even in the so-called ‘voiced’ series. Languages that contrast their plosive series via the feature [voice] have negative VOT values in the voiced series, which indicates that voicing commences prior to the release of the occlusion, as, for example, in Spanish (data cited after Lisker and Abramson 1964: 392):

(3)	/p/	/b/	/t/	/d/	/k/	/g/
	4	–138	9	–110	29	–108

We may, furthermore, compare the VOT values for Scottish Gaelic, which is universally recognised to contrast its plosive series not via the feature [voice], but via the feature [spread glottis], i.e. via aspiration (e.g. MacAulay 1992: 231; Ladefoged, Ladefoged, Turn, Hind, and Skilton 1998: 4–12; Gillies 2010: 232). The data are cited after Nance and Stuart-Smith 2013: 137:

(4)	/p ^h /	/p/	/t ^h /	/t/	/k ^h /	/k/
	71	17	73	23	89	33

A comparison of the Welsh VOT values with the Scottish Gaelic VOT values makes it clear that Modern Welsh does not contrast its plosive series via [voice] but, like Scottish Gaelic, via [spread glottis], i.e. via aspiration.

Laryngeal Realism

§3. Laryngeal Realism is an approach to phonology which ‘adopts a more transparent relationship between distinctive features as phonological entities and the phonetic substance of those features’ (definition as per Brown 2016: 397; the term ‘Laryngeal Realism’ originates with Honeybone 2005). Under Laryngeal Realism, which I adopt, the Celtic languages do not contrast their plosive series via [voice], but via the laryngeal feature [spread glottis], i.e. they contrast /p^h t^h k^h/ with /p t k/.⁴ Under the traditional view that the contrast is /p t k/ vs. /b d g/, one is forced to believe that voiced plosives were devoiced in such a sonorous environment as intervocalic position, which is a very unnatural sound change. Instead, under Laryngeal Realism, the aspirated voiceless plosives could be – but need not necessarily be – partially voiced by perseverant passive voicing in such an environment, while unaspirated voiceless plosives, after partial passive voicing, were spirantised, presumably because their

⁴Thus orthographic ⟨p t c/k⟩ represent /p^h t^h k^h/ and orthographic ⟨b d g⟩ represent /p t k/.

short occlusion became incomplete (Ohala 1990: 438; see also Eska 2020: 240). Philological evidence that such a contrast also obtained in the Continental Celtic languages is provided in Eska (2017a; 2017b) and further argumentation that it should be projected back to Proto-Celtic in Eska (2018a; 2018b).

Interarticulatory timing

§4. Another factor that will come into play is that ‘different outcomes of change may arise from small variations in the magnitude or coordination of consecutive segments or from adjustments operating along different dimensions all directed at achieving the same functional goal’ (Solé 2012: 124).⁵ For our purposes, what this means is that the relative timing of consecutive articulatory gestures may result in different segments being produced diachronically.

§5. Among the cases that Solé discusses is the treatment of fricative + nasal groups (2012: 125–9; cf. Solé 2007 for more detail). In order to generate turbulence, fricatives require a tightly closed velum, while the production of nasals requires the lowering of the velum. The diachronic development of such groups proceeds in two directions depending upon the interarticulatory timing of the adjacent segments. One result is due to the velum being lowered during the articulation of the fricative in anticipation of the production of the nasal, which reduces the oral pressure necessary to produce the fricative which, consequently, may not be perceived. This may result in gliding of the fricative, e.g. Standard Catalan *e[s]ma* > Majorcan Catalan *e[j]ma* ‘judgement’, or loss of the fricative altogether, e.g. Lat. *ro[s]marīnum* > **romarinu* > Cat. *romani*, Sp. *romero* ‘rosemary’. The other result is due to the lowering of the velum being delayed relative to the occlusion of the nasal. Consequently, the initial portion of the nasal denasalises and a plosive emerges, e.g. OE *glisnian*, *hlȳsnan* > ME *glis[t]en*, *lis[t]en* (cf. Ohala 1981).

§6. Another example, directly relevant to the triggering of the spirant mutation, is sandhi in Vedic Sanskrit. Hale (2017) invokes the notion of ‘degrees of separation’. Thus, with regard to the juncture of /s/ and /p^(h)/, he notes the following sandhi realisations (see further Allen 1962: 78):

- | | | |
|-------------------------------|-----------|---|
| (5) a. Word-internal | -⟨sp(h)⟩- | -V[sp ^(h)]V- |
| b. ‘Close’ sandhi | -⟨sp(h)⟩- | -V[s = p ^(h)]V- |
| c. ‘Not so close’ sandhi | -⟨hp(h)⟩- | -V[ϕ # p ^(h)]V- (<i>upadhmānīya</i>) ⁶ |
| d. End of Intonational Phrase | -⟨hp(h)⟩- | -V[h ## p ^(h)]V- (<i>visarjanīya</i>) |

We may note that ‘close’ sandhi represents clisis, so the consonantal group is in internal position within the phonological word, thus [ω [ω -Vs] = p^(h)V-]. ‘Not so close’ sandhi occurs between phonological words that occur within the same phonological phrase, thus [ϕ [ω -Vϕ] [ω p^(h)V-]].

⁵The material presented here in §§4–6 is substantially identical with that in Eska (2020: 242–3).

⁶Also -⟨hk(h)⟩- -V[x # k^(h)]V- (*jihvāmūlīya*).

SPIRANTISATION IN THE BRITTONIC LANGUAGES

§7. One of the most vexed issues in Brittonic linguistics is the matter of the origin of ‘spirantisation’, as evinced by the early vigorous debate on the pages of this journal between Greene (1956: 288–9) and Jackson (1960) and then, again, Greene (1966). This paper addresses the three major environments in which spirantisation – defined as the lenition of a plosive to a fricative or, in the case of segments bearing any degree of voice, a fricative or an approximant – occurs across all of the Brittonic languages. There are several other minor instances which occur in individual Brittonic languages.⁷

Geminates and spirantisation

§8. Original voiceless geminate plosives (= /pp^h tt^h kk^h/ under Laryngeal Realism) are ultimately realised as fricatives in the Brittonic languages, e.g.

- (6) a. Lat. *cippus* ⇒ Proto-Brit. **k^hipp^hos* > MBr *queff* ‘trunk (of a tree)’
 b. Proto-Brit. **k^hatt^hos* > MW *cath* ‘cat’
 c. Proto-Brit. **prokk^hos* > OCo *broch* ‘badger’.

§9. Jackson (1953: 565–70) states that these voiceless geminate plosives directly became fricatives, asserting that ‘[t]here is no need to discuss [...] how this happened.’ He is followed in this view by Koch (1989) and Isaac (2004; 2008).⁸

Geminate Inalterability

§10. It is well known that Geminate Inalterability blocks geminates from being affected by lenition processes prior to being reduced to singletons (Kirchner 2000; 2001: 97–135). Thus, in languages in which /p t k/ > /ϕ θ x/, /pp tt kk/ remain unaltered, i.e. they do not become /ϕϕ θθ xx/, since the occlusion of geminates may be anywhere from one and one-half to three times as long as for singletons (depending on the language), i.e. the incomplete occlusion necessary to yield a fricative is extremely unlikely. Kirchner (2001: 104–5) cites the example of Biblical Hebrew,⁹ which has a rule of frication of post-vocalic labials, velars, and non-emphatic coronals:

(7) Imperfect	Basic perfect	Causative perfect	Gloss
a. <i>yix[p]or</i>	<i>kaa[ϕ]ar</i>	<i>ki[pp]eer</i>	‘cover’
b. <i>yiϕ[t]ah</i>	<i>paa[θ]ah</i>	<i>pi[tt]eeah</i>	‘open’
c. <i>yiz[k]or</i>	<i>zaa[x]ar</i>	<i>zi[kk]eer</i>	‘remember’

⁷I intend to address these spirantisations on another occasion.

⁸It is not usually noticed that Jackson (1967: 317) later states that this change occurred ‘probably via an intermediate stage of very strongly aspirate stops’, though he does not pursue the matter.

⁹I cite the data in (7) after Kirchner’s source, Elmedlaoui (1993: 123–4), whose presentation is clearer for present purposes. All forms are 3 singular.

Here one sees that post-consonantal radical /p t k/ are unchanged in the imperfect, but are fricated to /ɸ θ x/ post-vocally in the basic perfect, while geminate /pp tt kk/ remain unchanged post-vocally in the causative perfect.

§11. In view of such data, an analysis that voiceless geminate plosives directly changed into fricatives in the prehistory of the Brittonic languages is clearly untenable.

Phonetic enhancement, degemination, spirantisation

§12. A group of scholars whom we may term the ‘Revisionist’ camp, including Harvey (1984), Thomas (1990), Schrijver (1999), and Sims-Williams (2007 = 2008),¹⁰ propose, with differences in the details of their respective arguments, that geminate voiceless plosives were degeminated via lenition and subsequently were subject to spirantisation – a view that goes back to Greene.

This approach is clearly on the right path, but begs the question, however, of why the new singletons were fricated rather than partially voiced, as previously happened to intervocalic singleton aspirated voiceless plosives via the earlier ‘soft’ lenition (see Eska 2020: 243–4), if their phonetic environments were the same.

§13. Under Laryngeal Realism, we expect medial /p^h t^h k^h/ to lose some of their aspiration. Geminates of these phonemes would be contrasted with singletons primarily by the duration of their occlusion. However, depending upon the details of individual languages, listeners may experience difficulty distinguishing singleton plosives from geminate plosives, as opposed to pairs of fricatives or sonorants, which listeners can readily distinguish (Dmitrieva 2018). Phonetic enhancements may be implemented to help distinguish singleton plosives from geminate plosives such as lengthening of the preceding vowel or lengthening of post-aspiration with the geminate plosives (Ridouane 2010).¹¹ The latter, which is relevant to the present argument, occurs, for example, in Turkish (Lahiri and Hankamer 1988), Cypriot Greek (Arvaniti and Tserdanelis 2000), and Moroccan Arabic (Zeroual, Hoole, and Fuchs 2006).

§14. I propose that the Proto-Brittonic geminates */pp^h tt^h kk^h/, though their degree of aspiration may have been regularly reduced in medial position, were articulated with the phonetic enhancement of post-aspiration as */[pp^h tt^h kk^h]-. They were then degeminated via lenition, as per the ‘Revisionist’ camp, to */[p^h t^h k^h]-. Aspirated plosives possess a shorter occlusion than unaspirated plosives,¹² and this shorter occlusion may become incomplete and lead to spirantisation. Thus we find:

¹⁰Sims-Williams (2007, nn. 1 and 14), in spite of its publication date, provides references to Iosad (2005) that are not present in Sims-Williams (2008).

¹¹On phonetic enhancement in general, see Avery and Idsardi (2001), Keyser and Stevens (2006), Stevens and Keyser (2010), Hall (2011), and Beckman, Jessen, and Ringen (2013).

¹²Cross-linguistically, one generally finds, within a given language, that the duration of the occlusion of an unaspirated voiceless plosive is the same as the duration of the occlusion + aspiration interval of an aspirated voiceless plosive combined (Kingston 1990: 429).

- (8) a. $*-/pp^h tt^h kk^h/- > *-[pp tt kk]-$ in medial position
 b. $*-[pp tt kk]- > *-[pp^h tt^h kk^h]-$ via phonetic enhancement
 c. $*-[pp^h tt^h kk^h]- > *-[p^h t^h k^h]-$ via degemination (lenition)
 d. $*-[p^h t^h k^h]- > -/\emptyset \theta x/-$ via incomplete occlusion and spirantisation.

THE SPIRANT MUTATION

§15. The spirant mutation affects traditional $/p t k/$ ($=/p^h t^h k^h/$ under Laryngeal Realism) after the following principal triggers:

- (9) a. Middle Breton (Hemon 1984: 7–9):
 1. The possessive pronouns *va* ‘my’, *he* ‘her’, and *o* ‘their’
 2. The numerals *tri* ‘three’ (masc.), *teir* ‘three’ (fem.), *pevar* ‘four’ (masc.), *peder* ‘four’ (fem.), and *nav* ‘nine’;
 b. Middle Cornish (Lewis 1946: 9 = 1990: 9):
 1. The possessive pronouns *ow* ‘my’, *hy* ‘her’, and *aga* ‘their’
 2. The numeral *try* ‘three’ (masc.);
 c. Middle Welsh (Evans 1964: 21):
 1. The possessive pronoun *y* ‘her’
 2. The numerals *tri* ‘three’ (masc.) and *chwech*, *chwe* ‘six’
 3. The prepositions *a* ‘with’ and *tra* ‘over, across’ and adverbial *tra* ‘very, excessive’
 4. The connective *a* ‘and’
 5. The negators *ny* and *na* ‘neither, nor’
 6. The complementiser *o* ‘if’
 7. The interrogative *cw* ‘where?’.

§16. The ‘Jacksonian’ camp requires initial singletons to become geminates prior to spirantisation, e.g. **esijās pennon* $>$ **eīdah pennon* (Transponat)¹³ $>$ **eia ppennon* $>$ MW *y phenn* ‘her head’. Under this analysis, the final $*-/s/$ of the genitive pronoun debuccalises to $*-/h/$, which then fully assimilates to the following voiceless plosive, thus forming a geminate, from which spirantisation ensues.

§17. As noted in §10, however, Geminate Inalterability blocks geminates from being affected by lenition processes prior to being reduced to singletons. Once again, therefore, I take the ‘Jacksonian’ approach to be untenable.

§18. The ‘Revisionist’ camp proposes that, when the triggering forms listed in (9) lost an original final consonant, spirantisation occurred, but only upon traditional $*/p t k/$ ($=/p^h t^h k^h/$ under Laryngeal Realism), e.g. traditional **min pennon* $>$ **mī pennon* $>$ MBr. *va fenn* ‘my head’.

¹³I.e. a phonological reconstruction that likely was not attested precisely in this form in Proto-Brittonic.

This approach begs two questions, however:

- (10) a. Why did spirantisation occur here rather than partial voicing, as under ‘soft’ lenition, if their phonetic environments were precisely the same?
 b. Why did it affect only the traditional voiceless series (= */p^h t^h k^h/ under Laryngeal Realism), and not the traditional voiced series (= */p t k/ under Laryngeal Realism), as well?

§19. Harvey (1984: 97–9) presumes that voiceless fricatives arose in Proto-Brittonic, first as free variants of */p t k/ arising from */pp tt kk/ after degemination via lenition, because voiced fricatives already existed.¹⁴ They thus filled a gap in the system. Note, to maintain clarity, that Harvey’s */p t k/ = */p^h t^h k^h/ under Laryngeal Realism.

But Harvey’s formulation does not address why spirantisation, rather than partial voicing, occurs. If the phonetic environment was precisely the same as for the ‘soft’ lenition, articulatory factors demand that partial voicing should have occurred a second time.¹⁵ One may compare the fact that palatalisation occurred in the prehistory of Old Irish three separate times with the same result (McCone 1996: 115–20).

§20. It is probable, instead, that the spirantisation result should be explained by an appeal to interarticulatory timing, as discussed in §§4–6. As posited by Iosad (2005), when traditional **min pennon* > * *mi pennon*, the possessive pronoun had not yet become a clitic, hence we have, under Laryngeal Realism, *[_φ [_ω *mi*] [_ω *p^hennon*]]. This leaves sufficient temporal space between the two lexemes for the initial of **p^hennon* to have retained enough aspiration to allow spirantisation to occur owing to incomplete occlusion. In contrast, a clitic would not have left sufficient temporal space and there would not have been enough aspiration for spirantisation to be possible, and thus partial voicing would have occurred instead. This is directly comparable to Hale’s ‘not so close’ sandhi, discussed in §6.¹⁶

§21. But why should spirantisation affect only the traditional voiceless plosive series (= */p^h t^h k^h/ under Laryngeal Realism)? Jackson’s (1953: 634–5) position is that Proto-Brittonic voiced geminates were simplified to singletons

¹⁴I note that the two ‘voiced’ fricatives of Welsh, /v δ/, are very difficult to distinguish from /f θ/ in the modern language. The former may be voiced intervocally only, but can also be completely voiceless in that environment. The principal cue that differentiates them is the longer duration of the constriction of /f θ/ (Ball 1984: 18–21; Jones 1984: 46).

¹⁵The only potential point of confusion would have been between the 3 singular possessive pronouns, for both masc. **eio pennon* and fem. **eia pennon* would have resulted in, for example, MW *y benn* for both genders. They could easily have been distinguished by the use of affixed pronouns, however, as became common in the Brittonic languages, even though they were not strictly needed for this purpose since the masculine and feminine pronouns actually trigger different mutations (Lewis 1946: 28 = 1990: 27; Evans 1964: 57–8; Hemon 1984: 75).

¹⁶This approach can also be employed to account for the differential treatment of the lenition of /p^h t^h k^h/ in Insular Celtic, i.e. spirantisation in Goidelic and partial voicing in Brittonic; see Eska (2020: 242–4).

before spirantisation occurred. But we have already seen that geminate plosives do not participate in lenition processes before they are degeminated.¹⁷

§22. Greene's (1966: 119) explanation for why spirantisation does not occur with the traditional voiced series fares no better. He claims that, were traditional */b d g/ fricated via spirantisation to **/β ð ɣ/, the result would have been the same as the 'soft' lenition mutation, which, in his view, would be problematic. This seems hardly likely to be a problem, however. One may compare the mixed mutation of Breton, in which /d/ undergoes provection, while /b g m/ undergo spirantisation,¹⁸ both of which occur as the result of other mutations – the provection mutation and the spirant mutation – as well.

§23. A straightforward explanation, however, falls out naturally under the assumption of the Laryngeal Realism view of Celtic phonology, whereby the plosive series were /p^h t^h k^h/ vs. /p t k/. The voiceless initials of MW *penn* 'head', MC *tyr* 'land', and MBr *cloch* 'bell' could be spirantised – and were – because they were aspirated, while the voiceless initials of MW *bwyt* 'food', MC *dorn* 'fist', and MBr *galar* 'sickness' were not spirantised – indeed, could not be – because they were unaspirated, hence:¹⁹

- (11) a. *[_ϕ [eia] [_ϕ p^hennon]] > MW *y phenn* 'her head'
 b. *[_ϕ [eia] [_ϕ pe:ton]] > MW *y bwyt* 'her food'
 c. *[_ϕ [eia] [_ϕ t^hi:ros]] > MCo *hy thyr* 'her land'
 d. *[_ϕ [eia] [_ϕ turnos]] > MCo *hy dorn* 'her fist'
 e. *[_ϕ [eia] [_ϕ k^hlokk^hos]] > MBr *he chloch* 'her bell'
 f. *[_ϕ [eia] [_ϕ kalaros]] > MBr *he galar* 'her sickness'.

SPIRANTISATION AFTER LIQUIDS

§24. Spirantisation of plosives and */m/ after liquids is regular in all of the Brittonic languages, e.g.:

- (12) a. Br *balc'h* 'proud' < Proto-Brit. */palk^h/
 b. MW *cerdd* 'skill' < *[k^herða:] < *[k^herʔa:] < Proto-Brit. */k^herta:/
 c. MCo *arvow* 'weapon' (pl.) < */arma/ < Lat. /arma/²⁰

§25. Jackson attributes spirantisation of the traditional voiced plosives (= /p t k/ under Laryngeal Realism) after liquids to lenition (1953: 432–3)

¹⁷In view of Geminate Inalterability, then, Jackson's view actually predicts that the traditional voiced plosives should undergo spirantisation, while the traditional voiceless plosives should not, precisely the opposite of what he posits.

¹⁸I note that most dialects of Modern Breton, unlike the other Insular Celtic languages, contrast their plosive series via the Laryngeal feature [voice], e.g. at Saint-Pol-de-Léon (Sommerfelt 1978: 48–56), surely due to prolonged contact with the [voice] language French.

¹⁹All syntagmata are Transponats. Before nouns commencing with vowels, sandhi /h/- is prefixed in Welsh (Evans 1964: 22–3). This is the result of resyllabification, thus **ei.ða.h ob.nus* (Transponat) > **eia hobnus* > MW *y hofuyn* 'her fear'.

²⁰Note that not all combinations occur. The special treatment of Proto-Brit. */-lt^h/ as W -/lt/ is treated in Eska (2019b).

and frication of the traditional voiceless plosives (= /p^h t^h k^h/ under Laryngeal Realism) to spirantisation (1953: 570–3).

§26. Russell (1985), however, combines them into a single process by positing that the feature [continuant] spreads from the liquid to both series of plosives at the same time. This seems much better. However, cross-linguistic evidence suggests that [continuant]-spreading from liquid to plosive only occurs with plosives that possess some degree of voicing, e.g.:

- (13) a. Basque, Catalan, Spanish:²¹ /b d g/ > [β ð ɣ] / L__ (Mascaró 1984)²²
 b. Italian: /b/ > /v/ / L__ (Rohlf s 1949: 436–7)
 c. Portuguese: /b/ > /v/ / L__ (Williams 1962: 91).

§27. That this restriction is not universal, however, is demonstrated by phrasal tokens such as Br *an amzer Fask* ‘Eastertime’ and *Sul Fask* ‘Easter Sunday’, in which spirantisation of /p^h/ occurs after a liquid. But why the differential treatment between Basque/Romance and Brittonic? The answer is that the former contrast their plosive series via the laryngeal feature [voice], i.e. /p t k/ vs. /b d g/ while in the Brittonic languages the contrast is made via the feature [spread glottis], i.e. /p^h t^h k^h/ vs. /p t k/. Since the period of occlusion of plosives that bear some voicing and aspirated voiceless plosives is shorter than for unaspirated voiceless plosives (cf. n. 12), [continuant]-spreading can cause their occlusions to become incomplete and result in spirantisation. The occlusion of unaspirated voiceless plosives in Basque/Romance, however, is sufficiently long to resist [continuant]-spreading.

§28. It seems that we are obliged to posit that plosives were spirantised after liquids in two stages, though not the stages that Jackson proposes. I propose instead that, under Laryngeal Realism, /p t k/ were partially passively voiced to [p̤ t̤ k̤] in the highly sonorous environment *L_V and underwent [continuant]-spreading prior to the apocope of final syllables. Thus, in autosegmental notation:

- (14) 
 [cont]

But /p^h t^h k^h/ underwent spirantisation to [ϕ θ x] in final position after the apocope of final syllables.²³ That this is the case is confirmed by Br *an amzer Fask* ‘Eastertime’ and *Sul Fask* ‘Easter Sunday’, in which spirantisation of /p^h/ can only have occurred after the apocope of the final syllables of *amzer*

²¹In Basque, voiceless plosives are sometimes voiced after /l/, but sometimes they are not. They remain voiceless after /r/ (Hualde 2003: 20–1). In Catalan and Spanish, voiceless plosives are usually preserved unchanged after liquids (Lausberg 1956: 44–5).

²²Mascaró (1991) provides a phonetic explanation for the lack of spirantisation of /d/ after /l/ in Spanish and Catalan.

²³Note that /p^h t^h k^h/ are strongly aspirated in final position in Modern Welsh, now usually only in English loans (Jones 1984: 42).

< Proto-Brit. **amserā* and *Sul* $\Leftarrow$ Lat. *solis* (Sims-Williams 2007: 45–6 = 2008: 511).

RELATIVE CHRONOLOGY

§29. Sims-Williams (2007: 44–6 = 2008: 510–1) sets out a relative chronology, combined with voicing, for the sound changes considered in this paper. They are as follows:

- (15) a. First spirantisation (also in Goidelic): traditional **/b d g/ > */β ð γ/ / V_V*
- b. Voicing: traditional **/p t k/ > */b d g/ / V_V*
- c. Second spirantisation: traditional **/p t k/ (< */pp tt kk/) > */ϕ θ x/ / V_* prior to apocope
- d. Third spirantisation: traditional **/p t k b d g/ > */ϕ θ x β ð γ/ / L_#* after apocope.²⁴

§30. Under the argument set out in this paper, as well as under the view that voicing and spirantisation can both be outcomes of lenition depending upon the interarticulatory timing between segments, I would revise Sims-Williams's relative chronology to the following, under the assumptions of Laryngeal Realism:

- (16) a. First lenition: Proto-Celt. **/p t k kʷ/ > */[p̥ t̥ k̥ k̥ʷ] > */[β ð γ γʷ] / V_[sonant]* in Proto-Celtic (Eska 2020: 239–40)
- b. Second lenition: Proto-Brit. **/pʰ tʰ kʰ/ > */[p t k] > */[p̥ t̥ k̥] / V_V*
- c. Third lenition: Proto-Brit. **/pʰ tʰ kʰ/ (< */ppʰ ttʰ kkʰ/) > */ϕ θ x/ / V_* prior to apocope
- d. First [continuant]-spreading: **/[p̥ t̥ k̥] > */[β ð γ] / L_V* prior to apocope
- e. Second [continuant]-spreading: **/pʰ tʰ kʰ/ > */ϕ θ x/ / L_#* after apocope.

RECAPITULATION

§31. Under the Laryngeal Realism view of Celtic phonology, whereby the plosives series were contrasted via the laryngeal feature [spread glottis] rather than the feature [voice], which is the traditional assumption, the environments that result in spirantisation across the Brittonic languages fall out naturally. The aspirated voiceless plosives */pʰ tʰ kʰ/* became fricatives because their occlusion is considerably shorter than unaspirated plosives and may become incomplete and, like fricatives, they bear the feature [spread glottis]. The unaspirated voiceless plosives possessed a longer occlusion and did not bear

²⁴Sims-Williams (2007: 55–6 = 2008: 522) discusses a fourth spirantisation that occurred only in Old Welsh, **/ntl/* and **/ntr/ > /θl/* and */θr/* respectively. I do not consider it in this paper because it is not pan-Brittonic; cf. OW *ithr* 'between' to MBr *intre*, MCo *ynter* and MW *kathyl* 'song' to Br *kentel* 'lesson'. I intend to address this spirantisation on another occasion.

the feature [spread glottis], so did not undergo spirantisation unless they had previously undergone passive voicing, which would have resulted in a shorter occlusion.

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