Hauchumsprung and the historical phonology of Greek **h*

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Abstract

Ancient Greek underwent a sporadic sound change that copied an **h* from the second syllable of a word to the first syllable, applying when the first syllable was vowel-initial, and perhaps also when it was stop-initial; this complements the analyses proposed so far in Greek historical phonology, particularly Sturm (2016, 2017), in accounting for the various sources of Proto-Greek **h*. This change, *Hauchumsprung*, is unusual among recorded sound changes for involving the copying of a consonant over intervening material. *Hauchumsprung*, the φρουρά rule, and Grassmann's Law can be unified as three different footprints of a single sound change: one that copied aspiration from the middle of a word to the beginning of a word in early Greek.

Keywords

Greek – aspiration – Grassmann – *Hauchumsprung* – historical – phonology

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Higgins: “In Hertford, Hereford, and Hampshire, hurricanes hardly ever happen.”

Eliza: “In 'Ertford, 'Ereford and 'Ampshire, 'urricanes 'ardly hever 'appen.”

Higgins: “Oh, no, no! Have you no ear at all?”

My Fair Lady

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This paper is about the ancient Greek sound change informally called *Hauchumsprung* (Lejeune 1972):

If a word began with a vowel or *w and exhibited an *h between the first and second syllabics, either intervocalic or as part of a cluster including a sonorant, the *h was copied into the onset of the initial syllable.

RINGE, forthc.

As we'll see, a survey of the Greek lexicon shows that something like *Hauchumsprung* (or *H-sprung* for short) is active in at least Attic Greek, and sometimes other dialects—but the change seems to be sporadic and rare. Section 1 summarizes what's already known about the origins of *h in other environments in Greek; section 2 presents some positive examples of *H-sprung*, along with a connected change that I call the φρουρά rule; and section 3 presents the exceptions to *H-sprung*. Section 4 proposes that *H-sprung* and the φρουρά rule, along with a hypothesized precursor to Grassmann's Law, are part of a more general sound change—'*Urhauchumsprung*'—copying aspiration from the middle of a word to the beginning.

1 Ancient Greek h

The historical phonology of *h* in Greek is mostly well-understood. There are four regular sources of early Greek *h*:

1. *s in most positions
2. *H_i word-initially
3. insertion before word-initial *u
4. *u word-initially, under particular conditions

Like Iranian and Armenian, Greek has debuccalization of PIE *s to *h* in most positions. Word-initially, *s > *h* is conventionally spelt in the ancient Greek alphabet using the 'rough breathing' sign ' over a following vowel, as in *septḥḥ 'seven' > ἑπτά; the 'smooth breathing' ' spells a word-initial vowel without an *h* before it. In psilotic dialects of Greek (from ψιλός 'smooth'), we see a regular loss of initial *h*. Intervocalically, *h disappears in all dialects except Mycenaean, the earliest attested Greek: *génh₁esos 'race (gen.sg.)' > *genehos > γένεος.

Next to stops and word-finally, *s stays as a sibilant: *h₁ésti 'he/she/it is' > ἐστί, *u₁lk^wos 'wolf' > λύκος. Most other positions are covered by the case where *s is next to a resonant, either initially or medially, in which case it becomes *h. Initially, *hR > *R > R, with mostly the same outcome as an initial resonant. Medially, *hR and *Rh have a complicated range of outcomes; the most

common in Attic-Ionic and in the West Greek dialects is a singleton *R* with compensatory lengthening of the preceding vowel, and in Thessalian and Lesbian, a geminate *RR* with no lengthening of the vowel.

The second source of **h* is word-initial **H_i*, where **H* is any of the three PIE laryngeals: **H_iékh₂* ‘liver’ > ἥπαρ. A third source is word-initial **u*, as in ὕδρα ‘sea serpent’ < **udréh₂*: so words in non-psilotic dialects aren’t allowed to begin with ***ú-*. Sturm (2017) argues that words with inherited initial *h* (from other sources) before *u* came to be more common than words beginning with plain *u*, so speakers analogized *h* to all originally *u*-initial words.

The final source is word-initial **u*, under a set of conditions that Sturm (2016) analyses as the presence of a following turbulent segment. In ἵστωρ ‘one who knows’ < **uistōr* < **uid-tōr*, we see *h* (giving this rule its traditional name of the ‘ἵστωρ rule’); but ἔτος ‘year’ < **uētos* is vowel-initial. Accepting Sturm’s rule means we don’t need Ringe’s addendum about *H-sprung* also affecting initial **u*: we can treat any **u*-initial words giving us later *h* as instances of the ἵστωρ rule, not *H-sprung*.

2 *H-sprung*

2.1 Examples of *H-sprung*

- εὔω ‘sing’ < **h₁eus-*. Comparing Sanskrit *oṣati* and Latin *ūrō* gives us **h₁eus-e/o-*, which in Greek gives **h₁eus-e/o-* > **ewhō* > **hewhō* > εὔω. The copying of the **h* from the onset of the second syllable to the beginning of the word is an example of *H-sprung*.
- ἔως ‘dawn’ < **h₂eus-ōs*. This root also appears in Latin *aurōra* and Sanskrit *uśás-* (in the zero-grade). We apparently have **h₂eus-ōs* > **awhōs* > **hawhōs* > **hāwōs* > **hāōs* > **hēōs* > ἔως in Attic specifically, with *H-sprung* giving an initial *h*. Ionic has ἠώς without the Attic shortening of **ē* before another vowel, and Argolic has epigraphic ἐπ’ ὀφῶ preserving the original **w*; based at least on the Attic form, we have no initial *h* and no *H-sprung*. The isolated derivative ἠρι ‘early’ < **āri* < **awheri* < **h₂eus-er-i* also doesn’t show *H-sprung*.
- ἧμαι ‘sit’ < **h₁eh₁s-*. From **h₁eh₁s-* attached to a 1sg. **-mai*, we apparently have **ēsmāi* > **ēhmai* > **hēhmai* > Homeric ἧμαι, with the initial *h* by *H-sprung* seen in derivatives like ἄφημαί, ἔφημαι, κάθημαι. We see *h* throughout the paradigm, including in 3sg. ἦσται with no historical **h* cluster, so Ringe (forthc.) proposes analogy with the *H-sprung* forms.
- ἡμεῖς ‘we’ < **ns-me*. From PIE **ns-me*, seen in Avestan *ahma* and Sanskrit *asmán*, we have Attic ἡμεῖς, Doric ἄμες, and Aeolic ἄμμες. The long vowels in

Attic and Doric, and the geminate in Aeolic, are outcomes of the **hm* cluster; the *h* in Attic and Doric must be from *H-sprung*. Sihler (1995) proposes analogy with ὑμεῖς ‘you (pl.)’, which gets its *h* regularly before initial **u*-.

- ῥήναι ‘reins’ < **h₂ens*-. Beekes and van Beek (‘BvB’; 2010) compare Latin *ānsa* ‘handle’ and Irish *éisi* (pl.) ‘reins’ to reconstruct **h₂ens*-, which has to give us Greek **h₂ens-iai* > **ansiai* > **anhiai* > **hanhiai* > **hāniai* > ῥήναι. Unexpectedly, the root appears without aspiration in Laconian ἀνιοχῖδων (Colvin 2006).
- οἶμος ‘way, course’ < **h₁oi-s-mo*-. Alongside vowel-initial οἶμος, we have a form οἶμος with initial *h*, as well as a compound φοοίμιον (see below) showing aspiration; the root is **h₁ei-* ‘go’ in the *o*-grade.

Following Ruijgh (1967: 61), Ringe (forthc.) suggests that *H-sprung* could also be used to explain ἄρμα ‘chariot’ < **h₂er-sm_h*, from a root **h₂er-* ‘fit’ also seen in ἄραρισκω. Brugmann (1907) explains ὄνος ‘ass’ as cognate with Latin *asinus*, supposedly both borrowings from the same language, through an earlier **osonos* > **ohonos* > **hoonos* misparsed as ὁ ὄνος ‘the ass’; but this is very speculative.

Finally, as a productive grammatical residue of *H-sprung*, the language regularly adds *h* to the beginning of augmented forms of *h*-initial verbs (Lejeune 1972). From ἔπομαι ‘follow’, we have an imperfect εἰπόμην < **he-ep-* < **e-hep-*, with transfer of **h* to the augment by *H-sprung*.

2.2 The φοουρά rule

There are a few attested forms (Sihler 1995:173,) that apparently show a medial **h* aspirating an initial stop, all from compounds of προ-: φοουρά ‘watch’ < **pro-horā*, φοοῦδος ‘having gone’ < **pro-hodos*, φοοίμιον ‘prelude’ < **pro-hoimion*. Sihler proposes that προ- ~ φοο- is a new alternation in some idiolects by analogy with *lautgesetzlich* alternations like ἐπ- ~ ἐφ-; but this would require a strange analysis by the learner in which ἐπ- and ἐφ- are separate allomorphs conditioned by the phonology of the root, rather than straightforward outcomes of a regular process turning /p+h/ into /p^h/. Instead, we could notice that the φοουρά rule has the same effect as *H-sprung*, except in a complementary set of environments. We could collapse the two by widening the definition of *H-sprung* to include voiceless stops as targets—simplifying the statement of the change, meaning **h* now aspirates everything that can be aspirated.

The form φοοίμιον is interesting and potentially awkward, because if the φοουρά rule really is the same as *H-sprung*, we would need it to have applied twice in the history of the same form: **h₁oi_smion* > **oi_hmion* > **hoimion* by *H-sprung*, then **pro-hoimion* > φοοίμιον, also by *H-sprung*. But we can give ourselves a possible solution in terms of relative chronology. If *pro-* was affixed to a form **oi_hmion*, and then vowel contraction happened before *H-sprung*, we would get **proi_hmion* > φοοίμιον with only one round of *H-sprung*. This means

φοῖμιον and ὄμιος got their aspiration in parallel, by both being input to *H-sprung*, not because the former is derived from the latter.

There are a few more words with no evidence of aspiration, even though they contain an initial voiceless stop followed by **h* in the next syllable: πέος ‘penis’ < **pes-os*; κεδίζω ‘split’ < **kes-*; κρήνη ‘well’ < **kresn-*; τρέω ‘flee’ < **tres-*. As Jay Jasanoff (p.c.) points out, we can take this as evidence that the φρουρά rule applied after the loss of intervocalic **h*. This means the three φρουρά forms are all later formations, which fits with their productive status as compounds; so the **h* in **pro-horā* etc. must have survived thanks to being in initial position.

3 Exceptions to *H-sprung*

- ἄρχω ‘begin’. There are a few potential etymologies of this verb: Klingenschmitt (1974) proposes **h₂r-ske/o-* from some root **h₂er-*, while LIV² proposes **(h₂)rg^h-ske/o-* from a root **h₂erg^h-*, also found in modern German *ragen* ‘rise’. In most **CsC* sequences in Greek (including this one), **s* was lost, so this word might not be expected to show *H-sprung* anyway.
- αὔριον ‘tomorrow’ < **h₂e_{us}-r-* ‘dawn’. BvB (2010) compare Lithuanian *aušrà* ‘dawn’ and Sanskrit *usrá-* ‘morning’, both derivatives of **h₂e_{us}-* ‘dawn’. Unlike in ἔως, from the same root, we don’t see *H-sprung*: **h₂e_{us}-r-* > **ausrion* > αὔριον (**αὔριον).
- εἰμί ‘be’ < **h₁es-*. None of the forms of the copula have a initial *h* in any Greek dialect; Attic has εἰμί, εἶ, ἐστί, ἐσμέν, ἐστέ, εἰσί in the present tense, for example. In εἰμί < **ehmi*, εἶ < **ehi*, and εἰσί < **ehenti*, we’d expect *H-sprung* to apply. Ringe (forthc.) suggests levelling from vowel-initial ἐστί and ἐστέ, which keep **s* before a stop, as has already happened in ἐσμέν (expected **εἰμέν); but speakers would have to level the lack of **h* without levelling the full stem, or else we’d see **ἐσμί, **ἐσί, etc. Jeremy Rau (p.c.) points out that the copula was enclitic on the previous word, in which case the beginning of the root might not count as ‘word-initial’ for the purposes of *H-sprung*.
- εὖς ‘good’, εὖ ‘well’. Comparing Sanskrit *su-* and Hittite *aššu-* gives **h₁su-* ‘good’ (BvB 2010), which should give **εὖ- under *H-sprung*. The use of this root as an adjective only appears in epic, but we do see εὖ- as the first part of a compound in Attic.
- ὀρρος ‘rump’, οὐρά ‘tail’. BvB (2010) compare a cognate set including modern English *arse* and Old Irish *err* ‘tail’ to reconstruct a root **h₁ers-h₂-*. In the *o*-grade, this gives us a doublet **h₁ors-h₂* > **orsa* > 1) οὐρά, with ⟨ου⟩ spelling the output of compensatory lengthening, and 2) ὀρρος, with assimilation **rs* > ρρ. We don’t see **ὀρρος or **οὐρά by *H-sprung*.

- οἶς ‘ear’, oblique stem ὦτ-. The PIE paradigm of this word has nominative and accusative **h₂óus*, genitive **h₂éusos*. The oblique cases should show *H-sprung* from an innovated **h₂ous-nt-* > **ousat* > **ouhat-* > ὦτ- (BvB 2010). Ringe (forthc.) suggests that the lack of initial *h* is by analogy with ὄψ ‘eye’, which could also be the source of the *o*-grade vowel in the oblique cases; another possibility, pointed out by an anonymous reviewer, is levelling from nominative-accusative **h₂óus*.
- ὤμος ‘shoulder’ < **h₃ems-o-*. From cognates including Sanskrit *ámśa-* and Latin *umerus*, we can reconstruct **h₃ems-o-*; the long vowel in Greek could be an inherited lengthened-grade or an irregular outcome of the first compensatory lengthening, but we don’t have an aspirated ***ὤμος*.
- ὦνος ‘price’ < **uos-no-*. The root **uos-* is still preserved in Hittite *uāši-* ‘buy’, and the **no-* derivative appears in Sanskrit *vasná-* ‘price’ and Latin *vēnum* ‘object for sale’; Greek shows ὦνος rather than ***ὠνος*. Along with ὤμος, this form is independently odd for having the wrong outcome of the first compensatory lengthening.

Ringe’s condition that *H-sprung* is blocked by an *o* vowel is based on οὐρά, οὐρανός, οὐρέω, οἶς, ὤμος, and ὦνος, but this doesn’t account for αὔριον, εὖ-, and perhaps ἄρχω and εἰμί (if these are real counterexamples). Based on these etymologies, it seems that *H-sprung* wasn’t a regular sound change in Greek.

4 Discussion

Except for ἡμεῖς, none of the apparent positive examples of *H-sprung* seem explainable either by analogy with other forms or by re-evaluating the relevant etymologies; there are no forms of these paradigms that regularly show initial *h*, and the cognates from elsewhere in IE are clear enough that the words couldn’t have begun with **H_i* or **u*. If this is right, then although *H-sprung* wasn’t a regular sound change, we have to accept it at least as a sporadic change to this set of words.

As far as I know, *H-sprung* is unusual and possibly unique among recorded sound changes for *copying* a consonant over intervening material. There are attested sound changes that copy vowels over intervening consonants, as in the change in Hoocąk (Siouan) that breaks up consonant clusters by inserting a copy of the following vowel (Rankin et al. 2006), or perhaps Avestan *i*-epenthesis (Martínez and de Vaan 2014). There are attested sound changes that move consonants over intervening syllables, as in the long-distance displacement of liquids in the Occitan dialect of Bagnères-de-Luchon (Grammont 1905). And there are synchronic rules that can copy a consonant over inter-

vening vowels, as in the morphological reduplication processes well known from Indo-European, or the Amharic-based secret language used by sex workers in Addis Ababa that doubles all word-final consonants across an epenthetic schwa (McCarthy 1984). But none of these are quite parallel to *H-sprung*: a sound change (not a synchronic rule) that copies (not moves) consonants (not vowels).

The closest process I know of is the quite rare copying of /r/ across syllables in some varieties of American English (Hall et al. 2017), as in *farmiliar* for *familiar*, or *phortographer* for *photographer*. If *H-sprung* really is a sporadic sound change, this sporadic AmE *r*-copying would be a good parallel.

4.1 *Motor planning?*

One intuitively possible explanation for *H-sprung* is in terms of motor planning. Rather than just surface assimilation caused by anticipating the spread glottis gesture one syllable too early, *H-sprung* could have originated as a speech error. In the UCLA database of speech errors described in Fromkin (1971), there are a few sporadic mispronunciations that have a similar structure to *H-sprung*:

- *John dropped his cup of coffee* → ... *cuff of coffee*
 - *also share* → *alsho share*
 - *week long race* → *reek long race*
- etc.

This is superficially similar to phonetic anticipation, but as Fromkin argues, these errors seem to operate on phonological symbols rather than gestures: they happen at a relatively early level of production, sometimes even before the phonological rules of the language have applied.

Garrett and Johnson (2013) propose that a small number of sound changes might start off as motor planning errors of the Fromkin type: specifically, i) consonant harmony systems and ii) long-distance displacement of the type seen in Bagnères-de-Luchon. Hansson (2010) argues for a general analysis of consonant harmony systems as conventionalized speech errors: like speech errors, they tend to involve segments that are already phonetically similar, and the fact that consonant harmony tends to apply right-to-left parallels the tendency of speech errors to be anticipatory more often than perseverative.

In the absence of any more details, an account based on speech errors seems not to explain the facts of the change. For one thing, speech errors are not that common: Fromkin herself only recorded 600 errors in the database, out of three years of listening for errors in casual speech. With such a low background rate of speech errors, the chances of enough errors accumulating around one lexical item—especially as common a word as a basic pronoun like ἡμεῖς—

are intuitively very low. We'd also lose any explanation for the (albeit imperfect) conditioning of the change: there would be no particular reason why all the attested examples in Greek involve *H-sprung*, and not, say, *T-sprung* or *M-sprung*. In general, an account of sound change based on a purely phonological speech errors severs any explanatory link with phonetics.

4.2 Pre-Grassmann's Law

Instead of motor planning, we should have an account of *H-sprung* grounded in phonetics. An interesting possibility would be to connect *H-sprung* to another sound change involving spreading of aspiration over a distance: Grassmann's Law. In both Greek and Sanskrit, an aspirated stop (or *h*) followed by another aspirate deaspirated (or deleted, respectively), leaving fragmented alternations in inflectional paradigms: φύω 'I grow', πέφυκα 'I have grown'.

The modern analysis of dissimilatory sound changes, following Ohala (1981), is that they involve listener hypercorrection for assimilatory coarticulation. Aspirated or breathy-voiced segments have high energy in F₀ and high levels of noise (Blevins and Garrett 2004), both of which can last for an extended stretch of the acoustic signal. In the case of Grassmann's Law, the original speaker produces a phonetic output [p^hɛp^h] faithfully reflecting a surface phonological form /p^hɛp^h/; the listener falsely interprets this form as a coarticulated token of [pɛp^h], and so acquires /pɛp^h/. Diachronically, this gives us a sound change /p^hɛp^h/ > /pɛp^h/. But the reasoning of Ohala's story only makes sense if the speaker was *expecting* assimilation of aspiration: in other words, if Greek at some point contained a (phonetic or phonological) assimilation process that was substantial enough to be worth correcting for. This hypothetical earlier assimilation process would have copied aspiration from an aspirated stop in the middle of a word to an earlier unaspirated stop.

This means we have three processes in the history of Greek—*H-sprung*, the φρσφρᾶ rule, and this pre-Grassmann assimilation—with very similar effects—spreading aspiration from the middle of the word to the beginning of a word. Can we treat them as part of the same change?

Table 1 shows an eight-way typology of aspiration effects in Greek, according to the source and target of aspiration in each change. Pre-Grassmann assimilation copied aspiration from a stop to either a stop onset or an empty onset. The φρσφρᾶ rule copied aspiration from an **h* to a initial stop. *H-sprung* copied aspiration from an **h* to an initial empty onset. We can unify these three processes under the umbrella of one single sound change, which I call '*Urhauchum-sprung*' (or '*Ur-H-sprung*'): copy aspiration from the first medial onset, what-

TABLE 1 The different faces of ‘*Ur-H-sprung*’

	Assimilation	Dissimilation
#T _ T ^h	Pre-Grassmann	Grassmann
# _ T ^h	Pre-Grassmann	Grassmann
#T _ h	φρουρά́	–
# _ h	<i>H-sprung</i>	–

TABLE 2 A relative chronology

1.	Loss of intervocalic * <i>h</i>
2.	<i>Ur-H-sprung</i>
3.	Loss of * <i>h</i> in sonorant clusters, causing phonologization of half of <i>Ur-H-sprung</i>
4.	Grassmann’s Law, hypercorrecting for the other half of <i>Ur-H-sprung</i>

ever it is, to the beginning of the word, whatever it is. Because **h* and the aspirated stop series as the only segments in Greek that carry aspiration, we can think of this sound change as vacuously applying whenever the target segment is anything else.

In this picture, Grassmann’s Law is a hypercorrective effect of *Ur-H-sprung*, undoing the stop-conditioned change labelled ‘Pre-Grassmann’—and generalizing the context of the change to all cases of an aspirated segment (stop or **h*) followed by an aspirated stop.

But if Grassmann’s Law had involved hypercorrection for the other two cases of *Ur-H-sprung*, conditioned by medial **h*, we would expect to see Grassmann-type dissimilation in the context of an aspirated segment followed by **h*. In fact, one etymology tells us that Grassmann’s Law wasn’t triggered by intervocalic **h*: θεός ‘god’ < **θehós*, with **h* < *s* preserved in *θέσφατος* ‘god-spoken’. There are also no examples of Grassmann’s Law triggered by **h* as part of a cluster, and several counterexamples: *θάρρος* ‘bold’ < **d^hers-*, *φήνη* ‘bearded vulture’ < **b^hesn-*, *χήν* ‘goose’ < **g^hh₂ens-*, and *χίλιοι* ‘thousand’ < **g^hesl-*. So why didn’t Grassmann’s Law also undo *H-sprung* and the φρουρά́ rule?

Table 2 shows a potential explanation in terms of relative chronology. Based on the discussion of the φρουρά́ rule in section 2.2, the loss of intervocalic **h* must have preceded *Ur-H-sprung*. This means *Ur-H-sprung* had two triggers: i) medial **h*-sonorant clusters, and ii) medial aspirated stops.

Suppose that the loss of *h in sonorant clusters—which must have happened at some point before attested Greek—happened while *Ur-H-sprung* was still a synchronic phonetic process. To the first generation of language learners who failed to learn any medial *hs, the *h-triggered half of *Ur-H-sprung* would have to be phonologized as part of the underlying form of each target word. Without a separate source of aspiration in the word, the learner would be forced to learn ἡμεῖς, ἡνίαι, etc. as beginning with genuine h.

Once there were no more instances of medial *h, *Ur-H-sprung* survived, but now it had a more specific scope: all remaining examples of aspiration effects synchronically derivable from *Ur-H-sprung* were triggered by medial stops. Grassmann's Law involved hypercorrection for this later version of *Ur-H-sprung*, with no hypercorrection for the h-triggered cases because those had already been fossilized. If this is true, there's no sleight of hand needed in explaining why Grassmann's Law only undid half of *Ur-H-sprung*: in fact, Grassmann's Law undid all cases of *Ur-H-sprung* that still existed at the time that it applied. This gives us an explanation for the patterns in Table 1.

5. Conclusion

The evidence from the ancient Greek lexicon is clear that there was a sporadic sound change that copied an *h from the second syllable of a word to the first syllable, applying when the first syllable was vowel-initial, and perhaps also when it was stop-initial; this complements the analyses proposed so far in Greek historical phonology, particularly Sturm (2016, 2017), in accounting for the various sources of Proto-Greek *h. This change, *Hauchumsprung*, is unusual among recorded sound changes for involving the copying of a consonant over intervening material. *Hauchumsprung*, the φροῦρά rule, and Grassmann's Law can be unified as three different footprints of a single sound change: one that copied aspiration from the middle of a word to the beginning of a word in early Greek.

References

- Beekes, R.S.P. & van Beek, L. (2010). *Etymological Dictionary of Greek*. Leiden: Brill.
- Blevins, J., & Garrett, A. (2004). The evolution of metathesis. In Bruce Hayes et al. (eds.), *Phonetically Based Phonology*, 117–156. Oxford: Oxford University Press.
- Brugmann, K. (1908). Griechisch ἦνος und ὄνος *Indogermanische Forschungen* 22, 197–202.

- Clackson, J. (1994) *The Linguistic Relationship between Armenian and Greek*. Oxford: Blackwell.
- Collinge, N.E. (1985). *The Laws of Indo-European*. Amsterdam: John Benjamins.
- Colvin, S. (2006). Autosegmental phonology and word-internal *-h-* in Mycenaean Greek. *Glotta* 82, 36–54.
- Fritz, M. (1993). Griechisch ἀῦτμή ‘Dampf, Duft’. *Historische Sprachforschung* 106, 288–301.
- Fromkin, V.A. (1971). The non-anomalous nature of anomalous utterances. *Language* 47, 27–52.
- Garrett, A., & Johnson, K. (2013). Phonetic bias in sound change. In Alan Yu (ed.), *Origins of Sound Change: Approaches to Phonologization*, 51–97. Oxford: Oxford University Press.
- Grammont, M. (1905). La métathèse dans le parler de Bagnères-de-Luchon. *Mémoires de la société de linguistique de Paris* 13, 73–90.
- Hall, N., Vasquez, N., Damahuri, M., Aguirre, F., & Tree, C. (2017). Long-distance liquid coarticulation in American English. In *Proceedings of the Annual Meeting on Phonology 2016*.
- Klingenschmitt, G. (1974) Griechisch *parthénos*. In Manfred Mayrhofer et al. (eds.), *Antiquitatae Indogermanicae. Gedenkschrift für Hermann Güntert*, 273–279. Innsbruck: Institut fuer Sprachwissenschaft der Universitaet.
- Lejeune, M. (1972) *Phonétique historique du mycénien et du grec ancien*. Paris: Klincksieck.
- Martínez, J., & de Vaan, M. (2014). *Introduction to Avestan*. Leiden: Brill.
- Martirosyan, H. (2010) *Etymological Dictionary of the Armenian Inherited Lexicon*. Leiden: Brill.
- Meister, R. (1893) *Die Mimiamben des Herodas*. Leipzig: S. Hirzel.
- McCarthy, John J. (1984). Speech disguise and phonological representation in Amharic. In Harry van der Hulst and Norval Smith (eds.), *Advances in Nonlinear Phonology*, 305–312. Dordrecht: Foris.
- Ohala, J.J. (1981). The listener as a source of sound change. In: C.S. Masek et al. (eds.), *Papers from the Parasession on Language and Behavior*, 178–203. Chicago: Chicago Linguistic Society.
- Rankin, R.L., R.T. Carter, A. Wesley Jones, J.E. Koontz, D.S. Rood & I. Hartmann (eds.) (2006). *Comparative Siouan Dictionary*. Leipzig: Max Planck Institute for Evolutionary Anthropology.
- Ringe, D. (forthc.) *The Roots of Greek*. Manuscript.
- Ruijgh, C.J. (1967). *Études sur la grammaire et le vocabulaire du grec mycénien*. Amsterdam: A. M. Hakkert.
- Ruijgh, C.J. (1970). Review of: P. Chantraine, *Dictionnaire étymologique de la langue grecque. Histoire des mots*. T. 1. Paris: Klincksieck, 1968. *Lingua* 25, 302–321.

- Sihler, A. (1995). *New Comparative Grammar of Latin and Greek*. New York: Oxford University Press.
- Sturm, J. (2016) ἴστωρ and ἐορτή: the rough-breathing reflex of Greek *u. Paper presented at the 28th Annual UCLA Indo-European Conference.
- Sturm, J. (2017). Prothetic /h/ before word-initial /u/ in Attic: a word-initial constraint. Paper presented at the 29th Annual UCLA Indo-European Conference.