4-4-2023

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GREEK AND ROMAN MUSICAL STUDIES (2023) 1–54

GREEK AND ROMAN MUSICAL STUDIES

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Musical Evidence for Low Boundary Tones in Ancient Greek

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Abstract

Several scholars have suggested that in ancient Greek there was a low boundary tone at the end of a relatively small prosodic constituent such as a clitic group or maximal prosodic word. The boundary tone may phonologically motivate some puzzling pitch-accentual phenomena in the language. One is the diachronic pitch-peak retraction that led to the circumflex pitch accent (HL) on penultimate syllables (the "sōtêra rule"). Another is the intonational phrase-internal downstepping or deletion of a word-final acute accent (H); that conversion of an acute to a grave accent is known as "lulling" or "*koímēsis*". If such a low boundary tone existed, its effects should still be audible in ancient Greek non-strophic vocal music, where there is a significant correlation between the pitch movement of the text and the movement of the melody to which it is set, i.e. between tone and tune. Specifically, proponents of such a low boundary tone would predict that the turning point between falling and rising melody, the "musical trough", should center around the word-final mora or syllable. The present study provides the first full description of troughs in the Delphic Hymns and finds that they are indeed closely aligned with word-end. Furthermore, once other factors that could lead to word-final troughs are set aside, i.e. once potential confounds are controlled for, the association of the trough with word-end remains strong, suggesting that we should in fact reconstruct the low boundary tone.

Keywords

boundary tone – pitch accent – tone-to-tune setting – tonal crowding

1 Low Boundary Tone

Boundary tones are intonational pitch accents that appear at the beginning or end of prosodic constituents.[1] As Gussenhoven notes (2004, 135), they may be universal at the beginning or end of higher-level prosodic constituents such as intonational phrases. Boundary tones are likewise documented for lower-level prosodic constituents in some languages. Jun (2015) provides an overview in a framework that recognizes the following prosodic constituents, in descending order: an intonational phrase, an intermediate phrase, an accentual phrase, and a prosodic word. She reports low final boundary tones for the intonational phrase, intermediate phrase, and the accentual phrase, i.e. for all but the smallest prosodic constituent. The accentual phrase typically includes one word, but may include more, e.g. in Japanese, Dalabon, Georgian, and Korean (Jun 2015, 6).[2] Beginning with Devine and Stephens' 1994 *The Prosody of Greek Speech* (henceforth "PGS"), several analyses of ancient Greek accentuation posit a low boundary tone at the end of the word, or the word plus any following enclitic(s).[3] The low boundary tone posited for Greek (henceforth "L_{ω}") would thus be typologically comparable to the accentual phrase-final boundary tones reported in Jun 2015.

1.1 *The Sōtêra Rule*

The putative L_{ω} would help make phonological sense of at least one puzzling pitch-accentual phenomenon in the language. I propose – for the first time, to my knowledge – that it provides a plausible historical motivation for the otherwise mysterious "sōtêra rule". According to the sōtêra rule (also known as the "hêma rule" or the "final trochee rule"),[4] the accent of a penultimate syllable in ancient Greek is realized as a circumflex (HL) if and only if the penultimate syllable contains a long vowel or diphthong and the vowel of the final syllable is short (1ab); otherwise, the accent is realized as an acute (H) (1cd). The rule applies both to forms with persistent (i.e. lexically inherent) accent (1ac) and to forms with recessive (i.e. phonologically derived) accent (1bd).

1 Readers who are familiar with ancient Greek but unfamiliar with prosodic phonology may begin with David Goldstein's entry on the "Syntax-Phonology Interface" in the *Encyclopedia of Ancient Greek Language and Linguistics* (Goldstein 2013) and follow the cross references or links to the related entries on the "Utterance", the "Intonational Phrase", etc.

2 Initial low boundary tones are found at the beginning of every prosodic word in Turkish (Ipek and Jun 2013), Northern Kyungsang Korean (Jun et al. 2006), and Serbo-Croatian (Godjevac 2005).

3 See PGS 154, 180, 189, 191; Itô and Mester 2017; Revithiadou 2018. The low boundary tone also figures in some unpublished work on ancient Greek accentuation, e.g. Sandell 2020.

4 For more detail on the sōtêra rule, see Gunkel 2014b with references.

(1) (a) σωτῆρα sɔ:tê:ra 'saviour:ACC.SG'
(b) πολυπῖδαξ polupî:daks 'having many springs:NOM.SG'
(c) σωτήρων sɔ:té:rɔ:n 'saviour:GEN.PL'
(d) ἀνθρώποις ant^{h}rɔ́:poi̯s 'human:DAT.PL'

In contrast to other accentual rules of ancient Greek such as the Law of Limitation,[5] the sōtêra rule does not refer to syllable weight but to vowel length: it applies if the final syllable has a short vowel nucleus; it does not matter whether that final syllable is light (3a) or heavy (3b–d). This invites an explanation in terms of tone, because the tone bearing units of the language are vowels and diphthongs.[6] It does not seem amenable to an analysis that refers to weight or weight-based prosodic constituents, i.e. feet.

Historically, the sōtêra rule involved the retraction of the pitch peak from relatively late to relatively early in a long vowel or diphthong in forms such as those given in (2). To roughly represent the peak timing, I rewrite acute-accented long vowels and diphthongs as VV́, and circumflex-accented ones as V́V.[7] (I will use this notation only for example (2) and the following discussion). This captures the fact that in acute-accented VV-syllables, the peak occurs relatively late, whereas in circumflex-accented VV-syllables, it occurs relatively early.[8]

(2) (a) *sɔɔtɛ́ra$^{L\omega}$ > sɔɔtéɛra $^{L\omega}$ (cf. Vedic *-tā́ram*)
(b) *woíkos $^{L\omega}$ > (w)óikos $^{L\omega}$ (cf. Vedic *véśaḥ* 'house')

5 See Probert 2010 with further references.

6 For discussion of vowels/diphthongs as the tone bearing units of ancient Greek, see PGS 118, 152, 192f., 371f. Note also that on the basis of accentual parallels such as φῦλά τε and φύλλά τε, Wackernagel (1893, 24–5, 37) argued that ancient Greek had resonant diphthongs. In other words, the syllable rhymes [u:] and [ul] both bore circumflex accents phonologically, though not graphically. On Wackernagel's analysis, rhymes consisting of a short vowel plus a liquid, nasal, or sibilant were capable of bearing a circumflex accent. Wackernagel's view has been followed by some (e.g. Postgate 1924, Allen 1973), however Roussou and Probert (in press, ch. 4) and Probert (in preparation) convincingly argue that it is unlikely that the resonant diphthong analysis is correct.

7 This shorthand rewriting is intended to approximate the phonetic timing of the peak, not to espouse the phonological analysis of the acute as a high tone associated with the second vocalic mora vs. the circumflex as a high tone associated with the first mora. For a recent version of that view of the two accents, including an autosegmental-metrical representation, see Jasanoff 2017, 10–12.

8 Part of the evidence for the peak timing in acute- vs. circumflex-accented syllables comes from music: if an acute-accented syllable is set to two notes, they may rise or fall in melody; if a circumflex accented syllable is set to two notes, they strongly tend to be falling in melody.

The goal of such a peak retraction is to give the speaker more time to execute the transition from the high target, i.e. the accentual H of the acute accent, to the low target of the L_{ω} (PGS 189).[9] This way of avoiding the "crowding" of the two tones is known as "temporal shifting" in the phonological literature (Gordon 2016, 255–61) and has parallels in Chichewa (Myers 1999, 2003, 91) and Chickasaw (Gordon 2008).

This would fit into the broader development of Greek accentuation as follows. The Greek circumflex was probably not inherited from Proto-Indo-European, or some parent language intermediate between PIE and Greek, rather it arose in the prehistory of the Greek language when an acute-accented vowel contracted with the following vowel, which bore the post-accentual fall in pitch (V́.V > V̂ː), e.g. in the dative singular of first-declension nouns of the type φορ-ᾶι = *pʰor-âːi̯* (Jasanoff 2004).

(3) *-áh$_2$ai̯ > *-áai̯ > -âːi̯

In my view, it is likely on typological grounds that those circumflexes arose only on word-final VV-syllables, which were the longest, most sonorous syllables in the language; such syllables are privileged contour tone hosts thanks to their segmental make-up (VV) as well as their final position in the prosodic word.[10] As a matter of fact, word-final VV-syllables are the only environment in attested Greek where there is a phonological contrast between the circumflex and the acute.[11]

After the circumflex arose on final VV-syllable, speakers (of at least some dialects)[12] retracted the accentual peak in forms such as sɔɔtéera $^{L\omega}$ and (w)óikos $^{L\omega}$. Next, learners (of those dialects) perceived the retracted peak

9 An anonymous reviewer points out that in sequences of a host word plus enclitic, acute accents may be separated by as little as a single mora (e.g. λυσόμενός τε *Il.* 1.13), perhaps showing "that accent proximity was not generally avoided". I suggest that the phonological processes governing the proximity of two acutes (H … H) differed from those governing the proximity of an acute and a low boundary tone (H … L). Crucially, the latter requires a high-to-low transition, which the former does not.

10 For the phonological typology of contour tones, see Gordon 2001, Zhang 2002, 2004; for a more recent survey with further references, see Gordon 2016. For accent-independent, metrical evidence that word-final heavy syllables of ancient Greek content words had a greater duration than medial and initial heavy syllables, see Devine and Stephens 1984.

11 The less economical alternative is to reconstruct circumflexes (and a phonological contrast between acute and circumflex) on nonfinal syllables as well, then a further change that removes those nonfinal circumflexes (and the contrast).

12 On the question of whether the σωτῆρα rule applied in Doric, see Probert (2006, 71) and Gunkel (2014b, 297) with further references. The Boeotian evidence has since been revisited in Vessella 2016.

and ensuing fall in forms such as [sɔɔtéèra] and [(w)óìkos] as the circumflex accent that already existed on word-final VV-syllables. In Ohala's terms (1993), circumflex accents on penultimate syllables arose via a hypocorrective sound change.

1.2 *Lulling*

The putative L_ω has also been invoked to help explain another puzzling pitch-accentual phenomenon in the language. Devine and Stephens (PGS 181) suggest that L_ω might explain "lulling" (also known as *koímēsis*), i.e. the conversion of a word-final acute accent to a grave one. The environment for lulling is traditionally presented disjunctively: within the intonational phrase,[13] a word-final acute is realized as such before an enclitic (4a);[14] elsewhere it is "lulled" to a grave (4b).[15] Note that it is not clear whether the grave represents a lowered (downstepped) H or a deleted H. In what follows, I continue to use the grave symbol ("ˋ") or a question mark to represent it, including in the IPA transcriptions of the following Homeric examples.

(4) (a) ἀγαθός περ ἐών (... (agat^{h}ós per)$_{PWd}$ (eɔ́ːn)$_{PWd}$ ...)$_{ιˋ}$ 'despite being brave'

(b) ἀγαθὸς Μενέλαος (... (agat^{h}òs)$_{PWd}$ (menélaːos)$_{PWd}$ ...)$_{ι}$ 'brave Menelaus'

Devine and Stephens suggest – among other possibilities – that "the Greek grave can be viewed as a sort of compromise [...] between the accentual High and the word final Low" (PGS 181). The idea seems to be that if a L_ω existed in ancient Greek, it would have immediately followed the high tone (H) of the word-final acute in cases such as (5a [cf. 4b]), but not in cases such as (5b [cf. 4a]), where an enclitic followed the word and the L_ω was associated with the end of the clitic group (i.e. word-plus-enclitic unit).[16]

13 I leave aside why the acute is also realized as such at the end of the intonational phrase, on which see Allen 1973, 248–51 and PGS 431f. with further references.

14 Analyses that would have oxytones such as ἀγαθός enter the post-lexical phonology without an accent (Blumenfeld 2004, cf. also Trubetzkoy 1939, 190, 215f.) do not explain why the acute drifts left when the host vowel is elided, e.g. the acute of ἀγαθά in τὰ δ' ἀγάθ' ἐκτελῆ γενέσθαι (*Persae* 218).

15 Laum (1928) argued that lulling was only real in monosyllables (e.g. μὲν θεοί) and disyllabic prepositions immediately followed by an accented syllable (e.g. ἐπὶ νῆας); elsewhere lulling was an orthographic convention. Evidence against Laum's view has since been delivered by Giessler 1923, Erbse 1960, 371–406, and Mazzucchi 1979, *inter alios*. For further references, see Probert 2003, 17.

16 As Ryan Sandell points out to me, the analysis in Ito and Mester (2017) cannot capture this. Their account of recessive accentuation crucially depends on having a low boundary

(5) (a) agat^{h}o^{H}s$^{L\omega}$
(b) agat^{h}o^{H}s per$^{L\omega}$

On Devine and Stephens' account, the grave would mark the lowering (downstepping)[17] of the high tone before the immediately following L_{ω}. Alternatively, the grave would mark the deletion[18] of the high tone before L_{ω}. On either account, lulling would be a type of tonal crowding avoidance. On the lulling-as-lowering scenario, the lower realization of the high tone would compress the tone range and ease the transition ("rescaling of pitch targets", in the terminology of Gordon 2016, 256f.). On the lulling-as-deletion scenario, the deletion would remove the transition altogether (cf. Gordon *ibid.*).[19]

Thus the putative L_{ω} may have played a small but significant role in the historical development of Greek accentuation. In my view, it is likely that it motivated the historical peak retraction reflected in the synchronic "sōtêra rule", and it is at least worth entertaining the idea that it motivated "lulling". If L_{ω} existed, the most direct evidence should be in the fragments of non-strophic vocal music, where the melodies provide something like pitch tracks for the texts that they are set to.

Devine and Stephens (PGS 180, 187f.) have tentatively suggested that there may have been a low boundary tone on the basis of the setting of proparoxytone words in the Delphic hymns. They find that on average, pitch falls relatively steeply from the acute-accented antepenultimate syllable to the post-accentual (i.e. penultimate) syllable, then less steeply from the penultimate syllable to the ultimate one. They suggest that the latter transition could point to a low boundary tone. In what follows, I expand on their study by examining all of the turning points between falling and rising melody in the Delphic hymns (i.e. including but not limited to proparoxytone words) and find that the evidence supports L_{ω}. Finally, I offer a sketch reconstruction of how L_{ω} arose diachronically in Greek, connecting it to several other phonological developments in the language.

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tone (L% in their notation) at the right edge of every *minimal* prosodic word. On their analysis, as far as I can see, we would expect to find lulling preceding enclitics as well.

17 For the grave as a lowered acute, see Ehrlich 1906, 573f., 1912, 50–265; Debrunner 1929, 54f.; Sturtevant 1940, 100f.; Winnington-Ingram 1955, 62, 66; Erbse 1960, 377f.; Allen 1973, 245–8; PGS 180–3, 356–61, Probert 2003, 16f., 20; 2006, 59; 2010, 2; Gunkel 2014a.

18 For the grave as a de-accented acute, see Meillet 1905–6; Grammont 1948, 388–90; Miller 1976, 16–18; Nagy 2000, 15 n. 19.

19 The setting of grave-accented words raises questions about both scenarios, since there's no obvious evidence for a high target, a downstepped high target, or a low target there.

2 The Delphic Hymns

The Delphic hymns (DAGM 20, 21) are two of the most important pieces of nonstrophic vocal music in ancient Greek, thanks to their length, their age, and the fact that they are preserved as inscriptions.[20] They were composed by the poets Athenaeus and Limenius and performed in 128/7 BC at the Pythaid festival in Delphi by a chorus of the Athenian guild of artists known as the *technitai*.[21] Each hymn is a paean that celebrates the foundational myth of the Pythian sanctuary, Apollo's slaying of the serpent that occupied the sanctuary before his arrival. The music of the paeans is not strophic, but it is articulated into sections that are sometimes – and somewhat confusingly – referred to as musical "paragraphs". The texts are in paeonic meter (the basic unit being ⏑⏑ ⏑ ⏑⏑),[22] except for the prayer that closes Limenius' composition (21.34–40), which is in Aeolic meter.

In the Delphic hymns and other pieces of nonstrophic vocal music, we observe a non-accidental correlation between pitch movement in the text and the movement of the melody. There is general agreement that three generalizations hold.[23] They are formulated by Probert (2003, 20 with further references) as follows.

A. The accented syllable of a word is usually sung on a note no lower than that of any other syllable in the word.
B. On long vowels that take two notes the first note is usually higher if the syllable has a circumflex, but the second note if the syllable has an acute.
C. A final syllable with a grave accent (as written in our printed texts) is sung on a note no lower than that of any other syllable in its word, but no higher than the accented and pre-accented syllables of the following word.

20 Several later compositions are also of special interest, namely the Seikilos epitaph (DAGM 23, 1st or 2nd century AD), the anonymous invocation of the Muse (DAGM 24), and three compositions of Mesomedes (DAGM 25, 27, 28, ca. 150 AD), a musician in Hadrian's court.

21 For a discussion of the authorship and the date of the performance, see DAGM 70f. with further references.

22 On the meter of the Delphic hymns, see West 1982, 145f.

23 Crusius (1891, 171f., 1894a, 173) was the first to note the correlation between tone and tune on the basis of the Seikilos epitaph. He formulated generalizations A and B on the basis of the additional material provided by the Delphic hymns in Crusius 1894b, 113–23. Wackernagel (1896) was the first to formulate generalization C. See further Pöhlmann 1970, 140, West 1992, 199, and Probert 2006, 48 (all with further references).

These three generalizations are concerned with the setting of accented syllables *per se* (B), accented syllables relative to other syllables within the same word (A), and grave-accented syllables relative to other syllables within the same word as well as the initial syllable(s) of the following word (C). They corroborate non-musical evidence that pitch peaked over acute-accented syllables, and that it peaked and fell again over circumflex-accented ones.[24]

The scholars who produced the generalizations mainly focused on the setting of accented syllables. This is perfectly understandable, since we have independent evidence for their pitch properties. In considering the settings of accented syllables in relationship to surrounding syllables, their findings already point in a clear direction: the generalizations should not be understood as three rules that the poets followed in order to set accented syllables, rather they reflect the poets' more general practice of correlating the pitch movement of the text and the musical melody. Thus, studying the settings in nonstrophic vocal music does not only provide information about the phonetic nature of the accents, it also permits us to reconstruct the movement of pitch *between* the accents, e.g. the pre-accentual rise and post-accentual fall, and the position of the turning point between falling and rising pitch.

In thinking about this, it is helpful to compare similar traditions in other languages, i.e. vocal music where there is a higher-than-chance correlation between the melody of speech (tone) and the melody of song (tune). There is a growing literature on "tone-tune association" that facilitates the comparison.[25] From that literature I will adopt a classification of the ways in which a tonal transition (Level, Rising, or Falling – capitalized below) may be set to a musical transition (level, rising, or falling – lower case below). This allows us to distinguish three types of transition settings. First, there are three "parallel" settings, in which level tone is matched by level tune, rising tone by rising tune, and falling tone by falling tune (Ll, Rr, Ff). Second, there are four "oblique" settings (shaded light gray), in which rising or falling tone is set to level tune, or level tone is set to rising or falling tune (Lr, Lf, Rl, Fl). Third, there are two "opposing" settings (dark gray), in which rising tone is set to falling tune and vice versa (Rf, Fr). These are shown in Table 1.

24 For a nice summary of the non-musical evidence with references, see Probert 2003, 3–18.

25 See Schellenberg 2012, McPherson and Ryan 2018, 119–22, and Ladd and Kirby 2022, all with references. Devine and Stephens (PGS 162–71) situate the ancient Greek tradition against the backdrop of what was known about tone-tune association at the time.

TABLE 1 Three-way classification of transition settings: parallel (unshaded), oblique (light gray), opposing (dark gray)

	Level tune	**Rising tune**	**Falling tune**
Level tone	Ll	Lr	Lf
Rising tone	Rl	Rr	Rf
Falling tone	Fl	Fr	Ff

While generalization (A) is not formulated with this classification of transition settings in mind, we can nevertheless infer from it that parallel and oblique settings are more frequent than opposing settings in this type of ancient Greek vocal music, at least if we assume (as usual) that the pitch peak of a word occurs during the acute- or circumflex-accented syllable.

3 Illustration: The Setting of Trisyllables with Medial Acute

In order to illustrate parallel, oblique, and opposing settings, we will have a look at how trisyllables with an acute accent on the medial syllable are set to music in the Delphic hymns, e.g. μεγάλου [megálu:] (20.18), χρυσέα [kʰry:séa:] (20.15), ναέτας [naéta:s] (21.36). I use table-like figures with rows and columns to represent the settings in a way that is intended to be legible for musicians and non-musicians alike. The text, broken down into syllables, is given in the bottom row. Given the traditional nature of ancient Greek vocal music, it is not clear (to me) how traditional, i.e. linguistically conservative, the phonology would have been in 127 BC. I have chosen to present the language in the form of conservative Athenian Attic of the late classical/early Hellenistic period.[26] The reader should feel free to translate it into whatever form she deems appropriate. For example, my ἁγίοις [hagíoi̯s] could be translated to a more innovative [(h)agíø:s] or [(h)agíy:s]. The differences should have no bearing on the pitch movements under discussion here.

The row immediately above the text contains the lowest note(s) in the setting. Each row above that is a semitone (i.e. half-step) higher (e.g. C, Db, D, Eb, E, F). As for the musical notes, I adopt the equivalents that are conventionally

26 For an overview with references, see Horrocks 2010, 160–72.

used in scholarship (e.g. in DAGM), though there is general agreement that the actual pitch was probably about a minor third lower (cf. West 1992, 273–6). The columns reflect the role of the mora in Greek poetry and song. Each column has the duration of a single mora. In the Delphic hymns, a light syllable is set to (what we conventionally transcribe as) an eighth note, and a heavy syllable is set either to a quarter note (which is twice as long as an eighth note) or to two eighth notes. The setting of a heavy syllable to two eighth notes is called a melism.

In trisyllables with a medial acute accent, where no melisms are involved, there are two melodic transitions, i.e. from the note of the first syllable to that of the second, and from the note of the second syllable to that of the third. In the setting of μεγάλου [megálu:] (6), for instance, the first melodic transition is rising (one semitone, from G to Ab), and the second transition is falling (three semitones, from Ab to F). Note that the first two syllables are monomoraic (light) and therefore set to eighth notes; the final syllable is bimoraic (heavy) and set to a quarter note.

(6) μεγάλου (20.18)

	Ab		
G			
		F	
me	gá	lu:	

There are 22 medially accented trisyllables with two transitions in the Delphic hymns.[27] As shown in Table 2, the two transitions are symmetrical. Transition 1 is ca. 75% rising, ca. 25% level, and never falling. Transition 2 presents the mirror image: ca. 75% falling, ca. 25% level, and never rising. The difference between the setting of t1 and t2 is significant despite the small size of the sample ($\chi^2 = 32$, df = 2, $p < 0.001$).

27 Note that this includes one underlying tetrasyllable with an elided final vowel, i.e. ἀθώ-πευτ' (20.24).

TABLE 2 Melodic transitions in trisyllables with medial acute

	Rising	**Level**	**Falling**
Transition 1	16 (73%)	6 (27%)	0 (0%)
Transition 2	0 (0%)	6 (27%)	16 (73%)

In this data set, then, assuming that pitch rose to the peak of the acute-accented syllable and then fell again, we see that roughly 70% of the transitions are parallel, roughly 30% are oblique, and none are opposing. This would appear to reflect the poets' preferences. Taking ">>" to represent "is preferable to", we could represent it as a ranking: parallel >> oblique >> opposing.

When we consider the two transitions (t1 and t2) in combination, as in Table 3, we see that there are four possible combinations: rising-falling (parallel-parallel), rising-level (parallel-oblique), level-falling (oblique-parallel), and level-level (oblique-oblique); level-level is unattested.

TABLE 3 Transition settings in trisyllables with medial acute

t1/t2	**Falling**	**Level**
Rising	10 (45%)	6 (27%)
Level	6 (27%)	0 (0%)

Examples of the three attested combinations are given in (7), in order of descending frequency. Note that "#" marks a morphological word boundary and resyllabified consonants are shown in the position in which they were pronounced, e.g. μαντεῖον ἐφέπων giving [n#e.pʰé.poːn] in (7c).

(7) (a) Rising-falling: δειράδα (21.23)

		F	
E			
			D
di:		rá	da

(b) Rising-level: αἰόλον (20.23)

		Ab	Ab
F			
s#aɪ̯		ɪ̯ó	lo

(c) Level-falling: ἐφέπων (20.8)

C	C		
		G	
n#e	pʰé	po:n	

Given the close correlation between tone and tune, in the aggregate, the settings in the Delphic hymns should provide something like pitch tracks for the language, as has been convincingly argued by Devine and Stephens (PGS 172–94, 220–3 *et passim*). In this dataset, on average, transition 1 is a rise of 1.2 semitones and transition 2 is a fall of 3.2 semitones.[28] (The median values are t1 = 1 semitone, t2 = 2.5 semitones.) For trisyllables with a medial acute accent, then, we can reconstruct – as expected – a pre-accentual rise in pitch to the peak of the acute followed by a post-accentual fall in pitch. We can add to this that the post-accentual fall is roughly two and a half times as steep as the pre-accentual rise, on average. The asymmetry cannot be solely attributed to declination, i.e. the tendency for pitch to decline across phrases and utterances,[29] whose downward slope is far less steep (cf. PGS 441ff.). It should mostly be attributed to a low accentual and/or boundary tone (see §5).

28 An anonymous reviewer suggests that word-initial and -final sequences of two light syllables (LL) are more likely to be set to a level transition. Two of five word-initial LL sequences are set level, the average rise being 0.67 semitones. While the reviewer might be correct, the difference is statistically insignificant in the data discussed above.

29 On declination in general, see Gussenhoven 2004, 80–9, 97–113, Ladd 2008, 75f. *et passim*. On declination in ancient Greek specifically, see PGS 435ff.

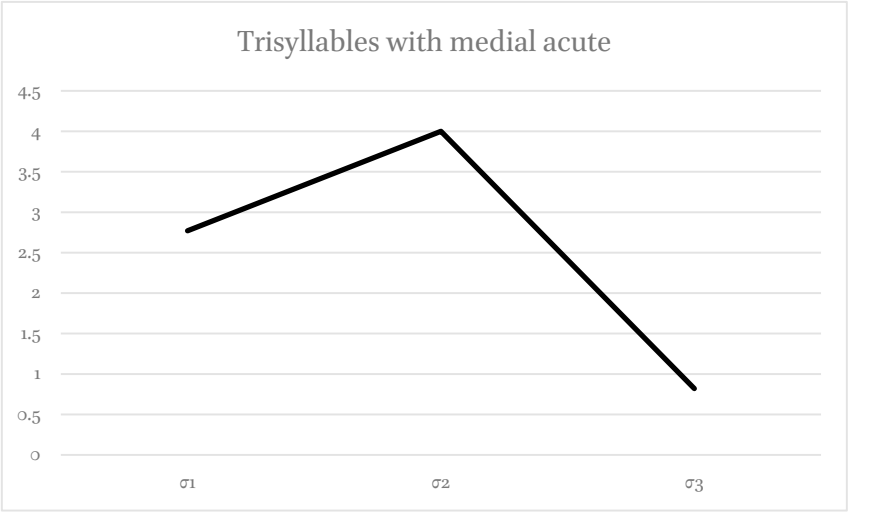

FIGURE 1 Average melodic transitions in semitones of trisyllables with medial acute

The settings of trisyllables with a medial acute that are mapped to melisms add some detail to the picture. There are seven in the Delphic hymns whose settings are fully preserved. In all seven, the first syllable is set to a rising melism (e.g. 8a). In two, the third syllable is set to a melism as well. In one case, it is falling (8b), in the other, it is rising (8c).

(8) (a) ἀμπέχει (21.12)

		F		
	E		E	
D				
s#am		pé	kʰiː	

(b) αἰόλοις (20.14)

		D		
	Db		Db	
C				C
n#ai̯		i̯ó	loi̯s	

(c) Δελφίσιν (20.6)

		Eb		Eb
	D		D	
C				
del		pʰí	sin	

The settings of the trisyllables that we just briefly surveyed suggest that the pre-accentual rise starts at the beginning of the word, and the post-accentual fall ends near the end of a word (or word plus enclitic, in other data). The seven rising melisms over the initial syllable corroborate that assumption: the rise from the first to the second mora of the first syllable would be a parallel setting like the rise from the first to the second syllable in the non-melismatic forms, or the rise from the second mora of the first syllable to the second syllable in the melismatic ones. One of the two falling melisms (8b) would corroborate it as well. The setting of Δελφίσιν [delpʰísin] (8c) raises an issue. If pitch always fell all the way through the final mora of the word, the melism must represent an opposing setting. If the turning point could occur on a pre-final mora (under certain conditions), the setting may be parallel and reflect that.

As pointed out by Allen (1973, 245f.), in Vedic Sanskrit,[30] the turning point between a post-accentual fall and a pre-accentual rise is not tied to word boundary. In Allen's example from the Ṛgveda *urūṇasā́v asutṛ́pā* [u.ru:.ɳa.sá:.u̯a.su.tṛ́.pa:] (RV 10.14.12), the post-accentual fall occurs over the first syllable of the second word [u̯a], and the falling-to-rising turning point occurs over the syllable after that [su], which is the pre-accentual syllable. Using H for high pitch, F for falling, L for low, and # for word boundary, we can represent the approximate pitch movement over the relevant syllables as in (9). In Vedic, the fall-to-rise turning point is systematically tied to the accentual peak. As in (9), the turning point usually occurs on the pre-peak syllable.[31]

30 There are three main sources of information on Vedic accentuation: the accent marking in the texts (Saṃhitā and Padapāṭha); grammatical works (esp. the Prātiśākhyas); and traditional oral performances of the texts, including contemporary performances. For an overview of Vedic accentuation with further references, see Beguš 2016.

31 To capture the fact that the preaccentual-syllable usually has the lowest pitch, I suggest that we should consider positing a LH*.

(9) °*sáv asutṛ́*° (RV 10.14.12)

H			H
	F		
		L	
sá:	u̯#a	su	tṛ́

Vedic shows us that it is not a linguistic universal that the turning point between falling and rising pitch must align with word boundary. Since its accentual system is closely related to Greek, it is clear that at least one of the languages has innovated with respect to this aspect of the tonal system. Next we turn to an investigation of the turning point between falling and rising melody and pitch.

4 Musical Troughs in the Delphic Hymns

All else being equal, a low boundary tone (L_ω) would cause the turning point between falling and rising pitch to be aligned with the end of the word or clitic-group, i.e. the with the final mora or syllable. Given the general correlation of tone and tune in the Delphic hymns, we should see the effects of a L_ω there, if it existed. On average, the turning point between falling and rising melody should center around the final mora or syllable.

Let us define "musical troughs" as a single-note turning point between falling and rising melody, e.g. the note C in the sequence D C Db in (10), the setting of Ἄφαιστος αἴθε<ι> [há:pʰai̯stos ái̯tʰi:] (20.11f.). In the aggregate, they should reflect turning points between falling and rising pitch in the language, i.e. "pitch troughs".

(10) Ἄφαιστος αἴθε<ι> (20.11f.)

F							
		D			D		
					Db		Db
				C			
n#á:		pʰai̯s		to	s#ái̯		tʰi:

Because we are interested in evidence for a (maximal prosodic) word-final low tone, we should set aside troughs that could be attributed to boundary tones that are associated with the beginning or end of larger prosodic constituents such as the intonational phrase. As noted at the outset of this study, those are cross-linguistically very common. For instance, consider the following setting (11), which straddles a sentence/utterance boundary.

(11) κόραι. Ἀλλὰ Λατοῦς (21.26)

							F	F	
					E	E			
A									
	G								
			E						
kó	ra:î̯##		al		la²#		la:	tû:	

The first syllable Ἀλλὰ hosts a trough according to the definition given above. However it is possible, even likely, that the setting reflects a sentence-final fall and/or a sentence-initial rise (cf. PGS 430f.) rather than tones associated with the word. In what follows, I exclude troughs that immediately precede or follow punctuation (comma, raised dot, period).[32] That is a rough way of removing potential effects of boundary tones associated with higher-level prosodic constituents such as the intonational phrase or utterance.

4.1 *Eighth-Note Troughs*

Troughs that consist of an eighth-note may either be aligned with the sole mora of a light syllable (12a) or with one of the two morae of a heavy syllable (12b). There are 46 in the Delphic hymns.

32 In addition to (11) = 21.26, this requires excluding the troughs at κλειτύν, ὕμνων (21.2) and τρίποδα, βαῖν' (21.22).

(12) (a) Ὄλυμπον ἀνακίδναται (20.13f.) with the trough aligned with *po*

F										
	Eb									
						Db				
					C			C		
				B					B	
			Ab							
s#ó	lym		po	n#a	na	kíd		na	taị̯	

(b) αἰόλοις μέλεσιν (20.14f.) with the trough aligned with the second mora of *loi̯s*

		D					
	Db		Db		Db		
C				C		C	
							Ab
n#aị̯		i̯ó	loi̯s		mé	le	si

In (13a) the article plus the enclitic conjunction form a clitic group τάν τε. In (13b), δέ νιν forms a clitic group.

(13) (a) τάν τε δορίς[τεπτον (21.38)

D		D	D				
	Bb						
tá:n	te#	do	rís		tep	ton	

(b) ὁμοῦ δέ νιν Ἄραψ (20.12f.)

					G		
			F				
						Eb	
	D						
		Db					
				C			
B							
ho	mû:#		dé	ni	n#á	raps	

In the examples above (12ab, 13ab), the trough is aligned with the word- or clitic group-final mora. This holds true of the majority of eighth-note troughs (33/46 = 72%). The second most frequent alignment is one mora earlier (22%). The penultimate mora that hosts the trough is either the the first mora of a word-final bimoraic syllable (14a), the only mora of a penultimate syllable (14b), or the second mora of a penultimate syllable (14c). It is worth pointing out that the rise to the next peak begins one mora earlier than we would expect if (a) there were an immovable, immutable L_{ω} target and (b) that target were perfectly reflected in the musical setting.[33]

(14) (a) Δελφίσιν Κασταλίδος (20.6)

								Ab	
							G		
					F				F
		Eb		Eb					
	D		D						
C									
del		pʰí	sin#		kas		ta	lí	do

33 See PGS 189–194 on "secondary rise".

(b) δεξάμενος ἀμβρόταν (21.18)

							F		
						E		E	
D		D			D				
				C					
			B						
dek		sá	me	no	s#am		bró	ta:n	

(c) βωμοῖσιν Ἄφαιστος (20.11f.)

		F			F				
D							D		
				C					C
			B						
bo:		mô̱i̱		si	n#á:		pʰai̱s̱		to

This leaves us with a residue of 6% that include two instances (4%) where an eighth-note trough occurs one mora after the end of the maximal prosodic word (/clitic group/appositive group). One is shown in (15a), where the grave-accented postpositive δὲ hosts the trough. The setting of δὲ is reminiscent of the setting of the enclitics τε and νιν in (13ab). Finally, there is one instance (2%) of an eighth-note trough that is aligned with the antepenultimate mora (15b).

(15) (a) ἁγίοις δὲ βωμοῖσιν (20.11)

	Gb								
F		F					F		
					D				
				Db					
									C
								B	
ha	gí	oi̯s#		de$^{?}$#	bo:		môi̯		si

(b) μελίπνοον δὲ Λίβυς (21.15)

						G	
					Eb		Eb
	D		D				
		B					
A							
me	lí	pno	on#		de$^{?}$#	lí	by

There are two more settings with eighth-note troughs that seem special. Each exhibits two troughs. In δικόρυφον κλειτύν (21.2), the first trough is on *ru* and the second trough is on the second mora of *kleı̯*. It is possible that setting δικόρυφον to two melodic peaks (*kó*, *pʰon*) expresses the notion 'twin-peaked' musically.[34] In Ἀτθίδ' ἐπὶ γαλ[όφωι (21.14) the first (classified) trough is on *de* and the second (unclassified) trough is on the second mora of *ga:*. Two possibilities seem worth considering. (a) Limenius sets γαλόφωι so as to echo the δικόρυφον and thereby ties Mount Parnassus and Delphi to a corresponding hill in Athens. (b) The setting reflects Limenius's analysis of the compound γαλόφωι

34 Thus originally Reinach (1911, 164, 1926, 18), followed by Pöhlmann (1960, 68) and West (1992, 294), among others.

'ridge' as γᾶς λόφωι 'earth's crest' (cf. PGS 167, 351). The two are not mutually exclusive. I exclude those four troughs from the tallies.

4.2 *Quarter-Note Troughs*

Quarter-note troughs are always aligned with a heavy syllable. There are only 14 in the Delphic hymns. In the majority (71%), the trough is aligned with the word-final syllable, as in (16a). In three instances (21%), the trough occurs one syllable later (16b); in one it occurs a syllable earlier (16c).

(16) (a) χρυσέα δ᾽ ἀδύθρους (20.15)

F		F				F		
				D				
			Db					
							C	
$k^hry:$		sé	a:#		d#a:		$t^hru:s$	

(b) δώμασιν ἀπταίστους (21.37)

D								
		Bb	Bb			Bb	Bb	
				A				
dó:		ma	si	n#ap		tái̯s	tu:s	

(c) ναίουσα Τριτωνίδος (20.10)

									Ab		
								G		G	
					F		F				
D				D							
		Db									
náị		ịu:		sa#	tri:		to:		ní	dos	

4.3 *Interim Summary*

Excluding troughs that straddle punctuation as well as the two twin-peaked troughs discussed above, we arrive at the distribution of troughs shown in Table 4. Close to three quarters (72%) are associated with the final mora, in the case of eighth-note troughs, or the final syllable, in the case of quarter-note troughs. As discussed above, non-final troughs are near-final.

TABLE 4 Troughs associated with final morae/syllables vs. non-final ones

	Final	**Non-final**	**Total**
Eighth-note	33	13	46
Quarter note	10	4	14
Total	43	17	60

5 Distinguishing Accentual L from Boundary L_ω

We have seen that the troughs center around the word-final mora/syllable, which may point to the existence of a low boundary tone L_ω. However, accentual low tones at the end of the word would have the same effect. As a next step, we should remove from the data set all words that have an accentual L on the final mora and check whether any evidence for L_ω remains. In order to

do so, I will adopt a tonal analysis of ancient Greek accent based primarily on Golston 1990.[35]

– circumflex = HL
– persistent (lexically inherent) acute = H
– recessive (phonologically derived) acute = HL*

Regarding HL*, I assume that the starred low tone aligns with the first mora of the rightmost foot; the preceding H aligns one mora earlier and is graphically represented by the acute. The word-final foot is a moraic trochee, which consists either of one heavy syllable (1) or two light syllables (2); one word-final consonant is extrametrical.[36]

This applies to the three most frequent accentual types in the Delphic hymns in the following way. Recessive proparoxytones (16x) are the most frequent type, e.g. θύγατρες [tʰýgatres] 'daughters:VOC' (17a). Because the accentual L* (of HL*) does not occupy the final syllable, there is room for the putative L_ω to have an effect (17b).

(17) (a) θύγατρες (20.2)
H L*
tʰý (ga tre)<s>
(b) θύγατρες (20.2)
H L* L_ω
tʰý (ga tre)<s>

This effect could be seen in the setting θύγατρες εὐώλ[ενοι] [tʰýgatres e͡u̯u̯ó:lenoi̯] 'o fair-armed daughters' (20.2), where the trough is aligned with the final syllable, i.e. one syllable later than the accentual L*.

35 Note that adopting a more "traditional" analysis, where all acutes (including recessive ones) are H, we would have more evidence for L_ω. The more "modern" analysis, with recessive HL*, introduces a further accentual L, which can be responsible for word-final troughs, e.g. in disyllabic recessive forms such as ἔσχε.

36 Golston 1990 builds on Sauzet 1989. For an overview of the analyses that operate with HL* for recessive acutes, see Probert 2010.

(18) θύγατρες εὐώλ[ενοι] (20.2)

D									
	C		C		C				
		Ab							
tʰý	ga	tre	s#eu̯		u̯ó:		le	noi̯	

Recessive paroxytones of three or more syllables (9x) are the second most frequent type, e.g. ἐριβρόμου [eribrómu:] 'loud-thundering:GEN.SG' (19a). Because the accentual L* does not occupy the final mora, there is room for the putative L_{ω} to have an effect (19b).

(19) (a) ἐριβρόμου (20.2)

		H	L*
e	ri	bró	(mu:)

(b) ἐριβρόμου (20.2)

		H	L* L_{ω}
e	ri	bró	(mu:)

This effect could be seen in ἐ[ρι]βρόμου θύγατρες [eribrómu: tʰýgatres] 'o (fair-armed) daughters of loud-booming (Zeus)' (20.2), where the trough is aligned with the final mora, i.e. one mora after the accentual L*. Note that the musical setting of the first two syllables ἐ[ρι] is lost.

(20) ἐ[ρι]βρόμου θύγατρες (20.2)

		Eb					
			D		D		
				C		C	
							Ab
e	[ri]	bró	mu:#		tʰý	ga	tre

Persistent perispomena (7×) are the third most frequent type, e.g. τεχνιτῶν [tekʰniːtôːn] 'artists:GEN' (21). Because the accentual L already occupies the final mora, there is no room for a putative L_ω to have an effect; it would presumably be delinked or deleted.

(21) τεχνιτῶν (21.20)

		HL
te	kʰniː	tôːn

We will accordingly not attribute word-final troughs such as τεχνιτῶν ἔνοικος (21.20f.) to L_ω, rather to the accentual L. In what follows all such examples, i.e. wherever a trough could be due to an accentual low tone, are excluded from the counts.

(22) τεχνιτῶν ἔνοικος (21.20f.)

			F		F				
	E			E					E
D						D		D	
te	kʰniː		tôː		n#é	noi̯		kos	

As Philomen Probert kindly points out to me, we should also exclude data where a mora or syllable is sandwiched between two accentual peaks. Where else could the trough occur? For eighth-note troughs that are not already excluded by virtue of potentially hosting an accentual low tone, this would also rule out δέ νιν Ἄραψ [dé nin áraps] (20.13, trough at *ni*), τόνδε πάγον [tónde págon] (20.19, trough at *de*). For quarter-note troughs not already excluded by virtue of potentially hosting an accentual low tone, this would rule out πέτρας ναίεθ' [pétraːs nái̯i̯etʰ] (21.3, trough at *traːs*), [νη]νέμους δ' ἔσχεν [neːnémuːs d éskʰen] (21.9, trough at *muːs*), and ἀγηράτωι θάλλ[ουσαν [ageːráto:i̯ tʰálluːsan] (21.39, trough at *toːi̯*).

Finally, we should exclude cases where a trough could not possibly occur on the word- or clitic group-final syllable. There is only one, namely Ἀτθίδ' ἐπὶ γαλ[όφωι [attʰíd epì gaːlópʰoːi̯] (21.14, trough at *d#e*), where elision of the word-final vowel results in an acute accent on the surface-final syllable.

Once we remove the items with a potential accentual L on the word-final mora, troughs sandwiched between accentual peaks, and cases where a trough could not occur on the final mora/syllable, we are left with 36 troughs, as shown in Table 5. Of these, 61% are aligned with the final mora/syllable.

TABLE 5 Trough alignment excluding accentual L, sandwiched troughs, and *Att^{h}íd'*

	Final	**Non-final**	**Total**
Eighth-note	16	12	28
Quarter note	6	2	8
Total	22	14	36

It is useful to compare this with (non-sandwiched) troughs that *do* have an accentual low tone on the final syllable, e.g. [ἀ]γακλυταῖς Δελφίσιν [agaklytâi̯s delph^{h}ísin] (20.6, trough on the second/final mora of *tâi̯s*), νάματ᾽ ἐπινίσεται [náːmat epiníːsetai̯] (20.7, trough at *ma*), and γλαυκᾶς ἐλαίας [glau̯kâːs elái̯i̯aːs] (21.6, with trough on the post-ultimate syllable *s#e*). If we are more sure of the existence of the accentual low tones than we are of the putative L_{ω}, they should provide a kind of baseline for comparison that shows how frequently the musical troughs align with low tones. As shown in Table 6, ten of fourteen (71%) of those troughs are aligned with the word-final mora/syllable. Though the data is sparse, this suggests that troughs are not perfectly aligned with the word-final morae/syllable that host accentual low tones either.

TABLE 6 Trough alignment in non-sandwiched final morae/syllables that host an accentual L

	Final	**Non-final**	**Total**
Eighth-note	9	2	11
Quarter note	1	2	3
Total	10	4	14

At this point, we are in a position to compare the troughs that can be attributed to an accentual low tone (L*) (22 final, 14 non-final in Table 6) to the troughs that *cannot* be attributed to an accentual low tone but *could* be attributed to a low boundary tone (L_{ω}) (10 final, 4 non-final in Table 5). The difference is not significant ($\chi^2 = 0.13$, $p = 0.72$). If we entertain the existence of both as outlined above, this permits us to say that whatever causes the trough to be aligned a bit earlier or later than the word-final mora/syllable is comparable in both groups.

6 Concluding Remarks

On the assumption that the Delphic hymns provide something like pitch tracks for ancient Greek, musical troughs should reflect turning points in pitch. As has been noted in the past (e.g. Allen 1973, 246, PGS 180f.), the troughs tend to coincide with word boundary. The survey above shows that they occur on the word-final mora (in the case of eighth-notes) or the word-final syllable (in the case of quarter notes) 72% of the time (Table 4). Furthermore, the non-final troughs are near-final. Once we remove (a) troughs that can be attributed to accentual low tones, e.g. the second tone of the HL circumflex accent, (b) troughs that must be final because they are sandwiched by peaks, and (c) troughs that cannot be final, the numbers remain similar: 61% of troughs are final (Table 5) and the rest are near-final. Given how tone-to-tune mapping works in other languages/traditions, we do not expect the melody to perfectly reflect pitch. That would explain some of the non-but-near-final troughs. The overview of trough alignment involving final morae/syllables that host an *accentual* low tone provides a rough baseline for comparison. There the troughs are final in 71% of cases. This suggests that after an accentual low tone, pitch generally continued to fall until the end of the word or clitic group. The pre-accentual rise tended to begin just afterwards, i.e. with the first syllable of the following word. If we observed that phenomenon in the pitch tracks of a language, we would posit a low boundary tone.

In the related accentual system of Vedic Sanskrit, the turning point between a post-accentual fall and a pre-accentual rise is not tied to word boundary (9). Contrast Greek musical troughs – presumably reflecting such turning points – where the preceding peak is relatively close, and the following peak is relatively distant, e.g. δειράδα φιλένθεον [di:ráda pʰilénᵗʰeon] (21.23, trough at *da*) and δεσπότι Κρησίων [despóti kre:sío:n] (21.35, trough at *ti*). There are some reasons to think that the Greek alignment of the turning point with word boundary is an innovation. It is attractive to connect the Greek turning point with other innovations that clearly demarcated word-end in Greek:

a. the restriction of the accent to the final two or three syllables, i.e. the "law of limitation";
b. the loss of word-final stops, e.g. **tód* > *tó* = τό (cf. Vedic *tád*), **mélit* > *méli* = μέλι (cf. μέλιτος, μέλισσα, and Hittite *mi-li-it* 'honey');
c. the merger of word-final *m* and *n*, e.g. second declension accusative singular **-om* > *-on* = -ον (cf. Old Latin *-om*, Vedic *-am*);

Garrett (2006, 141) proposes that those changes are phonetically related via word-final laryngealization.[37] Since the other changes, e.g. the merger of word-final *m* and *n* > *n*, are clearly Greek innovations, the turning point, or as Garrett puts it, the fact that Greek "regularized falling pitch at the right edge of the word" (*ibid.*), would likely be an innovation as well. On a more speculative note, that low boundary tone may well have earlier been associated with larger prosodic constituents (e.g. the intonational phrase), and later been generalized to smaller ones, eventually the word or clitic-group.[38] The same has been argued for word-final devoicing and other phonological processes that are phonetically motivated at the end of utterances, but not at the end of smaller prosodic constituents.[39]

Acknowledgements

A fellowship from the Center for Hellenic Studies greatly facilitated this research. I would also like to thank Taylor Arnold (University of Richmond), Philomen Probert (University of Oxford), Kevin Ryan (Harvard University), and Ryan Sandell (Ludwig-Maximilians-Universität München) for their valuable input.

Abbreviations

PGS = Devine, A.M., and Stephens, L.D. (1994). *The Prosody of Greek Speech*. Oxford: Oxford University Press.

DAGM = Pöhlmann, E., and West, M.L. (2001). *Documents of Ancient Greek Music*. Oxford: Clarendon.

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37 Garrett also dates the changes to the post-Mycenaean period, about which I remain uncertain.

38 I thank Michael Weiss for pointing this out to me.

39 See Myers and Padgett 2014 for a survey and references.

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Appendix 1: Trisyllables with Medial Acute in the Delphic Hymns, in Order of Occurrence

Note that in the "setting" column, lower case notes are an octave higher than upper case notes, e.g. "g" is an octave above "G".

1.1 *Settings without Melisms* (*N* = 22)

Form	Locus	t1	t2	Setting
πετέρας	20.5	level	falling	eb eb d
ἐφέπων	20.8	level	falling	c c G
ἁγίοις	20.11	rising	falling	f gb f
χρυσέα	20.15	level	falling	f f db
ἀδύθρους	20.15	rising	falling	d f c
Ἀθθίδα	20.17	rising	level	f ab ab
μεγάλου	20.18	rising	falling	g ab f
προφαίνεις	20.20	level	falling	g g f
αἰόλον	20.23	rising	level	f ab ab
ἀθώπευτ᾽	20.24	rising	level	f ab ab
ἐλαίας	21.6	rising	falling	d eb d
[νη]νέμους	21.9	rising	falling	d f E
ἐκείνας	21.19	rising	falling	c d c
δειράδα	21.23	rising	falling	e f d
κατέκτας	21.29	rising	falling	e f E
Παλλάδος	21.34	rising	falling	e f d
δεσπότι	21.35	level	falling	d d Bb
Κρησίων	21.35	rising	falling	d eb A
κυδίστα	21.36	rising	level	A Bb Bb
ναέτας	21.36	rising	level	d eb eb
ἀπταίστους	21.37	rising	level	A Bb Bb
Ῥωμαίων	21.39	level	falling	d d Bb

1.2 *Settings with Melisms* (*N* = 7)

Form	Locus	t1	t2	Setting
Δελφίσιν	20.6	rising	falling	c_d eb d_eb
εὐύδρου	20.7	rising	falling	f_g ab g
αἰόλοις	20.14	rising	falling	c_db d db_c
ἀμπέχει	21.12	rising	falling	d_e f e
Κυνθίαν	21.13	rising	falling	d_e f e
ἀμβρόταν	21.18	rising	falling	d_e f e
ἀμβρόται	21.25	rising	falling	G_A Bb A

Appendix 2: Troughs in DAGM 20 and 21, in Order of Occurrence, to the Exclusion of Troughs That Straddle Major Punctuation

βαθύδενδρον αἳ λά[χετε (20.1)

D	D								
		C			C		C		
				Ab					
ba	tʰý	den		dro	n#aiˀ#		lá	kʰe	te

ἐ[ρι]βρόμου θύγατρες (20.2)

		Eb					
			D		D		
				C		C	
							Ab
e	[ri]	bró	mu:#		tʰý	ga	tre

θύγατρες εὐώλ[ενοι] (20.2)

D									
	C		C		C				
		Ab							
tʰý	ga	tre	s#eu̯		u̯ó:		le	noi̯	

συνόμαιμον ἵνα (20.3)

Eb	Eb					
		D			D	D
				C		
su	nó	maḭ		mo	n#í	na

Φοῖβον ὠιδαῖσι (20.3f.)

D							
	C		C		C		
		Ab				Ab	Ab
pʰôḭ		bo	n#oːḭ		dâḭ		si

δικόρυνβα Παρνασσίδος (20.4f.)

	Ab										
G		G			G		G		G		
				Eb						Eb	
di	kó	rum		ba#	par		na:s		sí	dos	

[ἀ]γακλυταῖς Δελφίσιν (20.6)

							Eb		Eb
						D		D	
		C	C		C				
	Ab			Ab					
a	ga	kly	tâi̯s#		del		pʰí	sin	

Δελφίσιν Κασταλίδος (20.6)

								Ab	
							G		
					F				F
		Eb		Eb					
	D		D						
C									
del		pʰí	sin#		kas		ta	lí	do

νάματ᾽ ἐπινίσεται (20.7)

G									
			F	F	F				
		Eb							
							Db	Db	
ná:		ma	t#e	pi	ní:		se	taị̯	

ναίουσα Τριτωνίδος (20.10)

									Ab		
								G		G	
					F		F				
D				D							
		Db									
nái̯		i̯u:		sa#	tri:		to:		ní	dos	

ἁγίοις δὲ βωμοῖσιν (20.11)

	Gb								
F		F					F		
					D				
				Db					
									C
								B	
ha	gí	oi̯s#		de²#	bo:		môi̯		si

βωμοῖσιν Ἄφαιστος (20.11f.)

		F			F				
D							D		
				C					C
			B						
bo:		môi̯		si	n#á:		pʰai̯s		to

Ἄφαιστος αἴθε<ι> (20.11f.)

F							
		D			D		
					Db		Db
				C			
n#á:		pʰai̯s		to	s#ái̯		tʰi:

ὁμοῦ δέ νιν (20.12f.)

			F	
	D			
		Db		
				C
B				
ho	mû:#		dé	ni

δέ νιν Ἄραψ (20.13)

		G		
F				
			Eb	
	C			
dé	ni	n#á	rap	

Ἄραψ ἀτμὸς ἐς Ὄλυμπον (20.13)

G										
						F	F			
	Eb				Eb			Eb		
			D							
										Ab
n#á	rap		s#at		mo?	s#e	s#ó	lym		po

Ὄλυμπον ἀνακίδναται (20.13f.)

F										
	Eb									
						Db				
					C			C		
				B					B	
			Ab							
s#ó	lym		po	n#a	na	kíd		na	taị̯	

αἰόλοις μέλεσιν (20.14f.)

		D					
	Db		Db		Db		
C				C		C	
							Ab
n#aɪ̯		ɪ̯ó		loɪ̯s#		mé	le	si

μέλεσιν ὠιδὰν κρέκει (20.14f.)

Db							Db		
	C					C		C	
			B		B				
		Ab							
mé	le	si	n#oːɪ̯		daʾːn		kré	kiː	

χρυσέα δ᾽ ἀδύθρους (20.15)

F		F					F		
					D				
			Db						
								C	
kʰryː		sé	aː#		d#aː		dý	tʰruːs	

ὕμνοισιν ἀναμέλπεται (20.16)

							Db			
C						C		C		
		B			B				B	
				Ab						
hým		noi̯		si	n#a	na	mél		pe	tai̯

[τεχνι]τῶν πρόπας (20.16f.)

			Ab				
					G		
				F			
						Eb	
te		kʰni:		tô:n	pró	pa:	

πρόπας ἑσμὸς Ἀθθίδα (20.17)

								Ab	Ab
G									
			F		F	F			
	Eb								
pró	pa:		s#es		mo?	s#at		tʰí	da

τόνδε πάγον (20.19)

Ab			Ab	
		G		
				F
tón		de#	pá	go

θνατοῖς προφαίνει[ς (20.20)

G				G	G		G	
			F					
		Db						
tʰnaː		tôi̯s#		pro	pʰái̯		niːs	

[τρ]ίποδα μαντεῖον (20.21)

					D		D
C		C	C			C	
	Ab						
trí	po	da#	man		têi̯		i̯o

μαντεῖον ὡς εἶ[λες] (20.21)

							F		
					Eb			Eb	
		D		D					
C			C						
man		têi̯		i̯o	n#oː		s#îː		le

ἐφρ]ούρει δράκων (20.22)

		Ab			Ab		
				G		G	
			F				
	Eb						
s#e		pʰrú:		ri:#	drá	ko:	

ὅτε τέ[κος (20.22)

G		G	
	G		
hó	te#	té	kos

συρίγμαθ᾽ ἱεὶς ἀθώπε[υτ᾽ (20.24)

										Ab		Ab	
							F		F				
		Eb				Eb							
	D				D								
				C									
sy:		ríŋ		ma	tʰ#i:		e?:		s#a	tʰó:		peu̯	

δικόρυφον κλειτύν (21.2)

			F			
	E					
D		D		D		D
					Bb	
di	kó	ry	pʰon#		kli:	tý

πέτρας ναίεθ’ (21.3)

Eb			Eb		
	D				
pé	traːs#		nái̯		i̯e

μέλπετε δὲ Πύθιον (21.4)

F			F	F	F			
							E	E
		Bb						
mél		pe	te#	deˀ#	pýː		tʰi	on

γλαυκᾶς ἐλαίας (21.6)

		G						
F								
			Eb		Eb			
				D			D	
glaʊ̯		kâː		s#e	láiˌ		ia̯ːs	

πόλος οὐράνιος (21.8)

F						
		E		E		
	D				D	
						C
pó	lo	s#uː		rá	ni	o

[νη]νέμους δ᾽ ἔσχεν (21.9)

		F			F		
D							D
			E				
neː		né	mu:s#		d#és		kʰe

μέγας Ὠκεανός (21.11)

D		D	D	D	D
	C				
mé	ga	s#o:	ke	a	nó

τότε λιπὼν Κυνθίαν (21.13)

							F		
E						E		E	
		D	D		D				
	C								
tó	te#	li	po^{ʔ}:n#		kyn		t^{h}í	a:n	

Ἀτθίδ’ ἐπὶ γαλ[όφωι (21.14): two troughs

		A							
				F	F		F		
E			E			E			
n#at		t^{h}í	d#e	pi^{ʔ}	ga:		ló	p^{h}o:	

μελίπνοον δὲ Λίβυς (21.15)

						G	
					Eb		Eb
	D		D				
		B					
A							
me	lí	pno	on#		de?#	lí	by

ὅτι νόωι (21.18)

F		F	F	
	D			
hó	ti	nó	o:i̯	

δεξάμενος ἀμβρόταν (21.18)

							F		
						E		E	
D		D			D				
				C					
			B						
dek		sá	me	no	s#am		bró	ta:n	

ἀμβρόταν Δι[ὸς ἐπέγνω (21.18)

		F			F						
	E		E								
D											
s#am		bró	ta:n#		di	o$^{?}$	s#e	péŋ		no:	

ὧν ἐκείνας (21.18f.)

			D			
					C	
C		C				
	B					
hô:		n#e	kí:		na:	

ἐκείνας ἀπ᾽ ἀρχᾶς (21.19)

	D			D	D		
			C				
C							
n#e	kí:		na:	s#a	p#ar	k^{h}â:s	

αὐτ[ο]χθόνων ἠδὲ Βάκχου (21.19f.)

		E		E						E			
							C		C			C	
					E								
s#au̯		tokʰ		tʰó	no:		n#e:		deʔ#	bák		kʰu:	

τεχνιτῶν ἔνοικος (21.20f.)

			F		F				
	E			E					E
D						D		D	
te	kʰni:		tô:		n#é	noi̯		kos	

ἔχεις τρίποδα (21.22)

F			F		
		E		E	E
	D				
s#é	kʰi:s#		trí	po	da

Π]αρνασίαν δειράδα (21.22f.)

			F#	F#					
								F	
						E			
									D
		E							
par		na:	sí	a:n#		di:		rá	da

δειράδα φιλένθεον (21.23)

		F							
E				E	E				
			D						
							E	E	
di:		rá	da#	p^hi	lén		t^he	on	

παῖδα Γᾶς (21.27)

			F	
D				
		C		
pâi̯		da#	gâːs	

πόθον ἔσχε (21.28)

F		F		
	E			
				D
pó	tʰo	n#és		kʰe

ἔσχε ματρὸς (21.28)

F									
					E			E	
			D						
n#és			kʰe#		maː			troʔs	

κατέκτ[α]ς οσ[(21.29)

	F			
E				
				A
		E		
ka	ték	ta:		s#o$^{?}$

σύριγμ᾽ ἀπ᾽ ε[ὐν]ῶν (21.30)

	F				F		
				D			E
		D					
sý:		riŋ	m#a	p#eu̯		nô:n	

λη<ι>ζόμενος ὤλεθ᾽ (21.33)

					G	
		F		F		F
			E			
D						
le:(i̯)	dzó	me	no	s#ó:		le

ὤλεθ᾽ ὑγρᾶι (21.33)

					Bb	
G			G			
		F				
s#ó:		le	t^h#yg		râ:i̯	

σῶιζε θεόκτιστον (21.34)

F		F	F				
	E			E		E	
sô:i̯	dze#	t^he	ók	tis		ton	

δεσπότι Κρησίων (21.35)

					Eb		
D	D		D				
		Bb					
						A	
des	pó	ti#	kre:		sí	o:n	

δώμασιν ἀπταίστους (21.37)

D								
	Bb	Bb			Bb		Bb	
			A					
dó:	ma	si	n#ap		tái̯s		tu:s	

τάν τε δορίσ[τεπτον (21.38)

D			D	D					
		Bb							
tá:n		te#	do	rís		tep		ton	

ἀγηράτωι θάλλ[ουσαν (21.39)

						D					
	Bb		Bb								
				A							
G											
t#a	ge:		rá	to:i̯#		tʰál		lu:		san	