

Article

*A Comparative Approach of PIE Laryngeals
and Balto-Slavic Tones*

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Abstract: The paper deals with the particular subset of Proto-Indo-European phonemes called *laryngeals*. It is generally hypothesized that PIE had three or four such laryngeals, the nature of which has been studied mostly in respect with their segmental features. In the paper, Balto-Slavic data and tonogenesis are analyzed so as to determine which tonogenetic features can be retrieved for the laryngeals hypothesized in PIE. The second part of the paper compares the tonogenetic properties of PIE laryngeals with the processes attested in Chinese and Yeniseian languages. This source of information on the phonetic nature of PIE laryngeals has never been harnessed before.

Keywords: Proto-Indo-European, Balto-Slavic, Laryngeal, Tonogenesis.

The paper deals with the particular subset of Proto-Indo-European (PIE) phonemes called *laryngeals*. It is generally hypothesized that PIE had three or four such laryngeals. Most theories about the actual phonetic nature of PIE laryngeals are based on the segmental or graphic traces, which they left in the languages of the Anatolian subbranch and on the features they transferred onto neighboring sounds, especially vowels in Indo-European languages, and sometimes also on consonants.

The paper compares the tonogenetic properties of PIE laryngeals, as they can be observed in Balto-Slavic, with the touchstone cases of Chinese and Yeniseian, where the tonogenetic phonemes are well-established or little doubtful.

1. *The issue of laryngeals in Proto-Indo-European*

As is well-known since Ferdinand de Saussure's (1857-1913) postulation of “coefficients sonantiques” in his famous *mémoire* published in 1879, and the reinterpretation of the “coefficients sonantiques” as Afrasian-like phonemes by Hermann Möller (1850-1923), PIE most probably had at least three proto-phonemes, called laryngeals, which are symbolized H_1, H_2, H_3 (the fourth being H_4).

The term *laryngeal* is not meant to be strictly laryngeal in an anatomical sense, though it is quite obvious that guttural sounds seem the most probable hypothesis. In his *mémoire*, Saussure showed that the paradigm of apparently irregular alternations could be made parallel to that of explicitly regular alternations, provided the postulation of unattested entities, which he himself wrote e, A, O :

$eC \sim oC \sim \emptyset C$
$el \sim ol \sim l$
$er \sim or \sim r$
$en \sim on \sim \eta$
$em \sim om \sim \mathfrak{m}$

Table1 Explicitly regular alternations

On the basis of these regular alternations between the so-called e-grade, o-grade and zero-grade (\emptyset), Saussure had it that the following alternations: $\bar{e} \sim \bar{o} \sim e, \bar{a} \sim \bar{\emptyset} \sim a, \bar{\emptyset} \sim \bar{\emptyset} \sim \emptyset$, which involve long and short vowels, could be integrated in the same regular mold according to the following equations:

Data	With <i>coefficients</i>	With <i>laryngeals</i>
$\bar{e} \sim \bar{o} \sim e$	$e+e \sim o+e \sim \emptyset+e$	$eH_1 \sim oH_1 \sim \emptyset H_1$
$\bar{a} \sim \bar{o} \sim a$	$e+A \sim o+A \sim \emptyset+A$	$eH_2 \sim oH_2 \sim \emptyset H_2$
$\bar{o} \sim \bar{o} \sim o$	$e+O \sim o+O \sim \emptyset+O$	$eH_3 \sim oH_3 \sim \emptyset H_3$

Table2 Apparently irregular alternations and their formulations

Saussure (1879:145) contains similar tables for the “coefficients” *A* and *O* in the Greek, Italic and Proto-Germanic languages. The original idea of Saussure was reworked by Möller (1880:151), who suggested immediately after Saussure published his *mémoire* that the coefficients were *Kehlkopflaute*: some kind of guttural sounds. The same year, Sweet (1880:146-147) made a similar suggestion and called them *glottids*, but the word ‘laryngeal’ has been preferred in present-day literature.

Following Benveniste's approach of PIE roots, it is generally accepted that PIE roots never started with vowels but with laryngeals, so that the postulated laryngeals H_1 , H_2 , H_3 also existed word or root-initially with similar influence or “coloring” on vowels: $H_1e > e$, $H_2e > a$, $H_3e > o$. The numbers are taken from Brugmann who distinguished three kinds of *a* in Old Indian according to their comparanda in the other languages. Hittite needs a fourth laryngeal: $H_4e > a$ versus $H_2e > ha$ in cuneiform.

2. Phonetic hypotheses about PIE laryngeals

So far the exact nature of PIE laryngeals has remained somewhat elusive. Explicit traces in the Anatolian branch of the Indo-European family have confirmed the validity of Saussure's approach in its principles, but that testimony does not address nor solve all the issues. A synthetic presentation of the orthodox point of view is:

I essentially follow the views of what can nowadays be considered orthodox laryngeal theory (See e.g. Mayhofer, 1985 ; Beekes, 1988a). I shall not discuss the rich variety of alternative proposals, e.g. Adrados' palatalized and labialized laryngeals, Puhvel's nine laryngeals and Szemerényi's one laryngeal. [...] These laryngeals are written here $*h_1$, $*h_2$ and $*h_3$ (cover-symbol H). Their exact phonetic nature is unknown and is in fact irrelevant to their existence, but Indo-Europeanists agree that they were consonants. (Schrijver 1991:2)

The testimony of Anatolian is described by Melchert:

In general cuneiform -vt-tv- spellings are used for inherited voiceless stops and -v-tv- for inherited voiced or voiced aspirate stops. This applies to Palaic and C[uneiform] Luvian, as well as Hittite. (1994:16) Cf. Hoffner–Melchert (2008:35) as well.

The Akkadian syllabary has a series of signs for a consonant conventionally transliterated as *h*. The sound in Akkadian is apparently a voiceless velar fricative. In Hittite words *h* reflects the PIE “laryngeals” $*h_2$ and $*h_3$. Orthographically, *h* patterns like the stops with contrastive *-hh-* and *-h-* between vowels, usually *-h-* in clusters (but occasionally geminate). Once again regular morphophonemic alternations such as strong stem *nah-* versus weak *nahh-* supports the assumption that *-hh-* versus *-h-* is contrastive. [...] Historically, geminate *-hh-* is the regular reflex of $*h_2$, while all clear cases of medial *-h-* continue “lenited” $*h_2$. (1994:21) Cf. Hoffner–Melchert (2008:38-9) as well.

My assumption to pharyngeal articulation for Proto-Anatolian and the cuneiform languages is not crucial, and velar fricatives instead are quite possible. (1994:22) Cf. Hoffner–Melchert (2008:38) as well.

$*h_1$ / I know of no compelling evidence for the preservation of PIE $*h_1$ / in Proto-Anatolian in any position. [...] In most positions it is lost without a trace. (1994:65)

$*h_2$ / PIE $*h_2$ / is generally preserved in Proto-Anatolian as a fortis, voiceless fricative which I symbolize as H. (1994:68)

*/*h₃/* The only major controversy regarding laryngeals in Anatolian concerns the fate of initial */*h₃/*. (1994:71.) [...] */*h₃/* is preserved initially as *h-* in Hittite, Palaic and Cuneiform Luvian. I assume that initial */*h₃/* was a lenis voiced fricative */*h/* in Proto-Anatolian, distinct from the fortis, voiceless fricative */*H/* which is the regular reflex of */*h₂/*. (1994:72)

On the whole the underlying reasonings of the *communis opinio* is that **H₁* does not have graphic reflexes in Anatolian while **H₂* and **H₃* have more or less consistent traces. In addition, assuming the hypothesis that PIE grapheme **e* was indeed [e] and that it was modified into [a] or [o] by neighboring laryngeals, then it would seem that **H₁* had much less coloring potential than **H₂* and **H₃* did. The following table summarizes several hypotheses proposed for systems with three laryngeals:

	H ₁	H ₂ /H _a	H ₃
Möller (1917:3-4)	?	h̥	ς
Melchert (1994)	∅	x or h̥	h
Meier-Brügger (2002:106)	h	x	γ ^(w)
Beekes (1995), Schrijver (1991:2)	?	ς	ς ^w
Fortson (2010:64)	h or ?	h̥	ς

Table3: Hypotheses with three laryngeals

This approach, though mainstream, is nevertheless not entirely satisfactory and, on the basis of Anatolian, it would appear that PIE is best handled with four laryngeals instead of just three:

In the most common theory, P.I.E. had three laryngeals, noted H₁, H₂ and H₃ that could “color” a neighboring vowel ‘e’. The laryngeal H₁ had no coloration effect, the laryngeal H₂ colored in ‘a’ and the laryngeal H₃ colored in ‘o’. In Hittite, the laryngeal H₁ vanished and the laryngeal H₃ was retained only in initial position. In median position, the fricative resulting from a laryngeal can be lenis (written between two vowels by ‘h̥’) or fortis (written between two vowels by ‘hh’). [...] It should be noted that the theory described here is incomplete : it does not explain cases where Hittite displays a ‘h̥’ where there is no laryngeal, and conversely cases where Hittite does not display a ‘h̥’ where a laryngeal occurred. (Friedrich 2008:16)

As noted by Mallory–Adams (2006:50), “There are different schools of laryngeal use and argument over how many laryngeals should be reconstructed: opinions range from none to as many as six; three or four tend to be the general consensus.” Emended theories with four laryngeals tend to split **H₂* into one phoneme with explicit traces in Anatolian, of uvular or velar nature, and another phoneme **H₄* without graphic counterpart in Anatolian, of deeper articulatory nature, as in Bomhard (2008:49). One of the most complex systems based on mainly theoretical reasons can be found in Martinet (1986:146). It (quite dubiously in my opinion) hypothesizes no fewer than 10 phonemes.

3. The tonogenetic properties of PIE laryngeals

As mentioned before, PIE laryngeals were originally posited for the sake of integrating apparently irregular alternations (of morphological nature) into the general and regular mold. The clearest features ascribable to PIE laryngeals is that they lengthen vowels, modify (“color”) vowel timber, can generate aspirated stops and sometimes leave traces as prosthetic or interconsonantal vowels. These features are mostly of segmental nature.

Other features, which were already noticed at the beginning of the 20th century, include prosodic features like tones in Balto-Slavic and the lengthening of rhotics in Indo-Aryan /r̄/. In the first section of the paper, Balto-Slavic data will be analyzed in order to determine which tonogenetic features can be retrieved for the different laryngeals hypothesized in PIE. The second part of the paper will compare the tonogenetic properties of PIE laryngeals with the processes attested in Chinese and Yeniseian languages. This external source of information makes it possible to ascribe plausible values to PIE laryngeals.

The accentuation of Balto-Slavic languages is a fairly complex body of data. Apart from descriptive works of the individual languages and their dialects, literature on this topic mostly deals with accent paradigms and accent mobility. These issues are fairly difficult to disentangle as most Balto-Slavic languages have undergone numerous changes involving positional shift toward the end or the initial syllable of inflected forms. And these changes may have happened either at the Proto-Balto-Slavic stage or in subsequent stages. A detailed and critical survey of Balto-Slavic accentology can be found in Olander (2009). It must be emphasized that the present survey does not try to address issues about accent mobility. On the contrary, it focuses, as much as is possible, on what most probably did not change from PIE down to present-day Balto-Slavic languages.

It is usually assumed that the PIE-stage accented syllable is best preserved in Old Indian, and to a lesser extent in Greek, because of the law of limitation. For that matter, only words or forms that seem unmodified when compared to Sanskrit cognates can securely be used for tonogenetic analyses. All the other forms entail an additional layer of potentially speculative thinking about what might have happened between the PIE stage and later phases in Balto-Slavic or in the individual languages.

The methodology applied is therefore to compare Balto-Slavic words or forms with their exact equivalents in Old Indian or Greek, that is to say items that derive from exactly the same PIE proto-forms and are accented exactly on the same syllable. These items have undergone (presumably) no change and retain the original PIE situation, as much as is possible. They provide a clear body of data where the tonogenetic influence of laryngeals can be observed in its purest form, that is to say untainted by analogical interference or any consideration related to accent mobility.

It is unfortunately not always possible to find exact matches for all phonetic environments but lacking comparanda can also be replaced by the regular morphology and prosody of PIE, which on the whole is well-known. In addition, the influence of PIE laryngeals on prosody must also be compared with items where short and long vowels are untainted by neighboring laryngeals.

A first target of the following lines is to determine the tonogenetic history of Štokavian.

4. *The reflexes of PIE high pitch without influence of laryngeals*

As regards orthographic conventions, readers may be interested to keep in mind the following points: Lithuanian <˘> means ‘short and stressed’, <˙> ‘long and rising’, <˘˘> ‘long and falling’. As an exception *īr and *ūr, which bear falling tone, are instead written īr, ūr. As for South Slavic (Slovene and Štokavian) <˙> is ‘long and rising’, <˘> ‘long and falling’, <˘˘> ‘short and rising’, <˘˘˘> ‘short and falling’. Besides PIE roots are taken from Mallory-Adams (2006) who have an up-to-date four-laryngeal system, though some reconstructions cannot be accepted.

The first set of examples listed below does not involve laryngeal tonogenesis and indicates that, when Old Indian had high pitch on a syllable, then Lithuanian has high pitch [˘] or rising tone [˙] on the same syllable. It is well known that this high pitch, which is also reflected in Greek tones, is inherited from PIE. As a rule, originally short accented vowels in open syllables have been lengthened in Lithuanian and now bear a rising tone. In such words, Slovene still has a short rising tone <˘> but Štokavian has a short falling tone <˘˘>:

- (1) **dék̑m(t)* ‘ten’ (Cf. Mallory-Adams 2006:500), this item is only attested in non-Anatolian IE: Old Indian *dása*, Greek *δέκα*, Lithuanian *dėšimt*, [Slovene *desēt*], Štokavian *děset*,
- (2) **rótH₂eHa-* ‘wheel, cart’ (Cf. Mallory-Adams 2006:507), this item is only attested in non-Anatolian IE: Old Indian *ráthas*, Lithuanian *rātas*,
- (3) **sénos* ‘old’ (Cf. Mallory-Adams 2006:514), this item is only attested in non-Anatolian IE: Old Indian *sánas*, Lithuanian *sėnas*,
- (4) **swóp̑nos* ‘sleep, dream’ (Cf. Mallory-Adams 2006:514), Anatolian IE Hittite *supparija-* ‘to sleep’: Old Indian *svápna*, Lithuanian *sāpnas*, but **súpnos* in Greek *ὑπνος*, Slovene *sàn*, Štokavian *sàn*.

Some PIE words had accented long vowels which were not of laryngeal origin. These vowels are still long in Lithuanian and bear a rising tone. A good example is:

- (5) [Nom.] **yékw̥r*, [with accented case-markers] **yekwn-ýC* ‘liver’ (Cf. Mallory-Adams 2006:521 **yek^wr*), this item is only attested in non-Anatolian IE: **yékw-* in Greek ἥπαρ, Lithuanian *jėknos*, but analogically shortened **yékw-* in Old Indian *yákr̥t*.

It can be observed that, in this word, Lithuanian has a rising tone when Greek has a circumflex hence falling tone. Another example attested in Slavic is:

- (6) **mūs* ‘mouse’ (Cf. Mallory-Adams 2006:500), this item is only attested in non-Anatolian IE: Greek μῦς m. [long falling], Slavic f. : Slovene (Nom.) *miš* [short rising] and (Gen.) *miši* [long rising], Štokavian *mīš* [short falling] and (Gen.) *mīši* [short rising], Russian *мышь*,

As regards PIE non-laryngeal long vowels, Greek ἥπαρ shows they originally bore high pitch on the first mora. If **mūs* did not have an internal laryngeal, the same is true in Štokavian *mīš*. As will appear below, if **mūs* had an internal laryngeal: **muHs*, then the laryngeal can only be **H₁* ou **H₂*. In this latter case, a connection with **meH₁-* ‘to cut’, hence ‘to gnaw’, is possible. Besides, Slovene underwent an innovation changing long falling to (long) rising.

As can be observed with PIE diphthongs involving **i/j* and **u/w*, Lithuanian changed the originally falling prosody of PIE into rising tone:

- (7) **néwjos* ‘new’ (Cf. Mallory-Adams 2006:501), Hittite *newa-*, Old Indian *návyas*, Lithuanian *naũjas*, but **néwos* in Greek νέος, Slovene *nōv*, *nōva*, *nōvo*, Štokavian *nōv*, *nōva*, *nōvo*. Russian shows that this adjective was originally accented on the last syllable when feminine: *но́в(ыя)*, *но́ва*, *но́во*. Slavic data cannot be used to exemplify **ew* because Proto-Slavic **nówo* had two syllables.
- (8) **kreu(s)* ‘to strike, break’ (Cf. Mallory-Adams 2006:491): (dialectal word) **króusos* ‘breaking, piece’ in Slovene *krùh* (Gn.) *krúha*, Croatian *krùh* ‘bread’,
- (9) **sn(e)ighwos* ‘snow’ (Cf. Mallory-Adams 2006:511), this item is only attested in non-Anatolian IE: **snéighwos* in Lithuanian *sniėgas*, Slovene *snég* ‘snow’, Štokavian *snìjeg*, Russian *снег*, but *(*s*)*nighweH_a* in Greek νίφα. Štokavian *snìjeg* can be described as a metathesis of **éi* into *ije* with the regular prosodic change: **èi* > **ije* > *ije*.

Logically, in *naũjas*, the first part of the diphthong *au* should bear high pitch, if Lithuanian were unchanged. This means that Lithuanian changed PIE falling **éw* into rising *aũ*. A similar change affected the long *é* of **yékw̥r*, which was originally falling as shown by Greek ἥπαρ. The same change happened with resonants like PIE **ým*, **ýn*, **ýl* and **ýr*, which now have a rising tone in Lithuanian **vĩ*, **vñ*, **vļ* and **vř*, whereas PIE had high pitch on the vowels and must therefore have had a falling prosody in that type of syllabic nucleus. For example:

- (10) **pélnos* (Cf. Mallory-Adams 2006:485 **péln-* ‘animal hide): Lithuanian *peĩnas* ‘earning, win’, Slovene *plén*, Štokavian *plén* (var. *plìjen*) ‘prey’. Cf. Gr. πωλεῖν ‘to sell’, Dor. πωλά, Att. πωλή f. ‘sale’, Old Indian *paṇa-* m. ‘playing for a stake, bet’, *sprṇóti* ‘to save, gain, win’,
- (11) **ǵhómbhos* ‘nail, tooth’ (Cf. Mallory-Adams 2006:485), this item is only attested in non-Anatolian IE: Old Indian *jámbha* (m.), Greek γόμφος ‘bolt, nail’, Slovene *zób*, Štokavian *zúb* ‘tooth’, Russian *зуб*.
- (12) **H_aént(e)ros* (Cf. Mallory-Adams 2006:485), this item is only attested in non-Anatolian IE: Old Indian *ántaras* ‘other’, Lithuanian *aĩtras* ‘other, second’,
- (13) **H₁ént(e)rom* (Cf. Mallory-Adams 2006:478 **H₁ént(e)rom* ‘innards’), this item is only attested in non-Anatolian IE: Greek έντερον ‘bowel(s)’, Slovene *jétra*, Štokavian *jêtra* ‘liver’,
- (14) (dialectal word) **wórnos* ‘crow’ (not in Mallory-Adams 2006): Lithuanian *vaĩrnas* (m.), Slovene *vrán*, Štokavian *vrán*, Russian *ворон*. This word is also attested in Tokharian B *wrauñā* ‘crow’.

It can be further observed that, on the contrary, accented resonants like PIE **m̃, ñ, r̃* and *l̃* still bear high pitch in Lithuanian even after a prosthetic vowel *i* was introduced at some point in the prehistory of Lithuanian: PIE **m̃, ñ, r̃* and *l̃* > Lithuanian *iṁ, iñ, iṛ* and *iṛ* respectively. This class of items preserves the original prosody of PIE.

- (15) **wĺkwos* ‘wolf’ (Cf. Mallory-Adams 2006:514), this item is only attested in non-Anatolian IE: Old Indian *vṛka*, Lithuanian *vil̃kas*, Slovene *vólk*, Štokavian *vúk*, Russian *волк*,
 (16) **septm̃t(H)os* ‘seventh’ (Cf. Mallory-Adams 2006:509 who cite only **septm̃mós* ‘seventh’): Old Indian *saptáthas*, Lithuanian *septim̃tas*,
 (17) **tṛnu* ‘thorn’ (Cf. Mallory-Adams 2006:517): Old Indian *tṛṇa-* (n.) ‘grass, herb, straw’, Slovene *tṛn*, Štokavian *tṛn* ‘thorn’, Russian *мѣрн*.

In words like **wĺkw*, Slovene shows a long rising tone, which means that pitch remained on the resonant, as in Lithuanian, whereas Štokavian is *vúk* with a long falling tone, a feature that will be explained later. On the contrary the long falling tone of Štokavian *zúb* continues the prosody of PIE **ǵhómbhos*, whereas Slovene long rising *zób* is emended. As an aside, it can be noted that Lithuanian shortened final long vowels, so that no information can be retrieved in that position. All items with word-final stress have a short vowel:

- (18) **ǵh(e)im-éH₄* ‘winter’ (Cf. Mallory-Adams 2006:475), Anatolian IE Hittite *gim(a)*: Old Indian *himá*, Lithuanian *giemà*, Russian *зимá* but modified in Slovene, Štokavian *zíma*, with a long rising tone on the first syllable, retracted from the previous high pitch on the second.

The reflexes of PIE high pitch can be summarized as follows:

PIE	Prosodic reflexes	Lithuanian
<i>*é, *ó, *éi, *éu</i>	changed into long rising	<i>ē, uō, iē, aū</i>
<i>*ým, *ýn, *ýl, *ýr</i>	changed into rising diphthong	<i>vṁ, vñ, vḷ, vṛ</i>
<i>*m̃, *ñ, *l̃, *r̃</i>	rearranged as rising diphthong	<i>iṁ, iñ, iḷ, iṛ</i>

Table4 PIE and Lithuanian comparative prosody

PIE	Prosodic reflexes	Slovene
<i>*é</i>	changed to short rising	<i>*é</i>
<i>*é, *ó, *éi, *éu</i>	changed into long rising	<i>é, á, é, ú</i>
<i>*ým, *ýn</i>	changed into long rising	<i>(denasalized) v̂</i>
<i>*ýl, *ýr</i>	changed into long rising	<i>l̂, r̂</i>
<i>*m̃, *ñ</i>	(unattested)	?
<i>*r̃</i>	changed into long rising	<i>r̂</i>
<i>*l̃</i>	rearranged as rising diphthong	<i>ól</i>

Table5 PIE and Slovene comparative prosody

PIE	Prosodic reflexes	Štokavian
<i>*é</i>	rearranged as short falling	<i>ě</i>
<i>*é, *ó, *éu</i>	still falling but short	<i>ě, à, ù</i>
<i>*éi</i>	still falling (but metathesized)	<i>ije</i>
<i>*ým, *ýn</i>	still falling but long	<i>(denasalized) v̂</i>
<i>*ýl, *ýr</i>	still falling but long	<i>l̂, r̂</i>
<i>*m̃, ñ</i>	(unattested)	?
<i>*r̃</i>	changed to long falling	<i>ř</i>
<i>*l̃</i>	rearranged as long falling vowel	<i>û</i>

Table6 PIE and Štokavian comparative prosody

On the whole, in spite of a handful of changes: **éi* metathesized as *ije*, **í* vocalized as *û*, the tonal features of Štokavian are faithful continuators of PIE prosody. It can be noted that falling tone, either <v̂> ‘long falling’ or <v̄> ‘short falling’, is the *unmarked* reflex of PIE high pitch in present-day Štokavian. This is the core situation that needs to be compared with vowels or diphthongs involved in laryngeal tonogenetic processes.

5. The tonogenetic influence of PIE laryngeals **H*

As mentioned before, Anatolian data are best analyzed with two a-coloring laryngeals, one that has explicit traces as *h* in cuneiform (**H₂*) and another that does not (**H₄*). A clear distinction is only possible when the root is represented in Anatolian. A cover symbol for both is **H_a*. It can be noted that Kloekhorst (2008), who wrote an etymological dictionary of Hittite, resorted to a system with only three laryngeals. His grapheme **H₂* is therefore a confused cover symbol for **H_a*.

To begin with, several kinship words share the same ending: **pH_atēr* ‘father’, **méH_atēr* ‘mother’, **dhugH_atēr* ‘daughter’, **yénH_atēr* ‘husband's brother's wife, sister-in-law’, etc. The laryngeal is *H_a* on account of Greek πατήρ, μήτηρ (but Doric μάτηρ), θυγάτηρ, etc. This suffix causes aspiration in Old Indian *duhitār* < **dhughatār* and should therefore be reconstructed as *-H₂tēr*. This reconstruction cannot be absolutely secured because the only attestation in Anatolian is interconsonantal, and all **H* become <a> in that position in that branch: HLuwian *tuwatra/i-* ‘daughter’ (Kloekhorst 2008:902).

A first issue is to determine whether minimal pairs can be found showing divergent results for each laryngeal. A first context to examine is **C(R)ṽH_xC*:

- (19) **séH₁mṽ* (n.) ‘seed’ (Cf. Mallory-Adams 2006:508 **seH₁men*): Lithuanian *sémens*, Slovene *séme*, Štokavian *sjěme*, Russian *céмя*,
- (20) **bhréH₂ter* (m.) ‘brother’ (Cf. Mallory-Adams 2006:468 *bhréH_at-*): Old Indian *bhrátā*, Slovene *brát*, (Gen.) *bráta*, Štokavian *brät*, (Gen.) *bräta*. Lithuanian *brólis* is a different formation,
- (21) no nominal instance of *-éH₃C*. The laryngeal *H₃* was fairly rare in that position in PIE and there seems to be no comparanda in Balto-Slavic. There exist verbal forms but they show obvious leveling which renders their testimony somewhat fragile. The laryngeal of **ǵneH₃-* and **déH₃-* is secured by Greek forms like γινώσκω ‘I know’ and δίδωμι ‘I give’, hence
 - (21a) **ǵnéH₃-mi* ‘I know’, **ǵñH₃-ti* ‘to know’ (= Greek γνῶσις): Slovene *znám*, *znáti* ‘to be able to’, Štokavian *znâm*, *znâti*,
 - (21b) **déH₃-mi* ‘I give’, **dĤ₃-ti* ‘to give’: Lithuanian *dúomi*, *dúoti*, Slovene *dám*, *dâti*, Štokavian *dâm*, *dâti*. The vowel of infinitives like *znâti*, *znâti* and *dúoti*, *dâti*, *dâti* is obviously taken from the present but the tone of Štokavian *znâm*, *dâm* may continue the original pitch. As shown by Old Indian *gâti*, Greek βάσις, Gothic *gaqumþs* < **gwh̥ti* ‘act of coming’, Štokavian *znâti* and *dâti* are supposed to stand for **ǵñH₃-ti* and **dĤ₃-ti*, but one would rather expect **ǵñH₃-ti* > **znâti* > (present-day) *znâti* and **dĤ₃-ti* > **dòti* > (present-day) *dòti*. These two infinitives seem to be mutually contaminated as regards tone and vowel.
- (22) **néH_{4s}* ‘nose’ (Cf. Mallory-Adams 2006:487 **H_xnass*), only attested in non-Anatolian IE: Old Indian *nāsā*, Lithuanian *nósis* (f.) < **nās*, Latvian *nāss*, Slovene *nós*, (Gen.) *nosâ* (or remade *nōsa*) Štokavian *nós*, (Gen.) *nōsa* (retracted from **nosâ*), Russian *нос*. The reconstruction proposed by Mallory-Adams is unacceptable. Next, a number of Indo-Europeanists tend to think that this word had an ancient paradigm (stressed) *nās*, (unstressed) *nās* and postulate that PIE had such a phoneme /a/. (Cf. for example Fortson 2010:66). But Slavic actually refutes that idea as Štokavian in that case should be ***nās*, with the regular short falling tone of PIE originally long vowels. Normally Slavic should not have long [ō] as in Štokavian *nós* because Pre-Slavic **ō*, **ā* both became **ā* while Pre-Slavic **ō*, **ǎ* both became **ǎ*. The long vowel [ō] must be an innovation, as Pre-Slavic (stressed) **nās*, (unstressed) **nās* should have become Slavic **nās*, **nos*. It is therefore logical to conclude that a phonetic leveling occurred, yielding Proto-Slavic **nōs*, **nos*, and it is reasonable to think that Štokavian *nós* continues the tone that **nās* bore. The leveling changed the vowels but maintained the tone.

It is unclear to which extent monosyllabic words can be used as tones have distributional limitations in that kind of Balto-Slavic words and monosyllabic words also often show peculiar behavior as regards prosody or vowel length from a general typological point of view.

- (23) (?) **dwéH₃* ‘two’ (Cf. Mallory-Adams 2006:471 **dwéH₃[u]*): Old Indian *d(u)váu*, *dvá*, Greek *δύο*, *δύω* (**duH₃*) ‘two’, *δώ-δεκα* (**dweH₃*) ‘twelve’, Lithuanian *dù* (? < **dwuo*), Slovene *dvá*, Štokavian *dvâ*. This word shows the same pattern as **ġneH₃*- and **deH₃*- in Slavic. As will appear below only **H₄* generates long falling tone in Štokavian, so the correct reconstruction might in fact be **dwóH₄*. Anyway this point does not have much bearing.

6. Reconstructing the tonal system of Ancient Štokavian

On that preliminary basis, it is possible to draw a number of inferences:

- Štokavian *nós* and *brât* bear different tones because PIE **néH_{4s}* ‘nose’ and **bhréH_{2ter}* ‘brother’ had two different laryngeals.
- Two sets of laryngeals can be distinguished: **H₁* and **H₂* which yield short falling tone <v̂> in Štokavian, as happens with any PIE non-laryngeal long vowel, as opposed to **H₄* which yields long falling tone <v̂̄>.
- The testimony of **H₃* in Štokavian *znâm*, *znâti* is ambiguous. Other examples will show that **H₃* sides with **H₄*, rather than **H₁* and **H₂*.

At this point, some reasoning is necessary. Logically, the reflexes of PIE **éH₁* and **éH₂* (and of **é̄*, **ó̄*) in Štokavian should be long. This means that present-day short falling tone originates in an ancient long falling tone. But then, this also means that present-day long falling tone must have been something different: it was therefore long rising in Ancient Štokavian. Because of the retraction of pitch, that created a fourth tone, the prosodic features of the tones were modified.

PIE	Ancient Štokavian		Present-day Štokavian
<i>Inherited tones</i>			
* <i>é</i>	* <i>è</i>	modified into short falling	<i>ě</i>
* <i>é̄</i> , * <i>ó̄</i>	* <i>ê</i> , * <i>â</i>	still falling but now short	<i>ě̄</i> , <i>â̄</i>
* <i>éH₁</i> , * <i>éH₂</i>	* <i>jê</i> , * <i>â</i>	still falling but now short	<i>jě̄</i> , <i>â̄</i>
* <i>éH₃</i> , * <i>éH₄</i>	* <i>ó</i> , * <i>á</i>	modified into long falling	<i>ô</i> , <i>â</i>
* <i>éi</i>	* <i>ěj</i>	still falling but metathesized	<i>ije</i>
<i>Retracted innovative tones</i>			
short vowel	<i>ôtac</i>	retracted into a neo-short rising	<i>òtac</i>
long vowel	* <i>zīmà</i> or * <i>zīmá</i>	retracted into a neo-long rising	<i>zíma</i>

Table 7 PIE and Štokavian comparative prosody

Originally, Ancient Štokavian only had three tones: short rise that continued PIE pitch, long fall that continued PIE **éH₁* and **éH₂* (and possibly long vowels) and long rise that continued PIE diphthongs, **éH₃* and **éH₄*. There was no short falling tone in the prosodic system of Ancient Štokavian, because nothing in PIE can be the antecedent of a short falling tone in this language.

The following steps leading to present-day Štokavian can be inferred:

1. The long falling <v̂̄> tone, inherited from PIE **éH₁* and **éH₂* was changed into short falling <v̂>.
2. The short rising <v̂> tone, inherited from PIE pitch, and long rising <v̂̄> tone, inherited from PIE **éH₃* and **éH₄* were changed into short falling <v̂> and long falling <v̂̄>, respectively.
3. Retraction from the next syllable created a neo-short rising <v̂> or neo-long rising <v̂̄> tone on the first syllable, depending on the vocalic length, on which the tone was retracted.

At this point, as regards Štokavian, the following properties can be inferred for each laryngeal :

- $*H_1$ ($*sjēme > sjēme$) and $*H_2$ ($*brāt > brāt$) originally caused vowel length and falling tone. In recent times, vowel length was lost, resulting in a short falling tone.
- $*H_3$ ($*dvā > dvā$) and $*H_4$ ($*nās > *nós > nós$) originally caused vowel length and rising tone. In recent times, prosodic rise was changed into prosodic fall, because of the neo-long rising tone caused by retraction.

It is unclear if (Ancient) Štokavian retained all four PIE laryngeals as phonemes, but, in all cases, on account of their tonogenetic features, it kept two pairs distinctly apart: $*H_{1/2}$ and $*H_{3/4}$. One would say that probably only two distinct phonemes remained.

Lithuanian and Slovene do not provide any apparent indication for such a distinction. The prosodic reflex of all laryngeals in these two languages is uniform. Several explanations of this situation are possible:

- (1) tonogenesis is a late process that took place in each language according to specific processes,
- (2) some languages had lost or fused laryngeals before tonogenesis began,
- (3) the distinction originally existed but got blurred by additional changes.

On the whole the issue hinges around one crucial question: is it possible to reconstruct a tonal Proto-Balto-Slavic that can account for all prosodic patterns in individual languages or dialects or do we have to conclude that Proto-Balto-Slavic was not tonal yet? Before this question can be tackled all cases must be first examined and tonal developments need to be clarified in each language.

7. More examples with laryngeals

Another set of words contrasting $*-IC$ with $*-IH_xC$ is:

- (24) $*pélnos$ (Cf. Mallory-Adams 2006:485 $*péln-$ ‘animal hide’): Lithuanian *pėlnas* ‘earning, win’, Slovene *plén*, Štokavian *plén* (var. *plījen*), Russian *полон* ‘prey’. Cf. Gr. *πωλεῖν* ‘to sell’, Dor. *πωλά*, Att. *πωλή* f. ‘sale’, Old Indian *paṇa-* (accent unknown) m. ‘playing for a stake, bet’, *sprṇóti* ‘to save, gain, win’,
- (25) $*wíkwos$ ‘wolf’ (Cf. Mallory-Adams 2006:514), this item is only attested in non-Anatolian IE: Old Indian *vṛka*, Lithuanian *vilkas*, Slovene *vólk*, Štokavian *vúk*, Russian *волк*,
- (26) $*wíH_2neH_a$ ‘wool’ (Cf. Mallory-Adams 2006:520 $*wíH_2neH_a$), Anatolian IE Hittite *hu-la-na*: Old Indian *úrṇā*, Greek *λίῆνος*, Lithuanian *vilna*, Slovene *vólna*, Štokavian *vūna*. It is unclear whether Dorian *lānos*, with a different meaning, can be accepted to confirm $*H_a$. Logically Hittite *hulana* cannot be accounted for with $*wíH_2neH_a$ directly unless a metathesis occurred whereby the laryngeal became initial. It could be either $*H_2wíH_4neH_a$ or $*H_2wíH_1neH_a$ but Kloekhorst (2008:357) indicates that $*H_2wíH_1neH_a$ should become Hittite $**hullana$ and it can be added that $*H_2wíH_4neH_a$ should become Štokavian $**vūna$. It therefore appears that the reconstruction is $*wíH_2neH_a$ and that a metathesis occurred in Hittite.
- (27) $*síH_4n-$ ‘sun’ (Cf. Mallory-Adams 2006:508 $*séH_{aul-}$): numerous variants (1) $*seH_{awel-}$ in Greek *ἥλιος*, Hom. *ἠέλιος*, Dorian *ἀέλιος*, (2) $*séH_{aul}$ in Lithuanian *sáule*, (3) $*súH_{4l-}$ Old Indian *súras*, *súryas* (m.), rearranged $*síH_{4n-}$ in Slovene *sónce*, Štokavian *súnce*, Russian *солнце*,

Another set of words contrasting $*-rC$ with $*-rH_xC$ is:

- (28) $*bherH_xǵ-$ ‘birch’ (Cf. Mallory-Adams 2006:467 who cite $*bherH_xǵós$): (1) $*bhṛH_xǵós$ in Sanskrit *bhūrjā* (m.), (2) $*bherH_xǵós$ ‘birch’ in Lithuanian *bėržas* (m.), (3) $*bhérH_xǵeH_a$ in Slovene *bréza*, Štokavian *brèza*, Russian *берёза*. If a connection between $*bheH_a$ ‘to shine’ and $*bherH_xǵ$ ‘bright’ is accepted then this is an ambiguous case of $*H_a$.

- (29) **k(w)órH_akeH_a* ‘magpie’ (Cf. Mallory-Adams 2006:491 who cite **kvr-C* ‘crow’ and 492 **karH_xka*), this item is only attested in non-Anatolian IE: Lithuanian *šárka* ‘magpie’, Slovene *sráka*, Štokavian *svràka*, Russian *copóka* ‘magpie’. Greek *κόραξ* ‘crow’ is a different formation: **kórηk*. On account of Greek *κρώζω*, *κράζω* (ἔκραγον, κέκραγα) ‘to crow’ the laryngeal is **H_a*.
- (30) **krH₁pyeH_a* ‘sort of shoes’: Lithuanian *kùrpė* ‘sandal’, Slovene *kípelj*, Štokavian *kǝplje* ‘snowboot(s)’. It is unclear where pitch originally was. Greek *κηπίς* (f.) ‘high boots’ < **krH₁pi* is a different formation and is irrelevant. It is probable that this feminine word was accented on the root in Balto-Slavic.
- (31) **gwíH_xtlom* ‘throat’ (Cf. Mallory-Adams 2006:476 **gwerH₃* ‘to swallow’): Greek *βιβρώσκω* ‘to eat (up)’, Slovene *gřlo*, Štokavian *gřlo*, Russian *зóрло* ‘throat’. As shown by Greek that kind of instrumental neuter words with *-tron*, *-tlon*, *-dhlon* endings normally have radical pitch: *τέρετρον* ‘borer, gimlet’ < **tíH₁-*, *ἄροτρον* ‘plough’ < **H_aíH₃-*, etc. The tone of Štokavian *gřlo* is not consistent with **H₃*, rather **H₁* or **H₂*.
- (32) **príH₄wo* ‘first’ (Cf. Mallory-Adams 2006:503 **príH_x-* ‘first’ and 506 **prH_aeH₁* ‘in front of, before’): Old Indian *púrva*, Lithuanian *pírmas*, Slovene *přvi*, Štokavian *přvi*, Russian *нёрвый*. The tone of Štokavian shows that **H* is **H₄*.

Other cases with diphthongs:

- (33) *(*s*)*póih_xneH_a* ‘foam’ (Cf. Mallory-Adams 2006:512 *(*s*)*poH_xin-*), only attested in non-Anatolian IE: Old Indian *phéna*, Lithuanian *spáine*, Slovene *péna*, Štokavian *pjèna*, Russian *néna*. The laryngeal cannot be intervocalic as Slovene would then be ***péna*, and cannot be **H₄*. If a semantic connection between foam, milk and fat is accepted, on account of Skt. *spháyate* ‘to become fat’, this is probably an example of **H₂*.

Examples with retracted accent (Hirt's law):

- (34) **ǵltóm* ‘gold’ (Cf. Mallory-Adams 2006:476): Slovene *zlató*, Štokavian *zlâto*, Russian *зóлото*. Retraction without laryngeal,
- (35) **plH₁nós* ‘full’ (Cf. Mallory-Adams 2006:505): Sanskrit *pūrná*, Lithuanian *pilnas*, Slovene *póln*, Štokavian *pǝn*, Russian *пóлон*,
- (36) **dhuH₂mós* ‘smoke’ (Cf. Mallory-Adams 2006:472): Slovene *dím*, (Gen.) *díma* (m.), Štokavian *dǝm*, Russian *дым*,
- (37) **griH_xwéH_a* ‘neck’ (Cf. Mallory-Adams 2006:477): Slovene *gríva*, Štokavian *grǝva* ‘mane’. The laryngeal is probably the same as in **gwíH_xtlom* ‘throat’,
- (38) **g^wiH₃-wó-* ‘alive’ (Cf. Mallory-Adams 2006:476), masc. Sanskrit *jīvá*, Slovene *žǝv*, (Gen.) *žíva*, Štokavian *žǝv*, (Gen.) *žíva*, Russian *живóй*,
- (39) **g(w)renH₄diH* ‘chest’: a rather isolated Slavic word, Slovene *gród*, Štokavian *grǝdi*, Russian *гpyдъ*. The tone of Štokavian shows that **H* is **H₄*.

More complex examples involve contractions with a laryngeal as syllable boundary:

- (40) **H₂wéH₁-(nt-)* ‘wind’ (Cf. Mallory-Adams 2006:482) Anatolian IE Hittite *hu-u-wa-an-te-eš*: Old Indian *vātās* (< metrically **wáHat-* < *H₂wéH₁ntos*), Lithuanian *vétra* (f.) ‘storm’, *véjas* ‘wind’, Slovene *véter*, Štokavian *vjètar*, Russian *вётер*,
- (41) **méH₁-(n-)* ‘moon, month’ (Cf. Mallory-Adams 2006:498), only attested in non-Anatolian IE: Old Indian *más*, Lithuanian *ménuo*, *ménas*, but **mé-H₁n-s-* in Slovene *mésec*, Štokavian *mǝsec*, Russian *мэсяц*,
- (42) **gwíH_an-* ‘acorn’ (Cf. Mallory-Adams 2006:476 **gwelH_a-*): **gwíH_anos* in Greek *βάλανος*, **gwíH_and(h)os* > Proto-Slavic **želādō* in Slovene *žélod*, (Gen.) *želóda*, Štokavian *žǝlúd*, Russian *жёлóдъ*.

In these examples (40–42), Slavic shows a falling tone, either short or long, but the laryngeal probably played no role in the tonogenesis as, in all cases, the contraction involved a high pitch

followed by a low pitch in the next syllable. These items are therefore irrelevant for the analysis of Balto-Slavic tonogenesis, but they confirm that PIE originally had high pitch.

8. Comparative Balto-Slavic tonogenesis

Slovene would appear to be the easiest to explain. Monomoraic PIE high pitch became short rising <v̇>, bimoraic nuclei of all kinds: PIE *v̇, *v̇i, *v̇u, *v̇H, *v̇R, *ṘH became long rising <v̇, l̇v̇, ṙv̇, v̇l̇, v̇ṙ, ḟ>, new bimoraic nuclei with Slavic prosthetic *ol, *or <*l̇, *ṙ kept high pitch on the resonant and are now long rising <v̇l̇, v̇ṙ>, trimoraic monosyllabic nuclei of all kinds also became long rising, but originally bisyllabic nuclei like PIE *v̇Hv̇, *v̇HṘ or *v̇Hṇ kept the falling prosody of PIE and are now long falling <v̇> as could be expected from PIE high pitch on the first mora. In other words laryngeals play no tonogenetic role in Slovene, present-day tones are entirely controlled by the structure of syllables and of syllabic nuclei that existed in Proto-Slavic. Slovene provides no information apart from the mere presence or absence of laryngeals.

Lithuanian is different and laryngeals do play a direct role in tonogenesis, but, as all laryngeals yield the same falling tone, it would seem that Proto-Lithuanian had only one laryngeal left and this laryngeal was so marked with prosodic fall that it caused all nuclei with no laryngeal to be changed into prosodic rise. Bimoraic nuclei of all kinds: PIE *v̇, *v̇i, *v̇u, *v̇R, became long rising <v̇, v̇l̇, v̇ṙ, v̇l̇, v̇ṙ, v̇ṁ, v̇ṅ> instead of originally falling, new bimoraic nuclei with Baltic prosthetic *il, *ir <*l̇, *ṙ kept high pitch on the resonant and are now long rising <v̇l̇, v̇ṙ>, bimoraic and trimoraic nuclei involving laryngeals: PIE *v̇H, *ṘH, *v̇iH, *v̇uH, *v̇RH uniformly became long falling, and originally bisyllabic nuclei like PIE *v̇Hv̇ kept the falling prosody of PIE and are now long falling <v̇, v̇ṙ, v̇>.

It can be noted that Latvian has inverted tones when compared to Lithuanian: PIE *v̇, *v̇i, *v̇u, *v̇R still have falling tone, written <v̇>, which means no prosodic change happened, whereas bimoraic and trimoraic nuclei involving laryngeals: PIE *v̇H, *ṘH, *v̇iH, *v̇uH, *v̇RH bear either the sustained high tone <v̇> (originally mobile pitch) or the so-called broken tone <v̇> (columnar pitch), which involves high pitch followed by glottalization or similar phonetic features. This means that Latvian originates in a system with one laryngeal, but it was not the same as in Lithuanian, as the laryngeal of Latvian caused (sustained) high pitch, whereas that of Lithuanian caused falling pitch. As will appear in the rest of the paper, the laryngeal of Latvian was a glottal stop, and glottalization is not an acquired feature but the continuation of the original Proto-Latvian laryngeal. All PIE laryngeals fused into Proto-Latvian [ʔ]. This also means that the laryngeal of Lithuanian was not a glottal stop and that tonogenesis is a post-Proto-Baltic process.

Lithuanian tones and Latvian tones are independent innovations caused by two different segmental phonemes. This explains why tones are apparently inverted between these two closely related languages. Besides, this issue may be linked to alternations between word-initial *e* and *a*, known as Rozwadowski's change.

Štokavian is the only language that has (near) minimal pairs like *sjème* (<*séH₁mṇ), *brät* (<*bréH₂tēr) versus *nós* (<*néH₄s), *vùna* (<*w̃l̇H₂neH_a) versus *súnce* (<*s̃l̇H₄n-), *g̃lo* (<*g̃w̃l̇H_xtlom) versus *p̃rvi* (<*p̃ṙH₄wo), *d̃im* (<*d̃huH₂mós) versus *gr̃udi* (<*g̃(w)renH₄díH). Proto-Štokavian must have retained at least two laryngeals and their tonogenetic features were different when tones were created. A first point is that monoraic high pitch, bimoraic PIE *v̇, *v̇i, *v̇u, *v̇N and trimoraic bisyllabic PIE *v̇Hv̇, *v̇Hṇ have all kept the falling prosody of PIE but they are now all short falling. The three vocalic lengths, which could be expected, are now lost. An oddity is that Štokavian nevertheless still has long falling tone in a number of words: *nós*, *vúk*, *p̃rvi*, etc. Obviously this falling tone must be an innovation. In the case of *vúk* <*w̃[o]lk̃ the prosody must have been originally long rising tone. This means that present-day *nós*, *vúk*, *p̃rvi* with long falling tone originate in Proto-Štokavian *nós*, *vúk*, *p̃rvi* with long rising. A prosodic change happened in that type of words. The case of PIE *v̇R is different as it was metathesized as *ṙv̇, *l̇v̇ and kept the original bimoraic falling prosody. This means that the loss of length in Proto-Štokavian continuators of PIE *v̇, *v̇i, *v̇u, *v̇N, *v̇Hv̇, *v̇Hṇ happened first and metathesis of *v̇R is second. At one point, Proto-Štokavian had

inherited long rising tone \acute{v} , \acute{l} or \acute{r} (< PIE $*\acute{v}H_4$, $[\acute{v}H_4]$, $*\acute{r}H_4$) and it created long falling tone in metathesized $*r\grave{v}$, $*l\grave{v}$. The distinction was later lost, both tones being now long falling, a process that has obvious relationships with another innovation whereby unstressed long vowels attracted high pitch from the next syllable: $\bar{v}_- \grave{v} > \acute{v}_- v$ as in *glāvā* > *gláva* ‘head (Nom.)’. This latter change is usually dated ca. the 15th century AD. We can therefore conclude that $*H_1$, H_2 are marked as causing prosodic fall, $*H_4$ as causing prosodic rise. The case of $*H_3$ is apparently ambiguous as *dām*, *znām* conflict with *gřlo*.

9. Prosodic and tonogenetic features of laryngeals

So we can now answer some of the questions raised before: there is no doubt that tones developed in each language (Slovene, Štokavian, Lithuanian, Latvian) independently. Neither Proto-Slavic nor Proto-Slavic were tonal.

The so-called “acute” or “circumflex” intonations are fictitious entities which make sense from a purely comparative and synchronic point of view but never existed as inherited features in these proto-languages and make no sense from a genetic and diachronic point of view. They are patterns of prosodic correspondences between present-day languages which should not be projected in the past.

Tonogenesis is an endemic feature of Balto-Slavic but it is in no way an inherited feature. Most authors assume that laryngeals disappeared in Pre-Balto-Slavic. For example, Olander (2008:3) describes “a pre-stage of Proto-Balto-Slavic where the [PIE] laryngeals had disappeared”. This point of view is impossible. The divergent tonogeneses of Proto-Latvian, Proto-Lithuanian and Proto-Štokavian can only be explained if (at least) one laryngeal, but not the same, was still there in Proto-Latvian and Proto-Lithuanian and at least two, with contrasting results, were still there in Proto-Štokavian. In other words the somewhat bewildering complexity of Proto-Balto-Slavic prosody originates in erroneous premises for the most part. Laws like Hirt's law are probably not sound changes that might have happened at an early stage but shared and late innovations.

10. Prosodic and tonogenetic features of laryngeals

The tonogenesis of Chinese and Yeniseian has been described in another paper and it is possible to examine PIE laryngeals more fruitfully. The different PIE laryngeals can be assigned to the following types:

- Absence of laryngeal corresponds to Chinese Píng and Yeniseian Tone1. This is PIE high pitch.
- Laryngeal of the Chinese Qù type and Yeniseian Tone4 causing falling tone: $*H_1$, which must be some kind of voiceless guttural fricative. Considering that $*H_1$ does not leave any graphic traces in the Anatolian branch, it seems quite reasonable to conclude that $*H_1$ was a voiceless fricative [h], of pharyngeal deep articulation, in the PIE language.
- Laryngeal of the Yeniseian Tone3 type: $*H_2$, which must be some kind of voiced guttural fricatives. Considering that $*H_2$ leaves graphic traces in Anatolian as a kind of velar (or less probably uvular) phoneme, it seems quite reasonable to conclude that $*H_2$ was a voiced velar fricative [ɣ].
- Laryngeals of the Chinese Shǎng and Yeniseian Tone2 type causing rising tone: $*H_4$ and $*H_3$. Considering that $*H_4$ does not leave any graphic traces in Anatolian IE, it seems quite reasonable to conclude that $*H_4$ was a glottal stop [ʔ] in the PIE language. As for $*H_3$, considering that it appears to be written in Anatolian IE with some instability as *h* or \emptyset , a voiced pharyngeal [ʕ] would be the best match.

The conclusion of the present survey is therefore that: $*H_1 = [h]$, $*H_2 = [\gamma]$, $*H_3 = [\ʕ]$ and $*H_4 = [ʔ]$.

11. *About the Glottalic Theory of PIE*

Another issue that can now be tackled is the hypothesis that the so-called voiced series of PIE was in fact (pre-)glottalized. This is known as the Glottalic Theory. This approach has not succeeded in becoming the mainstream point of view. An interesting example to look at is:

- (42) **nogwós* ‘naked’ (Cf. Mallory-Adams 2006:501 **ne/ogwós*), Anatolian IE Hittite *nekumant-*: Old Indian *nagná*, Greek γυμνός (with metathesis), Hesychius λυμνός (< **νυμνός*), Lithuanian *níoga*, Latvian *nógs* [nuoʔgs], Slovene *nág*, Štokavian *nâg*, *nâga*, *nâgo*, Russian *наго́й*, *нага́*, *на́го*,

To begin with, as regards the segmental material, it is striking that Balto-Slavic words reflect a long vowel as if PIE were **nōgwós*. This phenomenon is known as Winter's Law. Now, if Proto-Slavic were **noʔgwós*, according to Hirt's Law, the glottal stop (**H₄*) should have retracted pitch as **nóʔgwos*, in addition Štokavian should be *nâg*, *nâga*, *nâgo*. In other words, Proto-Slavic cannot have been pre-glottalized. PIE (trad.) **g* does not equate **H₄g* in Slavic languages.

The case of Latvian is different as present-day Latvian involves glottalization or creakiness: [nuoʔgs] is equivalent to “PIE” **noH₄gos* only from the point of view of Latvian. It must be emphasized that the falling tone of Lithuanian cannot originate in glottalic features and that *níoga* continues *[nohgo], a kind of preaspirated stop, which is equivalent to “PIE” **noH_{1/2}gó* from the point of view of Lithuanian. Latvian provides a direct testimony that the so-called voiced series involves glottalization but, if PIE **g* was glottalized then it must have been [kʔ], and this phoneme has three different reflexes in Balto-Slavic: Proto-Slavic was *[gʔ], which triggered vocalic length in the preceding syllable but did not equate inherited clusters like *[Hg], Proto-Lithuanian was [hg] or [h̥g], equating all inherited clusters *[Hg], Proto-Latvian was [ʔg], equating all inherited clusters *[Hg]. Balto-Slavic therefore provides support for postglottalized phonemes as the original pronunciation of the so-called voiced series. It can be noted that Winter's Law is not a sound change that might have affected Proto-Balto-Slavic but a pattern of phonetic correspondences between present-day languages.

And as a final word my conclusion is that Balto-Slavic tonogenetic processes can only be dealt with adequately when each language is examined separately. From that point of view, Yeniseian is a very interesting example with a partially segmental and partially tonal phonology. It is quite possible that Proto-Balto-Slavic began to acquire some tonal features but the final crystalization of tones with complete loss of laryngeals arose in each language independently.

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