

*Indo-European Linguistics in the 21st Century (5)***Reconstructing the Triple Representation of Schwa with a single laryngeal PIE *h ≈ *h₂**

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ABSTRACT: The paradigm crisis in IE linguistics, resulting from the incapability of monolaryngealism (Szemerényi) and trilaryngealism (Eichner et alii) to reconstruct *h₍₂₎ except on the basis of Hitt. ḫ, was preliminarily solved in Pyysalo 2013, 2019, where its cause, de Saussure’s and Møller’s defective ablaut *Ae : *A : *eA, was corrected by adding the long quantity PIE *ē, yielding a pattern

*Aē : *Ae : *A : *eA : *ēA (where *A = Neogr. *ə = PIE *a).

The paper at hand defines the sufficient condition for ending the crisis, viz. presenting the critical solutions to all main problems of the (P)IE vowel system in connection to PIE *h = Hitt. ḫ, including the explanation for the correlation between PIE *h and the (IE) ‘a-vocalism’ (Neogr. *ə a ā), the reconstruction of the triple representation of schwa in Greek with a single PIE *h, the solution to BRUGMANN’s law, and the description of the maximal PIE ablaut in connection with PIE *h.

1. Introduction: The elimination of Neogr. *a and *ā from PIE

1.1 At its zenith the Neogrammarian vowel system, the main architects of which were Karl Brugmann and Hermann Osthoff, consisted of eight cover symbols:

Neogr. *a *e *o *ā *ā *ē *ō *ə (Grundr.² 1: 1-178).

After the emergence of the laryngeal theory (LT) of Hermann Møller and the new Hittite (and Anatolian) languages, including the new phoneme Hitt. ḫ, the Neogrammarian system was temporarily sidelined due to the new competition for the solution of the (P)IE laryngeal and vowel problem.¹ This led IE linguistics into complex changes of fortune during the 20th century that by the 1970s had left only two models, the monolaryngealism of Szemerényi and the trilaryngealism of Eichner (see Pyysalo & Janhunen 2018a and Pyysalo 2019), to compete for the solution.

1.2 By now the paradigm crisis of IE linguistics that began in the 1970s has ground the only two widely recognized theories to a halt, as neither Eichner’s nor Szemerényi’s theory is able to unambiguously postulate the centre of gravity of the PIE reconstruction, PIE *h (= *h₂), based on its numerically most important criterion, the IE a-vocalism (Pyysalo 2019).²

1.3 The reason of the failure and the subsequent splintering of the LT into numerous sub-varieties³ is the common assumption of PIE *a (and *ā) independently of PIE *h₍₂₎.

¹ This situation is still essentially unchanged – since the revisionist LT models that have appeared after Eichner are either weaker (Melchert-Rix) or dysfunctional (Kortlandt) – apart from the fact that Szemerényi’s early theory has recently been fully revised and formulated as the glottal fricative theory in Pyysalo 2013 and digitized in PIE Lexicon at <http://pielexicon.hum.helsinki.fi>.

² Compare Kuhn’s diagnosis (1970: 83): “(...) the rules of normal science become increasingly blurred. Though there still is a paradigm, few practitioners prove to be entirely agreed about what it is. Even formerly standard solutions of solved problems are called in question.”

³ For the emergence of multiple incompatible sub-models as a sign of crisis, see Kuhn (1970: 70-1): “(...) in the early 1770’s, there were almost as many versions of the phlogiston theory as there were pneumatic chemists. That proliferation of versions of a theory is a very usual symptom of crisis. In his preface, Copernicus complained of it as well.” and (1970: 72): “Increasingly, the research it guided

The ultimate reason for this assumption was, in turn, de Saussure's and Møller's incomplete formulation of ablaut DSM *Ae : *A : *eA that did not fully account for Neogr. *a. This enabled Szemerényi to assume the vowel *a independently of PIE *h₍₂₎, and to formulate criticism (1970) that in turn forced Eichner to make the same the assumption, incapacitating both models and thus IE linguistics itself (see Pyysalo 2019).⁴

1.4 In a first step to restore the reconstructive capability of the field, the pattern DSM *Ae : A : eA was replaced with its complete form in Pyysalo 2019, i.e. including PIE *ē and the phonetic interpretation of DS *A = Neogr. *ə = PIE *a as indicated below

$$\text{DSM+ } *A\bar{e} : *Ae : *A : *eA : *ēA = \text{PIE } *a\bar{e} : *ae : *a : *ea : *ēa$$

The article at hand continues directly from this by detailing the reconstructive solutions sufficient to end the crisis.

1.5 Despite the fall of mono- and trilaringeal models, i.e. systems of hypotheses,⁵ both contain correct individual hypotheses that can be extracted and to which other provable statements presented during the research history can be added. As a result a consistent synthesis of the proto-vowel system and PIE *h, equaling the sufficient condition for ending the paradigm crisis in IE linguistics, will be formulated in this paper. This system, the glottal fricative theory (GFT), initially presented in Pyysalo 2013, solves all most challenging reconstructive problems, including the correlation between the IE 'a-vocalism' and PIE *h, the triple representation of schwa, Brugmann's law, and the maximal PIE ablaut in connection to PIE *h.

2. On the historical interpretation and the properties of Hitt. ḫ and PIE *h

2.1 A single PIE 'laryngeal' reflecting Hitt. ḫ is reconstructed in all versions of monolaryngealism from Zgusta (1951) to Calin (2018) and from Szemerényi (1970: 131) to Pyysalo (2013). Similarly, in Eichner's theory, the most advanced LT proposed,⁶ only one laryngeal *h₂ reflects Hitt. ḫ.⁷

2.1.1 The difference between monolaryngealism and (Eichner's) trilaringealism is that the latter postulates Pre-(Proto)-Indo-European laryngeals based on Møller's Proto-Indo-Semitic root hypothesis CC·C whether attested in the IE material (*h₂) or not (ḫ₁ ḫ₃), a practice followed in the LT ever since Møller. Monolaryngealism, pursuing an empirical path, denies the justification of postulating phonemes that have not left

resembled that conducted under the competing schools of the pre-paradigm period, another typical effect of the crisis."

⁴ Cf. Kuhn (1970: 84): "All crises begin with the blurring of a paradigm and the consequent loosening of the rules for normal research. In this respect research during crisis very much resembles research during the pre-paradigm period (...)."

⁵ Kuhn (1970: 92): "(...) revolutions are inaugurated by a growing sense (...) that the existing institutions have ceased adequately to meet the problems posed by an environment that they have in part created. (...) the sense of malfunction that can lead to crisis is prerequisite to revolution."

⁶ Note, however, that the optimized LT, having two laryngeals as outlined in Pyysalo & Janhunen 2019, is slightly more economical and advanced than Eichner's trilaringealism.

⁷ See Eichner (1978: 162, fn77) for the observation that all examples of Hitt. ḫ- = ḫ₃- are uncertain and can be explained with *h₂-. As a result, this model only recognizes one 'laryngeal' in Old Anatolian, exactly as monolaryngealism. In addition to *h₂, Eichner postulates ḫ₁ and ḫ₃ as non-attested (or lost) phonemes.

unambiguous, observable, and confirmed traces in the IE languages, and thus reconstructs only a single item PIE *h (\approx *h₂) = Hitt. ḫ.⁸

2.1.2 Eichner's failure to respond to Szemerényi's criticism concerning the non-binding postulation of †h₁ and †h₃ based on the Proto-Indo-Semitic root hypothesis and vowel timbre alone (see Pyysalo 2019: 5) is remedied when one notes that only a single PIE *h can be postulated based on the measurable features of the data.⁹

2.2 As regards the phonetic interpretation of the laryngeal, Szemerényi's argument implying a glottal 'spirant' (i.e. fricative) PIE *h (IPA [h]) is a safe starting point.¹⁰

2.3 Monolaryngealism holds the view that the 'colouring effect' (or causing allophony) is not a feature of PIE *h. This state of affairs is by now confirmed by several independent factors separately discussed below.

2.3.1 From the distributional point of view there have been three different historical approaches to explain the (P)IE vocalisms. The orthodox LT explained the vocalisms *only* with laryngeals, the revisionist LT with laryngeals *and* vowels, and monolaryngealism *only* with vowels:¹¹

	Laryngeal(s)	Vowels	
Orthodox LT	x	–	(Møller-Benveniste-Puhvel)
Revisionist LT	x	x	(Saussure-Kuryłowicz-Eichner)
Monolaryngealism	–	x	(Zgusta-Szemerényi-Pyysalo)

As these are also the only mathematical possibilities and both the orthodox and the revisionist LT proved to be unsuccessful (see Pyysalo & Janhunen 2018a, 2018b, 2019, and Pyysalo 2019), the IE vocalisms can only be explained on the basis of PIE vowels, i.e. without resorting to a colouring effect of the 'laryngeal(s)'.

2.3.2 In Pyysalo 2019 the following PIE values were attached to the Neogrammarian cover symbols representing the 'a-vocalism':

- (a) Neogr. *a has the values PIE *ae/ea (DSM *Ae/eA) → *aa/aa → IE a
- (b) Neogr. *Ø/ə has the values PIE *a/á (DSM *A) → IE Ø/a : i)
- (c) Neogr. *ā has the values PIE *aē/ēa (DSM -Ø-) → *aā/āa → IE ā)

⁸ For monolaryngealism's criticism of the Semitic typology underlying the LT, see Szemerényi (1967: 92-93) "there is no intrinsic reason why we should attempt to reduce all IE 'roots' to a single tri-phonemic pattern of the CVC-type [...]. On the contrary, it is clear that such notions were due to a double influence from Semitic linguistics: (a) in Semitic all words begin with a consonant; (b) in Semitic the general root-shape is tri-radical. But, of course neither feature is binding for IE." For the original formulation of the Proto-Indo-Semitic root hypothesis CC·(C), see Møller (1879: 492 and 1906: xiv).

⁹ For the actual proof of the non-existence of other laryngeals, in particular †h₁ and †h₃, see respectively §3.6.3.c and §3.8.1.g below.

¹⁰ Despite the accuracy of Szemerényi's glottal fricative interpretation, it should be noted that in theory Hitt. ḫ could represent several earlier PIE 'laryngeals' that have collided. However, the comparatively proven IE languages do not contain anything to confirm or refute this (see Pyysalo 2013: 460-1).

¹¹ The orthodox LT is defined as reconstructing only one vowel, usually PIE *e. In revisionist theories at least two (usually PIE *e and *o) or three (PIE *e a o) vowels appear. For the terminology and discussion of this distinction, see Pyysalo & Janhunen 2018a.

This demonstrates that the vowel PIE *a, not PIE *h, is the cause of ‘a-vocalism’ through assimilations of PIE *a and *e/ē and fronting of PIE *á → Lat. a, OIr. a, etc.

2.3.3 Phonetically and phonologically the strategy of monolaryngealism, i.e. explaining vowels such as IPA [a] (Lat. a etc.), IPA [i] (RV. i etc.) and IPA [a] = PIE *a as bundles of features gaining their character from their places of articulation in the oral cavity, i.e. as a phonemic phenomenon, is more natural than explaining them as allophonic variants caused by laryngeals, which are located in the larynx.

2.4 Szemerényi’s (1967) system of PIE stops contained two series of stops, SZ *k *p *t (tenues) and SZ *g *b *d (mediae). He also reconstructed the fricative PIE *h (in addition to *s). In Pyysalo (2013: 372ff.) the system of stops and PIE *h was simplified by postulating a voiced variant PIE *h̥, which in turn is the cause of the voice of PIE *g b d (mediae) as indicated by the rules:

$$*h̥-T \quad \rightarrow \quad *h̥-D \quad \quad T-h̥ \quad \rightarrow \quad D-h̥^{12}$$

As also PIE *gh̥ bh̥ dh̥ can be derived from *k+h̥ *p+h̥ *t+h̥ (Pyysalo 2013: 398ff.), PIE *h/h̥ and PIE *p k t suffice for the reconstruction of the entire PIE stop system.

2.4.1 By now the existence of the variants PIE *h/h̥ (both reflected as Hitt. ḫ) has independent confirmation in the Ugaritic script (Ra’s Šamra), where two distinct velar fricatives, voiceless Ugar. ḫ [x] and voiced Ugar. ḡ [ɣ], appear.¹³ These are used in the writing of words of certain Hittite origin (see Patri 2009 and Watson 2010), e.g. in

Hitt. aliḫḫani-	: Ugar.-Hitt. ’alḫn (Patri 2009: 97)
Hitt. ḫati-	: Ugar.-Hitt. ḫt (Patri 2009: 97)
Hitt. puduḫeba-	: Ugar.-Hitt. pdḡb (Patri 2009: 97)
Hitt. tarḫundaša-	: Ugar.-Hitt. trḡnds (Patri 2009: 97)
Hitt. tudḫaliya-	: Ugar.-Hitt. ttḡl and Ugar.-Hitt. tdḡl (Patri 2009: 97)

2.4.2 On the basis of this the values can be identified with the respective ones in PIE:

$$(\text{Ugar.-})\text{Hitt. } \mathfrak{h} = \text{PIE } *h \quad \quad (\text{Ugar.-})\text{Hitt. } \mathfrak{g} = \text{PIE } *h̥.$$

Although neither variant has been preserved as a segmental phoneme outside Old Anatolian, they can be proven to have existed as follows:

(a) The confirmation for Hitt. ḫ = PIE *h was already presented by Szemerényi (1967), who noted that PIE *h is to be interpreted as a glottal spirant (i.e. fricative) IPA [h] due to its co-occurrence in the aspirated stop series PIE *Th = T+h, where PIE *h = Ugar.-Hitt. ḫ.

¹² The shapes *h̥—T and *T—h̥ stand for any roots containing a single voiceless unaspirated stop and voiced *h̥ (e.g. *ḫat- *ḫark-, or *ḫaḱr-).

¹³ The articles of Patri (2009) and Watson (2010) were regrettably not yet known by me when writing Pyysalo 2013, due to which the proof of the existence of a voiced variant PIE *h̥ leaned only on a single example. The broader data provided independently by Patri and Watson now confirm the fundamental conjecture of Pyysalo 2013, viz. the existence of the variants PIE *h/h̥.

(b) The confirmation for Hitt. \acute{g} = PIE * \acute{h} is obtained once we note that Szemerényi's (1967) series SZ *Dh actually does not stand for D+h – because *h is impossible following a voiced phoneme – but for PIE *D \acute{h} = D+h, thus containing the voiced glottal fricative PIE * \acute{h} = Hitt. \acute{g} (Pyysalo 2013: 398ff.).¹⁴

2.4.3 The capability of PIE * \acute{h} (Ugar.-Hitt. \acute{g}) to transfer its voicing to surrounding stops, allowing us to reduce the voicing of the stops to the glottal fricative, is possibly reflected in the royal name Hitt. tud- \acute{h} alia- (^mc.) ‘Tudhalia’ (glossed with Akk. šar kiššati ‘king of the earth/land’, NOMS. 1389.2, du/tu-ud- \acute{h} a-li-ia-). In Ugaritic two alternative spellings reveal a voiceless Ugar.-Hitt. tut- and a voiced Ugar.-Hitt. tud- before Hitt. \acute{g} al- as indicated in the pair

Ugar.-Hitt. tt \acute{g} l : Ugar.-Hitt. td \acute{g} l

This could be interpreted as implying that the voiced glottal fricative could transfer its voice to an adjacent voiceless stop just as happened in PIE and in the prehistory of other IE languages, although additional examples from Old Anatolian is required for confirmation.

2.4.4 In some examples of Hitt. \acute{h} the hitherto unexplained alternation of voiceless and voiced stops implied by Sturtevant's law can be explained by the alternation of PIE *h/ \acute{h} , for instance in the doublets (IEW 223-6) below:

PIE *toah-

Gr. τό- (pr.) ‘geben’ (Grundr² 1: 654, τότω ‘dato’)

Hitt. iški-tah- (vb.2.) ‘ein Zeichen geben’(HHand. 65, iš-kit₉-ta-a \acute{h} - \acute{h} i)

PIE *dōa \acute{h} -

Gr. δώ- (ao.) ‘geben’ (GEW 1: 388-9, ἔδων [1sg])

Hitt. iški-dā \acute{h} - (vb.2.) ‘give a sign’ (HED 2: 426, iš-ki-da-a-a \acute{h} - \acute{h} i)¹⁵

2.4.5 Due the identity of meaning, form, and etymology the voiceless and voiced variants PIE *h/ \acute{h} contained in doublets like PIE *toah- *dōa \acute{h} - ‘geben’ represent a single phoneme, referred to below with the cover symbol PIE * \acute{h} = PIE *h/ \acute{h} .¹⁶ An example of this alternation is provided by two etymologically related root variants displaying the alternation T/D:

PIE *uVha \acute{k} -

*uēha \acute{k} - OIr. fích- (pf.) ‘fight’ (LP 364, fích [3sg])

*uoha \acute{k} - OHG. weha- (vb.) ‘moliri: kämpfen, sich abmühen’ (Gl. 765)

PIE *uV \acute{h} a \acute{g} -

¹⁴ The existence of a Hitt. \acute{g} = PIE * \acute{h} occurring independently of the presence of stops implies that this phoneme caused the voicing of the stops and not vice versa.

¹⁵ The first part of the compound, Hitt. iški- with an initial dummy vowel, is a zero grade of the respective *o-grade in Hitt. šagai- šagei- ‘Zeichen’ (for these, see HEG S: 714ff.).

¹⁶ This alternation of voice, already recognized by Brugmann (Grundr² 1: 629-632), recurs in hundreds, if not thousands, of etymologically connected correspondence sets.

- *uēfiag- Latv. vēžē- (vb.refl.) ‘zum Schlag ausholen’ (LiEtWb. 1235)
 *uofiaġ- RV. vāja- (m.) ‘Kampf’ (WbRV. 1250)

2.4.6 The real significance of PIE **h* lies in the fact that the voice of the PIE stops provides a new criterion for the postulation of PIE **h* and allows the comparison of multiple related roots with alternation of voiceless and voiced stops T/D explained by the underlying PIE **h*/*h* and thus revealing a single PIE starting point **h*. This criterion is so widespread that only the IE ‘a-colouring’ and Hitt. *h* itself can be numerically compared with it, a state of affairs considerably reducing the negative effect of the loss of PIE **h*.¹⁷

3. The connection between Hitt. *h* and the IE ‘a-vocalism’ and their PIE origin

3.1 The single most important result of IE linguistics in the 20th century was the establishment of the connection between de Saussure’s and Møller’s **A* and Hitt. *h*, which was soon to be independently confirmed by numerous comparative linguists.

3.1.1 After the collapse of the orthodox LT, explaining the ‘a-vocalism’ exclusively with **h*₂, the revisionist LT assumed the vowels **a* (and **ā*) independently of PIE **h*₍₂₎, like the monolaryngealists Zgusta and Szemerényi had done earlier.

3.2 However, there had been a price to pay for Zgusta and Szemerényi: after denying the correlation between the ‘a-vocalism’ and Hitt. *h* they were no longer able to offer criteria for the postulation of PIE **h* apart from Hitt. *h* itself (see Pyysalo 2019). The criterion offered by Hitt. *h* is, however, far less common in the material than the IE ‘a-vocalism’. Even more importantly, the IE ‘a-vocalism’ is indispensable in facilitating the systematic comparison and etymology between Old Anatolian and the rest of the IE languages. Due to this defect alone Szemerényi’s early theory never stood a chance to solve the fundamental problem of the PIE vowel and laryngeal system in the first place.

3.3. In his response Eichner adopted Szemerényi’s vowel system and as a part of it the assumption of **a* and **ā* independently of **h*₂. This led his revised LT and its variants such as Melchert-Rix in LIV² into an impasse closely resembling that in which monolaryngealism had already found itself: While Szemerényi’s system does not offer a criterion for distinguishing between SZ **ha* : **a* : **ah* apart from directly attested Hitt. *h*, Eichner’s model is likewise unable to distinguish LT **h*₂*e* from **h*₁*a* and LT **eh*₂ from **ah*₁ (Pyysalo 2019) and both from independent **a* (without a laryngeal). Thus Eichner dealt a mortal blow not only to his own revisionist model, but to the laryngeal theory as a whole with Szemerényi’s tools.

3.4 For this reason the inability of monolaryngealism (Szemerényi) and trilaryngealism (Eichner), the only two remaining theories, to reconstruct **h*₍₂₎ based on the criterion of the IE ‘a-vocalism’ is the heart of the paradigm crisis of IE linguistics: reconstructing the most recently confirmed phoneme in the PIE inventory, revealing its features, and establishing it in the IE etymology should be the priority of any IE theory – which is precisely what neither model succeeds in doing.

¹⁷ As the voiced glottal fricative PIE **h* is intimately related to the stop system, where its voice is reflected, this variant of PIE **h* will be discussed in a separate article, the next of the series at hand (see Pyysalo 2013: 356ff. for the original analysis and discussion).

3.4.1 In essence, solving this problem requires an explanation of the correlation between the IE ‘a-vocalism’ and Hitt. *ḫ* supported by the data *and* a theory that solves the related phonetic, phonological, and comparative problems in the material. A preliminary solution was offered in the previous paper (Pyysalo 2019), in which it was shown how the core of the problem is caused by the very first two vowels of the inventory postulated by August Schleicher, Paleogrammarian *a *ā, reflecting the early Sanskrito-centric system having no *e *ē *o *ō at all. After Brugmann and Osthoff split Paleogr. *a (and *ā) into three distinct vowels *e o a (and *ē *ō *ā) they, however, accepted the reconstruction of *a *ā (allegedly continued by Lat. a ā) without critical evaluation. These postulates were never contested or tested before de Saussure, although testing was in fact necessary: Paleogr. *a *ā are the earliest items in the vowel inventory, thus potentially outdated by the more advanced proposal of de Saussure and Møller, *Ae : *A : *eA. That this is indeed the case can now be seen from the real existence of the three-term ablaut PIE *ē : *e : Ø e.g. in the root *ueǵh- ‘bewegen, ziehen, fahren’ (IEW 1118-20):

RV. ní (...) uh-	(ao.M.) ‘zuführen’ (WbRV. 1243, ní (...) uhīta [3sg])
Lat. ueho-	(vb.) ‘fahren, führen, tragen, bringen’ (WH 2: 742)
Lat. uēx-	(pf.) ‘idem’ (WH 2: 742, uēxī) ¹⁸

When the correct ablaut pattern PIE *ē : *e : Ø is used in the analysis of the IE ‘a-vocalism’, Paleogr. *a *ā can be disposed of by replacing the incomplete ablaut DSM *Ae : *A : *eA with its complete shape including PIE *ē as follows:

$$\text{DSM}^+ *A\bar{e} : *Ae : *A : *eA : *e\bar{A} \quad (\text{Pyysalo 2019 §4.4.4})^{19}$$

This ablaut pattern allows a segmental analysis of Paleogr. *a *ā, the reconstruction of which as independent phonemes is consequently no longer needed.

3.4.2 When we substitute *A with its real value PIE *a = IPA [a], the schema PIE *aē : *ae : *a : *ea : *ēa is obtained. By eliminating the accidental ablaut (PIE *ē *e *Ø *e *ē) from the pattern, the problem of the correlation between the IE ‘a-vocalism’ and Hitt. *ḫ* is simplified into the following question: *What is the relation between PIE *ḫ and PIE *a (= *A) causing these phonemes to appear together?*

3.5 The answer to the question of the relation between PIE *ḫ and PIE *a is, in turn, determined by the properties of the successor function. For any two mutually connected phonemes *x* and *y* only two relations are possible: Either *x* precedes *y* (relation *xy*) or *y* precedes *x* (relation *yx*). When the values *x* = PIE *ḫ and *y* = PIE *a are substituted, the relation between PIE *ḫ and PIE *a is shown to be one in which they appear the in pairs PIE *ḫa and PIE *aḫ.

3.5.1 The correlation between DS *A (PIE *a) and Hitt. *ḫ* (PIE *ḫ) can thus be explained without assuming the identity of DS *A and Hitt. *ḫ* by the fact that the two phonemes always stood in (diphomemic) pairs PIE *ḫa and PIE *aḫ.²⁰ With this observation the correlation of the classical (orthodox) LT between Hitt. *ḫ* and *h₂ (*A), dismissed by

¹⁸ For the confirmation of the existence of the long PIE *ē, see Lat. uēxī : RV. ávāt : OCS. věšŭ.

¹⁹ Here DSM⁺ *A ↔ Neogr. *ə, DSM⁺ *Ae, *eA → Neogr. *a, and DSM⁺ *Aē, *eA → Neogr. *ā.

²⁰ There are many alternative ways to formulate this argument, all leading to the reconstructive necessity of postulating PIE *ḫa *aḫ (for the original approach, see Pyysalo 2013: 92ff.).

Szemerényi and lost by Eichner, has been re-established: PIE *a always implies PIE *h (Hitt. h) and PIE *h always implies PIE *a.

3.5.2 As this restores the capability of the field to reconstruct PIE *h based on the ‘a-vocalism’ (and vice versa), it should be noted that an early version of the diphonemic hypothesis was suggested already by Karl Oštir (1913: 167), who was the first to propose that *H was accompanied by a *schwa secundum* *ɸ in diphonemic *ɸH and *Hɸ. He was soon followed in this by Jerzy Kuryłowicz (1935: 29 & fn2, 55f.) and Edgar Sturtevant (1941: 184), who understood the impossibility of a laryngeal being vocalized.²¹ Although Oštir’s early formulation is unacceptable due to the comparatively ill-defined item †ɸ,²² this problem can be eliminated if †ɸ is replaced with the provable vowel PIE *a (Neogr. *ə = DS *A), yielding PIE *hɑ *ah.²³

3.5.3 The diphonemic pairs PIE *hɑ *ah are in full agreement with the features attached to the laryngeal *h₂ apart from its phonetic interpretation IPA [h] vs. [x]:²⁴

(a) PIE *hɑ and PIE *ah respectively cause progressive and regressive assimilation of adjacent *e or *ē, thus accounting for the allophony (or colouring effect) of LT *_aX_a. They also explain the lack of colouring effect on PIE *e and *ē adjacent to PIE *h through the following equations after the successive losses of PIE *a and PIE *h:

$$\begin{array}{ll} \text{PIE } *e_h\alpha \rightarrow \text{Hitt. } e_h, \text{ Lat. } e & (\text{and}) & \text{PIE } *a_h e \rightarrow \text{Hitt. } h_e, \text{ Lat. } e. \\ \text{PIE } *ē_h\alpha \rightarrow \text{Hitt. } ē_h, \text{ Lat. } ē & (\text{and}) & \text{PIE } *a_h ē \rightarrow \text{Hitt. } h_ē, \text{ Lat. } ē. \end{array}$$

(b) PIE *hɑ and *ah explain the syllabicity directly based on the vowel PIE *a (Neogr. *ə) without the inconsistent assumption of a syllabic obstruent *ɣ.

(c) Distinguishing between originally accented PIE *h_á/áh and unaccented PIE *h_ɑ/ah allows us to reconstruct the hitherto unexplained difference between the preserved and lost vocalic reflexes of Neogr. *ə.²⁵

(d) In sum, the laryngeal LT *h₂ is manifestly overloaded with features, and

- 1) Is too strong in its universal colouring effect $eh_2e \rightarrow ah_2a$.²⁶
- 2) Requires an impossible assumption of a vocalic obstruent †ɣ.
- 3) Does not explain the distinction between the continued and lost reflexes of ‘schwa’.

Due to these problems

²¹ A similar suggestion based on an anaptyctic vowel instead of a *schwa secundum* has been discussed by Tischler (1981: 322).

²² For the impossibility of defining *schwa secundum* †ɸ, see Pyysalo (2013: 194f.). In short, it is possible to reconstruct all alleged instances of †ɸ with the vowels *e *o *a *i *u, making the postulate ill-defined.

²³ Since both PIE *h (= Hitt. h : RV. ’) and PIE *a (= Lat. a : OInd. i) are comparatively well-defined items, their combination in diphonemic pairs PIE *hɑ and PIE *ah is also comparatively feasible.

²⁴ The mainstream phonetic interpretation of ‘*h₂’ is IPA [x] (based on the interpretation of Sumerian h as IPA [x]), regardless of the possibility that IPA [h] is equally possible, since the phonetic interpretation of Sumerian h in turn depends on Semitic, in turn in possession of multiple laryngeals.

²⁵ The opposition PIE *á vs. *a can hardly be formulated in the framework of the LT, since this would require a consonant to carry an accent *_aǰ_a.

²⁶ Note that Lex Eichner does not solve the problem, because PIE *e is often required alongside ‘*h₂’ as e.g. in Hitt. ḫašteli- (c.) ‘Held’ (HEG H: 203-4) : Gr. ἐσθλό- (a.) ‘tüchtig, brav, edel’ (GEW 1: 574).

- 1) No single phoneme having all these features can exist.
- 2) The cluster of properties should rather be split into a ‘laryngeal’ and an ‘a-coloured’ vowel that can appear in the pairs PIE *ḥa and *aḥ.²⁷

3.5.4 The ultimate proof of the diphonemic hypothesis will result from the compilation of a representative IE etymological dictionary in which it is inductively demonstrated that either of the values PIE *ḥa or *aḥ is consistently compatible with the data of every correspondence indicating PIE *ḥ or *a. Although such a demonstration lies beyond the scope of this article, it should be readily noted that proof for individual tokens of PIE *ḥa or *aḥ is already available in examples such as those quoted below:

(a) The four-syllabic scansion required by RV. párijmā in RV. 1.122.3²⁸ necessitates *both* a hiatus (implying PIE *h) *and* an additional syllable (implying PIE *a), i.e. PIE *ḥa, hence an extra (fourth) syllable in PIE *peri·ḥaǵmē.²⁹

(b) PIE *há is confirmed in RV. sómam [sgA], requiring a three-syllabic scansion CV’V:CV, i.e. /sá’úma-/ in RV. 4.26.7 (WbRV. 1579).³⁰ In order to account for the hiatus, PIE *h has to be postulated, and to explain the quantity of ú, PIE *á has to be reconstructed: PIE *soháumo- → *sohúumo- → *sahúma- → RV. sa’úma-.³¹

(c) The correspondence Lat. callo- = OInd. kiṇa- (Neogr. *kəlno-) contains PIE *á. PIE *á is confirmed by the identity Lat. a = OInd. i (non-palatalizing) and PIE *h by the revised Fortunatov’s law³² (see Pyysalo 2013 §3.3.2), according to which the environments resulting in a cerebral in Sanskrit were the following:

$$*VHLT \rightarrow V+t/\text{th}/d/\text{dh}/\eta/\text{ṣ} \quad (\text{and}) \quad *VLHT \rightarrow V+t/\text{th}/d/\text{dh}/\eta/\text{ṣ}.^{33}$$

3.5.5 The existence of numerous similar examples, necessitating the simultaneous presence of both components of PIE *ḥa or PIE *aḥ, means that the diphonemic pairs are not only a hypothesis, but a *sine qua non* in the reconstruction: no IE theory can cover the above (and similar) examples and be complete (and thus valid) unless it contains the morphophonological rule of diphonemic pairs.

²⁷ In terms of definitions, in addition to the three recognized classes of phonemes, viz. V (vowel (only)), R (+vocalic or +consonantal), and C (obstruent (only)), the existence of a fourth class of entities, D(iphonemes), consisting of a vowel (V) and a consonant (C) or a consonant (C) and a vowel (V) in diphonemic pairs VC and CV, is therefore possible, and is actually the only possibility that can meaningfully explain the required features of the cover symbol LT *x = *_ax_a : a_xa : a_xa. De SAUSSURE defined *A as a ‘coefficient sonantique’, a phoneme functioning as either a vowel or a consonant, but based on the features PIE *ḥa and *aḥ, the underlying item is *both* a vowel *and* a consonant: the syllabic and assimilatory features originate in PIE *a and the consonantal features in PIE *h.

²⁸ Grassmann’s scansion PIIr. †parijamā is both impossible (PIIr. *a cannot be lost) and outdated due to the availability of PIE *á in the reconstruction.

²⁹ Should only an additional syllabic element, *ə, be reconstructed, this would force the preceding RV. i to turn into y, thus resulting in a three-syllabic scansion: †páryəjmā → †paryjmā → RV. †párijmā instead of four syllables required by the metre.

³⁰ The hiatus (marked with ’) in sá’úma- matches the ‘laryngeal’ without ‘a-colouring’ in Hitt. šeḥur-(n.) ‘Urin, Schmutz’ (HEG 2: 973-7, še-e-ḥur [sgNA]).

³¹ For the revised version of HIRT’s ‘schwa assimilation’ PIE *uHá- → *uHú- → uú- → ú, see Pyysalo (2013: 209f.).

³² The sign ‘+’ denotes a revised sound law revised in PYYSALO 2013, covering the originally described phenomenon but reformulated with a revised condition.

³³ For a digitally proven example, compare e.g. AV. ā-ghāṭá- (EWA 1: 159) and TochA. kálta·ńk- (Poucha 61) in PIE Lexicon (<http://pielexicon.hum.helsinki.fi>) with translations and derivation.

3.5.6 The connection between PIE *h and PIE *a (DS *A) consists in *the phonemes always appearing together in the diphonemic pairs* PIE *h₁a *ah₁. This can become the cornerstone for formulating the sufficient condition for ending the paradigm crisis as its ramifications also solve the fundamental problems of the PIE vowel/laryngeal system.³⁴

3.6 When the pairs PIE *h₁a and PIE *ah₁ are substituted for *A in the schema expressing the complete form of the ablaut LT *Ae : A : eA (see Pyysalo 2019), i.e. DSM+ *Aē : *Ae : *A : *eA : *ēA, we first obtain:

$$\text{PIE}(*h_1a) = *h_1a\bar{e} : *h_1ae : *h_1a/h_1\acute{a} : *eh_1a : *ēh_1a \quad (1a)^{35}$$

$$\text{PIE}(*ah_1) = *ah_1\bar{e} : *ah_1e : *ah_1/\acute{a}h_1 : *eah_1 : *ēah_1 \quad (1b)^{36}$$

The ‘colouring rules’ (i.e. assimilations), applied both to *e and *ē, first yield:

$$\text{PIE}+(*h_1a) = *h_1a\bar{a} : *h_1aa : *h_1a/h_1\acute{a} : *eh_1a : *ēh_1a \quad (2a)$$

$$\text{PIE}+(*ah_1) = *ah_1\bar{e} : *ah_1e : *ah_1/\acute{a}h_1 : *aah_1 : *āah_1 \quad (2b)$$

Then, following the loss of (unaccented) GFT *a = DS *A the formulas result in:

$$\text{PIE}++(*h_1a) = *h_1\bar{a} : *h_1a : *h_1/h_1\acute{a} : *eh_1 : *ēh_1 \quad (3a)$$

$$\text{PIE}++(*ah_1) = *h_1\bar{e} : *h_1e : *h_1/\acute{a}h_1 : *ah_1 : *āh_1 \quad (3b)$$

3.6.1 The outcomes (3a) and (3b) match the Hittite reflexes as such:

$$\text{Hitt.}(*h_1a) = \text{Hitt. } h_1\bar{a} : h_1a : h_1/h_1\acute{a} : eh_1 : \bar{e}h_1 \quad (4a)$$

$$\text{Hitt.}(*ah_1) = \text{Hitt. } h_1\bar{e} : h_1e : h_1/\acute{a}h_1 : ah_1 : \bar{a}h_1 \quad (4b)$$

The absence of the ‘colouring effect’ is accounted for for both long and short vowels in Hitt. eh₁ : ēh₁ and Hitt. h₁ē : h₁e, thus closing the gap left by Lex Eichner.³⁷

3.6.2 In the rest of the group the loss of PIE *h₁ results in the schemata:

$$\text{IE}(*h_1a) = *a : *a : a/i/\emptyset : *e : *e \quad (5a)$$

$$\text{IE}(*ah_1) = *e : *e : a/i/\emptyset : *a : *a \quad (5b)$$

As (5a) and (5b) are identical except for the reversed order of the terms, they collide into a single pattern in all IE languages except for Old Anatolian:

$$\text{IE}(*h_1a/ah_1) = *e : *e : *a/i/\emptyset : *a : *a \quad (6)$$

³⁴ For the sake of illustration, both the vowel (Neogr. *pater-) and the consonant (LT *ph₂ter-) are reconstructed for the famous word for ‘father’ in PIE *pa₂ter- (Pyysalo 2013: 89-97 & 459-464), as if in a combination of both classical reconstructions, i.e. “pəh₂ter”.

³⁵ For the examples, also including the ablaut PIE *o/ō, see §3.8.2.

³⁶ For the examples, also including the ablaut PIE *o/ō, see §3.8.1.

³⁷ Compare Kuhn’s (1970: 68) observation: “(...) that astronomy’s complexity was increasing far more rapidly than its accuracy and that a discrepancy corrected in one place was likely to show up in another.” As an example of this, assuming Lex Eichner makes all instances of *eh₁ and *ēh₁ not directly confirmed by OAnat. h₁ ambiguous as *ēh₂ is equally possible.

3.6.3 The relations of the terms of the formula (6), i.e. \bar{e} (6.1), e (6.2), $a/i/\emptyset$ (6.3), a (6.4), and \bar{a} (6.5), represent critical ablaut patterns here exemplified by the root Neogr. *dhē- ‘put’:

(a) The alternation IE $\bar{e} : e$ (Lat. *fēci : faciō*), or the relation 6.1 : 6.3, represents the pattern Neogr. * $\bar{e} : *ə$ (LT * $eh_1 : *h_1$) standing for PIE * $\bar{e}h_a : *h_a(e)$.

(b) The alternation IE $\bar{e} : e$ (Gr. *τίθημι : θετός*), or the relation 6.1 : 6.2, was falsely explained as having analogical Gr. ε for $\alpha \leftarrow *ə$ by the Neogrammarians. Also erroneously, Møller posited LT * $eh_1 : *h_1$ for underlying PIE * $\bar{e}h_a : *eh_a \rightarrow *eh : *eh \rightarrow$ Gr. $\eta : \varepsilon$.

(c) The comparison of two distinct ablaut relations above, Lat. $\bar{e} : a$ (*fēci : faciō*) and Gr. $\eta : \varepsilon$ (*τίθημι : θετός*), reveals the common mistake of the Neogrammarians and the LT to be the assumption of a single two-termed pattern (Neogr. * $\bar{e} : *ə$ or LT * $eh_1 : *h_1$), whereas both patterns are in fact subsets of a single pattern with *six distinct correspondence sets* on the IE level, $\bar{e} : e : a/i/\emptyset : a : \bar{a}$, which in turn reflect the original pattern

$$\text{PIE}(*h_a) = \quad *h_a\bar{e} : *h_ae : *h_á/h_a : *eh_a : *eh_a \quad (1a)$$

The first term (* h_1) of the ‘triple representation of schwa’ in Greek has thus been explained with a single ‘laryngeal’ PIE * h , and furthermore it is provable that Gr. $\eta : \varepsilon \neq$ Lat. $\bar{e} : a$. In other words the laryngeal $^{\dagger}h_1$ was erroneously defined by Møller on the basis of a false identification of Gr. $\varepsilon \neq$ Lat. a , making it void.

3.6.4 The impact on later research of the Neogrammarians’ and the LT’s (i.e. de Saussure’s and Møller’s) adoption of the two-term ablaut patterns instead of the correct five-term one can be summarized as follows:

(a) Early monolaryngealism, the heir of the Neogrammarians, failed, because Zgusta and Szemerényi did not consider and refine de Saussure’s idea of *A (SZ * $ə$) as the common denominator of the IE ‘a-vocalism’, but instead reverted to the two-term ablaut schema Neogr. * $\bar{a} : *ə$.³⁸ As a result their incomplete ablaut patterns succeeded in explaining the absence of ‘a-colouring’ in Hitt. *he, eh*, but not the correlation between Hitt. *h* and the IE ‘a-vocalism’, not to mention the full PIE ablaut in connection with PIE * h .

(b) The LT continued to use Møller’s methodology, which algebraically transforms the Neogrammarian vowels into ‘laryngeals’, and three two-term ablaut schemata not unlike that of the Neogrammarians. When Eichner amalgamated Szemerényi’s vowel system onto the chassis of Møller’s trilaryngealism, two mutually contradictory explanations, LT * h_2e vs. * h_1a and LT * eh_2 vs. * ah_1 , rendered also his revisionist LT thoroughly ambiguous and incapable of reconstructing PIE * $h_{(2)}$, just as had happened to Szemerényi some years earlier.

3.6.5 The absence of the ‘a-colouring’ in Hitt. *he, eh* is solved by diphenemic pairs PIE * $h_a/*ah$ in environments PIE * e and * \bar{e} in a manner indicated in the schwebeablaut matrix below:

³⁸ For Szemerényi’s discussion of Neogr. * $ə$, see 1996: 40-41 (§4.1.11).

I	II	III	IV
PIE * $\text{h}ae$	→ $\text{h}aa$	→ $\text{h}a$	→ Hitt. $\text{h}a$, Lat. a , etc. ³⁹
PIE * $\text{h}a\bar{e}$	→ $\text{h}a\bar{a}$	→ $\text{h}\bar{a}$	→ Hitt. $\text{h}\bar{a}$, Lat. \bar{a} , etc. ⁴⁰
PIE * eah	→ aah	→ ah	→ Hitt. ah , Lat. a , etc. ⁴¹
PIE * $\bar{e}ah$	→ $\bar{a}ah$	→ $\bar{a}h$	→ Hitt. $\bar{a}h$, Lat. \bar{a} , etc. ⁴²
PIE * $e\text{h}a$		→ $e\text{h}$	→ Hitt. $e\text{h}$, Lat. e , etc. ⁴³
PIE * $\bar{e}\text{h}a$		→ $\bar{e}\text{h}$	→ Hitt. $\bar{e}\text{h}$, Lat. \bar{e} , etc. ⁴⁴
PIE * $a\text{h}e$		→ he	→ Hitt. he , Lat. e , etc. ⁴⁵
PIE * $a\text{h}\bar{e}$		→ $h\bar{e}$	→ Hitt. $h\bar{e}$, Lat. \bar{e} , etc.

Once the assimilations II have taken place, the ‘ a -loss’ rule III, the counterpart of the * A -loss of de Saussure and Møller, follows, finally leaving the vowels IE e/\bar{e} originally adjacent to PIE * h unaffected by colouring in IV. The problem of the overstated colouring rules of the LT can thus be solved by means of a single PIE * h more effectively than by Lex Eichner, since both environments PIE * e and * \bar{e} in which the phenomenon actually occurs are included.

3.7 After the ‘ e -vocalism’ in connection to PIE * $\text{h}a$ * $a\text{h}$, the next target is the ‘ o -vocalism’ (Neogr. * \bar{a} * o * \bar{o}) and its relation to PIE * h , especially with regard to the disputed Brugmann’s law and the related ablaut problems and patterns.

3.7.1 Brugmann (1876: 363ff.) reconstructed Neogr. * o as the basic o -quality vowel of his system, characterized by him as being ‘half-long’ (1879: 2ff.) and standing in ablaut * e : \emptyset : * o (1876: 367).⁴⁶ Brugmann’s term ‘half-long’ is readily understandable on the basis of his well-known examples (Grundr² 1: 138-146, 168):

Gr. γόνυ : RV. $\acute{j}anu$ (WbRV. 483)

³⁹ For PIE * $\text{h}ae$, see PIE $\sqrt{\text{shaeu-}}$ in Illyr. sauo- (m.) ‘Flußname’ (IEW. 912-3, Illyr. sauus [sgN]) : OGaul. $\text{sau}\bar{a}$ - (f.) ‘Flußname’ (saua [sgN]).

⁴⁰ For PIE * $\text{h}a\bar{e}$, see PIE $\sqrt{\text{haes-}}$ in Hitt. $\text{h}\bar{a}\text{ša-}$ (c.) ‘Feuerstelle’ (HEG 1: 196, $\text{h}\bar{a}$ - $\text{a}\bar{\text{š}}$ - ša - $\text{a}\bar{\text{š}}$ [sgN]) : OLat. $\bar{a}\bar{s}\bar{a}$ - (f.) ‘Aufbau zum Opfern, Altar’ (WH 1: 61, $\bar{a}\bar{s}\bar{a}$).

⁴¹ For PIE * eah , see OPers. paya- (pr.M.) ‘to protect’ (OldP. 194, $\text{apaya}\bar{i}$ [1sg]) : LAv. ni-paya- (pr.) ‘beschützen’ (AIWb. 886, nipayeimi [1sg]).

⁴² For PIE * $\bar{e}ah$, see PIE $\sqrt{\text{pēahs-}}$ in Hitt. $\text{pa}\bar{\text{h}}\bar{\text{s-}}$ (vb.) ‘to protect’ (CHD P: 2f., $\text{pa-ah-}\bar{\text{š}}\bar{i}$ [2sg]), TochA. pās- (vb.M.) ‘custodire, tueri’ (Poucha 168, pāsantrā [3pl]), RV. pāri (...) pās- (s.ao.) ‘rings schützen’ (WbRV. 800, pāri pāsati [conj.]), and Lat. pāstōr- (m.) ‘Hirt’ (WH 2: 260, pāstor [N], pāstōris [G]).

⁴³ For PIE * $e\text{h}a$, see PIE * sehau- ‘Soma, Urin, Schmutz’ (IEW 912) in RV. só- (ao.) ‘Soma pressen, keltern’ (WbRV. 1523, sótā [2pl]) : Hitt. šehu-r- (n.) ‘Urin, Schmutz’ (HEG 2: 973-7, še-e-hur [sgNA]) and Hitt. šehu-kaniauant- (pt.) ‘mit Urin (šehu-) befleckt’ (HEG 2: 972).

⁴⁴ For PIE $\bar{e}\text{h}a$, see PIE * uēha- ‘wenden’, see Hitt. uēh- (vb1A.) ‘sich wenden, usw.’ (HHand. 200, ú-e-eh-zi) : Umbr. ue- (vb.) ‘ \approx wenden’ (WbOU. 835-6, uetu [3sg]). Note, however, that the quantity could also be short despite the double writing in Hitt. ú-e-eh- .

⁴⁵ For PIE * $a\text{h}e$, see PIE * ahegur(o)- ‘peak, top, stronghold, strong’ (IEW 8-9) in Hitt. hegur- (^{NA4n}) ‘peak, stronghold’ (HEG 1: 235, hé-gur) : RV. ágra- (n.) ‘Spitze, äußerstes ende, Gipfel’ (EWA 1: 45f.).

⁴⁶ For an early canonization of Brugmann’s law, see Osthoff (1878: 207ff.). For a description and discussion, see Collinge (1985: 13-21). On the literature, see Szemerényi (1996: 38n2). As of historical interest it may be mentioned that Brugmann’s law actually derives from Osthoff’s observation in 1876: 40-41: “[...] gedehntes wurzelhaftes \hat{a} griechischen o (in $\text{té-}\tau\text{o}\kappa\text{-}\alpha$, $\text{ké-}\kappa\text{lo}\phi\text{-}\alpha$), germanischen kurzem a (in got. sat , hlaf = $\text{ké-}\kappa\text{lo}\phi\text{-}\alpha$) entgegenstellt: $\text{pa-p}\bar{\text{a}}\text{-}\text{a}$, $\text{pa-p}\bar{\text{a}}\text{-}\text{a}$, $\text{sa-s}\bar{\text{a}}\text{-}\text{a}$ = got sat u.s.w., nicht etwa bloss $\text{ja-g}\bar{\text{a}}\text{-}\text{a}$ = got. qam vor einem nasal, $\text{ba-bh}\bar{\text{a}}\text{-}\text{a}$ = got. bar vor einer liquida.”

Gr. γέγονε	:	RV. jajāna [3sg]	(WbRV. 467)
Goth. satja-	:	RV. sādāya- (LAv. šādāya-)	(WbRV. 1458)
Gr. δοφέναι	:	RV. dāvāne [inf.]	(WbRV. 586)
Gr. δόρυ	:	RV. dāru (Av. dāuru)	(WbRV. 595-6)

In this correspondence set the short etymological *o in other IE languages contrasts with the long vowel Iir. ā in open syllables. In the closed syllable, however, both groups indicate a short vowel (IE o vs. Iir. a):

Gr. δέδορκε	:	RV. dadārśa [3sg]	(WbRV. 626)
Goth. band	:	AV. babāndha [3sg]	(EWA 2: 208)
Lith. vartýti	:	RV. vartāya- (cs.)	(WbRV. 1332)
Lat. torreō	:	OInd. ví-tarṣaya- (cs.)	(EWA 1: 635)
Gr. γόμφος	:	RV. jámbhaḥ [sgN]	(WbRV. 478)
Goth. gadars	:	RV. dadharṣa [3sg]	(WbRV. 694)

Based on this Brugmann proposed a sound law according to which *o results in OInd. ā = Av. ā in an open syllable, while the rest of the IE languages continue /o/:

Neogr. *oCV → OInd. ā, Av. ā : Gr. o, Lat. o, Arm. o, OIr. o, etc.

In a closed syllable *oC(C), however, the outcome in all languages is short.

3.7.2 However, a critical problem emerged almost immediately, when Johann Schmidt (1881) presented examples of ‘European o’ (Gr. o, Lat. o, OIr. o, Arm. o, etc.) corresponding to short OInd. a = Av. a in an open syllable:

RV. ánas-	‘Lastwagen’ (WbRV. 54)	:	Lat. onus-	‘Last’ (WH 2: 210)
RV. ápas-	‘Arbeit’ (WbRV. 74)	:	Lat. opus-	‘Arbeit’ (WH 2: 217)
RV. ávi-	‘Schaf’ (WbRV. 129)	:	Dor. ὄφι-	‘Schaf’ (GEW 2: 367)
RV. páti-	‘Herr’ (WbRV. 764)	:	Gr. πόσι-	‘Gatte’ (GEW 2: 584)
RV. patāya-	‘fliegen’ (WbRV. 762)	:	Gr. ποτέο-	‘id.’ (GEW 2: 522)

On paper, the counterexamples could be explained by reconstructing an original PIE *e for Indo-Iranian and PIE *o for the rest of the languages. This is, however, not viable, because *o is provable due to the absence of the second palatalization in e.g.

Gr. πότερο-	(pron.a.) ‘wer, welcher von beiden’ (GEW 2: 586)
LAv. katara-	(pron.a.) ‘wer, welcher von beiden’ (AIWb. 433)
RV. katará-	(pron.a.) ‘welcher von zweien’ (KEWA 1: 148) ⁴⁷

⁴⁷ LIV² does no better in explaining some similar examples with CoCh₁. Using a phoneme ^hh₁ that has no unambiguous traces at all is in itself a violation of the rules of science, made only worse by the fact that ^hh₁ was erroneously defined by Møller and does not exist (see §3.6.3.c).

3.7.3 Brugmann (Grundr² 1: 153-8) responded to Schmidt by postulating a second vowel Neogr. *â (≠ Neogr. *o), defined by the correspondence set:

Arm. a : Gr. o, Lat. o, OInd. a, Av. a⁴⁸

According to Brugmann, the vowel Neogr. *â does not participate in the ablaut Neogr. *e : Ø : *o.⁴⁹ However, due to problems, perhaps the most serious of them being that several examples actually show ablaut *e/o,⁵⁰ Brugmann (1904: 74-5) later withdrew the postulate Neogr. *â and retracted his law.⁵¹

3.7.4 Following the appearance of Hittite, the attention of most scholars turned to the attempts to reconcile Møller's six correspondence sets (or the respective seven Neogrammarian vowels) with the newly emerged Old Anatolian data. As a result, the problem of the eight vowel, Neogr. *â (≠ *o), was largely forgotten, and no significant developments with regard to Brugmann's law took place before Szemerényi (1996: 38, §4.1). While Szemerényi postulated only seven vowels against Brugmann's eight and was not explicit regarding Brugmann's law, he (1996: 39, §4.1.5) reconstructed SZ *o for Brugmann's *â, the o-vowel not lengthened in the Indo-Iranian open syllable, thus taking the 'short' o-vowel as the basic o-quality vowel of his system (e.g. in SZ *hoiis 'sheep'). From the point of view of theory formation this was a clear step forward in comparison to Brugmann, who erroneously defined the 'half-long' vowel, by definition complex (i.e. not basic), as the basic vowel. Szemerényi's partial success was, however, overshadowed by the incompleteness of his system in comparison to that of Brugmann's original:

Brugmann	*â (*ouï-)	*o (*doru-)
Szemerényi	*o (*hoiï-)	-(?)-

After reinterpreting Brugmann's *â as the basic vowel and denoting it with the symbol *o, Szemerényi did not present a cover symbol for the vowel in the correspondence set Gr. δόρυ- : RV. dāru-, i.e. his reconstruction does not account for the item appearing in Brugmann's law at all and is thus incomplete.

3.7.5 The completeness of Szemerényi's system with regard to Brugmann's law can be restored, however, if one initially

(a) Accepts Szemerényi's choice of PIE *o (Brugmann's *â) as the basic vowel in RV. páti- (m.) 'Schutzer, Herr, Gebieter, Behüter' (WbRV. 765) : Lat. poti- (a.) 'vermögend, mächtig' (WH 2: 350) as it is simpler than the 'half-long' o-vowel and thus a scientifically more defensible alternative.

⁴⁸ For examples, see e.g. Arm. akn 'Auge' : Lat. oculus 'id.' (WH 2: 200-2) and Arm. atéal 'hassen' : Lat. odium 'Hass, Widerstreben' (WH 2: 202-3).

⁴⁹ See also Brugmann (Grundr² 1: 92-93): "Der o-Laut war in der idg. Urzeit vermutlich in zwei Qualitäten vorhanden, deren eine man als â [...] d. h. als sehr offene o [...] bezeichnet."

⁵⁰ See e.g. IEW 842 for RV. páti- (m.) 'Schützer, Herr, Gebieter, Gemahl' (WbRV. 764), Lat. com·pot- (a.) 'teihhaftig' (WH 2: 350-1, compos) : Lat. hos·pet- (c.) 'Gastfreund' (WH 1: 660-1, hospes, hospitis [G]) and IEW 825-6 for RV. patáya- (cs.) 'fliegen' (WbRV. 762, patáyanti), Gr. ποτέο- (cs.M.) 'flattern' (GEW 2: 522, Gr. ποτέομαι) : Gr. πέτο- (pr.M.) 'fliegen' (GEW 2: 522, πέτομαι).

⁵¹ See Brugmann (1913: 191n2): "Die Ansicht, dass es im Uridg. zwei qualitativ verschiedene o-Vokale gegeben habe (Gr. I2 S. 138, 153, 156), steht auf schwachen Füßen. S. Meillet *Mém.* 8, 153ff., Pedersen *KZ.* 36, 86ff. 101ff."

(b) Uses *ǎ (Brugmann's *o) as a temporary cover symbol to represent the examples of the correspondence set of Brugmann's law (IE oCV : Iir. āCV) and in so doing preliminarily fills the gap in Szemerényi's vowel system.

3.7.6 Following these initial settings the value of the cover symbol *ǎ, as defined by Brugmann's law, stands as follows:

ǎCV	→	RV. ā, gAv. ā, etc.	:	Gr. o, Lat. o, etc.
ǎC(C)	→	RV. a, gAv. a, etc.	:	Gr. o, Lat. o, etc.

Here, one is to immediately observe that

(a) The postulation of an independent 'half-long' vowel PIE *ǎ is unacceptable, because the IE languages imply three oppositions of quantity instead of four that the assumption of half-long *ǎ would necessitate in the pattern $\emptyset : o : *ǎ : *ō$, which is unparalleled by the IE languages.

(b) Under these circumstances *ǎ must be a cover symbol consisting of the basic vowel SZ *o = PIE *o followed by an additional component *X that in *oXCV results in Iir. āCV, but is lost without a trace in the rest of the group, where the outcome continues *oCV.

3.7.7 The comparison of the Indo-Iranian examples of Brugmann's law with their Old Anatolian cognates reveals that Hitt. ḫ stands in the position X in PIE *oXCV, i.e. X = PIE *H.⁵² An example of this is provided by PIE *doǎḥ- *dóǎḥ- 'geben' (IEW 223-6). Hitt. ḫ is present in the following compound belonging to the root:

Hitt. iški·dāḫ- (vb.2.) 'give a sign' (HED 2: 426, iš-ki-da-a-aḫ-ḫi)

Simultaneously PIE *oH appears as short Gr. o corresponding to Iir. ā before CV:

Gr. δό·CV	(ao.M.) 'geben' (GEW 1: 388-9, ἐδόμην [1sg])
RV. dā·CV	(ao.) 'geben' (WbRV. 590, dāta [2pl])

The related root extensions imply the following corollaries for the 'o-vocalism':

(a) In the root extensions *doǎḥ·CV, there is an opposition between IE /o/ versus Iir. /ā/ similarly as in the unextended root above, for example in PIE *dóǎḥmen-:

Gr. δόμεν-	(vb.sb.bs.) 'zu geben' (GEW 1: 388-9, Hom. δόμεν(αι))
RV. dāman-	(n.) 'das Geben' (WbRV. 595, dāmane [sgD])

Identically, the short Gr. o matches RV. ā in PIE *doǎḫén- *dóǎḫen-:

RV. dāván-	(vb.sb.bs.) 'geben' (WbRV. 596, dāváne)
ODor. δόφεν-	(vb.sb.bs.) 'geben' (GEW 1: 388-9, δόφεναι)

Furthermore, Gr. o corresponds to short PIE *o in the rest of the IE languages:

⁵² PIE *H stands for any if the diphonemes PIE *ha *ah *fia *afi.

Fal. doui-	(pr.) ‘gewähren’ (WbOU. 614, douiad [conj3sg])
Umbr. pur-doui-	(pr.) ‘porriciō’ (WbOU. 613, purdouitu [3sg])
Latv. davana-	(f.) ‘Gabe’ (LiEtWb. 112)
Lith. davanà-	(f.) ‘Gabe’ (LiEtWb. 112)
Arc. ἀπυ·δόῶ-	(pr.) ‘give up, return, etc.’ (GrGr. 1: 745, ἀπυδόῶς [pt.])

(b) In the root extensions *doafi·V(C), there is no quantity opposition between IE /o/ and IIr. /a/ as shown by PIE *doafi·i(C) in

Gr. δοί-	(ao.) ‘geben’ (GEW 1: 388-9, δοίην [opt1sg])
RV. de-	(ao.) ‘geben’ (WbRV. 589, dehi [ipv2sg])

3.7.8 Concluding, according to the revised Brugmann’s law⁺ the Indo-Iranian lengthening takes place when PIE *oH is followed by CV, and the outcome is /o/ in the rest of the group:

PIE *oHCV → RV. ā, gAv. ā, ... : Lat. o, Gr. o, ... (Pyysalo 2013 §2.3.7)⁵³

Brugmann’s ‘half-long’ vowel *o has the value PIE *oH, while Brugmann’s *ā stands for PIE *o, exactly as diagnosed by Szemerényi. Consequently, as relevant for adjusting the LT, the compensatory lengthening of PIE *oH only takes place in Indo-Iranian, when followed by CV.⁵⁴ Otherwise PIE *oH always results in a short vowel exactly as PIE *eH does. To conclude, Brugmann’s initial observation of the existence of the phenomenon was correct, but in the absence of PIE *h̥ in the Neogrammarian phoneme inventory he was unable to reconstruct it properly.⁵⁵

3.7.9 The reconstruction of Helmut Rix, Martin Kümmel et al. in LIV² employs a form of Eichner’s theory, with which it is nearly identical except for assuming that word-initial *h₃ was preserved in (Old) Anatolian à la Melchert (1987), thus marking a slight shift backwards, towards Benveniste’s theory. In addition, Martin Kümmel (2012) has proposed a development Pre-PIE *ā → PIE *o → IIr. CāCV/CaC(C)- to account for Brugmann’s law, thus actually utilizing for the first time the long vowel *ā theoretically independently of *h₂. This is, however, difficult due to the counterexamples proving PIE *CoCV → IIr. CaCV (see §3.7.2). Furthermore, resorting to Pre-PIE *ā is not helpful, because /ā/ only came to exist in Late and Post-PIE as an outcome of the developments PIE *h̥aē → h̥ā → h̄ā (Hitt. h̄ā) → IE ā (Lat. ā etc.) and PIE *ēah̥ → āh̄ → āh̄ (Hitt. āh̄) → IE ā (Lat. ā etc.). Consequently there is no motivation for the

⁵³ For additional examples, see Pyysalo 2013 121ff., e.g. in Hitt. h̄āra- (vb.1.) ‘schmücken’ (HEG 1: 332, h̄āranzi [3pl]) : LAV. gaošāvara- (m.) ‘Ohrschmück, Ohrgehänge’ (AIWb. 486), or search for ‘BRUGMANN’S law’ on the PIE Lexicon full data page at <http://pielexicon.hum.helsinki.fi/?alpha=ALL>.

⁵⁴ On the basis of Gr. δόρυ- = RV. dāru- we reconstruct PIE *doḥaru- for SZEMERÉNYI’s missing set. The absence of PIE *h̥ in Hitt. daru- (GIŠn.) ‘Baum, Holz, Stange : GIŠ’ (HEG T: 230f., ta-ru [NA]) : CLu. daru- (GIŠn.) ‘Holz’ (HHand. 171, ta-a-ru) is accounted for by PIE *dh̥aeru- (schwebeablaut) with the ‘a-vocalism’ revealed in OIr. daur- (n.) ‘Eiche’ (DIL 175-6, daur [sgN], daro [sgG]) and confirmed by Maced. δάρυλλο- (f.) ‘Eiche’ (Hes., LSJ. 370). The initial stop is confirmed to be PIE *dh̥ by the extension OIcl. draug- (m.) ‘Baum, Baumstamm’ (ANEtWb. 81b, draugr [sgN]).

⁵⁵ Compare Kuhn (1970: 55): “(...) discovering a new sort of phenomenon is necessarily a complex event, one which involves recognizing both *that* something is and *what* it is.”

postulation of Pre-PIE *ā only to account for PIE *o, especially as Brugmann’s law⁺ can readily explain the lengthening with PIE *o+H.

3.7.10 As PIE *oH did not cause compensatory lengthening apart from Brugmann’s law⁺, the quantity of the long vowel Neogr. *ō, leaving aside contractions, can only reflect an original PIE *ō. Due to the loss of PIE *H outside Old Anatolian Neogr. *ō reflects three original PIE prototypes resulting in three correspondence sets:

PIE *ō : Hō : ōH : Hitt. ā : ḫā : āḫ : Gr. ω, Lith. uo, RV. ā, etc.

3.7.11 As correctly observed in the LT, the vowel PIE *o (and thus also *ō) was not affected by (i.e. assimilated to) PIE *a, but the latter was lost without a trace. Accordingly,

(a) For the short vowel PIE *o the following equations hold:

PIE *ḥao	→ *ḥo	→ Hitt. ḥa etc.	:	Lat. o etc. ⁵⁶
PIE *oḥa	→ *oḥ	→ Hitt. aḥ etc.	:	Lat. o etc. ⁵⁷
PIE *aḥo	→ *ḥo	→ Hitt. ḥa etc.	:	Lat. o etc. ⁵⁸
PIE *oaḥ	→ *oḥ	→ Hitt. aḥ etc.	:	Lat. o etc. ⁵⁹

(b) For the long vowel PIE *ō the following equations hold:

PIE *ḥaō	→ *ḥō	→ Hitt. ḫā etc.	:	Lat. ō etc. ⁶⁰
PIE *ōḥa	→ *ōḥ	→ Hitt. āḫ etc.	:	Lat. ō etc.
PIE *aḥō	→ *ḥō	→ Hitt. ḫā etc.	:	Lat. ō etc.
PIE *ōaḥ	→ *ōḥ	→ Hitt. āḫ etc.	:	Lat. ō etc.

(c) With zero grade included, the ablaut for the ‘o-vocalism’ is PIE *ō : o : Ø with three quantity oppositions, exactly as the ‘e-vocalism’.⁶¹

3.7.12 The following statements are provable:

⁵⁶ For PIE *ḥao in PIE *haoste/oi- ‘Bein’ (IEW 783), see Hitt. ḫaštai- (n.) ‘Knochen, usw.’ (HEG H: 237f., ḫa-aš-ta-a-i [sgNA]) : Gr. ὀστέο- (n.) ‘Bein’ (GEW 2: 436, ὀστέον [sgNA]).

⁵⁷ For PIE *oḥa, see PIE √sohau- ‘Soma pressen’ in RV. suṣāva- (pf.) ‘Soma pressen’ (WbRV. 1523, suṣāva [3sg]) : RV. sāvá- (m.) ‘Somapreßung, Somaspende’ (WbRV. 1513) with the lengthening of BRUGMANN’s law⁺.

⁵⁸ For PIE *aḥo in PIE *aḥoguro-, see possibly Hitt. URUḫagura- (‘Bei Uruša > Lalawainta’, OGH. 67, ḫa-ku-ra-aš [sgN]), if standing for the thematic *o-grade related to Hitt. ḫegur- (c.) ‘Fels(gipfel), Felsheiligtum’ (HHand. 49, ḫé-kur, ḫé-gur).

⁵⁹ For possible PIE *oaḥ in PIE *toaḥ- ‘geben’, see Gr. τό- (pr.) ‘geben’ (Grundr² 1: 654, τότω ‘dato’) : Hitt. iški-taḥ- (vb.2.) ‘ein Zeichen geben’ (HHand. 65, iš-kit₉-ta-aḫ-ḫi).

⁶⁰ Due to the disputed character of the Old Anatolian quantity, no examples are offered here for PIE *ō.

⁶¹ For an example of the ablaut PIE *ō : o : Ø, see e.g. √pt- ‘fly, fall’ (IEW 825-6, Hitt. peta- (vb.1.) ‘fliegen’, in Hitt. píd-da-an-zi [3pl]) in the bases PIE *pōt- Gr. ποτάομαι ‘flattern’ : RV. pātáya- (cs.M.) ‘dahineilen’ (WbRV. 762), PIE *pot- : Gr. ποτέομαι ‘flattern’ : RV. patáya- ‘fliegen’ (WbRV. 762), and PIE *pt- : Gr. ἔπτετο ‘flug’ : LAV. ptaḫ ‘flug’ (AIWb. 819-21).

(a) Owing to the non-existence of $\dagger h_3$ (see §3.8.1.g) the sole explanation for the IE ‘o-vocalism’ are the vowels PIE *o *ō.⁶²

(b) Since Neogr. *ə *a *ā always correlate with Hitt. ḫ, the following lemma is true for the hitherto ambiguous ‘a-vocalism’ of Old Anatolian, where a merger of *o/ō and *a/ā has taken place: Hitt. a/ā, if not standing for a dummy vowel or in environment Hitt. ḫ, always represents PIE *o/ō. This solves the apparent ambiguity problems of the revisionist LT (*h₃e-, *h₁o- or *h₁a- etc.) and monolaryngealism (SZ *o/ō vs. *a/ā) for Hitt. a/ā. Thus, for instance, only PIE *o- can be postulated for the initial vowel in Hitt. adeš- ‘Axt, Beil’ (HEG A: 94) : OEng. adesa-n- ‘addice, adze: ascia’ (ASaxD. 7), because Hitt. ḫ is not present.⁶³ Identically, the vowels in Hitt. ai- ‘brennen, wärmen’, Hitt. aš- ‘sein’, Hitt. ta- ‘nehmen’, Hitt. kuaš- ‘küssen’, and Hitt. da- ‘setzen’, etc. can only stand for PIE *o/ō.

3.8 After the treatment of the patterns PIE Ø : *e : *ē (§3.6) and PIE *ō : *o : Ø (§3.7) in connection with PIE *aḫ, *ḫa, it is now possible to proceed to the full ablaut pattern PIE *ō : *o : Ø : *e : *ē⁶⁴ in connection with diphonemic PIE *aḫ and *ḫa and with potential schwebeablaut, if attested.

3.8.1 The root shape PIE Cəḫ- in the maximal ablaut PIE *ō : *o : Ø : *e : *ē can be exemplified with PIE √daḥ- ‘geben, schenken’ (IEW 223-6),⁶⁵ for which the following ablaut bases (both in unextended and extended forms) are attested:

(a) PIE *dōaḥ-(Σ)-, the *ō-grade root, is attested in:

Hitt. iški·dāḫ-	(vb.2.) ‘give a sign’ (HED 2: 426, iš-ki-da-a-aḫ-ḫi)
OLith. dúo-	(vb.) ‘geben’ (LiEtWb. 111-2, dúomi [1sg])
Gr. δίδω-	(vb.) ‘geben’ (GEW 2: 388-9, δίδωμι [1sg])
Lat. dōno-	(n.) ‘Gabe, Opfer’ (WH 1: 360, dōnum [sgNA])
RV. dāna-	(n.) ‘Gabe, Geschenk’ (WbRV. 593, dānam [sgN])

(b) PIE *doaḥ-(Σ)-, the *o-grade root, is attested in:

RV. draviṇo·dá-	(m.) ‘Gut gebend’ (WbRV. 645)
Gr. δοί-	(ao.) ‘geben’ (GEW 1: 388f., δοίην [1sg])
OInd. dāpaya-	(cs.) ‘cause to give’ (MonWil. 474)
Gr. ἀντί·δοσι-	(f.) ‘antidote’ (GEW 1: 388, ἀντίδοσις [sgN])

⁶² For the non-existence of $\dagger h_3$, see Pyysalo 2016 and Pyysalo & Janhunen 2018a and 2019.

⁶³ Eichner’s examples of $\dagger h_3$ mistakenly replace PIE *o with $\dagger h_3$ e e.g. in 1978: 162, fn77: “Hingegen ist die Vertretung von *h₃- durch anatol. ø- wegen heth. artari ‘steht’ (Wurzel *H₃er, s. H. Rix MSS 27, 1969, 92f.) m.E. gesichert.”

⁶⁴ For the maximal ablaut pattern PIE *ō : *o : Ø : *e : *ē (Szemerényi 1996: 83-7), see e.g. √bher- ‘bringen, tragen usw.’ (IEW 128-32) attached with the following bases: *bhōr-: Gr. φῶρ ‘Dieb’ : RV. bhārá- (m.) ‘Bürde, Last’ (WbRV. 933), *bhor-: Gr. φόρος ‘Ertrag’ : OCS. sŭ·borŭ ‘Versammlung’, *bhr-: Gr. δῖ·φορος ‘chariot-board (for two)’ : LAV. bərat- ‘tragend, bringend’ : RV. bhṛtí- ‘Pflege, Unterhalt, aufgetragene Speise’, *bher-: Hom. φέρ- ‘carry’ : Lat. fer- ‘carry’ : RV. bhár- ‘carry’ : gAv. bar- ‘carry’, *bhēr- : Goth. beru- ‘carry’ (GoEtD. 57) : RV. bhārs- ‘carry’ (WbRV. 961).

⁶⁵ For the voiceless root PIE *taḥ-, see Dor. ἄφρο·δί·τῆ- (f.) ‘Aphrodite’ (KVG. 249), Gr. τό- (pr.) ‘geben’ (Grundr² 1: 654, τότω ‘dato’) and Hitt. iški·taḫ- (vb.2.) ‘ein Zeichen geben’ (HHand. 65, iš-ki-ta-aḫ-ḫi [3sg]).

Fal. douī-	(vb.) ‘geben, gewähren’ (WH 1: 363, douiad [conj3sg])
Umbr. pur·doui-	(vb.) ‘porricitō’ (WH 1: 363, pur·douitu [3sg])
Cypr. δοφέναι	(n.) ‘zu geben’ (GEW 1: 389, δοφέναι [inf.])
RV. dāváne	(n.) ‘zu geben’ (WbRV. 596, dāváne [inf.])

(c) PIE *dēaḥ-(Σ)-, the *ē-grade root, is attested in:

Lat. dā-	(vb.) ‘geben’ (WH 1: 360, dā [ipv2sg], dās [pr2sg])
Arm. ta-	(vb.) ‘geben’ (ArmGr 1: 496, tam [1sg])
Latv. dāva-	(vb.) ‘anbieten, schenken’ (LiEtWb. 112, dāvat [inf.])
Lith. dovanà-	(f.) ‘Gabe’ (LiEtWb. 112, dovanà [sgN])

(d) PIE *deaḥ-(Σ)-, the *e-grade root, is attested in:

Lat. da-	(vb.) ‘geben, gewähren’ (WH 1: 360-3, dare [inf.])
gAv. da-	(vb.) ‘geben’ (AIWb. 678, daidyāi [inf.])
Arm. ta-	(vb.) ‘geben’ (ArmGr 1: 496, tamk‘ [1pl])
RV. dá’a-	(vb.) ‘geben’ (WbRV. 590, daam, dáas, daat [1-3sg])
Gr. δάνοσ-	(n.) ‘Gabe, Darlehen’ (GEW 1: 347, δάνοσ [sgNA])
OInd. dīdapa-	(ao.) ‘geben’ (MonWil. 474, adīdapat [3sg])
Lat. dato-	(pf.pt.) ‘gegeben’ (WH 1: 360-3, datum = Fal. datu)

(e) PIE *dāfi-(Σ)-, the zero grade root with originally accented PIE *á, is attested in PIE *dāfi- and PIE *dāfu-:⁶⁶

Dor. ἀφρο·δῖ·τᾶ-	(f.) ‘Aphrodite’ (KVG. 249)
RV. díya-	(n.) ‘Gabe’ (WbRV. 600, díya-)
RV. dúv-	(f.?) ‘Gabe’ (WbRV. 623, dúvas [pIN, pIA])
ODor. δύφανο-	(vb.) ‘geben’ (GEW 1: 388-9, δυφάνοι [opt])

(f) PIE *daḥ-(Σ)-, the zero grade root with unaccented PIE *a (→ Neogr. *dh-), is attested in:

RV. dh·iṣ-	(f.) ‘Opfer·lust, Lust zu geben’ (WbRV. 683, dhiṣá) ⁶⁷
Osc. ā·mana·f-	(pf.) ‘über-, anheimgeben’ (WbOU. 448, aamanafed)
Osc. ē·mana·f-	(pf.) ‘über-, anheimgeben’ (WbOU. 448, emanafed)

(g) The direct comparison of the two distinct sets PIE *doaḥ-(Σ)- (e.g. Gr. δοτό-) and PIE *deaḥ-(Σ)- (e.g. Lat. dato-), used in the LT ever since de Saussure to define *h₃ in *dh₃to- : Gr. δοτό- = Lat. dato-, is erroneous and the postulate [†]h₃ consequently void.

⁶⁶ For the revised version of Hirt’s ‘schwa assimilations’ in PIE *dāfi- → *dífi- → *dīi-, see PYYSALO (2013: 217f.), and in PIE *dāfu- → *dúfiu- → dúu-, see Pyysalo (2013: 209f.).

⁶⁷ For the second part of the compound RV. dh·iṣ- ‘Opfer·lust’, see RV. √is- ‘suchen, begehren’ (WbRV. 223f.).

Accordingly, the second part of the triple representation of schwa has also been explained with a single laryngeal PIE *h. As the third part of the triple representation, Lat. statu- : Gr. στατό-, is trivial, the entire triple representation can be solved by means of a single laryngeal PIE *h in PIE *h₁ and *ah₂.

3.8.2 The root shape PIE *h₁ac- in ablaut PIE *ō : o : Ø : e : ē can be exemplified with the root PIE *h₁ag- ‘treiben, bringen’ (IEW 4ff.),⁶⁸ for which the following ablaut bases (both in unextended and extended forms) are attested:

(a) PIE *h₁ag-, the zero grade root with originally accented PIE *á-, is attested in:

RV. pári·jman- (m.) ‘Umwandler, Herumwandler’ (WbRV. 785)

In RV. 1.122.3 this stem requires a four-syllabic scansion. Since PIE *h₁ is needed for to account for the hiatus and PIE *á for the extra syllable, only PIE *h₁á is possible and PIE *péri·h₁agmen- is reconstructed.

(b) PIE *h₁ag-, the zero grade with unaccented PIE *a, is attested in the monosyllabic

RV. jmán- (m?) ‘Bahn’ (WbRV. 502, jmán [sgL])

(c) PIE *h₁aeǵ-, the *e-grade root, is attested, for instance, in:

Lat. agō (pr.3.) ‘(be)treiben, führen, verhandeln’ (WH 1: 23-4)

LA.v. aza- (vb.) ‘(weg)treiben’ (AIWb. 223, azaite)

(d) PIE *h₁aoǵ-, the *o-grade root, is attested in:

Gr. ὄγμο- (m.) ‘Schwad, Reihe’ (GEW 2: 347, ὄγμον ἄγειν)

(e) PIE *h₁aeǵ-, the *ē-grade root, is attested in:

Lat. amb·āgēs (f.) ‘Umgang’ (WH 1: 37)

Dor. στρατ·αγό- (m.) ‘Heerführer: “strategist”’ (GEW 2: 806)

(f) PIE *h₁aoǵ-, the *ō-grade root, is attested in:

Gr. ἄγ·ωγός (m.) ‘Führer’ (GEW 1: 18)

TochA. āsant (sb.m.) ‘dux: Führer, Lenker’ (Poucha 27)

OIcl. ōk- (pret.) ‘drove’ (ANetWb. 3)

(f) PIE *ēh₁ag-, the zero grade root prefixed with PIE *ē, is attested in:

Lat. ēg- (pf.) ‘(be)treiben, führen, verhandeln’ (WH 1: 23-4, ēgī)

Gr. ἤγ- (pf.M.) ‘treiben, führen, gehen’ (GEW 1: 18, ἤγμαι)

OSwed. āka- (vb.) ‘fahren’ (ANetWb. 3, āka [inf.]

⁶⁸ For the voiceless variant, PIE *hak-, see Osc. ligud acum ‘verhandeln’ (WbOU. 78-79, compare Lat. lege agere for the formulaic meaning).

4 The maximal PIE ablaut *ō : o : Ø : e : ē and the ablaut matrixes with PIE *ah or *ha

4.1 After the above revisions the eight cover symbols of the Neogrammarian vowel system at its zenith, Neogr. *e *ē *ə *a *ā *â *o *ō, have been simplified into five:

PIE *ē *e *o *ō *a (where PIE *a always appears with PIE *h)

As such the GFT is identical to de Saussure's 'primordial system' DS *e *o *A except for containing PIE *ē *ō and PIE *a always appearing with PIE *h in the diphenemic pairs PIE *ha and *ah.

4.2 When all mathematically possible permutations of PIE *ō : o : Ø : e : ē and PIE *ah and *ha are combined into a single table, the following four series are obtained:

PIE *ēah : *eah : *áh/ah : *oah : *ōah	→	Lat. ā : a : a/Ø : o : ō
PIE *ahē : *ahe : *áh/ah : *aho : *ahō	→	Lat. ē : e : a/Ø : o : ō
PIE *hāē : *hae : *há/ha : *hao : *hāō	→	Lat. ā : a : a/Ø : o : ō
PIE *ēha : *eha : *há/ha : *oha : *ōha	→	Lat. ē : e : a/Ø : o : ō

When the first two and last two lines are combined into single matrixes expressing the schwebeablaut on the x- and y-axes, two star-shaped matrixes for the maximal ablaut in connection with PIE *ah and *ha and their late PIE (PIE+) outcomes (resulting from the assimilation caused by PIE *a and its loss) are obtained.

4.2.1 The ablaut matrix for *ah comprises ten original PIE and ten late PIE+ states:

PIE		PIE
*ēah		*āh
*eah		*ah
*ahē : *ahe : *áh/ah : *aho : *ahō	→	*hē : *he : *áh/h : *ho : *hō
*oah		*oh
*ōah		*ōh

When the loss of PIE *h is applied to the late PIE matrix, a single pattern with seven terms, viz. Post-PIE ē : e : ā : a : a/i/Ø : o : ō, emerges, the output of which coincides with the IE vocalisms of the root PIE *dah- 'geben' (see §3.8.1). From this the actually attested IE forms follow by means of well-known sound laws.

4.2.2. The ablaut matrix for *ha comprises ten original PIE and ten late PIE+ states:

PIE		PIE+
*ēha		*ēh
*eha		*eh
*hāē : *hae : *há/ha : *hao : *hāō	→	*hā : *ha : *há/h : *ho : *hō
*oha		*oh
*ōha		*ōh

When the loss of PIE *h̥ is applied to the Late PIE matrix, a single pattern with seven terms, viz. Post-PIE ē : e : ā : a : a/i/Ø : o : ō, emerges, coinciding with the attested vocalizations of the root PIE *h̥ag- (see §3.8.2). From this the actually attested IE languages again follow by means of well-known sound laws.

4.3 As all attested PIE ablaut patterns for a single vowel⁶⁹ are subsets of the simple ablaut PIE *ō : o : Ø : e : ē or belong to the star-shaped matrixes, the Indo-European ablaut problem in connection with PIE *h̥ has been completely solved.

4.4 IE linguistics was led into a standoff by Szemerényi's and Eichner's assumption of the vowels *a and *ā, which, in turn, was due to the error in the formulation of de Saussure's and Møller's ablaut pattern *Ae/o : *A : *e/oA, which lacked the quantity PIE *ō *ē. Whether de Saussure and Møller can be held accountable is not easily decided given that the Neogrammarian vowel system critically lacked the long vowels in the late 1870s, when de Saussure and Møller adopted its ablaut patterns. Since they could only operate with two-term ablaut patterns and did not have the Hittite laryngeal or the diphonemic pairs PIE *h̥a *ah̥ at their disposal, de Saussure and Møller could hardly have had inferred the correct five-term ablaut or the two PIE ablaut matrixes making twenty distinctions: the preconditions for a success were not met at the time, and future generations were to pay dearly for the resulting, highly premature theory.

5. Conclusion: Digitalization of the PIE vowel system and PIE *h̥a and *ah̥

5.1 The revisions presented above mend the technical breakdown of the earlier reconstruction theories and restore the capability of the field to reconstruct PIE with regard to PIE *h̥. In all, the solutions display a better quantitative precision than competing theories, and the system of rules is more successful in solving the problems. In other words, Kuhn's (1970: 34) "(...) a more precise paradigm, obtained by the elimination of ambiguities that the original (...)" has been achieved and the paradigm crisis of IE linguistics is effectively over with regard to the reconstruction theory itself.

5.2 The respective solutions to the problems of the PIE plosive and sonorant systems, independently and in connection to PIE *h̥a and *ah̥, have already been presented in Pyysalo 2013 and will be summarized in the next papers of this series. This will result in a synthesis of consistent conjectures made during the course of the history of the field, which in turn constitute the full glottal fricative theory (GFT).

5.3 As the obstacles preventing consistent reconstruction were in fact eliminated more than five years ago in Pyysalo 2013, IE linguistics has made steady, tangible progress ever since in the PIE Lexicon project at <http://pielexicon.hum.helsinki.fi/>, where the core of the GFT and the comparative method have been almost completely digitalized. At the moment the earliest sound laws of some 120 of the most archaic IE languages have been digitized and the PIE Lexicon operating system is capable of mechanically generating the attested IE languages with a relatively small margin of error of about 1 percent.

⁶⁹ The ablaut patterns for two vowels are obtained through adding the maximal ablaut PIE *ō : o : Ø : e : ē to both sides of pairs *h̥a and *ah̥. Thus for the term PIE *ēh̥a, the two-vowel expansion is of the form *ēh̥a+ō *ēh̥a+o *ēh̥a+e *ēh̥a+ē, and so forth.

5.4 The recently published proof of the consistency of the digitized sound law system of PIE Lexicon⁷⁰ can be interpreted as an indication that the triumph of the ‘electronic Neogrammarians’, referred to by Patrick Sims-Williams in his paper outlining the developments in the mechanizing of historical linguistics⁷¹ is taking place before our eyes in Indo-European linguistics. Accordingly, IE linguistics is steadily developing into the next branch of natural science in a mechanized form. This will allow the scholars in the field to investigate its subject, Indo-European languages and Proto-Indo-European, in unforeseen detail and depth in the 21st century.

Abbreviations

A	accusative
a.	adjective
AIWb.	BARTHOLOMAE 1904
Akk.	Akkadian
ANetWb.	de VRIES 1961
ao.	aorist
Arc.	Arcadian (Greek)
Arm.	Armenian
ArmGr.	HÜBSCHMANN 1897
ASaxD.	BOSWORTH & TOLLER 1882-98
AV.	Atharva-Veda
Av.	Avestan
C	consonant
c.	genus commune
CHD	HOFFNER & GÜTERBOCK 1997 ^{eds}
CLu.	Cuneiform Luwian
conj	subjunctive
cs.	causative
Cypr.	Cypriot (Greek)
D	dative
Dor.	Doric (Greek)
DS	de SAUSSURE(’s reconstruction)
DSM	de SAUSSURE(’s) and MØLLER(’s reconstruction)
EWA	MAYRHOFER 1986-2000
f.	feminine
Fal.	Faliscan
G	genitive
gAv.	Gathic Avestan
GEW	FRISK 1960-1972
GFT	glottal fricative theory
Gl.	gloss
GoEtD.	Lehmann 1986
Goth.	Gothic
Gr.	Greek
GrGr.	SCHWYZER 1939
Grundr ²	BRUGMANN 1895-1916
H	cover symbol for PIE *h ₁ *h ₂ *h ₃ and *h ₄
h̥	cover symbol for PIE *h ₁ and *h ₂
HED	PUHVEL 1984ff.
HEG	TISCHLER 1977-2016
Hes.	Hesychios
HHand.	TISCHLER 2001

⁷⁰ For the consistency proof and the related discussion, see Pyysalo, Sahala & Hulden 2018.

⁷¹ For the ‘electronic Neogrammarians’ and the early attempts to digitize historical phonology before the success in PIE Lexicon, see Sims-Williams 2018.

Hitt.	Hittite
Hom.	Homeric
IE	Indo-European
IEW	POKORNY 1959
Ilr.	Indo-Iranian
Illyr.	Illyrian
inf.	infinitive
IPA	International Phonetic Alphabet
ipv	imperative
KEWA	MAYRHOFER 1956-80
KVG.	BRUGMANN 1904
L	locative
Lat.	Latin
Latv.	Latvian
LAv.	Late Avestan
Lex.	lexical form (of the grammarians)
LiEtWb.	FRAENKEL 1962-65
Lith.	Lithuanian
LIV ²	RIX, KÜMMEL et alii 2001
LSJ	LIDDELL, SCOTT 1940
LT	laryngeal theory
M.	middle
m.	masculine
Maced.	Macedonian
MonWil.	MONIER-WILLIAMS 1993
N	nominative
n.	neutral
Neogr.	Neogrammarian (reconstruction)
NOMS.	LAROCHE 1966
OAnat.	Old Anatolian
OCS.	Old Church Slavonic
ODor.	Old Doric (Greek)
OEng.	Old English
OGaul.	Old Gaulish
OGH.	MONTE & TISCHLER 1978
OHG.	Old High German
OIcl.	Old Icelandic
OInd.	Sanskrit
OIr.	Old Irish
OLat.	Old Latin
OldP.	KENT 1953
OLith.	Old Lithuanian
OPers.	Old Persian
opt	optative
Osc.	Oscan
OSwed.	Old Swedish
Paleogr.	Paleogrammarian
pf.	perfect
PIE	Proto-Indo-European
PIIr.	Proto-Indo-Iranian
pl	plural
Poucha	POUCHA 1955
pr.	present
pret.	preterite
pron.	pronominal
pt.	participle
R	resonant (sonorant, sonant)
refl.	reflexive
RV.	Rig-Vedic
sg	singular
SZ	SZEMERÉNYI('s reconstruction)

TochA.	Tocharian A
Ugar.	Ugaritic
Umbr.	Umbrian
V	vowel
vb.	verb
vb.sb.bs.	verbal noun base
WbOU.	UNTERMANN 2000.
WbRV.	GRASSMANN 1996
WH	WALDE & HOFMANN 1938

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