ROZHLEDY

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The glottalic model of Proto-Indo-European consonantism: re-igniting the dialog

ABSTRACT: The purpose of this article is to re-ignite a discussion concerning the reconstruction of the Proto-Indo-European consonant system. The article begins with a discussion of the traditional reconstruction, starting with August Schleicher (1861), continuing on with Karl Brugmann (1904), and ending with current views, as exemplified in the work of James Clackson (2007), Benjamin Fortson (2010), Calvert Watkins (1998), and Winfred P. Lehmann (1952). It then discusses a number of well-known problem areas with the traditional reconstruction and suggests that a better reconstruction is the Glottalic Model of Proto-Indo-European consonantism originally proposed by Thomas V. Gamkrelidze and Vjačeslav V. Ivanov (1972 and 1973), on the one hand, and Paul J. Hopper (1973), on the other. Next, several criticisms of the Glottalic Model are discussed and fully refuted. The article ends with trajectories of the revised Proto-Indo-European consonant system in the principal Indo-European daughter languages. In sum, the traditional reconstruction needs to be abandoned in favor of the Glottalic Model.

Key words: Proto-Indo-European consonantism, Glottalic Theory, root structure constraints

Introduction

Most of the standard handbooks follow a slightly modified form of the Neogrammarian reconstruction of the Proto-Indo-European phonological system. The authors of these handbooks are typically aware of and even comment on some glaring problems with that reconstruction. Even though several Indo-Europeanists have proposed various solutions, only one addresses and solves all of the problem areas – the Glottalic Model. While the Glottalic Model generated a great deal of interest when it was first proposed, due, in part, to some ill-founded criticisms, interest in it has waned over the past several years. The time has come to clarify, yet again, why the traditional reconstruction of the Proto-Indo-European phonological system is typologically improbable and to re-awaken interest in the Glottalic Model as a viable alternative.

Let us begin by giving a brief account of the history of the reconstruction of the Proto-Indo-European phonological system.

The pioneering Indo-Europeanist August Schleicher was the first (in 1861) to attempt to reconstruct the Proto-Indo-European phonological system. Schleicher's reconstruction (1876, vol. 1: 10–11) was heavily influenced by Sanskrit.

Table 1: The Proto-Indo-European phonological system as reconstructed by Schleicher

Consonants:

	Unaspirated		Aspirated	Spirants		Nasals	*r*-sound
	Voiceless	Voiced	Voiced	Voiceless	Voiced	Voiced	Voiced
Guttural	k	g	gh				
Palatal					j		
Lingual							r
Dental	t	d	dh	s		n	
Bilabial	p	b	bh		v	m	

Vowels:

	Original vowel	First increment	Second increment
a-grade	a	a + a = aa	a + aa = āa
i-grade	i	a + i = ai	a + ai = āi
u-grade	u	a + u = au	a + au = āu

Beginning in the late 1870s, a series of brilliant discoveries by a new generation of scholars, collectively known as the "Neogrammarians" (*Junggrammatiker* in German), made it necessary to make major modifications to Schleicher's reconstruction. The efforts of these scholars culminated in the work of Karl Brugmann (1904: 51–280) and, slightly later, that of Hermann Hirt (1921–1927, especially volumes 1 and 2).

Table 2: The Proto-Indo-European phonological system as reconstructed by Brugmann

Monophthongs:	e	o	a	i	u	ə		
	ē	ō	ā	ī	ū			
Diphthongs:	ei̯	oi̯	ai̯	əi̯	eu̯	ou̯	au̯	əu̯
	ēi̯	ōi̯	āi̯		ēu̯	ōu̯	āu̯	
Semivowels:	i̯	u̯	(j ?)					
Liquids and nasals:	l	r	m	n	n̂	ŋ		
Syllabic liquids and nasals:	l̥	r̥	m̥	n̥	n̥̂	ŋ̥		
	l̥̄	r̥̄	m̥̄	n̥̄	n̥̂̄	ŋ̥̄		
Occlusives:	p	ph	b	bh	(bilabial)			
	t	th	d	dh	(dental)			
	k̂	k̂h	ĝ	ĝh	(palatal)			
	q	qh	g	gh	(pure velar)			
	qᵘ	qᵘh	gᵘ	gᵘh	(labiovelar)			
Spirants:	s	sh	z	zh	þ	þh	ð	ðh

Notice that Brugmann's reconstruction of the Proto-Indo-European series of occlusives (*Verschlusslaute* in German) looks even more like Sanskrit than Schleicher's.

During the twentieth century, the Neogrammarian reconstruction underwent major changes. We will only summarize the most important changes here (cf. Bomhard 2015, vol. 1: 45–54 and Szemerényi 1972 for more information):

1. The series of voiceless aspirates was removed.
2. A series of laryngeals (most scholars posit three) was added.

3. The number of vowels was reduced to *$\breve{e}$, *$\breve{o}$, *$\breve{a}$. Some scholars go so far as to deny the existence of *$\breve{a}$ as well.
4. The diphthongs were reanalyzed as clusters of vowel plus non-syllabic resonant and non-syllabic resonant plus vowel.

Current thinking on how the Proto-Indo-European series of stops is to be reconstructed may be summed up by looking at what three prominent scholars have to say.

First, James Clackson (2007: 34) reconstructs the system of stops of Proto-Indo-European as follows:

Table 3: The Proto-Indo-European stop system as reconstructed by Clackson

	Labial	Dental	Palatal	Velar	Labiovelar
I	*p	*t	*k′	*k	*k^{w}
II	(*b)	*d	*g′	*g	*g^{w}
III	*b^{h}	*d^{h}	*g′^{h}	*g^{h}	*g^{wh}

Note that Clackson indicates the marginal status of the plain voiced labial stop (*b) by placing it in parentheses. Watkins (1998: 34) does the same thing (see below).

Next, a similar reconstruction for the Proto-Indo-European system of stops is found in the second edition of Benjamin Fortson's book (2010: 56):

Table 4: The Proto-Indo-European stop system as reconstructed by Fortson

	Labial	Dental	Palatal	Velar	Labiovelar
I	*p	*t	*$\hat{k}$	*k	*k^{w}
II	*b	*d	*$\hat{g}$	*g	*g^{w}
III	*bh	*dh	*$\hat{g}$h	*gh	*g^{w}h

Finally, to complete the picture, the following system of stops is reconstructed for Proto-Indo-European by Calvert Watkins (1998: 34), which is identical to that proposed by Clackson:

Table 5: The Proto-Indo-European stop system as reconstructed by Watkins

	Labial	Dental	Palatal	Velar	Labiovelar
I	*p	*t	*$\hat{k}$	*k	*k^{w}
II	(*b)	*d	*$\hat{g}$	*g	*g^{w}
III	*b^{h}	*d^{h}	*$\hat{g}^{h}$	*g^{h}	*g^{wh}

There are, without a doubt, many other excellent works devoted to issues involving the reconstruction of the Proto-Indo-European phonological system, but this brief survey should be enough to get us started.

These reconstructions are based upon work done in the first half of the twentieth century, which culminated in the reconstruction proposed in 1952 by Winfred P. Lehmann (1952: 99):

Table 6: The Proto-Indo-European phonological system as reconstructed by Lehmann

1. Obstruents:	p		t		k		k^w
	b		d		g		g^w
	b^h		d^h		g^h		g^{wh}
			s				
2. Resonants:	m		n				
	w	r	l	y			
3. Vowels:		e	a	o	e		
	i·	e·	a·	o·	u·		
4. Laryngeals:			x	γ	h	ʔ	

The important thing about all of these reconstructions, including Lehmann's, is that they set up only three series of stops for Proto-Indo-European: (I) plain voiceless (**p*, **t*, **k̂*, **k*, **k*^{w}), (II) plain voiced (**b*, **d*, **ĝ*, **g*, **g*^{w}), and (III) voiced aspirated (**bh*, **dh*, **ĝh*, **gh*, **g*^{w}*h*), removing the series of voiceless aspirates (**ph*, **th*, **k̂h*, **kh*, **k*^{w}*h*) reconstructed by the Neogrammarians (cf. Brugmann 1904: 52 – examples, 150–178). At the present time, the systems represented above may be considered the "standard" or "traditional" reconstruction, and this is the sense in which the term "traditional reconstruction" will be used throughout the remainder of this article. The basis for this reconstruction, including sound correspondences and examples, has been discussed in many works, and these should be consulted for details. From a strictly formulaic point of view, the traditional reconstruction can account quite nicely for the developments leading to the phonological systems found in the Indo-European daughter languages, and this is its principal strength and the reason why it has endured.

Problems with the traditional reconstruction

Now, the removal of the traditional voiceless aspirates creates a problem from a typological point of view. Data collected from the study of a great number of the world's languages have failed to turn up any systems in which voiced aspirates are added to the pair plain voiceless stop ~ plain voiced stop unless there are also corresponding voiceless aspirated stops in the system (cf. Jakobson 1971: 528; Martinet 1970: 115). This is an important point, affecting the entire structure of the traditional reconstruction. In order to explain this imbalance, several scholars have sought typological parallels with systems such as those found, for example, in the Indonesian language Javanese. In these rare systems, there is a three-way contrast, sometimes described as (A) plain (unaspirated) voiceless ~ (B) voiced ~ (C) "voiced aspirated": /T/ ~ /D/ ~ /D^h/. However, this interpretation is based upon a lack of understanding of the phonetics involved. Series (C) in such systems is, in reality, voiceless with breathy release – something like /t^{ɦ}/ – and not true "voiced aspirated" (cf. Maddieson 1984: 207; Weiss 2009: 23). Regarding the so-called "voiced aspirates" of Bario Kelabit, Blust notes:

> "Bario Kelabit has a second series of voiced obstruents *b*^{h}, *d*^{h}, *g*^{h} that begin voiced and end voiceless, with variable voiceless onset to the following vowel, as in *təb*^{h}*uh* [tə́bp^{h}uh] 'sugarcane', *id*^{h}*uŋ* [ʔídt^{h}ʊŋ] 'nose', or *ug*^{h}*əŋ* [ʔúgk^{h}əŋ] 'spin without wobbling, of a top'. These segments thus differ from the fully voiced murmured stops of Hindi or other Indo Aryan languages that are still some-

times called 'voiced aspirates'. Phonetically the Kelabit voiced aspirates occur only word-medially following a stressed vowel." (Blust 2013: 183)

We will have more to say about this later.

It should be noted that several scholars have proposed various solutions in an attempt to eliminate the problems caused by the removal of the traditional voiceless aspirates (for details, see Bomhard 2015, vol. 1: 51–54).

There are other problems with the traditional reconstruction besides the typological difficulties caused by the removal of the voiceless aspirates. Another problem, noted in most of the standard handbooks, is the statistically low frequency of occurrence – perhaps total absence – of the traditional voiced labial stop **b*. We may cite Meillet's comments on this matter:

"*b* is relatively rare; it does not occur in any important suffix nor in any ending; it is secondary in some of the words where it is found, thus, Skt. *píbāmi* 'I drink', OIr. *ibim* 'I drink', Lat. *bibō* (with initial *b* through assimilation) is an ancient reduplicated form in view of Skt. *pāhi* 'drink', Gk. *πῖθι*, OCS. *piti* 'to drink', Lat. *pōculum* 'cup'; […] other words are imitative, thus Gk. *βάρβαρος*, Lat. *balbus*, etc.; still others are limited to a few languages and give the impression of being recent borrowings." (Meillet 1964: 89)

The marginal status of **b* is difficult to understand from a typological viewpoint and is totally unexplainable within the traditional framework. This problem was investigated in 1951 by the Danish scholar Holger Pedersen. Pedersen noted that, in natural languages having a voicing contrast in stops, if there is a missing member in the labial series, it is /p/ that is missing and not /b/. This observation led Pedersen to suggest that the traditional plain voiced stops might originally have been plain voiceless stops, while the traditional plain voiceless stops might have been plain voiced stops.

Table 7: Comparison of the Proto-Indo-European stop system reconstructed by Brugmann with that reconstructed by Pedersen

Brugmann						Pedersen				
b	d	ĝ	g	gᵘ	=	Ø	t	k̂	k	kʷ
p	t	k̂	q	qᵘ	=	b	d	ĝ	g	gʷ

Later shifts would have changed the earlier plain voiced stops into the traditional plain voiceless stops and the earlier plain voiceless stops into the traditional plain voiced stops. In a footnote in his 1953 article entitled "Remarques sur le consonantisme sémitique", André Martinet objected to this "musical chairs" rearrangement:

"Since there are extremely few examples of the Common Indo-European phoneme reconstructed "analogically" as **b*, it is tempting to diagnose a gap there as well, as the late Holger Pedersen did in *Die gemeinindoeuropäischen und die vorindoeuropäischen Verschlusslaute*, pp. 10–16. But, instead of assuming, as did Pedersen, the loss of a Pre-Indo-European **p* followed by a musical-chairs [rearrangement] of *mediae* and *tenues*, one should be able to see in the series **d*, **g*, **gʷ* the result of evolution from an earlier series of glottalics, without labial representative."
(Martinet 1975: 251–252, fn. 1)

Though hinted at as early as 1939 by Trubetzkoy, this appears to be the first time that anyone had explicitly proposed reinterpreting the plain voiced stops of traditional

Proto-Indo-European as glottalics. Gamkrelidze devotes a whole paper (2001) to discussing Martinet's important role in the development of the Glottalic Theory.

The Glottalic Theory

Discovery – perhaps "rediscovery" would be a better term since Martinet's insightful remarks first appeared in 1953 – of what has come to be known as the Glottalic Theory came from two separate sources, each working independently. On the one-hand, the British-born American Germanist Paul J. Hopper hit upon the notion that Proto-Indo-European may have had a series of glottalized stops while he was a student at the University of Texas and taking a course in Kabardian from Aert Kuipers. Hopper went on about other business after graduation, waiting five years before putting his ideas into writing. On the other hand, the Georgian Indo-Europeanist Thomas V. Gamkrelidze, a native speaker of a language containing glottalics (Georgian), had been investigating the typological similarities between Proto-Kartvelian and Proto-Indo-European. It did not take Gamkrelidze long to realize the possibility that Proto-Indo-European might also have had glottalized stops. Gamkrelidze, in a joint article with the Russian Indo-Europeanist Vjačeslav V. Ivanov, was the first to make it into print (Gamkrelidze & Ivanov 1972). Hopper might have beat them into print had his paper on the subject not been rejected by the journal *Language*. He was then obliged to search for another journal willing to publish his views, which finally happened in 1973. Then, in 1973, Gamkrelidze and Ivanov published a German language version of their 1972 paper.

Hopper (1973: 141–166) proposed reinterpreting the plain voiced stops of traditional Proto-Indo-European – Lehmann's **b*, **d*, **g*, **g*^{w} – as glottalized stops (ejectives), that is, (**p'*), **t'*, **k'*, **k'*^{w}, respectively, because the traditional plain voiced stops "show many of the typological characteristics of glottalized stops (ejectives), e.g. they are excluded from inflectional affixes, they may not co-occur with another in the same root, etc.". Hopper also reinterpreted the traditional voiced aspirates as murmured stops.

Gamkrelidze and Ivanov (1972: 15–18 and 1973: 150–156) also reinterpret the traditional plain voiced stops as ejectives, but, unlike Hopper, they reinterpret the traditional plain voiceless stops as voiceless aspirates. They make no changes to the traditional voiced aspirates. They point out, however, that the feature of aspiration is phonemically irrelevant in a system of this type, the choice between the aspirated and unaspirated variants being mechanically determined by the paradigmatic alternations of root morphemes. In a later article, Gamkrelidze (1976: 403) gives the reconstruction below.

Table 8: Comparison of the Proto-Indo-European stop system reconstructed by Lehmann with that reconstructed by Gamkrelidze

Lehmann				Gamkrelidze		
b	b^{h}	p	=	p'	bh/b	ph/p
d	d^{h}	t	=	t'	dh/d	th/t
g	g^{h}	k	=	k'	gh/g	kh/k
g^{w}	g^{wh}	k^{w}	=	k'$_{\underline{u}}$	g$_{\underline{u}}$h/g$_{\underline{u}}$	k$_{\underline{u}}$h/k$_{\underline{u}}$

Many of the points discussed above by Gamkrelidze were also noted by Hopper, in particular the root structure constraint laws (cf. Hopper 1973: 158–161). Hopper also discusses possible trajectories of the new system in various Indo-European daughter languages.

The Glottalic Model has several clear advantages over the traditional reconstruction of the Proto-Indo-European stop system:

1. The reinterpretation of the traditional plain voiced stops as glottalics (ejectives) makes it easy to account for the fact that the phoneme traditionally reconstructed as **b* was highly marked in the system, being characterized by an extremely low frequency of occurrence (if it even existed at all). Such a low frequency distribution is extremely uncharacteristic of the patterning of the voiced labial stop /b/ in natural languages having a voicing contrast in stops, but it is fully characteristic of the patterning of the labial ejective /p'/ (cf. Gamkrelidze 1981: 605–606; Greenberg 1970: 127).
2. Not only does the reinterpretation of the traditional voiced stops as ejectives easily account for the frequency distribution of these sounds, it also explains the fact that they were used only very infrequently in inflectional affixes and pronouns, since this type of patterning is characteristic of the way ejectives behave in natural languages having such sounds.
3. For the first time, the root structure constraint laws can be credibly explained. These constraints turn out to be a simple voicing agreement rule with the corollary that two glottalics cannot co-occur in a root. Hopper (1973: 160) cites Hausa, Yucatec Mayan, and Quechua as examples of natural languages exhibiting a similar constraint against the co-occurrence of two glottalics. Akkadian may be added to this list as well if we take Geers' Law (cf. Ungnad & Matouš 1992: 26–27) to be a manifestation of such a constraint.
4. The so-called Germanic and Armenian "consonant shifts" (in German, *Lautverschiebungen*), which can only be accounted for very awkwardly within the traditional framework, turn out to be mirages. Under the revised reconstruction, these branches (along with the poorly-attested Phrygian) turn out to be relic areas.

Moreover, the reinterpretation of the traditional plain voiceless stops (**p*, **t*, **k̂*, **k*, **k*^{w}) as voiceless aspirates, with aspirated ~ unaspirated allophones, overcomes the problems caused by the removal of the traditional voiceless aspirates.

In 1984, Gamkrelidze and Ivanov published their monumental joint monograph entitled *Indoevropejskij jazyk i indoevropejcy: Rekonstrukcija i istoriko-tipologičeskij analiz prajazyka i protokul'tury* [Indo-European and the Indo-Europeans: A Reconstruction and Historical Typological Analysis of a Protolanguage and a Proto-Culture] (an English translation of this work has since been published, see Gamkrelidze & Ivanov 1995). As is to be expected, this massive work (2 volumes, 1,328 pages) contains the most detailed discussion of the Glottalic Theory that has yet appeared. Gamkrelidze and Ivanov's book also contains trajectories of the revised Proto-Indo-European phono-

logical system in the various Indo-European daughter languages, original proposals concerning the morphological structure of the Indo-European parent language (they propose that, at an earlier stage of development, Proto-Indo-European was an active language), an exhaustive treatment of the Proto-Indo-European lexicon, and a new theory about the homeland of the Indo-Europeans (they argue that the Indo-European homeland was located in eastern Anatolia in the vicinity of Lake Van). One of the most novel proposals put forth in the book is that Proto-Indo-European may have had labialized dentals and a labialized sibilant. Gamkrelidze and Ivanov also posit postvelars for Proto-Indo-European.

Criticisms of the Glottalic Theory

The Glottalic Theory has not escaped criticism. One of the sharpest criticisms concerns the alleged implausibility of the changes that would be required to arrive at the plain voiced stops found in the majority of the daughter languages. This issue has been dealt with at length by Paul D. Fallon in Chapter 6, Ejective Voicing, of his 2002 book (Fallon 2002). Here, Fallon provides empirical support for the Glottalic Theory of Proto-Indo-European consonantism. After presenting and discussing in great detail evidence from a number of languages, Fallon (2002: 278–285) examines and evaluates the plausibility of various paths for ejective voicing, as follows:

1. Direct Voicing: Fallon describes the process of direct voicing of ejectives as the spread of [voice] from a vowel, "a rather direct change which telescopes what historically may have been a series of minute changes. The results will often be a change to a pulmonic voiced consonant with loss of glottal constriction […]" On the other hand, "we can express this as indirect voicing in two parts, as the delinking of the laryngeal feature [c.g.], followed by default fill-in (or spreading)." (Fallon 2002: 279–280)
2. Indirect Voicing: "The indirect voicing of ejectives involves their loss of distinct glottalization and the subsequent voicing of the voiceless unaspirated series." (Fallon 2002: 280) This is the scenario that I believe best explains the Indo-European developments (for details on how the new system developed into the phonological systems found in the individual Indo-European daughter languages, see Bomhard (2015, vol. 1: 111–153); a summary is given below).
3. Laryngealization: "Another commonly posited path of development from ejective to voiced is via laryngealization." (Fallon 2002: 280–281)
4. Implosivization: "Many linguists now believe that PIE ejectives became implosive." (Fallon 2002: 281) As an example, a little later on, Fallon (2002: 282) suggests that, within the Quichean languages, ejectives may have become implosives as follows:

   Voiceless ejective → voiceless implosive → voiced implosive

At a later date, the implosives would have been changed to plain voiced stops. This is the scenario favored by Kümmel (2012: 303–306).

Fallon summarizes his findings by noting:

> "In sum, we have seen that there is a tremendous amount of variation in the production of ejectives, both cross-linguistically and individually. I have discussed four possible directions of change from ejective to voiced: direct and indirect voicing, laryngealization, and implosivization […] Creaky or laryngealized voicing seems to be fairly common, as we have seen in Kabardian, for example. And implosivization has occurred independently in a number of African and Central American languages. I feel that these changes are valid possibilities, and that given dialectal variation, they both could be paths of ejective development. And I hope that I have shown that we should not […] automatically rule out the possibility of direct phonetic or phonological change." (Fallon 2002: 285)

And further:

> "[…] I also hope that I have dispelled the myth of implausibility of ejective voicing. The data gathered here do not by any means validate the Ejective Model – such validation will require careful study and reassessment of almost 200 years of assumptions (such as the papers in Vennemann 1989). However, they do help rebut some of the Glottalic Theory's sharpest criticisms and should breathe new life into the debate. Garrett (1991: 803) said the Glottalic Theory "was an exciting proposal […] one whose time has come and gone". But like Mark Twain, I think rumors of its death are greatly exaggerated." (Fallon 2002: 288)

For additional information on the patterning of glottalics, see especially Greenberg (1970) and Wedekind (1990). It should be mentioned that Wedekind finds no support from the Semitic languages of Ethiopia for the types of root structure constraints involving glottalics posited for Proto-Indo-European. However, Gamkrelidze (2010: 170, fn. 2) rightly points out that these constraints are a common phonetic *tendency*, not a universal (see also Salmons 1993: 36).

Another criticism of the Glottalic Theory revolves around Germanic **rīk-* 'ruler', which is universally considered to be a loanword from Celtic **rīg-* (cf. Old Irish *rí* 'king'; Old Welsh *ri* 'king'; Gaulish *rigo-* in the toponym *Rigomagus*; etc.). The objection here is that **rīk-* requires a consonant shift from voiced to voiceless within Germanic, which is not possible within the framework of the Glottalic Theory. However, a careful examination shows that there is no basis for this objection. The form that was borrowed was undoubtedly **rīks* (with devoicing of [g] to [k] before [s] already in Celtic; cf. Gaulish *-rīx* in personal names, such as *Dumnorīx*, *Vercingetorīx*, etc.; cf. Gothic *reiks* '[n.] prince, ruler; [adj.] mighty, honorable, powerful'; Old Icelandic *ríkr* 'mighty, powerful'). The derivative forms found in Germanic (such as Gothic *reiki* 'rule, power, authority', *reikinōn* 'to rule, to govern', etc.) were then built on the stem **rīk-* (cf. Lehmann 1986: 283; Orël 2003: 305). We should note that there are loanwords in which consonants are clearly not shifted in Germanic, for instance, Old High German *kellari* 'cellar' (New High German *Keller*), Old Saxon *kelleri* 'cellar', Middle Dutch *kelre* 'cellar' (Dutch *kelder*), etc., borrowed from Latin *cellārium* 'relating to a store-room' by Germanic tribes around the end of the first century BCE (cf. Ramat 1998: 388).

Two additional criticisms have been directed against the Glottalic Theory. The first concerns the example of Javanese, which is alleged to have a typologically rare series of voiced aspirates, together with modally voiced and tenuis consonants but without an accompanying series of voiceless aspirates, thus violating Jakobson's famous observation, noted above, that data collected from the study of a great number of the world's languages have failed to turn up any systems in which voiced aspirates are added to the

pair plain voiceless stop ~ plain voiced stop unless there are also corresponding voiceless aspirated stops in the system. Even if the description of the Javanese phonemic inventory turns out to be correct (itself in doubt [see above]), everything about it (syllable structure, phonotactic constraints, suprasegmentals, etc.) is so utterly different from what is assumed to have existed in Proto-Indo-European (cf. Byrd 2010) that Javanese serves as an extremely poor model on which to base ideas about the Proto-Indo-European phonological system – especially when Javanese is considered within the context of related Austronesian languages; for an excellent introduction to the Indonesian language, including its history and relationship to other Austronesian and Malayic languages, cf. Sneddon (2003); see also Davies (2010), in which Javanese is discussed and compared with Madurese and Indonesian; Adelaar & Himmelmann (2004) for detailed descriptions of the principal Austronesian languages of Asia and Madagascar (Javanese is discussed in Chapter 21); and Blust (2013). Moreover, the discovery of a single alleged counter-example still does not invalidate Jakobson's observation but merely becomes a footnote to it. Unique types do indeed exist, but they are anomalies and are not exemplary of language in general. Accordingly, the conventional reconstruction of the Proto-Indo-European stop system, with plain voiceless, plain voiced, and voiced aspirated stops, without corresponding voiceless aspirates, remains typologically improbable. To reiterate the obvious: When there are two competing reconstructions for a given proto-language, the one that has the greatest typological support should be favored.

The final criticism concerns the fact that no attested Indo-European daughter language has preserved a series of glottalized stops (ejectives). This was the same objection that was raised against de Saussure's "coefficents sonantiques" prior to the identification of one of them in Hittite in 1927 by Cuny and Kuryłowicz. If the ejectives were lost early enough, it is not at all surprising that none of the daughter languages has preserved them as such. The remainder of this paper will deal with this issue within the context of the how the stop systems of the individual daughter languages can be derived from the revised system.

Revised Proto-Indo-European system of stops

Taking into consideration the above observations, the Proto-Indo-European stop system can best be reconstructed as follows (for more information, including references to the relevant literature, Chapters 3, 4, and 5 of my 2015 book should be consulted):

Table 9: Early Proto-Indo-European

I	*p^{h}	*t^{h}	*k^{h}	*k^{wh}
II	(*p')	*t'	*k'	*k'^{w}
III	*b	*d	*g	*g^{w}

Notes:
1. Series I is voiceless aspirated; series II is glottalized (ejectives); and series III is plain (unaspirated) voiced. This is a totally natural system with many typological parallels.
2. The velars have non-phonemic palatalized allophones before front vowels and **y*.

Table 10: Later Proto-Indo-European ("Disintegrating Indo-European")

I	*pʰ	*tʰ	*kʰ	*kʷʰ
II	(*p)	*t	*k	*kʷ
III	*bʰ	*dʰ	*gʰ	*gʷʰ

Notes:
1. The glottalics (series II) are deglottalized. The resulting system is very close to what is posited for Proto-Indo-European by Emonds (1972) and Griffen (1988).
2. Voiced aspirates (series III) may have already developed, or at least started to develop, at this stage, but this is uncertain. They are really only needed in order to account for developments in Armenian, Indo-Iranian, Greek, and Italic.

Development of the Proto-Indo-European stop system in the daughter languages

Let us now trace how the revised Proto-Indo-European system of stops developed in the principal daughter languages. (Note: other scholars have proposed different trajectories.)

Anatolian

Table 11: Development of the Proto-Indo-European stop system in Anatolian

	Pre-Anatolian Proto-Indo-European					Proto-Anatolian			
I	*pʰ	*tʰ	*kʰ	*kʷʰ	→	*pʰ	*tʰ	*kʰ	*kʷʰ
II	(*p')	*t'	*k'	*k'ʷ	→	(*p')	*t'	*k'	*k'ʷ
III	*b	*d	*g	*gʷ	→	*b	*d	*g	*gʷ

Notes:
1. Many scholars claim that series II and III merge in Anatolian. However, Kloekhorst has recently shown (2014) that three separate series must be posited for Proto-Anatolian.
2. According to Kloekhorst (2014), the glottalics become pre-glottalized in Proto-Anatolian. The glottalization is eventually lost: **t'*, **k'*, **k'ʷ* → **'t*, **'k*, **'kʷ* → **t*, **k*, **kʷ*.
3. The palatalized allophones of the velars become phonemic in the Luwian branch.

Germanic

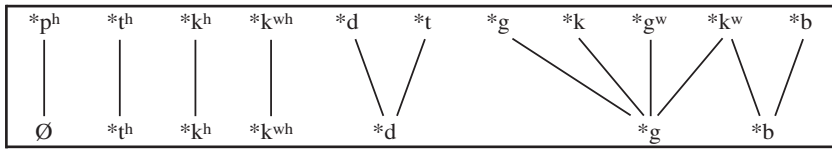
Table 12: Development of the Proto-Indo-European stop system in Germanic

	Pre-Germanic Proto-Indo-European					Proto-Germanic			
I	*pʰ	*tʰ	*kʰ	*kʷʰ	→	*f	*þ	*χ	*χʷ
II	(*p)	*t	*k	*kʷ	→	(*p)	*t	*k	*kʷ
III	*b	*d	*g	*gʷ	→	*b	*d	*g	*gʷ

Notes:
1. The voiceless aspirates (series I) become voiceless fricatives except after **s*.
2. Later, the resulting voiceless fricatives become the voiced fricatives **β*, **ð*, **ɣ*, and **ɣw*, respectively, except (A) initially and (B) medially between vowels when the accent falls on the contiguous preceding syllable (Verner's Law). **s* is also changed to **z* under the same conditions.
3. **b* remains initially, in gemination, and after nasals; **d* initially, in gemination, and after nasals, **l*, **z*, and **g*; and **g* only in gemination and after nasals. In other positions, however, **b*, **d*, **g* are changed into the voiced fricatives **β*, **ð*, **ɣ*, respectively. **gʷ* became **ɣ* initially and **w* medially.

Celtic

Table 13: Development of the Proto-Indo-European stop system in Celtic



Notes:
1. The earlier dental and velar plain (unaspirated) voiceless stops (**t* and **k*) merge completely with the plain voiced stops (**d* and **g*) in Pre-Proto-Celtic.
2. Next, the voiced labiovelar **gʷ* is delabialized and merges with **g*.
3. Then, the plain (unaspirated) labiovelar **kʷ* develops (A) into **b* initially and medially after consonants and (B) into **g* initially before **u* and medially between vowels and before consonants.
4. Original **pʰ* is lost in all of the Celtic languages: **pʰ* → **h* → **Ø*. However, *p* has been reintroduced into Old Irish through loanwords.

Baltic

Table 14: Development of the Proto-Indo-European stop system in Baltic

	Pre-Baltic Proto-Indo-European					Pre-Proto-Baltic			
I	*pʰ	*tʰ	*$\hat{k}$ʰ	*kʰ	→	*p	*t	*š	*k
II	(*p)	*t	*$\hat{k}$	*k	}				
III	*b	*d	*$\hat{g}$	*g	→	*b	*d	*ž	*g

Notes:
1. The labiovelars are delabialized, after which the palatalized allophones of the velars become phonemic.
2. The plain voiceless stops (series II) merge completely with the plain voiced stops (series III). Then, the voiceless aspirates are deaspirated.
3. The voiceless palatal stop (**$\hat{k}$*) becomes **š*, and the voiced palatal stop (**$\hat{g}$*) becomes **ž*.
4. In Lithuanian, Proto-Indo-European **s* is changed to **š* after **k* and **r* (but not after **i* and **u*).

Slavic

Table 15: Development of the Proto-Indo-European stop system in Slavic

	Pre-Slavic Proto-Indo-European					Pre-Proto-Slavic			
I	*pʰ	*tʰ	*$\hat{k}$ʰ	*kʰ	→	*p	*t	*s	*k
II	(*p)	*t	*$\hat{k}$	*k	}				
III	*b	*d	*$\hat{g}$	*g	→	*b	*d	*z	*g

Notes:
1. The labiovelars are delabialized, after which the palatalized allophones of the velars become phonemic.
2. The plain voiceless stops (series II) merge completely with the plain voiced stops (series III). Then, the voiceless aspirates are deaspirated.
3. The voiceless palatal stop (**$\hat{k}$*) becomes **s*, and the voiced palatal stop (**$\hat{g}$*) becomes **z*.
4. Proto-Indo-European **s* is changed to **š* after **r*, **u*, **k*, and **i* – this is called the "*ruki*-rule". A similar development is found in Indo-Iranian and partially in Lithuanian.

Tocharian

Table 16: Development of the Proto-Indo-European stop system in Tocharian

	Pre-Tocharian Proto-Indo-European					Tocharian			
I	*p^h	*t^h	*k^h	*k^{wh}	}	→	p (w)	t (c, ts)	k (ç)	k(w/u) (k, ç)
II	(*p)	*t	*k	*k^w	}					
III	*b	*d	*g	*g^w	}					

Notes:
1. First, the voiceless aspirates (series I) become deaspirated and then merge with the plain voiceless stops (series II).
2. Next, the plain voiced stops (series III) are devoiced.

Armenian

Armenian is particularly important in that it provides the key to understanding the developments in Pre-Indo-Iranian, Pre-Greek, and Pre-Italic. In the early prehistory of Pre-Armenian, Pre-Indo-Iranian, Pre-Greek, and Pre-Italic, the plain voiced stops (series III) become voiced aspirates. At a later date, in Pre-Indo-Iranian, Pre-Greek, and Pre-Italic, but not in Pre-Armenian, the plain voiceless (unaspirated) stops (series II) become voiced stops. Armenian, however, preserves the first stage of this shift – that is to say, the plain voiceless stops (series II) remain as such and are not changed to voiced stops. Thus, the Classical Armenian phonological system directly attests the three-way contrast (I) voiceless aspirated ~ (II) plain voiceless ~ (III) voiced aspirated in its stop system. It should be noted that Armenian and Indo-Iranian are so-called "*satəm*" languages, while Greek and Italic are so-called "*centum*" languages.

Table 17: Development of the Proto-Indo-European stop system in Armenian

	Pre-Armenian Proto-Indo-European					Armenian			
I	*p^h	*t^h	*$\hat{k}^h$	*k^h	→	h (w, Ø)	t^h	s	k^h
II	(*p)	*t	*$\hat{k}$	*k	→		t	c	k
III	*b^h	*d^h	*$\hat{g}^h$	*g^h	→	b (w)	d	j (z)	g (ǰ, ž)

Notes:
1. Earlier clusters of voiceless stop plus laryngeal develop as follows:
   pH → p^h
   tH → t^h
   kH → x
2. The voiced aspirates (series III) remain in Proto-Armenian (and some modern dialects) (cf. Garrett 1998) except that, medially between vowels, *b^h → *w*, *$\hat{g}^h$ → *z*, and *g^h → *ž*, while *g^h remains initially before back vowels but is changed to *ǰ* before front vowels.
3. Grassmann's Law did not operate in Armenian.
4. The traditional transcription of Armenian is given above.

Indo-Iranian

Table 18: Development of the Proto-Indo-European stop system in Indo-Iranian

	Pre-Indo-Iranian Proto-Indo-European					Proto-Indo-Iranian			
I	*p^h	*t^h	*$\hat{k}^h$	*k^h	→	*p ~ *p^h	*t ~ *t^h	*$\underset{\smile}{ts}$ ~ *$\underset{\smile}{ts}^h$	*k ~ *k^h
II	(*p)	*t	*$\hat{k}$	*k	→	*b	*d	*$\underset{\smile}{dz}$	*g
III	*b^h	*d^h	*$\hat{g}^h$	*g^h	→	*b ~ *b^h	*d ~ *d^h	*$\underset{\smile}{dz}$ ~ *$\underset{\smile}{dz}^h$	*g ~ *g^h

Notes:
1. As in Pre-Baltic, Pre-Slavic, Pre-Armenian, and Pre-Albanian, the labiovelars are (perhaps only partially at first) delabialized. The newly delabialized (labio)velars then merge with the unpalatalized allophones of the velars. This change brings about the phonemicization of the palatals since both palatalized velars (from earlier plain velars) and unpalatalized velars (from earlier labiovelars) are now found in the vicinity of front vowels, apophonic *o, and *y.
2. The plain voiced stops (series III) become voiced aspirates: *b, *d, *$\hat{g}$, *g → *b^h, *d^h, *$\hat{g}^h$, *g^h. This is a context-free development. This is the stage reached by Armenian.
3. When two voiced aspirates co-occur in a root, the first is deaspirated (Grassmann's Law). It should be noted that Grassmann's Law only appears in Indo-Aryan. In Iranian (Old Persian and Avestan), the plain voiced stops and the voiced aspirates have the same treatment.
4. In Pre-Indo-Iranian (and in Pre-Greek and Pre-Italic), but unlike Pre-Armenian, the plain voiceless stops (series II) develop into plain voiced stops: *p, *t, *$\hat{k}$, *k → *b, *d, *$\hat{g}$, *g. This is a context-free development. (As a typological parallel, it may be noted that an identical change has taken place in the Northwest Caucasian language Kabardian.)
5. The imbalance caused by the voicing of the plain voiceless stops causes the voiceless aspirates to be partially deaspirated. The deaspiration took place everywhere except (A) after initial *s- and (B) in onomatopoeia. However, aspiration is lost in the clusters *sp^h-, *st^h-, *sk^h- when an earlier laryngeal follows in the stem or when another aspirated stop follows in the stem: *$(s)t^heHy$- → *$(s)teHy$- → *$(s)t\bar{a}y$- (cf. Sanskrit *stāyati* 'he, she steals', *stāyú-ḥ*, *tāyú-ḥ* 'thief, robber'); *$(s)t^heHi$- → *$(s)teHi$- → *$(s)tai$- (cf. Sanskrit *stená-ḥ* 'thief', *stéya-ḥ* 'theft, robbery'). *$(s)t^henH$- → *$(s)tenH$- → *$(s)ten$- (cf. Sanskrit *stanati* 'resounds, reverberates'). Note: apparent exceptions to these rules appear to be due to the generalization of variant forms of the stems in question, or, in some cases, the exceptions are due to borrowing.
6. Additional voiceless aspirates arise from earlier clusters of voiceless stop plus laryngeal: *pH, *tH, *kH → *p^h, *t^h, *k^h, respectively.
7. *s is changed into *$š$ after *r, *u, *k, and *i. A similar change is also found in Slavic (and partially in Lithuanian).
8. *$\hat{k}$, *$\hat{g}$, *$\hat{g}^h$ are affricated to *$\underset{\smile}{ts}$, *$\underset{\smile}{dz}$, *$\underset{\smile}{dz}^h$, respectively.
9. Following that, the velars *k, *g, *g^h are palatalized to *k^y, *g^y, *g^{yh}, respectively, before *$\breve{e}$, *$\breve{i}$, and *y. Note: *k^h (from earlier *kH) is not palatalized.

Greek

Table 19: Development of the Proto-Indo-European stop system in Greek

	Pre-Greek Proto-Indo-European					Proto-Greek			
I	*p^h	*t^h	*k^h	*k^{wh}	→	*p	*t	*k	*k^w
II	(*p)	*t	*k	*k^w	→	(*b)	*d	*g	*g^w
III	*b^h	*d^h	*g^h	*g^{wh}	→	*p ~ *p^h	*t ~ *t^h	*k ~ *k^h	*k^w ~ *k^{wh}

Notes:
1. The plain voiced stops (series III) become voiced aspirates: *b, *d, *g, *g^w → *b^h, *d^h, *g^h, *g^{wh}. This is a context-free development.
2. As in Old Indic (but not Iranian), when two voiced aspirates co-occur in a root, the first is deaspirated (Grassmann's Law).
3. In Pre-Greek (and in Pre-Indo-Iranian and Pre-Italic), but unlike Pre-Armenian, the plain voiceless stops (series II) develop into plain voiced stops: *p, *t, *k, *k^w → *b, *d, *g, *g^w. This is a context-free development.
4. The imbalance caused by the voicing of the plain voiceless stops causes the voiceless aspirates to be partially deaspirated. Emonds (1972: 120) also assumes that some of the examples of voiceless aspirates found in Indo-Iranian, Greek, and Armenian are derived from the original voiceless aspirates, that is to say, they fail to undergo the expected deaspiration. Edmonds accounts for this by "reintroduction from a dialect that did not undergo Z2 [deaspiration]". In other words, he sees them as borrowings. While this may be true in some cases, I prefer to see them mostly as the natural result of developments within these branches themselves.
5. Additional voiceless aspirates arise from earlier clusters of voiceless stop plus laryngeal: *pH, *tH, *kH → *p^h, *t^h, *k^h, respectively.
6. At a later date, the voiced aspirates are devoiced – the unaspirated allophones become plain voiceless stops, and the aspirated allophones become voiceless aspirates: *b ~ *b^h, *d ~ *d^h, *g ~ *g^h, *g^w ~ *g^{wh} → *p ~ *p^h, *t ~ *t^h, *k ~ *k^h, *k^w ~ *k^{wh}. The newly-formed plain and aspirated voiceless stops merge completely with the previously-existing plain and aspirated voiceless stops. As a typological parallel, it may be noted that similar devoicing of earlier voiced aspirates has taken place in Romany.

The labiovelars were eliminated in Greek in historic times. The process of elimination probably occurred in several stages. Since the labiovelars mostly remain in Mycenaean, their elimination can reasonably be placed between the Mycenaean period and the beginning of the alphabetic period, that is, between about 1400–900 BCE. The developments were as follows:
1. Before or after *u*, *k^w, *k^{wh}, and *g^w are delabialized, and the resulting phonemes merge with *k*, *k^h*, and *g* (written κ, χ, and γ), respectively.
2. Next, *k^w, *k^{wh}, and *g^w are palatalized before *ĕ* and *ĭ*. The resulting sounds then merge with *t*, *t^h*, and *d* (written τ, θ, and δ), respectively, in the majority of Greek dialects.
3. Finally, all remaining labiovelars become labials: *k^w, *k^{wh}, and *g^w → *p*, *p^h*, and *b* (written π, φ, and β).

Italic

Table 20: Development of the Proto-Indo-European stop system in Italic

	Pre-Italic Proto-Indo-European					Proto-Italic			
I	*p^h	*t^h	*k^h	*k^{wh}	→	*p	*t	*k	*k^w
II	(*p)	*t	*k	*k^w	→	(*b)	*d	*g	*g^w
III	*b^h	*d^h	*g^h	*g^{wh}	→	*f	*θ	*χ	*χ^w

Notes:
1. Many of the early Pre-Italic developments are similar to what is assumed to have happened in Pre-Greek. Like Greek, Italic belongs to the so-called "*centum*" languages, which means that it initially preserved the original contrast between plain velars and labiovelars.

2. First, the plain voiced stops (series III) become voiced aspirates: **b*, **d*, **g*, **g^{w}* → **b^{h}*, **d^{h}*, **g^{h}*, **g^{wh}*. This is a context-free development.
3. Grassmann's Law did not operate in Italic.
4. In Pre-Italic (and in Pre-Indo-Iranian and Pre-Greek), but unlike Pre-Armenian, the plain voiceless stops (series II) develop into plain voiced stops: **p*, **t*, **k*, **k^{w}* → **b*, **d*, **g*, **g^{w}*. This is a context-free development.
5. The imbalance caused by the voicing of the plain voiceless stops causes the voiceless aspirates to be partially deaspirated.
6. Additional voiceless aspirates arise from earlier clusters of voiceless stop plus laryngeal: **pH*, **tH*, **kH* → **p^{h}*, **t^{h}*, **k^{h}*, respectively.
7. At a later date, the voiced aspirates are devoiced: **b^{h}*, **d^{h}*, **g^{h}*, **g^{wh}* → **p^{h}*, **t^{h}*, **k^{h}*, **k^{wh}*. The newly-formed voiceless aspirates merge completely with the previously-existing voiceless aspirates.
8. Finally, the voiceless aspirates (from earlier voiced aspirates as well as from clusters of voiceless stop plus laryngeal) became voiceless fricatives: **p^{h}*, **t^{h}*, **k^{h}*, **k^{wh}* → **f*, **θ*, **χ*, **χ^{w}*.

Albanian

Table 21: Development of the Proto-Indo-European stop system in Albanian

	Pre-Albanian Proto-Indo-European						Albanian				
I	*p^{h}	*t^{h}	*k̂^{h}	*k^{h}	*k^{wh}	→	p	t	th	k (q)	k (q, s)
II	(*p)	*t	*k̂	*k	*k^{w}	→	b	d	d (dh)	g (gj)	g (gj, z)
III	*b	*d	*ĝ	*g	*g^{w}	→	b	d (dh)	dh	g (gj)	g (gj, z)

Notes:
1. In Pre-Albanian (as in Pre-Slavic, Pre-Baltic, Pre-Indo-Iranian, and Pre-Armenian), the velars develop palatalized allophones when contiguous with front vowels, apophonic **o*, and **y*. In the early prehistory of these branches, the labiovelars are (perhaps only partially at first) delabialized. The newly delabialized (labio)velars merge with the unpalatalized allophones of the velars. This change brings about the phonemicization of the palatals since both palatalized velars (from earlier plain velars) and unpalatalized velars (from earlier labiovelars) are now found in the vicinity of front vowels, apophonic **o*, and **y*. Note: Albanian provides the strongest evidence for the existence of three distinct guttural series in its "Disintegrating Indo-European" ancestor: the labiovelars are distinguished from the plain velars by the fact that the former are palatalized to sibilants before front vowels, while the latter are not.
2. The palatals become palatalized alveolars: **k̂^{h}*, **k̂*, **ĝ* → **t^{yh}*, **t^{y}*, **d^{y}*. These later develop into interdental fricatives: **t^{yh}*, **t^{y}*, **d^{y}* → *th* [θ], *d* (*dh* [ð]), *dh* [ð].
3. Next, the plain voiceless stops (series II) become plain voiced stops: **p*, **t*, **k̂*, **k*, **k^{w}* → **b*, **d*, **ĝ*, **g*, **g^{w}*. In general, the developments of the plain voiced stops (series III) and the plain voiceless stops (series II) are identical, though initial **ĝ* appears as *d*, while initial **k̂* appears as *dh*. This seems to indicate that the labial and dental stops may have developed ahead of and slightly differently from the palatal, velar, and labiovelar stops.
4. Finally, the voiceless aspirates are deaspirated: **p^{h}*, **t^{h}*, **t^{yh}*, **k^{h}* → **p*, **t*, **t^{y}*, **k*.

Concluding remarks and afterthoughts

I have now completed the survey of how the revised Proto-Indo-European stop system developed in the major daughter languages. Only the key changes are mentioned – the developments are far more complicated than indicated above, and the standard handbooks should be consulted for details. Though I did not posit glottalics for the

immediate Proto-Indo-European antecedent of any of the non-Anatolian daughter languages, there are important clues that glottalics once existed. These were mentioned above – here, I will elaborate a little.

First, there is the problem of the marginal status of the traditional plain voiced stop (**b*). While it is common for languages having glottalics (ejectives) to have a gap at the labial point of articulation, it is not common for languages with a voicing contrast in stops to lack the voiced labial member. What we see quite clearly is that, in those daughter languages in which the earlier glottalics have developed into plain voiced stops, this gap is filled by various means, such as borrowings and by phonological developments specific to each daughter language. There are even indications that this process may have begun within the latest period of the Indo-European parent language itself, inasmuch as a very small number of etymologies can be established involving the traditional voiced labial stop, such as, for example, **belo-* 'strength, power; strong, powerful' (→ Sanskrit *bála-m* 'power, strength, might, vigor; force, violence, rigor, severity'; Greek *βελτίων*, *βέλτερος*, comparative of *ἀγαθός*, 'better, more excellent'; Latin *dē-bilis* 'feeble, weak'; Old Church Slavic *boljьjь* 'bigger, better'; Russian *ból'šij* [*больший*] 'greater', *bol'šój* [*большой*] 'big, large'). This points to the probability that the glottalics were lost relatively late, most likely just before the emergence of the individual non-Anatolian daughter languages – this is the period that I have called "Disintegrating Indo-European". Indeed, traces of their former existence may even have survived into the daughter languages themselves.

An important consideration needs to be mentioned at this point. While it seems probable that the glottalics were originally post-glottalized in all positions in Proto-Indo-European, there is evidence from some of the daughter languages – such as Winter's Law, cf. Collinge (1985: 225–227); the Danish stød, and the West Scandinavian pre-aspiration, for example, cf. Kortlandt (1981, 1988a, 1988b, 1989, 1998, 1999, 2007, and 2012) – that there may have been dialectal variation in the timing of glottalization before their ultimate loss. This seems to be what Kloekhorst (2014) is implying regarding the development of the glottalics in Anatolian. The typological parallel that I have in mind here as a possible model for what timing of glottalization rules may have been like in some dialects of "Disintegrating Indo-European" is the American Indian language Sm̓algyax (also called Coast Tsimshian) spoken in northwestern British Columbia and southeastern Alaska, as described by Dunn:

> "If a glottalized segment occurs before a vowel, the glottalic closure coincides with the consonant closure and the vocal cords are released after the consonant is released (k', k', p', t'). If the glottalized segment occurs after a vowel, the glottalic closure occurs before the consonant closure ('k, 'k, 'p, 't); if such a glottalized segment is word final, the vocal cords are unreleased thruout the production of the consonant sound. When a glottalized segment occurs between vowels, it is of the former type (k', p', t') if the second of the two vowels has the greater stress; it is of the latter type ('k, 'p, 't) when the first of the two vowels has the greater stress." (Dunn 1995, Part II: 4)

Such a scenario is hinted at by Salmons (1993: 24) but not elaborated upon.

Next, there is the fact that the traditional voiced stops were used only very infrequently in inflectional affixes and pronouns in Proto-Indo-European. Again, their use

in inflectional affixes becomes increasingly common in those daughter languages in which earlier glottalics (series II) have developed into plain voiced stops.

Finally, there are the root structure constraints. In traditional terms, the root structure constraints may be stated as follows (cf. Szemerényi 1996: 99):

Table 22: Proto-Indo-European root structure constraints

Possible	Impossible
1. Voiced-voiced aspirate (**bedh-*)	I. Voiced-voiced (**bed-*)
2. Voiced-voiceless (**dek-*)	II. Voiced aspirate-voiceless (**bhet-*)
3. Voiced aspirate-voiced (**bheid-*)	III. Voiceless-voiced aspirate (**tebh-*); III is, however, possible after **s-*: **steigh-* 'to go up'
4. Voiced aspirate-voiced aspirate (**bheidh-*)	
5. Voiceless-voiced (**ped-*)	
6. Voiceless-voiceless (**pet-*)	

From a typological perspective, the first forbidden root type (**bed-*) is rather odd. Roots of this type are widespread among the world's languages, and there is absolutely nothing to suggest that such a root type could not or should not exist in Proto-Indo-European. The only reasonable conclusion is that there is something wrong with the traditional reconstruction of the Proto-Indo-European stop system, specifically the plain voiced stops. This is, in part, what led to the suggestion that the traditional plain voiced stops may have been glottalics, since a constraint against the co-occurrence of two glottalics in a root is a recurrent feature in languages having glottalics (though not a universal). The substitution of glottalics for the traditional voiced stops allows for a rather straightforward reinterpretation of the root structure constraint laws. As noted above, the Proto-Indo-European root structure constraint laws turn out to be a simple voicing agreement rule with the corollary that two glottalics cannot co-occur in a root. It is likely that the forbidden root types existed at an earlier stage of development ("Pre-Proto-Indo-European"). Two rules may be formulated to account for the elimination of the forbidden types:

1. A rule of progressive voicing assimilation may be set up to account for the elimination of roots whose consonantal elements originally did not agree in voicing: **T* ~ **B* → **T* ~ **P*, **B* ~ **T* → **B* ~ **D*, etc.
2. A rule of regressive deglottalization may be set up to account for the elimination of roots containing two glottalics: **T'* ~ **K'* → **T* ~ **K'*, etc.

This brings us to an end of our study. We have reviewed the history of the reconstruction of the Proto-Indo-European consonant system, enumerated some well-known and often-repeated problems with the traditional reconstruction, argued that the Glottalic Model is a more probable reconstruction, and refuted criticisms of the Glottalic Model. In so doing, we have repeated some of what others have said before (see, in particular, Salmons 1993) and added new arguments and perspectives.

After being stagnant for a number of years, I think the time is ripe for re-igniting the dialog concerning the reconstruction of the Proto-Indo-European consonant system. This article attempts to do just that.

LIST OF ABBREVIATIONS OF LANGUAGES

Gk. Greek
Lat. Latin
OIr. Old Irish
OCS Old Church Slavic
Skt. Sanskrit

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