



Universiteit
Leiden

The Netherlands

Introduction: past, present, and future of the reconstruction of the Indo-European stop system

Pronk, T.C.; Kloekhorst, A.; Matasović, R.

Citation

Pronk, T. C., Kloekhorst, A., & Matasović, R. (2026). Introduction: past, present, and future of the reconstruction of the Indo-European stop system. In *Leiden Studies in Indo-European* (pp. 1-13). Leiden: Brill. doi:10.1163/9789004750449_002

Version: Publisher's Version

License: [Licensed under Article 25fa Copyright Act/Law \(Amendment Taverne\)](#)

Downloaded from: <https://hdl.handle.net/1887/4291477>

Note: To cite this publication please use the final published version (if applicable).

Introduction: Past, Present, and Future of the Reconstruction of the Indo-European Stop System

Tijmen Pronk, Alwin Kloekhorst and Ranko Matasović

1 The Traditional Reconstruction of the PIE Stop System and Its Typological Problems

In the nineteenth century, Indo-Europeanists reconstructed the Proto-Indo-European stop system as having the same series as Sanskrit, i.e. with voiceless, voiced, voiceless aspirated and voiced aspirated stops (see Figure 1.1; the four series are represented as **T*, **D*, **T^h*, and **D^h* respectively).

***p b ph bh* (labial).**
***t d th dh* (dental).**
***k g kh gh* (palatal).**
***q g qh gh* (velar).**

FIGURE 1.1

The stop system of Proto-Indo-European as reconstructed in Brugmann's classic comparative grammar of the Indo-European languages (1904: 20).

If there ever was a consensus about the phonetic interpretation of the PIE stops, it was the one represented in Brugmann's handbook (1904). However, by the middle of the 20th century it became widely recognized that the voiceless aspirates (the **T^h*-series) were an innovation within the Indo-Iranian branch, and the canonical reconstruction of the PIE stop system, found in most recent handbooks of Indo-European linguistics (e.g., Mayrhofer 1986; Fortson 2004; Clackson 2007; Beekes 2011), now consists of only three series: **T* ("*tenues*"), **D* ("*mediae*"), and **D^h* ("*mediae aspiratae*"). However, the phonetic interpretation of this system was problematic from the beginning. Already in the 1950s, André Martinet and Roman Jakobson cast doubts on the classical reconstruction by pointing out that it was typologically unrealistic, as there were, to their knowledge, no languages with voiced aspirates but lacking voiceless aspirates (Martinet 1955: 115; Jakobson 1958; see further Miller [this volume, Ch. 3] and Kloekhorst [this volume, Ch. 4]).

There followed several attempts at a revision of the traditional Brugmannian reconstruction of the PIE stop system. Although Martinet and Jakobson had focussed their attention on the *mediae aspiratae*, it soon became appar-

ent that the nature of the *mediae* was also open for debate. Already in 1951, Holger Pedersen noted the anomaly of the lack of a voiced bilabial (**b*) in PIE, and proposed a phonetic reinterpretation of the system, assuming that the traditional voiced stops were actually voiceless, and—vice versa—that the traditional voiceless stops were voiced, since the lack of the voiceless bilabial (/p/) is actually quite common in the languages of the world (Pedersen 1951: 10–16). This proposal was not accepted by anyone else, and André Martinet, in a footnote to his paper on Semitic consonantism in 1953, suggested that, rather than to accept such a “musical chairs” rearrangement of *mediae* and *tenuēs*, one should rather assume that the *mediae* developed from an earlier series of ejective stops without the bilabial member (/p/). This suggestion was soon forgotten, but in 1972 Soviet linguists Tamaz Gamkrelidze and Vyacheslav Ivanov revived it (apparently unaware of Martinet’s work), pointing out that in many languages of the Caucasus with three series of stops, it is often the bilabial ejective /p/ that is missing (Gamkrelidze & Ivanov 1972). In the same year, Paul J. Hopper independently proposed a similar reinterpretation of the PIE stop system with ejectives in the place of traditional *mediae* (Hopper 1973).¹ Around the same time, Jens Elmegård Rasmussen, also seemingly independently, suggested that the traditional *mediae* may have been emphatic stops (published in 1974).

Gamkrelidze and Ivanov also added some other arguments in favour of the glottalic interpretation of the **D*-series. One of their additional arguments is that it has long been noted that PIE had no roots of the shape **DVD*-, with two stops from the **D*-series, while roots with two stops from the other two series (i.e. stops of the shape **TVT*- and **D^hVD^h*-) were permitted. In many languages with glottalic stops, there is a restriction that allows only one glottalic stop per root (Gamkrelidze & Ivanov 1973: 153).² They also argued that a system with voiceless, glottalic, and aspirated stops (represented as **T* / **T'* / *T^hD^h* for traditional **T* / **D* / *D^h*) was typologically plausible.

1 Hopper’s paper was initially rejected by a publisher and appeared only a year later. Note that Gamkrelidze & Ivanov’s 1972 paper (in Russian) appeared in German in 1973.

2 The prohibition against roots of the structure **DVD*- (i.e. **TVT* in Gamkrelidze’s and Ivanov’s theory) can be understood as the result of a systemic dissimilation of two ejectives; such processes are typologically very common indeed, e. g. in Salishan languages such as Shuswap (Fallon 2002: 219–221). See further on this subject van Lieburg [this volume, Ch. 5].

2 The Reception of the Glottalic Theory

There followed a decade or two during which the “Glottalic Theory” was one of the most hotly debated topics in Indo-European linguistics. Gamkrelidze & Ivanov (1984: 962) touted the Glottalic Theory as “a new paradigm in Indo-European linguistics” (quoting Baldi) and especially Gamkrelidze published many papers on the subject, without adducing substantial new arguments in support of the theory (cf., e.g., Gamkrelidze 1987; 1989; 1990).

From its inception, the Glottalic Theory was met with a lot of scepticism. The critics questioned both the typological and the factual arguments of the proponents of the Glottalic Theory (Back 1979; Haider 1985; Huld 1986; Martínez 1997; Barrack 2002; 2003). It was argued, among other things, that ejectives, which are inherently voiceless, seldom develop directly into voiced stops,³ yet we find voiced reflexes of the proposed PIE ejectives (= *D*-series/*mediae*) in the majority of Indo-European branches: Indo-Iranian, Greek, Italic, Celtic, Balto-Slavic and Albanian. If the *D*-series indeed consisted of ejectives in PIE, then this change would have to have occurred independently in all of those branches, while in Germanic and Armenian a loss of glottalization would have to be assumed. Another counterargument that has been raised against the reconstruction of PIE ejectives is the fact that both Armenian and Germanic, which were supposed to preserve the original voiceless articulation of the PIE *D*-series = /t'/, have loanwords from other languages that seem to suggest that both branches underwent devoicing. Proto-Celtic **rīg*- ‘king’ (Gaulish *-rix*, Old Irish *rí*, gen. sg. *ríg*), for example, is reflected as Proto-Germanic **rīk*- (Gothic *reiks* ‘ruler’). It therefore seems to have been borrowed into Proto-Germanic before the operation of Grimm’s law, unless the donor form was the Proto-Celtic nom.sg. **rīks* (Bomhard 2016: 379). Likewise, it has been argued that Armenian *arcat*^c silver is borrowed from Iranian (cf. Avestan *ərəzata-*) rather than inherited from PIE **h₂rgnto-* (Latin *argentum*, Old Irish *airgid*, etc.), since inherited *-CnC- should have yielded Armenian *-CanC- instead of -CaC-.⁴ Armenian voiceless -c- in this word would have to have been devoiced from earlier *-j- or *-z- found in Iranian reflexes of the PIE word for ‘silver’. This, according to the critics of the Glottalic Theory, shows that the reflexes of the PIE *D*-series in Armenian must have also been subject to devoicing, i.e. that Armenian did not preserve the original voiceless articulation of the PIE ejet-

3 For typological parallels and potential evolutionary pathways of ejectives to voiced stops see Fallon 2002: 225–288 and Miller [this volume, Ch. 3].

4 Unless the second syllable of *arcat*^c was influenced by that of *erkat*^c ‘iron’.

ives (Job 1995). It was also pointed out that Indo-European loanwords with stops belonging to the **D*-series do not have ejectives in Kartvelian languages, in which this articulation type is widespread and old (Gippert 1994).

In spite of Gamkrelidze and Ivanov's efforts, their "new paradigm" was not accepted by the majority of Indo-Europeanists in the decade that followed the publication of their first paper. To many, the Glottalic Theory looked like a new and transient vogue, rather than a new paradigm in Indo-European studies.

3 The Accumulation of Comparative Evidence for the Glottalic Theory

In spite of its critics, the Glottalic Theory caught a second wind chiefly due to Frederik Kortlandt, who, in a series of publications, argued that there were not only typological arguments in favour of the Glottalic Theory, but that there was also comparative evidence. Kortlandt's claim was that a glottalic reconstruction would provide a natural explanation for the stop systems of Armenian (where some Eastern Armenian dialects have glottalized consonants as outcomes of the PIE **D*-series, Kortlandt 2010: 57–61), Sindhi (which has a series of implosive stops corresponding to the voiced stops of Sanskrit, Kortlandt 2010: 121–124), and Germanic (where the glottalic realization of English stops in coda position and the so-called "vestjysk stød" are part of the reflexes of the PIE **D*-series, Kortlandt 2010: 165–199). None of those proposals have been generally accepted (for a criticism see, e.g., Kümmel 2012). In addition to the comparative evidence for a glottalic series of stops, a number of sound laws that involve the PIE **D*-series have been argued to receive a more natural explanation in the Glottalic Theory: Winter's law in Balto-Slavic, Lachmann's law in Italic, Lubotsky's law in Indo-Iranian and the inner-PIE sound change **d > *h_l* (the so-called Kortlandt effect) (Kortlandt 2010: 55–63; Lubotsky 1981; see further the chapters by Matasović, Eskes, de Vaan, and Pronk in this volume [Ch. 6, 7, 15, 16]).

The debate remained alive, e.g. during a conference in Pavia 1985, which was partly dedicated to the discussion of various elements of the Glottalic Theory (papers published in Vennemann 1989). Useful overviews of the history of the Glottalic Theory and discussions of various types of arguments can be found in Salmons (1993), Bomhard (2016), Kortlandt (1995; 2020), Kloekhorst (2016: 232–235) and in Kümmel's chapter in this volume [Ch. 2].

4 The Many Stop Systems of PIE

Among scholars who proposed a realization of the PIE *D*-series that is different from plain voiced, there is no agreement about its exact realization (see Table 1.1). Many proponents of the Glottalic Theory argued for ejective realization (i.e. voiceless post-glottalized stops) of the PIE *D*-series, but in order to account for the fact that in many branches of IE the outcome of the stops is voiced, it has also been proposed that they were voiced or lenis preglottalized stops (Kortlandt 1985: 197), ‘stiff-voiced’ or ‘creaky-voiced’ (Clackson 2007: 48) or implosives (Haider 1985; Kümmel 2012). Salmons (1993: 70) observed that “[a]lternation within a single series between implosives (almost universally voiced) and ejectives (overwhelmingly voiceless) is well-attested cross-linguistically and such alternations can be captured by describing the series simply as glottalic.”

Most typological anomalies of the traditionally reconstructed system do not require the latest reconstructable PIE to have had a glottalic series, because they can have arisen in a precursor of PIE that did have a glottalic series (Haider 1985: 6). The reconstruction of the latest common ancestor of all Indo-European language therefore largely depends on the comparative evidence, rather than on typological considerations. Accordingly, Haider’s non-traditional reconstruction is specifically pre-PIE (so is, e.g., Pedersen’s reconstruction). For PIE proper, Haider accepts the traditional interpretation.

In most new proposals since the 1970s, aspiration is no longer a contrastive feature. In the proposed reconstructions by Andreev, Vennemann, Kortlandt, Kloekhorst, and Matasović, voice is not a contrastive feature on its own, i.e. either not at all, or only in combination with other factors like duration.

5 Allophonic and Diachronic Variation

Obviously, the realization of Proto-Indo-European stops may have varied both according to phonetic environment and over time, and the diachronic behaviour of specific stops or stop series in certain environments may therefore give interesting insights into their possible reconstruction. For instance, in word-final position, the three stop series merged into the *D*-series, which according to many scholars was a pre-PIE development, but which may have also taken place later in time.⁵ Since word-final voicing is cross-linguistically rare, if not

5 See Kloekhorst 2016: 220–222 and [this volume, Ch. 11] for the claim that the three series had not yet merged in word-final position in Hittite, which would imply that the merger is at least a post-Anatolian development.

TABLE 1.1 Proposed phonetic interpretations of the PIE stop series

<i>*T</i>	<i>*D</i>	<i>*D^h</i>	
voiceless	voiced	voiced aspirated	Traditional
voiceless	voiced	aspirated	Kuryłowicz 1935
voiceless	voiced	lenis fricatives	Prokosch 1939
voiced	voiceless	voiceless aspirated	Pedersen 1951
fortis	lenis	aspirated	Andreev 1957 ^a
voiceless aspirated	voiceless	voiced aspirated	Edmonds 1972
voiceless aspirated	ejective	voiced aspirated	Gamkrelidze & Ivanov 1972
voiceless	ejective	murmured	Hopper 1973
voiceless	ejective	voiced	Miller 1977; Bomhard 1979 ^b
voiceless aspirated	ejective	plain	Vennemann 1984
voiceless	implosive	voiced	Haider 1985; Kümmel 2012
fortis	ejective	lenis	Kortlandt 2010: 38; ^c Matasović [this volume, Ch. 6]
long voiceless	preglottalized short voiceless	short voiceless	Kloekhorst 2016

a For early PIE, Andreev (1957: 8) reconstructed **T* as emphatic, **D* as fortis, and **D^h* as lenis. These all became less “intensive” to produce the PIE system fortis—lenis—aspirated.

b Rasmussen (1974: 11) had already proposed a similar pre-PIE system, in which **D* was an “emphatic stop however phonetically realized (glottalized, pharyngealized, or just stronger)”.

c For late PIE, after Anatolian and Tocharian had split off, Kortlandt reconstructed **D* as preglottalized lenis. In earlier publications, he had reconstructed the PIE system as voiceless—ejective—voiceless aspirated (1978: 107) and as fortis—glottalic lenis—aspirated lenis (1985: 197–198), later suggesting that **D^h* may not have been aspirated (2004).

non-existent, the merger of **-T*, **-D* and **-D^h* into the *D*-series may have repercussions for the reconstruction of this series for the moment in time the merger took place. It is typologically more attractive to assume, for instance, that the three series merged into unreleased lenis stops (thus Lipp 2016), or into non-explosives (Kümmel 2012: 303). Another example is the fact that, in some positions, PIE **d* appears to have merged with **h₁*, the so-called “Kortlandt effect”. Exactly when and in which environments this change took place and to what extent these conditions may be useful for the precise reconstruction of the (allophonic) realization(s) of both **d* and **h₁* are questions that will be explored in the chapters by Matasović and Eskes in this volume [Ch. 6 and 7]. A third example is the fact that stops that are part of consonant clusters sometimes undergo specific changes. In some cases this happened already in

the parent language, but in other cases only in the (pre)history of specific daughter languages. A case in point is the generally accepted fact that, an epenthetic sibilant arose in clusters of two dental stops already in Proto-Indo-European: pre-PIE **TT* > PIE **TsT*.⁶ Less clear is the development of the so-called “thorn-clusters”: did these show specific developments already in Proto-Indo-European (thus Schindler 1977) or are we dealing with language specific developments (thus Kloekhorst 2014 [2016])?; and do their developments have repercussions for the reconstructions of individual stops? (see, e.g., Kloekhorst & Lubotsky [this volume, Ch. 8] on Gr. ἰχθῦς ‘fish’ and ἰκτίς ‘kite’). Likewise, the phonetic details and chronology of Bartholomae’s Law—the assimilation of **D^hT* to **DD^h*—are still a matter of debate, see, e.g., Kuryłowicz (1935: 50–51), Mayrhofer (1986: 115–117) and Pronk [this volume, Ch. 9].

Another potential consequence of the possibility that the realization of stops may have varied depending on their phonetic environment is that—if the PIE *mediae* are reconstructed as glottalic stops—the timing of the glottal closure may have been dependent on their position in the word or syllable. This might explain why some arguments in favour of the Glottalic Theory support the reconstruction of ejectives, while other arguments support the reconstruction of preglottalized stops (Bomhard 2016: 387, who adduces a typological parallel for such allophonic variation from Coast Tsimshian). Therefore, the reconstruction of ejectives for (any stage of) PIE, as in the earliest versions of the Glottalic Theory, does not necessarily contradict the reconstruction of preglottalized lenes as per Kortlandt or implosives as per Haider (the latter two are phonetically very similar). Apart from an allophonic distribution, other types of variation are also conceivable. Salmons (1993: 70), for example, suggested that perhaps there was a dialectal divide between branches with reflexes of ejectives (Germanic, Armenian, Anatolian, Phrygian) and branches with reflexes of implosives (the rest). Kortlandt (2018), on the other hand, argued for a diachronic distinction. In his reconstruction, preglottalized lenes **ʔD* evolved from earlier ejectives and the PIE system evolved into voiceless **T* – preglottalized voiced **ʔD* – voiced **D* after Anatolian and Tocharian had split off from the rest of PIE. He proposed that the early-PIE ejectives were an areal phenomenon connecting Indo-European and the languages of the Caucasus.

6 Note that Melchert (2003: 154) proposed that the same is true for “thorn-clusters”, i.e. pre-PIE **TK* > **TsK*, but this has been disputed, see Kloekhorst (2008: 861–862) and Lipp (2009: 61–70).

6 Outlook and Purpose of This Book

Today, the Glottalic Theory is accepted in only a few contemporary handbooks and textbooks of Indo-European linguistics. Szemerényi (1990: 169–173) rejects it as unfounded, Meier-Brügger (2003: 126) states that “... doubts as to the justification of the glottal approach to Proto-Indo-European have not been dismissed. Thus, glottals shall not be taken into account in present reconstructions”, and Kapović (2017: 18) remains sceptical, although he admits that the reconstruction of glottalized stops is possible for pre-PIE. Clackson (2007), Fortson (2010) and Byrd (2018) are also sceptical with regard to the glottalic theory. Those textbooks and handbooks in which the glottalic theory is accepted remain a minority: they include the short introduction to Indo-European linguistics by Gercenberg (2010) and the textbook by Beekes (2011), and of course the handbook by Gamkrelidze & Ivanov (1984). Thus, it is only fair to say that, as far as the scholarly community is concerned, the Glottalic Theory remains a controversial theory.

The debate about the nature of the *mediae aspiratae*, which was the focus of the literature about the PIE stop system in the middle of the 20th century, can no longer be separated from the controversy about the nature of the *mediae* that started with Pedersen’s observations in 1951. Those handbooks that accept a version of the Glottalic Theory also advocate an interpretation of the *mediae aspiratae* in which they are not voiced aspirated or breathy voiced stops, while those that reject the Glottalic Theory reconstruct voiced aspirated or murmured stops.

It seems fair to say that a growing number of scholars agree that the traditional reconstruction of the PIE stop system is probably wrong, but that no consensus exists on a viable alternative. There is, however, every reason to be optimistic that progress can still be made. Our knowledge of the synchronic and diachronic typology of stop systems has increased over the last decades. The present volume aims to give an up-to-date overview of the relevant data and arguments that play a role in the reconstruction of the stop system of PIE and the proto-languages of its branches.

The first half of this book is dedicated to more general discussions that touch upon the stop systems of Indo-European and their reconstruction. The chapter by Kümmel [Ch. 2] evaluates the contribution that the glottalic theory has made to the reconstruction of PIE. The chapters by Miller on Jakobson’s universal [Ch. 3] and by Kloekhorst on the so-called Cao Bang shift [Ch. 4] address the typology of stop systems and their evolution. Our typological and theoretical understanding of root structure has greatly improved, as shown by van Lieburg in her chapter on PIE root constraints [Ch. 5]. The chapters by Mataso-

vić [Ch. 6] and Eskes [Ch. 7] provide an up-to-date evaluation of the Kortlandt effect and its consequences for the reconstruction of PIE stops. Stop clusters and their realization are analyzed in the chapters by Kloekhorst & Lubotsky [Ch. 8] and Pronk [Ch. 9]. Finally, a discussion of diachronic relations between length and voice distinctions in stop systems is offered in the chapter by Kloekhorst [Ch. 10].

The second half of the volume is dedicated to the evolution of the stop system of the individual branches of PIE: Anatolian [Ch. 11 by Kloekhorst], Tocharian [Ch. 12 by Peyrot], Italo-Celtic [Ch. 13 by Schrijver], Germanic [Ch. 14 by Salmons], Indo-Iranian [Ch. 15 by de Vaan], Balto-Slavic [Ch. 16 by Pronk], Albanian [Ch. 17 by Kloekhorst], Greek and Phrygian [Ch. 18 by Ligorio], and Armenian [Ch. 19 by Sayeed & Vaux]. It is concluded by the chapter by Kloekhorst & Pronk on the reconstruction of the Proto-Indo-European stop system [Ch. 20].

The history of the stop systems of the Indo-European branches has often been viewed through the lens of the traditional reconstruction of PIE. In this volume, however, the focus is on branch-internal arguments for the reconstruction of the stop system of the proto-languages of the individual branches and that of intermediate proto-languages like Proto-Indo-Iranian and Proto-Graeco-Phrygian.⁷ This leads to a more balanced discussion of the relevant data that does justice to the fact that each branch has a long internal history, often spanning several millennia.

References

- Andreev, Nikolaj D. 1957. Periodizacija istorii indoevropskogo prajazyka. *Voprosy Jazykoznanija* 6/2, 3–18.
- Back, Michael. 1979. Die Rekonstruktion des indogermanischen Verschlusslautsystems im Lichte der einzelsprachlichen Veränderungen. *Zeitschrift für vergleichende Sprachforschung* 93/2, 179–195.
- Barrack, Charles M. 2002. The Glottalic Theory revisited: A negative appraisal. *Indogermanische Forschungen*, 107, 76–95.

7 In accordance with current views on Indo-European cladistics (Olander 2022), the following branches have been discussed together: Indic and Iranian, Baltic and Slavic, Italic and Celtic, and Greek and Phrygian. None of these groupings are (primarily) based on their stop systems.

- Barrack, Charles M. 2003. Part II: The typological fallacy underlying the Glottalic Theory. *Indogermanische Forschungen* 108, 1–16.
- Beekes, Robert S.P. 2011. *Comparative Indo-European Linguistics*. Amsterdam–Philadelphia: John Benjamins.
- Bomhard, Alan R. 1979. The Indo-European phonological system: New thoughts about its reconstruction and development. *Orbis* 28/1, 66–110.
- Bomhard, Alan R. 2016. The glottalic model of Proto-Indo-European consonantism: Reigniting the dialog. *Slovo a slovesnost* 77/4, 371–391.
- Brugmann, Karl. 1904. *Kurze vergleichende Grammatik der indogermanischen Sprachen*. Strassburg: K.J. Trübner.
- Byrd, Andrew Miles. 2018. The phonology of Proto-Indo-European. In: Jared S. Klein, Brian D. Joseph, and Matthias Fritz (eds.), *Handbook of Comparative Indo-European Linguistics*, vol. 3, 2056–2079. Berlin–Boston: Mouton de Gruyter.
- Clackson, James. 2007. *Indo-European Linguistics. An Introduction*. Cambridge: Cambridge University Press.
- Edmonds, Joseph. 1972. A reformulation of Grimm's law. In: Michael K. Brame (ed.), *Contributions to Generative Phonology*, 108–122. Austin, TX–London: University of Texas Press.
- Fallon, Paul D. 2002. *The Synchronic and Diachronic Phonology of Ejectives*. New York: Routledge.
- Fortson, Benjamin W. IV. 2010². *Indo-European Language and Culture. An Introduction*. Oxford: Blackwell.
- Gamkrelidze, Tamaz V. 1987. Glottal'naja teorija: novaja paradigma v indo-evropejskom sravnitel'nom jazykoznanii. *Voprosy Jazykoznanija* 1987/4, 26–35.
- Gamkrelidze, Tamaz V. 1989. Language typology and Indo-European reconstruction. In: Theo Vennemann (ed.), *The New Sound of Indo-European. Essays in Phonological Reconstruction*, 117–123. Berlin: Mouton De Gruyter.
- Gamkrelidze, Tamaz V. 1990. The Indo-European Glottalic Theory in the light of the recent critique. *Folia Linguistica Historica* 9, 3–12.
- Gamkrelidze, Tamaz V. and Vjačeslav V. Ivanov. 1972. Lingvističeskaja tipologija i rekonstrukcija sistemy smyčnyx. In: S.B. Bernštejn (ed.), *Konferencija po sravnitel'no-istoričeskoj grammatike indoevropskix jazykov (12–14 dekabrja)*. *Predvaritel'nye materialy*, 15–18. Moscow: Nauka.
- Gamkrelidze, Tamaz V. and Vjačeslav V. Ivanov. 1973. Sprachtypologie und die Rekonstruktion der gemeinindogermanischen Verschlüsse. *Phonetica* 27/3, 150–156.
- Gamkrelidze, Tamaz V. and Vjačeslav V. Ivanov. 1980. Rekonstrukcija sistemy smyčnyx obščeeindoevropskogo jazyka. Glottalizovanye smyčnye v indoevropejskom. *Voprosy Jazykoznanija* 1980/4, 21–35.
- Gamkrelidze, Tamaz V. and Vjačeslav V. Ivanov. 1984. *Indoevropskij jazyk i indo-*

- evropejcy*. Tbilisi: Izdatel'stvo Tbilisskogo Univerziteta. [translated into English as *Indo-European and the Indo-Europeans. A Reconstruction and Historical Analysis of a Proto-Language and a Proto-Culture*, Berlin–New York: Mouton De Gruyter, 1995.]
- Gercenberg, Leonid G. 2010. *Kratkoe vvedenie v indoevropeistiku*. Sankt-Peterburg: Nestor-Istorija.
- Gippert, Jost. 1994. Die Glottaltheorie und die Frage urindogermanisch-kaukasischer Sprachkontakte. In: Jens Elmegård Rasmussen (ed.), *In Honorem Holger Pedersen. Kolloquium der Indogermanischen Gesellschaft vom 26. bis 28. März 1993 in Kopenhagen*, 107–123. Wiesbaden: Reichert.
- Haider, Hubert. 1985. The fallacy of typology—remarks on the PIE stop system. *Lingua* 65, 1–27.
- Hopper, Paul. 1973. Glottalized and murmured occlusives in Indo-European. *Glossa* 7, 141–166.
- Huld, Martin. 1986. On the unacceptability of the Indo-European voiced stops as ejectives. *Indogermanische Forschungen* 91, 67–78.
- Jakobson, Roman. 1958. Typological studies and their contribution to historical comparative linguistics. In: Eva Sivertsen, Carl H. Borgstrøm, Arne Gallis, and Alf Sommerfelt (eds.), *Proceedings of the Eighth International Congress of Linguists*, 17–25. Oslo: University Press.
- Job, Michael. 1995. Did Proto-Indo-European have glottalized stops? *Diachronica* 12, 237–251.
- Kapović, Mate. 2017. Proto-Indo-European phonology. In: Mate Kapović (ed.) *Indo-European Languages*, 13–60. London: Routledge.
- Kloekhorst, Alwin. 2014 [2016]. Proto-Indo-European “thorn”-clusters. *Historische Sprachforschung* 127, 43–67.
- Kloekhorst, Alwin. 2016. The Anatolian stop system and the Indo-Hittite hypothesis. *Indogermanische Forschungen* 121, 213–247.
- Kortlandt, Frederik. 1985. Praindoevropejskie glottalizovannye smyčnye. *Voprosy Jazykoznanija* 1985/4, 43–53 = 1985. Proto-Indo-European glottalic stops: The comparative evidence. *Folia Linguistica Historica* 6/2, 183–201.
- Kortlandt, Frederik. 1995. General linguistics and Indo-European reconstruction. *Rask* 2, 91–109.
- Kortlandt, Frederik. 2004. Indo-Uralic consonant gradation. In: Irma Hyvärinen, Petri Kallio, and Jarmo Korhonen (eds.), *Etymologie Entlehnungen und Entwicklungen: Festschrift für Jorma Koivulehto zum 70. Geburtstag*, 163–170. Helsinki: Société Néophilologique.
- Kortlandt, Frederik. 2010. *Studies in Germanic, Indo-European and Indo-Uralic*. Amsterdam–New York: Rodopi.
- Kortlandt, Frederik. 2018. Proto-Indo-European glottalic consonants: The evidence revisited. *Münchener Studien zur Sprachwissenschaft* 71/1, 147–153.

- Kortlandt, Frederik. 2020. How I discovered Proto-Indo-European glottalic stops. *Journal of Indo-European Studies* 49, 1–12.
- Kümmel, Martin Joachim. 2012. Typology and Reconstruction. In: Benedicte Nielsen Whitehead et al. (eds.), *The Sound of Indo-European. Phonetics, Phonemics and Morphophonemics*, 291–330. Copenhagen: Museum Tusculanum.
- Kuryłowicz Jerzy. 1935. *Études indoeuropéennes*. Kraków: Skład główny w księgarni Gebethnera i Wolffa.
- Lipp, Reiner. 2009. *Die indogermanischen und einzelsprachlichen Palatale im Indoiranischen. Band 1: Neurekonstruktion, Nuristan-Sprachen, Genese der indoarischen Retroflexe, Indoarisch von Mitanni. Band 11: Thorn-Problem, indoiranische Laryngalkonvokalisation*. Heidelberg: Winter.
- Lipp, Reiner. 2016. Final stops in Indo-European: their phonological classification as a key to the Proto-Indo-European root structure constraint. *Slovo a slovesnost*, 77/4, 251–299.
- Lubotsky, Alexander. 1981. Gr. *pégnumi* : Skt. *pajrá-* and loss of laryngeals before mediae in Indo-Iranian. *Münchener Studien zur Sprachwissenschaft* 40, 133–138.
- Martinet, André. 1953. Remarques sur le consonantisme sémitique. *Bulletin de la Société Linguistique de Paris* 49, 67–78.
- Martinet, André. 1955. *Economie des Changements Phonétiques: Traité de Phonologie Diachronique*. Berne: Francke.
- Martínez, Javier. 1997. Tipología frente a tipología. Nuevos frentes de la hipótesis glotállica. *Revista de la Sociedad Española de Lingüística* 27, 115–134.
- Mayrhofer, Manfred. 1986. *Indogermanische Grammatik, Band 1. 2. Halbband: Lautlehre (Segmentale Phonologie des Inogermanischen)*. Heidelberg: Winter.
- Meier-Brügger, Michael. 2003. *Indo-European Linguistics*. Berlin–New York: De Gruyter.
- Melchert, H. Craig. 2003. PIE ‘thorn’ in Cuneiform Luvian? In: Karlene Jones-Bley et al. (eds.), *Proceedings of the Fourteenth Annual UCLA Indo-European Conference, Los Angeles, November 8–9 2002*, 145–161. Washington, D.C.: Institute for the Study of Man.
- Miller, D. Gary. 1977. Some theoretical and typological implications of an Indo-European root structure constraint. *Journal of Indo-European Studies* 5, 31–130.
- Olander, Thomas (ed.). 2022. *The Indo-European Language Family: A Phylogenetic Perspective*. Cambridge: Cambridge University Press.
- Pedersen, Holger. 1951. *Die gemeindoeuropäischen und vorindoeuropäischen Verschlusslaute*. Copenhagen: Munksgaard.
- Prokosch, Eduard. 1939. *A Comparative Germanic Grammar*. Baltimore, Md.: Linguistic Society of America.
- Rasmussen Jens Elmegård. 1974. *Haeretica Indogermanica: A Selection of Indo-European and Pre-Indo-European Studies*. Copenhagen: Munksgaard.

- Salmons, Joseph C. 1993. *The Glottalic Theory: Survey and Synthesis*. Washington, D.C.: Institute for the Study of Man.
- Vennemann, Theo. 1984. Hochgermanisch und Niedergermanisch: Die Verzweigungstheorie der germanisch-deutschen Lautverschiebungen. *Beiträge zur Geschichte der deutschen Sprache und Literatur* 106, 1–45.
- Vennemann, Theo (ed.). 1989. *The New Sound of Indo-European. Essays in Phonological Reconstruction*. Berlin: Mouton De Gruyter.