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THE PHONETICS OF PIE *D, II: THE EVIDENCE FROM DAUGHTER LANGUAGES

Abstract

*In numerous IE languages, either their synchronic fact or the diachronic processes reveal some level of asymmetry in the area of coronal obstruents, specifically the stops and the nasal, or their reflexes resulting from various phonetic processes as assibilation, palatalization, or lenition. Especially the evidence from Germanic, Greek, Italic, Tocharian, and Anatolian supports the hypothesis that such a symmetry is a shared and possibly inherited feature of their phonology. Data from Indic and Armenian may also provide further support, while the merger of the voiced stops and voiced aspirated stops in Iranian, Balto-Slavic, Albanian and Celtic make their evidence less reliable. Overall, the evidence points toward the reflexes of PIE *d patterning with PIE *n, while the reflexes of *d^h and *t often result in markedly different outcomes of the same individual changes which also at the same stage target *d. The apical character of *d is the best explanation of the frequent shift towards, on the one hand, rhotics and laterals, on the other, to sibilants realized at a different articulatory position than that of the other members of the same dental-alveolar series.*

Keywords

Proto-Indo-European; Indo-European languages; phonology; coronal; assibilation

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1 The data

As this paper represents a first step in research into the asymmetries in the apical × laminal character of the outcomes of PIE coronals, the amount of data involved in this analysis is limited mostly to the best attested languages and several phenomena will of necessity be treated only superficially, especially possible further evidence related to language contact, as well as the evidence of minor languages (either within or outside major branches). The hypothesis confronted with the data in the separate branches is the following: the proto-language(s) inherited an asymmetry in the coronal class, i.e. PIE **t* and **d*^{h} were laminal, the PIE **d* was apical, and this asymmetry is in different ways continued into the (pre)history of the separate branches.

The first step in each case is to scrutinize the behaviour of the reflexes of this class in separate languages in search of possible asymmetries and then to evaluate to what degree may such asymmetries be inherited and explained by common descent. In the light of the general tendencies of PIE **d* (Bičovský 2021, this volume) the most likely changes to reveal such an asymmetry are movements on the sonority scale towards affricates, fricatives, and approximants, gradual or abrupt, phonological mergers, and assimilatory processes, in which the members of this class function as either triggers, or targets. Ideally, these changes should be of such a nature that they would typically (cross-linguistically) involve larger classes of sounds (e.g. all obstruents, or all stops, etc.) and are largely independent of the articulatory position. These are especially: assibilation and lenition/fortition, and palatalization. Other changes may be revealing a phonetic proximity to other segments, which is the case of merger, but also of dissimilation.

Especially those cases are of interest, where the three segments appear to behave asymmetrically contrary to expectations, and ideally, reflexes of **t* and **d*^{h} operate in unison (which for the voiced coronal is often difficult to prove even in languages where there was no merger of these series, e.g. Vedic). It should be stressed here that the observation that there is frequently an asymmetry in this series does not necessarily translate to proof of the retracted character of **d*, even if the data appear to be consistent with this position. Also, the data are of various types, some necessarily rest on reconstruction, others are based also on consideration of the writing systems in question, or on possible contact phenomena.

A separate problem is implied in the different treatment of the opposition of the three PIE series of stops. In the extreme case of Tocharian, all three coalesce. In a number of branches, only the contrast between the voiced series was neutralized, separately in the history of each branch, for which there are indications at least in some of them: Balto-Slavic (Winter's law must have operated before this merger), Celtic (e.g. the different behaviour of the outcomes of **g*^{w} as **b vs.* **g*^{wh} as **g*^{w}), Iranian (Bartholomae's law is clearly pre-merger in Indo-Iranian), Albanian (no traces), and

Anatolian (whether any changes occurred before the merger is uncertain, see 3.3.). Any contrast with the outcomes of the PIE (supposed) apical **d vs.* dental **t* could only be preserved on the condition that the merger in the voiced series favoured the apical. Given that **d*^{h} was both more frequent and possibly less marked than **d*, it is likely that the neutralization favoured a laminal-alveolar place of contact.

Greek, Indic, Armenian, Italic, and Germanic continue the three series (with only contextual mergers). Clearly, a merger of an apical and laminal segment results in a single outcome (with extended allophony) – it is a matter of another study to examine the possible indications as to which articulation became dominant. The mergers, or lack thereof, in the five branches where **d* and **d*^{h} remain distinct are, however, valuable evidence for establishing phonetic proximity between the continuants of these PIE phonemes at any stage.

1.1 Germanic

An inclination of the reflexes of PIE **t *d*^{h} to the laminal (dental) pronunciation is revealed already by the first sound shift (Grimm's law), while the position of **d* is less clear, and may perhaps be inferred from the later changes in OHG. The first systemic change of stops in Germanic is the Grimm's law whereby, the PIE **p *t *k *k*^{w} shifted to PGerm. **f *þ *χ *χ*^{w}, PIE **b *d *g *g*^{w} developed into PGerm. **p *t *k *k*^{w}, and PIE **b*^{h} **d*^{h} **g*^{h} **g*^{wh} became PGerm. **β/*b *ð/*d *γ *w*. In all probability, the feature which accounts for the first shift of tenues to fricatives is aspiration (Ringe 2006, 214–15), which is also relevant for the change in OHG. The subsequent conditioned voicing of voiceless fricatives resulted in merger with their voiced counterparts, thus securing their phonetic proximity (i.e. **þ* merging with **ð* in Verner's law). Ringe (2006, loc. cit.) explicitly refers to PGerm. **t *d *þ *n *l* as *dentals* as opposed to *alveolar *s *z *r*, but goes on to say that "It is possible that the dental stop had become alveolar," without any further discussion (i.e. both dental stops, or some of them?), so that it is only possible to speculate that he had in mind the effects of the changes in OHG.

An indication of possible asymmetry is possibly manifested in the second Lautverschiebung of OHG, where the reflexes of PGerm. **t* (of PIE **d*) are assibilated to (what in modern German is) a laminal affricate *t*^{s} or fricative *s*. As this assibilation is the result of a systemic shift (an effect of aspiration) rather than of an assimilation (e.g. palatalization), the explanation for this specific movement must lie in its basic articulatory position, about which the least conclusion to be made is the following: the position of the active articulator vis-à-vis the palate was different from the position of the pre-Grimm PGerm. **t* and while the original trigger for the shift may have been the same (aspiration), the results are markedly different. The OHG scribes consistently discriminated from the earliest period between the outcome of this spirantization (<z> or <zz>) and the original sibilant (<s>), which most probably was apical (note that it is borrowed into Czech as /ʃ/ and /ʒ/, e.g. OHG *rōsa*

'rose' > Cz. *růže*), which implies only that the early OHG *t* was either post-laminal alveolar, which entails a movement of the apex to a position relatively fronted with respect to the alveolar ridge (i.e. this pronunciation is in fact even further from the apical-alveolar proposed for the PIE **d*) or post-alveolar laminal (which is a position closer to the expected alveolar-apical in terms of the palate, but not in terms of the tip of tongue). It is, however, also conceivable that the segment was apical, and the shift to a laminal was a matter of dissimilation from the original apical sibilant **s*. Thus the double outcome of assibilation of the reflexes of PIE **t* and **d* in Germanic are suggestive of some kind of asymmetry, inherited, or created during the evolution of Proto-Germanic to OHG, but is not directly indicative of the phonetic details of the reflexes of PIE **d*.

1.2 Greek

Greek presents a number of individual changes which may be indicative of a tendency of the voiced member of the alveolar/dental series to be articulated with the apex against the alveolar ridge. These are of a mixed character: some evidence may be deduced from the writing system(s), some from individual changes.

1.2.1 Adoption of Linear B and the alphabet

The reconstruction of the Proto-Greek system and the changes which are already revealed in the early dialects of the 1st millennium, received a considerable impulse by the discovery of the documents of the Mycenaean era. These in turn rely on their interpretation on the later stages and also on the comparative evidence. This is due particularly to the writing system inherited and adopted from Minoans, which is inadequate to represent a language with complex phonotactic structures, contrast in vocalic length, and a large stop inventory. In this respect, the Linear B writing system is surprisingly asymmetrical with respect to the coronal stop series[1]. While as a rule, each triad of stops is represented by a single series of syllabograms, e.g. /k/, /g/, and /k^h/ are represented by *Ka Ke Ki Ko Ku*, this is not so with coronals, where /d/ is represented differently from both /t/ and /t^h/, the descendants of PIE **t* and **d^h*.

That there was some level of similarity between the Pre-Greek phoneme represented by <*da*> and Greek *l* is e.g. by spelling of what later is a lateral in λαβύρινθος as *da-pu$_2$-ri-to* suggest, a situation reminiscent of the Latin change of (or borrowing of) *d* > *l* (for which see below 3.4.). Thus one possible (and in fact tempting) conclusion is that the series <*dV*> represents a lateral of some sort, albeit closer in pronunciation to Greek *d* than to *l*, which in turn makes this assumption problematic, if not immediately to be discarded. Another logical possibility, i.e. that the Minoan language

1 For the attempts to interpret *pu$_2$* as /bu/ in Witczak (1993), see now Judson (2017), who argues convincingly that the sign represented /p^{h}u/.

only distinguished [voice] in the dental series, is also possible, a situation reminiscent of Finnish: "Moreover, if the opposition were a genuine voice opposition, one would expect that all those speakers who have the phoneme /d/ also find it easy to pronounce [b] and [g], and to systematically distinguish between /p/ and /b/, and between /k/ and /g/. But this does not seem to be the case: speakers who have /d/ in their paradigm do not necessarily have /b/ and /g/ in their native paradigm, and they do not necessarily master the corresponding oppositions in foreign languages. On several criteria, then, /d/ is an odd one among the Finnish consonants, and hard to classify for its manner of articulation." (Suomi et al. 2009, 34).

Another view is that of Davis (2014), who supposed a voiced fricative δ, again, a possibility in principle, but typologically improbable (e.g. one would expect to find voiceless counterparts etc.), but here again, the example of Finnish is illustrative (Suomi et al. loc. cit.): "The synchronic phonetic and systemic oddity of /d/ has its explanation in the unusual way in which the consonant entered and spread in the language. What is now /d/ in the native vocabulary, was a few centuries ago /ð/ for all speakers. For example, the equivalent of the modern *sydän* [sydæn] "hear" was pronounced [syðæn]."

Thus in principle, Minoan may have had a full inventory of voiceless stops + a voiced *d* or ð, but the Finnish system is a result of language contact, and Minoan would have to adopt loans from other languages (even, presumably, Greek, or Anatolian). Of course, Greeks might have adopted only those syllabograms which found more or less direct counterpart in their phonology, and so e.g. if Linear A hypothetically used *fV* or *θV* series, these would have found no use in Mycenaean, but this is a speculation at best. Thus the most convincing solution is that the Minoan language (note: I use Minoan as a cover term for the language from the speakers of which Greeks adopted Linear B, but which nothing is implied as to the language behind Linear A) systematically distinguished between the articulatory position [dental] and [alveolar], or [dental] and [retroflex] (for more on this position, see Risch – Hajnal (2006, 273) who however speculate about an interdental pronunciation for the *d*-series, while in principle the same could be speculated about the *t*-series[2]).

All this implies inevitably that the articulatory position of Mycenaean *d* was markedly different from *t* and t^h and this detail, perhaps not appreciated by Greeks themselves, led to the adoption of the "apical" series. The Cypriot syllabary, though clearly cognate with Linear B, does not share this anomaly, and on the one hand, there exists a separate series for *lV*, on the other hand, the *dV* series is missing. However, the straightforward solution – formal proximity of the Linear B *d*-series

2 "Es lässt sich spekulieren, dass sich die *d*-Reihe in Linear B aus einer in der Artikulationsstelle leicht divergierenden Reihe von Linear A rekrutiert (denn Artikulationsarten warden in Linear B bei Verschlusslauten ansonsten nicht unterschieden). Am ehesten kommt als Vorbild für die myk. *d*-Reihe eine Zeichengruppe in Frage, die in Linear A einen Interdental ausdrückt."

and Cypriot *l*-series – is not defendable, as the separate signs do not show any regular similarity to their Linear B (supposed) models[3]. As for the exact phonetic nature PGk. **l* and its possible allophones, what little evidence there is points in the direction of an alveolar lateral, perhaps even velarized: the outcome of the syllabic **l* is a syllable containing the result of a prop-vowel which unlike in Balto-Slavic or Celtic, is a low back vowel (*α* in most dialects, but Aiol. *ο*).

It should be noted however, that later (1 millennium CE) Greek *d* was in all likelihood laminal and is lenited into an interdental fricative. It is probable that further work especially on the phonology of borrowings from and into Greek would shed more light on such a shift, which is beyond the intended scope of this paper.

1.2.2 Assibilations

There are in fact other asymmetries between Pre-Greek **t* **t*^{h} and **d* though the evaluation thereof is difficult. Sihler (1995, 190–2) notes that **ty* and **t*^{h}*y* assibilated to σ, while (p. 191) "it is unknown whether **dy* followed a course similar to **t*$^{(h)}$*y*, as there is not difference in outcomes of original **dy* and restored **d*^{z}*y*. It is reasonable to suppose that the voiced and voiceless apicals developed in a parallel fashion at first." The reasonability of the latter supposition rests probably on an expectation of symmetry (which, needless to say, is a good heuristic regardless of specific single cases). Sihler (1995, 150) commenting on the dialectal Greek **-ti-* > **-si-* also notes that "PG **d* of whatever origin never assibilates before ι. PG **t*^{h}*i* > σι, but under a constraint that verges on the bizzare, the change occurs only in adjectives in –ιος based on place names in –ινθος. {...} Such place names are generally thought to be non-Greek in origin." Unfortunately, Sihler's work does not provide reference to the work of other scholars, though he was very probably aware of Rix (1992, 90–1), who simply lists the outcomes of the palatalization of **d* along with the velar series, in which way again, **d* breaks the ranks of the coronals, and the outcomes of **t*^{j} and **t*^{hj} are kept apart from the palatalized velars, as their outcomes differ in certain dialects or word position, pointing to a longer period of what finally appears as merger between these two series.

In Linear B, the outcomes of the Proto-Greek clusters **k*^{j} **g*^{j} **k*^{hj} and **d*^{j} are represented by a single series (albeit only <*za*> <*ze*> and <*zo*>; and distinct from the *s*-series) which again indicates a similarity or even merger, e.g. for **d*^{j} *to-pe-za* /tropeZa/ 'table' (**k*^{w}*tr-ped-jā*, later τράπεζα), for **k*^{j} *za-we-te* 'of this year' (**kjā-wetes-*, Ion. σῆτες), for **g*^{j} *me-zo* 'bigger' (**mégjōs*, μείζων), cf. Bartoněk (2004, 142).

The later outcomes of the **d*^{j} and **g*^{j} in Greek dialects of the 1st millennium are notoriously difficult ground for reconstruction. They are represented by the outcome of the Phoenician glyph *zayin*, which was probably /z/, or, in some dialects, by

3 This observation I make from the perspective of other glyph equations between the two scripts, which are near-identical, but naturally, given the relatively higher complexity of the corresponding Linear B signs, some level of simplification could in principle provide the shapes in Cypriot.

<(δ)δ> or on occasion by <σδ> (these are the dialects where also the outcome of the voiceless palatalized segments was ττ rather than σσ], however, <ζ> does not only represent **dʲ* and **gʲ* but also earlier **sd*.[4] In this lies the chief problem: although the typical outcome of palatalization of **dʲ* and **gʲ* are voiced affricates, which are composed of a closure and partial release thereof resulting in a sequence similar to a stop and fricative, *zd* as an outcome of PIE **sd* has both elements in reversed order. This problem can only partially be resolved, if the earlier Greek had – in terms of dialectal distribution (note that whether the outcomes was both *zd* and *dz* in one and the same dialect is dubious) – a situation similar to Early Slavic, where **dʲ* has both *ʒd* and *dz* as outcomes, cf. Slovak *medzi* and Russ. *meždu* 'in between' from **medio-*, where the original sound may have been a geminate of one kind or another (geminate stop or fricative) which, as an interval, was resolved into a TS or ST sequence by fortization (if the sequence was a fricative) or lenization (if it was a stop). The difference between *ʒd* and *sd* can perhaps be reconciled if the cluster was a homorganic apical *s̱ḏ*, as I suggest for the PIE clusters in Bičovský 2021.

Summing up, the Greek evidence shows traces of an asymmetry and are in this way compatible with the hypothesis of apical **d* in PIE.

1.3 Anatolian

In Anatolian, the outcome of both the PIE *media* and *media aspirata* is the same (cf. Melchert 1994, 60), they appear as the (e.g.) Hittite "voiced" stops (though the distinction of [voice] as probably secondary and the contrast was one of [lenis] × [fortis]). The problem is that the exact pronunciation of the Anatolian /d/ may have continued the articulatory position of PIE **d* or **dʰ* and may have been symmetrical to /t/, or it may not. There are but a few indications that the PIE tenuis behaves differently from the corresponding media (aspirate) and they are difficult to evaluate. Often, the difficulty lies in chronology of sound changes in Anatolian.

1.3.1 Spelling conventions

Since **d* and **dʰ* supposedly merge already on the Proto-Anatolian level, and all three PIE stops fall together in initial position, in principle it should not be possible to differentiate between the outcomes of each phoneme. However, it is worth-while to consider whether certain scribal conventions may not be revealing of some original distinction. First of all, the claim that the two rows merged in Proto-Anatolian was challenged by Alwin Kloekhorst in his recent article, on the basis of scribal practice. In his 2019 treatment of Hittite dentals, he identified an asymmetry in the spelling conventions of the scribes in the Old Hittite period (2019, 155) that, according to him, consistently discriminated between the the outcomes of PIE **-nt-* and

4 The problametic relation of <δ> and <ζ> to the outcomes of palatalization of **d *g*, indicative both of an ongoing sound-change and inter-dialectal differences, is manifested in epigraphical material and suggestive of an earlier geminate stage [ɟː], see Méndez Dosuna (1993).

*-*nd*^{h}- (spelled with *TA* or *DA*) as opposed to PIE *-*nd*- which supposedly is reflected exclusively by <*nTA*>. This in turn is supposed to be a continuation of a scribal practice which discriminated between the outcomes of the three PIE series, insisting, *contra communis opinio*, that "[T]here can be no doubt that of the three dental phonemes that have to be distinguished for Old Hittite, at least the fortis and lenis stops must have remained distinct phonemes also after the OH period." (p. 149, op. cit.). If it reflects phonetic reality, this distribution is far more likely to be related to whatever were the laryngeal features of the Hittite (by implication, Anatolian?) dentals, than a possible retraction. It remains to be seen, however, whether this radical position will gain acceptance among specialists in Hittite.

Another fact of Hittite orthography which may reveal a possible apical, rather than laminal outcome of the merger of PIE *M* and *MA*, is the practice of Hittite scribes in writing initial *t-* (in this position, all three PIE stops should have merged). As the <ta> <da> series, as much as <pa> <ba> and <ka> <ga>, should be interchangeable, there are cases where certain words are consistently written with a <da> series, others with <ta> (while no such tendency is manifested by the labial or velar series). Kloekhorst (2009, 21) writes "It must be admitted that certain words show an almost consistent spelling with e.g. DA whereas others are spelled exclusively with TA (e.g. *dāi* 'take' [PIE *deh_3 'give', JB]) is consistently spelled with the sign DA; the sentence initial conjunction *ta* is consistently spelled with TA), but all attempts to interpret these cases as pointing to a phonemic opposition in voice, have failed. We rather have to interpret these cases as spelling conventions". Never the less, writing conventions are not random in their motivation though they may appear random in their practice.[5] Yet the actual motivations for this practice is probably irretrievable and therefore of limited importance to the topic of this article. As a possible counter-argument for the merger of dentals/alveolars in anlaut, Rieken (2008) argues for a consistent difference in representing original Anatolian tenues *vs* mediae in (hieroglyphic) Luwian. In both cases, the scribes at different stages were aware of some kind of difference in representation of the coronal series, which was absent in labials or velars.

1.3.2 Assibilation

Both Pre-Hittite **ti* and **di̯* undergo changes, with the result in Hittite being in each case a voiceless sibilant. Yet, while **ti* yields Hittite *zi* [ʦi][6], as in the 3sg. pres. act.

5 While it is conceivable that the early scribal practice was etymologically consistent and that a possible later merger made this largely a matter of convention, prone to subsequent analogy and etymological mismatch; other factors are also possible.

6 Kimball (1999, 286) reconstructs the phonetic value of [tʂ] for /ts/ <z>, presumably a retroflex affricate similar to dialectal MnE *tr-*, but the very fact that this should be an outcome of palatalization is contradictory to the retroflex pronunciation and at best could be a later adjustment of a post-alveolar segment, typically as optimalization of feature contrasts – for which, however, the conditions in Hittite are lacking (for the typical strategies of sibilant systems cf. Żygis (2010, esp. 128–133). Also, the same

mi-conjugation ending, earlier **di̯* or **di* is reflected by <š> (probably an apical *s*, as I argue in Bičovský 2008), as in *šīuš* 'god' built on the stem of PIE **di̯ēu-* and *šīwatt-* 'day' from **di̯ewot-* 'light' (note that the rest of the Anatolian family does not share in this change, e.g. Palaic **tiuna-* 'god' and Luwian ^{d}*Tiu̯ad-* 'sun deity'; Kimball (1999, 292) points out the important fact that "[b]ecause there are no other indisputable sequences of **dy* or **di* in Anatolian or Hittite, the details of the phonological development of these words remain obscure"). In any case, the outcome of this assibilation is identical – at least in graphical representation – to the Hittite apical <š>. Kloekhorst (2009, 86) points out that there is, however, evidence available only for the anlaut cluster and we have no guarantee of what the outcome may have been medially. Kimball (loc. cit.) states that "**d*^{h} was not assibilated before **y*" but the data to support this is again meagre. On the whole, it does not seem prudent to draw conclusions on the two possible examples, coming from the same root and possibly still relatable by speakers as etymologically pertinent. Also, it is not immediately clear at what stage during the gradual merger of the three series in initial position the assibilation of the reflexes of PIE **di̯* took place and whether to posit a voiced affricate with subsequent devoicing and de-africation. The fact that the expected outcome of such change, a voiced affricate, appears as a fricative, while the voiceless counterpart appears as an affricate, may indicate a relatively earlier stage for the assibilation of **di̯*.

In another recent work (2016), Kloekhorst comments specifically on the unexpected difference in outcomes of the Hittite [dental]+*i̯* clusters (p. 219–220) and ascribes it to a difference in consonantal length: "the difference in outcome between **ti̯-* and **di̯-* can only be explained by assuming that phonetically the fortis and the lenis dental stop differed from each other in consonantal length: **ti̯-* = *[t:j] > [t͡s] = /ts/, whereas **di̯-* = *[tj] > [s] = /s/." I believe that in fact this is explainable in terms of the traditional system of PIE stops on the basis of a difference in articulatory position.

The outcome of the otherwise counterintuitive change of PAnat. coronal stops in initial **Tl*, is **ʦl* (Kloekhorst, loc. cit.), and it appears that whatever contrasts there was between the two consonants, it was levelled out before *l*. On the surface, this appears strikingly similar to the behaviour of TT clusters in Anatolian (and elsewhere), yielding *ʦt*, as in *ētʦteni* 'eat' 2pl. < **h*$_1$*édte*. As the initial clusters **tl-* **dl-* and **d*^{h}*l-* were disfavoured in PIE (note Byrd 2015, 279–80 listing PIE edge phonotactics, gives only very few examples for these anlaut positions, making it dubious as to the reality of these clusters in PIE, with PIE **dlong*^{h}*o-* 'long'[7] and possibly **dluk-*

glyph is employed to represent the first element of the original PIE *TT* clusters, again, more likely to have been laminal sequences (see sec. 2).

7 A recent discussion of this etymon is Blažek (2015).

'sweet'[8] being the two more securely reconstructed forms for PIE), it is therefore difficult to conclude much on the basis of such limited evidence.[9]

1.3.3 Lambdacism

As the outcomes of PIE mediae in Hittite are supposed to be +[lenis] in medial environment, the conditions were favourable for a further change to approximants or fricatives. Such changes are occasionally attested in Luwian (Melchert 1994, 174), e.g. the PIE root **deh*$_3$ 'give' in Luwian as *lā-*, famously for the PIE **h*$_1$*néh*$_3$*mn* 'name' the Hittite form *lāman* (which however is interpreted as a dissimilatory change (Kloekhorst 2008, 518). Kloekhorst (2016) (of whom Prósper 2019 is apparently unaware in proposing similar sound-law for Italic) concludes that the initial *l* is an outcome of, ultimately, PIE **dh*$_3$ and proposes this as a sound law. His assumption, i.e. that the intermediate step was **ð*, is based on typological considerations, yet assuming this change was rather a single step **d* > **l* is clearly a superior option as it requires fewer steps and does not introduce a new phoneme, or indeed *phonemic class of voiced fricatives,* into the inventory of Pre-Proto-Luwian (in Kloekhorst's terms, op. cit. 44; note that loc. cit. he allows for alternative explanations). Again, the number of convincing etymologies so far is limited.

1.4 Italic

For Italic, the dental character can be securely reconstructed for the outcomes of PIE **d*^{h}, as the intermediate step in the evolution to initial *f-* (also medial in Sabellic) was most probably the dental fricative **þ* (although whether the direction was **d*^{h} > **t*^{h} > **þ* or **d*^{h} > **ð* > **þ* is a matter of ongoing debate, cf. the monograph dedicated to this topic by Stuart-Smith 2004). On the other hand, the apical character of Italic *d* could perhaps be supported by the behaviour of intervocalic *–d-* in Umbrian, where the result (transcribed by **ř** or *rs***,** e.g. Umbrian **peři** *persi* loc.sg. 'foot' < **pédi*) suggests proximity to the Umbrian rhotic (similar sporadic cases attest to the same similarity in Latin, e.g. *meridiēs* for *medidiēs*, Leumann (1977, 154–155) and the sibilant, which is in itself both a continuation of the PIE apical and a segment prone

8 The equation between Gk. γλυκύς 'sweet', Myc. *de-re-u-ko* 'sweet' and later Gk. n. γλεῦκος 'sweet wine' and Latin *dulcis* is problematic on many levels, Vaan (2008, 182) proposes **dlk-* as a partial solution which, if correct, makes this a rather different sequence to **dlV-* and may imply different treatment by speakers. Beekes (2010, 277) is unsure of the PIE form (however, this is a position Beekes takes rather more frequently than other specialist on Greek etymology), and also sees the *-u-* as problematic.

9 Even more problematic is the PIE etymon for 'milk', which may be reflected in Gk. n. γάλακτ- 'milk', Lat. n. *lact-* and has been derived both from **glkt-* and **dlkt-*, the first implying a Greek dissimilation (in this way linking it to γλυκύς as 'the sweet stuff'), the latter a loss of the velar in **gl-*, which is irregular. In a 2017 study, Garnier et al. (p. 301) return to this problem, rejecting the link to Arm. *kat'n* 'milk' and with it a possible independent confirmation for the initial *g-*, offering an alternative link to Alb. *dhallë* through **ĝ-*. They also refuse the link to Lat. *lac* (p. 302), suggesting in its stead PIE **h*$_2$*melĝ*, howbeit at the expense of a series of analogies. As far as their arguments *in contra* the etymological link are concerned, these are sound and worth considering – the alternative etymologies offered are slightly less convincing.

to rhotacism itself within Italic. In the following two cases, *d* is lost or transformed in such a way which is consistent with a relatively short interval of tongue-palate contact. In a number of cases, Italic **d* is lost or changed in Lat. in contexts where other segments are stable, e.g. the already mentioned Lat. *suāvis* 'sweet, pleasant' < **sweh$_2$du-* 'sweet'. The 3rd cent. BCE change of **dw-* > *b-*, e.g. *duenos* > *bonus* 'good' is possibly to be interpreted as a temporal collapsing of the articulatory gestures with concomitant blurring of the acoustic markers of the articulatory position of the stop. The loss of **d* (and **g*) before yod in Latin (or even Italic, cf. Weiss 2009b, 159) is as much compatible with a palatalization (and a resulting palatal geminate) or with a loss of closure in the voiced consonant leading to the geminate yod directly. Apical **d* however would favour the latter alternative. It is remarkable that such change is restricted to the voiced stops in Latin. As the typical result of these changes, where the **gi̯ *di̯* merge in their outcomes is a voiced affricate *ʤ* or *ʣ* (as in e.g. Greek), which does not regularly transform to [j], the transition to *–ii-* is surprising and may indicate a different trajectory (as an alternative, a spirantization of *d* and *g* could facilitate the assimilation in these cases, even if this is *ad hoc*).

Initial **tl*, however rare in PIE, was possibly reduced to *l-* only in Latin, as the Umbrian *Tlatie*, possibly related to *Latium*, shows, while the fates of **dl-* are uncertain on the Italic level, since the reflexes of the PIE **dlong^{h}o-* 'long' are only found in Latin *longus* (for Lat. *dulcis* and its possible etymological relations, see fn. 19).

The relation of Italic **d* and **l*, or individual cases of *d* > *l* in the recorded history of Latin, have been the focus of linguistic inquiry since antiquity. In her recent article on the subject, B. Prósper summarizes much of the debate, listing again the notorious examples, such as OLat. DACRIMA > *lacrima, lacruma* 'tear'; *dingua* > *lingua* 'tongue'; pairs such as *odor* 'smell' *vs. olēre* 'to smell', *lēvir* 'husband's brother' contrasted with Gk. δαήρ and adding a number of possible new etymologies of Lat. *la-* (Prósper 2019, 460–467), while also listing data from Sabellic, such as South Picene *kduíú* = Lat. *clueō*, where the similarity of the two segments leads to a reversal (if in fact the segment represented by *d* is a voiced coronal stop at all). Prósper bases her proposed change of initial **da-* (older **dh$_2$-*) to **la-* to a continued implosive character of PIE **d* in Italic (op. cit. 470), adducing typological observations by Greenberg (1970, 129) on the propensity of *ɗ* to be further reduced to a glottalized *l* or *r*. Even if not all her etymologies may convince, her explanation is clearly superior to any preceding one in establishing a plausible context for the change and also a mechanism which would account for the shift. I find it however difficult to believe that implosives continued into Italic. The implosive system was first invoked for Pre-PIE to account for the traditional, if typologically odd, PIE opposition, as famously criticized by Roman Jakobson. In Weiss (2009a), the opposition between implosive (or non-explosive, as he suggests on slide 58) and explosive is shifted in favour of explosive *vs*. breathy (aspirated in traditional sense) consonants. Given that the behaviour of PIE mediae aspiratae in Italic is similar to that of Greek (devoicing

to voiceless aspirates, with subsequent spirantization, which only occurs in Greek much later) it appears that the threefold opposition of classical PIE was preserved in Italic (as it was also in the closely related Celtic, and even in Tocharian) and the outcomes of the shift, the breathy stops, were at some point opposed to the "plain" explosives. Never the less, Italic data mostly confirm the retracted character of PIE **d* and the laminal character of **t* and **d*^{h}.

1.5 Indo-Iranian

In Iranian, the reflexes of PII voiced and voiced aspirates merged. For this reason, the evidence of this branch is of limited relevance. It is notable that both the reflex of the voiceless coronal stop and the result of the merger of the two mediae are prone to lenition, especially preceding a stop (for the voiceless stops) or when intervocalic (for the voiced series), resulting in **θ* and **δ* respectively, e.g. Av. *fδrōi* dat.sg. 'father' (**ph*$_2$*tréi*), *čaθuuarō* 'four' (< **k*^{w}*etwóres*), YAv, *yeiδi* for OAv. *yadi* 'when' etc. In this respect, it would appear that any asymmetry possibly inherited from the Indo-Iranian was lost. Proto-Indo-Iranian **t*^{h} (PIE **th*$_2$) along with the clusters *Th*$_2$ in general, becomes a fricative, e.g. Av. *paθō* GEN.SG. 'path' (**pnth*$_2$*ós*), see CANTERA (2017, 21–22)

For Indic the situation is better in that the contrast is preserved but apart from that, there is not much to be deduced from the data. The descriptions by native phoneticians reveal little of importance: the whole series is, descriptively, "dental", *dantamūla-*. There are only a few instances where pre-Vedic **d* did behave slightly differently from its unvoiced and aspirated counterparts.

One such is the assimilation of **-dn-* to *-nn-*, e.g. ved. *ánna-* 'food', from **h*$_1$*édnom* (EWA, I, 79) as opposed to *ratna-* 'jewel' or *budhná-* 'bottom'. This suggests a stronger affinity between the voiced stop and the nasal.[10] The sequence *-nn-* is also the regular outcome of **-ná-* verbal adjectives/PTC with roots in final *-d* in Vedic and the change has in this way become part of synchronic morphonology. The place of articulation of /n/ is, again, *dantamūla-* "dental", but here there are indications that this term need not be descriptively correct or precise – or would not have been at the time of the composition of the Vedas, whatever sub-phonemic changes may have taken place in between then and the beginning of the native phonetic tradition. As a result of some earlier change, in Vedic, the dental(?) *n* is prone to undergo cerebralization or retroflexion in a synchronic phonological alternation when preceded by a retroflex consonant or *r* unless "a coronal non-continuant intervenes" Kobayashi (2004, 146 and the discussion on pp. 146–148). Here, an apical-alveolar articulation would make it more likely for *n* to switch to a retroflex than a corresponding dental, and the assimilation of **-dn-* to **-nn-* would also be more natural – in this manner, indirectly, the retracted character of **d* may gain support.

10 However, it must be added, as Kroonen notes (2018, 146), that such participles, or verbal adjectives, are mostly formed to roots in *-RH* and *-d*, which makes it difficult to provide more examples for the *-tn-* and *-dhn-* clusters.

This is consistent with Kobayashi's conclusion (op. cit. 153) that: "the retroflexion of /ṇ/, which comes from second-hand spreading of [-anterior] from an /r/ or /ṣ/ to its left, might be due primarily to the configuration of the active articulator like [laminal] and [apical] or [sublaminal] and originally have had nothing to do with place" in as much as the default articulator was the tip of tongue.

1.5.1 Assibilation

Also, while the sequences **tį̂* and **dʰį̂* do not undergo assibilation (e.g. the inf. in *-dhyai* or √tyaj 'abandon, dismiss'), there are but few Ved. lexemes with *jy-* as an outcome of PII **dį̂-*: *jyók* 'for a long time', *jyótati* 'shine', *jyótsnā* 'moonlight night', *jyau-* 'Jupiter' (EWA, 604–5; a few more, such as *jyótsnā* 'moonlight night', are built on these derivations), but as e.g. for *jyau-* the more conservative (in terms of phonology) *dyáu-* 'sky (god)' is available; these forms are dialectal, more extensive in Middle Indic where assibilation is not limited to the voiced stop. Apparently, dialectal realization of this rare cluster was acoustically close enough to whatever the pronunciation of the palatalized outcomes of IIr voiced velar were at that stage, which may have been palatal (favouring in fact a laminal *d*) or postalveolar (favouring an apical segment). This difference in outcomes of palatalization (*dj* patterning with velars) is reminiscent of similar phenomena in Greek, Italic, and Tocharian. Though with some reservations, Indic can be included in the group of IE languages which support the PIE asymmetry.

1.6 Armenian

Even though Armenian has potential to shed light on the behaviour of PIE **d* vis-à-vis **t* and **dʰ*, as the three PIE stop series have separate continuants, Armenian historical phonology is a difficult field given the rather limited amount of data and the fact that some phonological strings are either documented by only a few cases, or not at all. E.g. the change of PIE **dw* to **(e)rk* (for which more below) is limited to four or five examples. Never the less, some indications of either laminal or apical articulation are perhaps discernible.

Especially the development of the Proto-Armenian **tʰ* (< PIE **t*) has received much attention (its loss in inter-vocal position which is not mirrored in the other members of the same class). The behaviour of the PIE **t* **d* **dʰ* series in Proto-Armenian should be symmetrical to the situation of the rest of the system, with the voiceless stop receiving aspiration to **tʰ*, the voiced counterpart becoming devoiced to **d̥* and later shifted to **t* and the voiced aspirate **dʰ* de-aspirated to **d*. In a recent work on Armenian historical phonology, Kim (2016) discusses the evolution of Pre-Armenian **t* in different word positions in order to propose a unitary explanation for a number of disparate facts in which he invokes the laminal position of the outcome of the PIE **t*. After sonorants, the former tenues (at least the dentals and velars) surface as identical to mediae aspiratae, i.e. they appear in Classical Armenian as *d g*, e.g **mrtó-* > *mard*

'man' or **pénk^{w}e* > *hing* 'five'. The difficulty with this change lies in such examples as Arm. *sirt* 'heart' (PIE **ḱḗrd-i-*), where the original voiced stop appears as voiceless, as would be expected. However, regardless of whether the change of original **rt* to **rd* occurred before or after the general shift of voiced stops to voiceless, in this environment they should have merged. Scholars cited by Kim (p. 159) argue that the "the PIE voiceless and voiced plain stops should have fallen together after sonorants, regardless of the relative chronology of the shifts involved – unless one wishes to posit some kind of *ad hoc* distinction between the dentals in pre-Arm. **marT* and **sirT*." Naturally, one could posit such a distinction in articulatory position on the basis of possible PIE asymmetry – but this alone does not provide a solution as long as facts about laryngeals features of these segments in these environments could somehow be linked to a distinction in articulatory position (i.e. the same solution would have be applicable also to velar segments).

Several scholars suggested trajectories that bypass this collision course (reviewed by Kim op. cit., 157–159) by endowing the post-sonorant tenues with some extra phonological feature to maintain the distinction. Kim's quite plausible solution (p. 160) that the outcome was originally a voiced dental fricative [ð] implies that the original character of Pre-Armenian **t* was dental. However, as the attested material does not preserve a dental segment, this is but indirect evidence for PIE **t*.

Another peculiar change, which apparently only involves **d*, is the famous change of PIE cluster **dw* to *(e)rk* (though this is not agreed upon by all scholars, e.g. Beekes (2003, 199–200). The voiceless counterpart, in PIE **tw-*, evolves into **k^{h}* e.g. *k^{ʿ}o* 'your' < **two-si̯o-*, and no rhotic emerges in the process (yet, the cluster is voiceless, and the voiced segment is more likely to have been interpreted as a sonorant). The various accounts of this change (an overview in Macak 2017, 1050) have this much in common: the ultimate source of *r* in this cluster is identified in PIE **d*. Given the apical character of anterior rhotics, it is logical to assume that an apical **d* is close enough to the reflex of PIE **r*. On the whole, the Armenian evidence is compatible with an asymmetry – that is there are both indications of dental character of Pre-Armenian **t* and alveolar **d*, while not much can be said about **d^{h}*.

1.7 Tocharian

Apart from PIE **d*, the evolution of the other PIE stops on their way to Proto-Tocharian appears to have been rather straightforward: the three PIE series collapsed gradually to a single one (and also all three velar series merged, eventually). The evolution of PIE **d* in Tocharian is problematic, with the outcomes zero or ʦ.[11] The standard point of reference on this problem is Winter (1962), but several scholars addressed this conundrum since then (Adams 1988; Ringe 1996, Kim 2012). The disappearance

11 The resulting phoneme is represented in the Brahmi script by a digraph composed of *t* and *s*, rather than *ś* or *ṣ*, which makes the value [t^{s}] extremely likely.

of **d* mostly before resonants does not provide much evidence for the articulatory position, although the articulatory mechanism (non-plosive or implosive) could be at least a contributing factor, as long as it could be decisively established that this phonological feature was inherited into Tocharian, of which I am sceptical. Given the limited number of reliable etymologies and the problems of correct etymological identification of cognates due to the massive merger and contrast elimination, it is not surprising that Hock (1993, 282) takes this as an exemplary case where reconstruction methodology fails to provide a good solution. "Although unconditioned split, i.e., sporadic, non-regular sound change, is anathema to historical linguistics, it appears as if we have to accept it here. For again, the alternatives are even worse. We would either have to deny relationship of these forms to the corresponding ones in the other Indo-European languages and thus attribute their recurrent similarities to chance. Or we would have to reconstruct for the proto-language a contrast between **ʦ* and **t*, **dz* and **d*, **dhzh* (or the like) and **dh*, merely to account for a difficulty affecting a single branch of Indo-European."

The examples adduced by Hock to this case are the following: PIE **treyes* TA *tre* TB *trai* 'three', PIE **tu* TA *tu* TB *twe* 'you sg.', PIE **deḱ* TA *täk* 'think etc.', PIE **dō* TB *pe-te* 'give', PIE **dhubro-* TA *tpar* TB *tapre* 'high/low', PIE **dhē* TA TB *tā-* 'put', as opposed to PIE **poti-* TA *pats* TB *pets* 'husband', PIE **der* TA TB *tsar* 'separate', PIE **daḱ* TA TB *tsāk* 'bite', PIE **dheg^{w}h* TA TB *tsäk* 'burn'. PIE **d* thus undergoes different treatment in apparently identical contexts (PIE **daḱ vs. *der* as *t- vs.* ʦ-). The basic question is, what phonetic or other phenomenon could have intervened for **d* to split into **d* and **?* or **t* and **?*. The question marks are used intentionally to indicate that it is too early to commit oneself to any specific phonetic value of the more irregular and unexpected outcome of the split (such as **dz*). Hock's problem is only partly solved by the fact that some of the cases of **d- > *t-* are now etymologized differently (e.g. by Adams 2009 or Malzahn 2010) and the change **d > *ʦ* is generally accepted. The greater problem is the inexplicable lack of merger in the coronal series as such as opposed to the evolution of the rest of the system. Regardless of the relative chronology of mergers in [voice] and [aspiration], or their evolution (e.g. whether aspirated stops passed through a voiceless stage), PIE **d* should have at some point merged with either the reflexes of PIE **t* or PIE **d^{h}* (with merger marked by *!*):

Stage	Scenario I	Scenario II	Scenario III	Scenario IV
1	**t *d *d^{h}*	**t *d *d^{h}*	**t *d *d^{h}*	**t *d *d^{h}*
2	**t! *d*	**t! *t^{h}*	**t *d *t^{h}*	**t *d *t^{h}*
3	**t*	**t*	**t! *t^{h}*	**t *d *t*
4			**t*	**t!*

An intermediate step before the final merger, which is presupposed in each scenario, is perhaps a shift from an opposition +/-[voiced] to +/-[tense], where a superior

representation of **d* would be [d̥] and system of **t *d̥* as respectively +[tense] and -[tense]. The fact, that the resulting system is *t* ~ ʦ ~ *t* requires an explanation which is independent of the gradual merger of the three series in terms of their laryngeal features. The reflexes of **d* remained distinct from the other two series through spirantization. This phonetic development is common and well understood and in fact documented even in the history of Tocharian, as most Proto-Tocharian segments were palatalized and the stops of the velar and coronal series were assibilated, with the following results: **tʲ* > [ʧ] <c>, e.g. **ph₂tēr* 'father' > TB *pācer* **kʲ* > [ʧ] <c>, e.g. **ĝerh₂-* 'ripen, get old' > *śäräy* 'adult men'. The affrication of **d* is clearly earlier than the Proto-Tocharian palatalization, Hackstein (2017, 1322) would even put it at a very early stage: "As regards the relative chronology of the deaspiration and devoicing of stops, the contrasting reflexes of PIE **t* and **dʰ* as opposed to PIE **d* suggest that, at least in the case of the coronals, de-aspiration and devoicing postdate the affrication of PIE **d* > CToch. **ʦ*." Even the result of palatalization of **ʦ* is distinct: [ʃ] <ś> opposed to <c> [ʧ]. In a similar fashion, Kim (2012, 14) writes "[p]robably voiced aspirates were then devoiced (**[dʰ]>*[tʰ]), and**d* [d] was affricated to **[dz]. ... Then the now voiceless aspirates and the voiced stops fell together with voiceless stops."

The assibilation of **d* is both an uncontroversial fact and an explanatory conundrum. Though in itself it is common, the typical triggering features or contexts are missing. Thus in a number of languages, *d* is (eventually) assibilated to *dz* through palatalization (Slavic, Romance, Indo-Iranian) but it is usually the case that the corresponding voiceless segment undergoes the same change and also – trivially, the context of front vowels and *i̯* is present. In Tocharian, this change takes place irrespective of its phonetic environment (with the exclusion of the cases where **d* disappears) and does not involve the rest of the coronal series. As mentioned in Bičovský 2021 2.4, another frequent source of spirantization is aspiration. Unfortunately, the reflex of PIE **d* is in fact the least likely segment to evolve aspiration, as this is usually the case with either tenues (Germanic, Armenian, possibly Celtic, note that there are also indications of Grassman's law in Tocharian, whereby **d* is the outcome of dissimilation of aspiration – in the traditional formulation of this law) or the reflexes of PIE mediae aspiratae, not to mention that if it was the specific character of **d* as a member of the class corresponding to PIE mediae, similar behaviour would have been expected with the rest of this class. Neither solution is satisfactory and it appears that we are obliged to accept the fact without having a good explanation: the change is apparently spontaneous.

From the perspective of my hypothesis, it remains to evaluate the potential merits of interpreting the change as relevant specifically to **d* on account of its original apical character, continued in some level of retraction respective to the reflexes of **t* and **dʰ*. The difference between either **d₁* (< PIE **d*) and **d₂* (< PIE **dʰ*) or **t₁* (< PIE **t*, or also **dʰ*) and **t₂* (< PIE **d*) could be only maintained through either artic-

ulatory position or articulatory mechanism. In the recorded Tocharian, the latter distinction is certain, +/-[affricate], while it is not clear, whether both are alveolar-laminal, which for *ʦ* is the best interpretation both in terms of orthography and in maintaining the contrast to [ʧ], or whether *t* (or its ancestor in Common Tocharian) is not articulated in some other manner/place.

The scenario that would account for these results, is the following: at some stage, the contrast of *[t] : *[d̥], [p] : [b̥], and [k$^{(w)}$] : [g̊$^{(w)}$] resulted in *[t] : *[ʦ], [p], and [k$^{(w)}$]. In order for this to happen, there must have been a significant difference between *[t] : *[d̥], marked on *[d̥], which was not relevant for [p] : [b̥], and [k$^{(w)}$] : [g̊$^{(w)}$], and it clearly was not [voice], or [aspiration]. As the coronal segments offer a wider spectrum of possible tongue-palate contact combinations, then either the labial or the velar region, it is in such a feature that the explanation is most likely to be found. If *[d̥] continued PIE retracted apical **d*, it may have been still an apical segment, with the corresponding smaller area and shorter interval of contact and a propensity to shift towards approximants. As the resulting segment is not a resonant, it is very likely that the segment was not voiced at the crucial moment, an in this way one has to account only for the fact that an apical alveolar stop would be likely to undergo "spontaneous" assibilation. The reasons why speakers would have preferred the arising affricate allophone of *[d̥] to the stop may be of a general character (ease of pronunciation) – but in this respect, such allophones would be expected to exist at the same stage for at least *[t], if not for the other stops. The alternative is a compensatory process: the affricate allophone was acoustically distinct from *[t], an opportunity to maintain, or even enhance a contrast which was not available in the other stop classes.

With respect to the usual reconstruction of **d* > **d*^{z} (e.g. Hackstein, loc. cit.), there is a serious objection to be raised. The spontaneous shift **d* > **dz* is typologically unexpected[12]. One could in principle use the compensatory logic and assume that the assibilation was provoked by an impending merger with the voiced aspirate **d*^{h} but the subsequent devoicing instead of a shift to a fricative *z* is still a problem for typology. On the other hand, if assibilation of *d* is interpreted as a lenition and **d* was laminal, one would rather expect to encounter a dental fricative *ð* (voiced dental affricate is extremely rare). In this respect at least, the apical character of Proto-Tocharian **d* is more likely. Some further facts of Tocharian historical phonology may also be of relevance, namely the results of Proto-Tocharian palatalization:

12 "Typologisch auffällig, da man isolierte Assibilierung eher bei **stimmlosen** Plosive erwarten würde"; and Kümmel 2007, 173. In addition to his scepticism, studies such as Żigys et al. (2012) show that voiced sibilant affricates are cross-linguistically rare and conclude that (2012, 299) "(1) voiceless stops undergo affrication more readily than voiced ones, and (2) voiced affricates deaffricate more commonly than voiceless ones, thereby contributing to the asymmetry in fre-quency between voiced *vs*. voiceless affricates." For this reason, I consider deaffrication to a [z] a far more likely outcome of **dz* than [ts]. Also, Maddieson (1984, 47) writes that "generally, the existence of a given voiced fricative in the inventory implies the presence of a voiceless counterpart in the inventory."

**d* > [ʦ]	palatalized to <ś> [ʃ]
**k* (< PIE velars)	palatalized to <ś> [ʃ]
**t* (< PIE **t *dʰ*)	palatalized to <c> [ʧ]

At first glance, the results suggest the direct opposite of what would be expected as an outcome of palatalization of an apical segment, presumably [ʧ] – which is incidentally the outcome of the same change for the rest of the coronal series. Yet it must be kept in mind that the result of assibilation of **d*, one of the earliest changes in the course of the evolution from PIE to Common Tocharian, would have been apical only at the early stages but could have shifted to the typologically more common laminal position soon afterwards, especially as the psychoacoustic space of sibilants was at that time probably occupied by a single segment, the descendant of PIE apical **s* and the two were to maintain contrast (such shifts are indeed attested).

A further note on the difference between the outcomes of the palatalization of **k* and **ʦ* as opposed to **t*: given that in the first case the result is a fricative and at the same time it is commonly the case that stops pass through the affricate stage on their way to sibilants, the reflexes of palatalized **k* (and **ʦ*) appear to have set on the course towards **ʃ* earlier, while the reflex for **tʲ* remains an affricate. Also, one may compare as typological parallel the fate of velars in Vedic, where the results of PIE **ḱ* are reflected by a palatal sibilant *ç*[13], while the result of the later change (in this case, palatalization of velars) remains distinct and is in time shifted to a post-alveolar affricate [ʧ] (although in the voiced series, there is ultimately a merger). Schematically:

1. [apical] **d* > **d̻* > **t* > **ʦ*
2. *ʦ* [apical] > **ʦ* [laminal] polarized by the apical sibilant **s*
3. palatalization of velars **kʲ* > **c* > **ʨ*
4. palatalization of **ʦ* > **ʨ* and merger with the outcomes of 3.
5. deaffrication of **ʨ* to **ç*
6. palatalization of **t* > **tʲ* > ? > *ʧ* <c> (perhaps started even before 5.), polarized against **ʦ* and **ç*

For the **t* (< PIE **t *dʰ*) to shift to [ʧ] as result of previous palatalization, rather than merge with the outcomes of the velar palatalization, either an articulation favouring this specific shift (in fact, a laminal-alveolar, rather than the laminal *t* would be a good candidate) or a **ʨ* emerging side by side with earlier **ç* are viable solutions, albeit the latter requires for such a **ʨ* to be retracted and labialized, which may have been provoked precisely by the already existing palatal segment (cf. parallels in Slavic: Żygis 2010). It is perhaps relevant in order to appreciate the merits of

13 Which is the Brahmi character employed to represent the Tocharian phoneme, i.e. the character corresponding to Sanskrit *ś*. It rather unlikely, on typological grounds, to reconstruct a system with two apical "shibilants", and the classical Sankrit system of *ś s* and *ṣ* is a preferable solution, *pace* Hackstein (loc. cit.).

such dissimilation to realize that the stop system of Tocharian underwent a drastic reduction and here there is a potential for further contextual reduction of contrast between the two members of the now very limited class of stops, in a language of considerable morphonological complexity.

It remains to be noted that in Tocharian, direct traces of the laminal realization of PIE **t* and **d*^{h} are not evident. Unlike in Germanic, Italic, Celtic, or Greek, these elements have never shifted towards the dental fricatives which in my opinion are a clear indication of the dental character of the original stops. In this way, the proposed explanation for the unexpected shift **d* > *ts* is supported by the data from outside of Tocharian and this is fully compatible with an inherited asymmetry.

1.8 Celtic, Albanian, Balto-Slavic

Of the three remaining major branches (leaving aside the evidence of the minor languages), the early merger of **d* and **d*^{h} makes it difficult to identify any changes that would result from a difference between the supposed alveolar and dental. The fact that Czech, being a member of the Slavic branch, shows an asymmetry in this articulatory region, may in fact be a continuation of the original state of affairs, but given the relatively short period of documentation, this amounts to a mere speculation and the value of Czech in this context is typological. Insular Celtic, for instance, provides clear indications of the laminal place for both **t* and **d* (i.e. dental in the traditional sense), through the results of lenization (e.g. OIr *–VthV-* /VϑV/ for Primitive Irish *VtV*, and /VðV/ for the voiced segment) and no traces of retraction.

2 Conclusions

On the evidence of Indic, Italic, Germanic, Greek and Tocharian, as well as possibly Anatolian and Slavic, it appears that these branches either acquired an asymmetry in the coronal series, independent of each other, or inherited this state of affairs from the parent proto-language. As there may be independent reasons to suspect that the character of the PIE mediae was such that it could lead to a retracted articulatory position of **d*, and this articulatory setting may have survived on a sub-phonemic level, the superior explanation of these facts is an original asymmetry in Proto-Indo-European, of a laminal pair **t* and **d*^{h} and apical **d*.

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