Proto-Indo-European "thorn"-clusters
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(1) Introduction

Since the beginning of Indo-European linguistics, the group of words in which the Skt. cluster *kṣ* corresponds to Gk. *KT* have received much attention. According to Brugmann (1897: 790), these clusters must reflect a combination of a PIE velar plus "*þ*-Laute"[1] (hence the name "thorn"-clusters), which was the standard view for many decades. For instance, in Pokorny 1959, the word for 'bear' (Skt. *ŕ̥kṣa-*, Gr. ἄρκτος) is reconstructed as **ŕ̥k̑þo-* (875); the word for 'earth' (Skt. *kṣám-*, Gr. χθών) as **g̑ʰðem-* (414); etc. When in 1932 Kretschmer equated the words for 'earth' in the newly found languages Hittite (*tēkan*) and Tocharian B (*tkaṃ*) with the thus far common reconstruction **g̑ʰðem-*, he was able to convincingly show that the initial cluster must originally not have contained a "thorn", but rather consisted of a dental and a velar stop, **dʰg̑ʰ-*. According to Kretschmer, the original order of these stops was retained in Hittite and Tocharian, but in Greek and Indo-Iranian the cluster was metathesized to **g̑ʰdʰ-*, with a subsequent development of **-dʰ-* to *-s-* in Indic "weil ihm zwei Verschlußlaute im Wortbeginn ungewohnt waren" (1932: 67). In the other languages, **dʰg̑ʰ-* was simplified to **g̑ʰ-*, yielding Lat. *hum-*, Lit. *žem-*, OCS *zem-*, etc. Burrow (1959) argued, however, that assuming a metathesis in Indic is unnecessary. In analogy to Skt. *kṣumánt-* 'having cattle' ~ Av. *fšūmaṇt-* 'id.' < **pk̑u-mént-*, where an initial cluster **pk̑-* yielded Skt. *kṣ-*,[2] showing a development of palatovelar **k̑* into the retroflex sibilant *ṣ*, Burrow argued that we may assume a similar change for the "thorn"-clusters: **Hŕ̥tk̑o- > *ŕ̥tśa- > *ŕ̥tṣa- > ŕ̥kṣa-* 'bear' and **dʰg̑ʰém- > *dʰȷ̑ʰám- > *dzʰám- > ḍẓʰám- > ṭṣám- > kṣám-* 'earth'.[3]

In his famous 1977 article 'A thorny problem', Schindler therefore concluded that the assumption of a separate phoneme **þ* or **ð* "is superfluous for an early stage of Indo-European" (1977: 34). According to him, all words with "thorn"-clusters reflect a cluster **TK* (the one word where he reconstructs **KT*, namely 'yesterday', will be treated in detail below). Moreover, he assumed that already in the PIE mother language this cluster was reduced in some environments, for instance before a syllabic nasal: **TKN̥C > *KN̥C*. Recently, Lipp, in his book *Die indogermanischen und einzelsprachlichen Palatale im Indoiranischen* (2009), devotes a 350 pages long chapter to "Das Problem des Ansatzes von idg. *þ* (Thorn)", in which he provides a very detailed account of all problems, proposed solutions and material regarding the "thorn"-clusters. Although this chapter is extremely elaborate, I still have the feeling that not all details regarding this topic have

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[1] He states, however, that "[d]ie Qualität dieser uridg. Reibelaute [...] nicht genauer zu bestimmen [ist]; die Zeichen *þ* und *ð* sind nur ein Notbehelf".

[2] This is not a regular development, however. We must assume that **pk̑u-mént-* first yielded **pśumánt-*, after which **p-* was dissimilated against **-m-*, yielding **k̑śumánt-*, which subsequently developed in *kṣumánt-*. Cf. e.g. **pleu-men- >* Skt. *klomán-* 'the right lung' for a similar dissimilation.

[3] Similarly in *kṣi-* ~ Gr. φθι- < **dʰgʷʰi-*, where due to the following *-i-*, **dʰgʷʰ-* was first palatalized to **dʰȷ̑ʰ-*, and then developed similarly to **dʰȷ̑ʰ-* < **dʰg̑ʰ-*, cf. Burrow 1959b.

been sufficiently covered. In the following it is my aim to present my views on these details. I will focus on *TK*-clusters in word-initial position.

(2) **'Yesterday'**

The first point that needs elucidation is the word for 'yesterday'. On the basis of Skt. *hyáḥ*, Gr. χθές, Lat. *heri*, *hesternus*, OHG *gesterēn*, Alb. *dje*, etc., the word was, in "thorn"-terminology, reconstructed as *$\acute{g}^h\delta ies$.[4] Brandenstein (1936: 29) gives two possibilities for analyzing this word. His first proposal is to interpret it as a compound of a form of *$\acute{g}^hi$ 'this' and an element *$dies$ 'day' as attested in Skt. *sa-dyáḥ* 'today'. This proposal was taken over by Schindler (1977: 34),[5] who reconstructs *$\acute{g}^h$-dies* and therefore assumes that "thorn"-clusters can also go back to a cluster *KT*. Apart from the fact that it is unclear to me how Schindler envisages the relationship between the particle *$\acute{g}^hi$ and the element *$\acute{g}^h$- (does he interpret it as a zero-grade or as a reduced form of some sort?), there are also formal problems. Other words containing an initial cluster *KT*-, e.g. derivatives of *$k^w etuor$- 'four' that use the zero-grade stem *$k^w tur$-, do not show any "thorn"-development: Skt. *turī́ya-* 'fourth' (not **$k\c{s}urī́ya$-), YAv. *tūiriia-* 'fourth', *ā-xtūirīm* 'four times' (not **$x\check{s}ūr$-), Gr, τράπεζα 'table' < *$k^w tur-ped-ih_2$ 'having four feet' (not **πράπεζα).[6] Also in medial position, the cluster *KT* does not behave as *TK*, compare e.g. *$h_3e\acute{k}teh_3$ 'eight' > Skt. *aṣṭā́* (not **$ak\c{s}ā́$), Gr. ὀκτώ. A reconstruction *$\acute{g}^h$-dies* for 'yesterday' is therefore better forgotten.[7] Brandenstein's second proposal is to assume that *$\acute{g}^h\delta ies$ is "eine Ableitung von jenem idg. Wort [...], auf das das nhd. *Tag* zurückgeht". This proposal is taken over by Puhvel (1987: 317), who reconstructs *$d^h\acute{g}^h$-ies*, a form containing the comparative suffix *-ies- derived from the root *$d^he\acute{g}^h$- as found in the Germanic words for 'day' (Goth. *dags*, ON *dagr*, OHG *tag* < *$d^ho\acute{g}^h$-o-).[8] This interpretation would indeed better fit the anlauting consonants, Skt. *h*-, Gr. χθ-, etc., and is therefore nowadays quite generally taken over.[9] There is one problem concerning the reconstruction *$d^h\acute{g}^h ies$, however, namely that in Gr. χθές, Lat. *hes*- and Germ. *ges- no trace of *-i- can be found. For Greek, Lipp therefore has to assume an *ad hoc* "Schwund von ι̯ zur Vereinfachung der anlautenden Trikonsonanz"

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[4] E.g. Walde 1930: 664, Pokorny 1959: 416.

[5] Without referring to Brandenstein, although he was familiar with Brandenstein's article (cf. the reference on p. 33).

[6] Schindler has to regard these words as "analogical: *$k^w turih_2o$- replaced *$k^w\text{þ}urih_2o$- after the full grade in *$k^w etuores$" (1977: 34).

[7] Nevertheless, it can still be found in e.g. NIL: 70. Also Vine's recent suggestion (2008) that *$\acute{g}^hdiés$ actually goes back to an earlier *$\acute{g}^h h_1diés$ (the laryngeal having been lost due to the rule *CH.CC > *C.CC), in which *$\acute{g}^h h_1$- is the zero-grade of a root *$\acute{g}^h eh_1$- "zurücklassen" that is reflected in Slav. *za* 'back, behind' < *$\acute{g}^h oh_1$ and Skt. *jáhāti* 'leaves behind', still does not explain why the cluster *$\acute{g}^hd$- in this word would show a "thorn"-development, whereas other words with an initial cluster *KT*- do not.

[8] According to Neri *apud* Lipp (2009: 191), the root *$d^he\acute{g}^h$- originally meant "hell sein, glänzen" and would also underly the word for 'earth', *$d^he\acute{g}^h$-m-, litt. "die Glänzende" and the word for 'fish', *$d^h\acute{g}^h$-uH-, litt. "glänzendes Wesen". As we will see below, the roots for 'earth' and 'fish' must be reconstructed differently, and therefore cannot be etymologically connected with *$d^he\acute{g}^h$- 'day'. Therewith the assumption that the original meaning of *$d^he\acute{g}^h$- is 'to shine' is unwarranted. Instead, I would rather connect the Germanic forms for 'day' with Lith. *dãžnas* 'many, often', *dažnìnis* 'repeatedly', *dažnùmas* 'frequency, multiplicity', which rather indicates that the root *$d^he\acute{g}^h$- originally meant 'to repeat itself (over and over again); cycle'.

[9] E.g. Beekes 2010: 1632; Lipp 2009: 189f.

(2009: 196). For Latin, he assumes that *$d^h\acute{g}^h$ies* yielded Proto-Italic *χjes*, which through "tautosyllabische Assimilation des als präpalataler Frikativ *[j]* artikulierten *i̯* an den vorangehenden velaren, d.h. postpalatalen Frikativ *χ*" (2009: 196) developed into *χes > hes-*. The fact that in *$\acute{g}^h$iem- > Lat. hiem-* 'winter' a similar assimilation apparently did not take place is explained by the *ad hoc* assumption that the latter form displays a Lindeman variant *$\acute{g}^h$(i)i̯em- >* PItal. *χijem- >* Lat. *hiem-* (2009: 196[19]). For Germanic, a similar *ad hoc* development is assumed by Lipp (2009: 197-8), namely *$d^h\acute{g}^h$ies > *γjes > *γes* (with assimilation of *j* to *γ*) *> *ges*. All these assumptions do not suffice.

It is better to separate Gr. χθές, Lat. *hes-* and Germ. *ges-*, which do not show a reflex of *-i̯-*, from Skt. *hyáḥ*, where a *-i̯-* is clearly present. The former forms straightforwardly point to a preform *$d^h\acute{g}^h$és*, which, according to Haye van den Oever (p.c.)[10] forms a petrified gen.sg. *$d^h\acute{g}^h$-és-s* from an original *s*-stem *d^heg^h-es-*, which is attested in OE *dǣg* 'day' *< *$d^h\bar{o}\acute{g}^h$-es-*.[11] Skt. *hyáḥ* is by Van den Oever compared with the Greek word χθιζός 'yesterday', which thus far has not received a convincing etymology. According to Van den Oever, the initial χθ- reflects the root *$d^h\acute{g}^h$-* as also found in χθές. The element -ζός is reconstructed by him as *di-ós*, gen.sg. of a root noun *dei-* 'day' and identical to -*dyáḥ* in Skt. *sadyáḥ* 'today' *< *sm-diós*. The -ι- in χθιζός must according to Van den Oever be an anaptyctic vowel that arose in the initial cluster of *$d^h\acute{g}^h$dios*, comparable to the anaptyctic vowel -ι- in e.g. πίτνημι 'to spread out' *< *$ptnéh_2mi$*. The thus reconstructed form *$d^h\acute{g}^h$dios* is interpreted as a compound *$d^h\acute{g}^h$-diós* "the day adjacent to (this) day". For Skt. *hyáḥ*, Van den Oever assumes that in Indic the *-d-* in *$d^h\acute{g}^h$dios* was dissimilated, yielding *$d^h\acute{g}^h$iós*, which regularly developed into *hyáḥ*.[12]

With this new interpretation of the words for 'yesterday', there is no need anymore to assume that "thorn"-clusters reflect a cluster *KT* as well.

(3) **PIE reduction of *TK- > *K-?**

On the basis of *$\acute{k}mtóm$* 'hundred' *< *$d\acute{k}mtóm$* (derived from *$dé\acute{k}mt$* 'ten') and Gr. καίνω 'to kill' *< *$t\acute{k}n\i̯\bar{o}$*, Schindler (1977: 31-2) assumes that already in PIE times a sequence *TKN̥* was reduced to *KN̥*. Since in Hitt. *taknaš* 'earth (gen.sg.)' *< *$d^h\acute{g}^hmós$* the initial cluster seems to be retained before a consonantal nasal, which would be unexpected in view of the supposed reduction of *TK-* before a vocalic nasal, Schindler assumes that in these cases a PIE anaptyctic vowel arose that protected the cluster: *TKNV > *$T_əKNV$* (1977: 32). However, in order to explain e.g. Skt. *jmás* 'earth (gen.sg.)' *< *$d^h\acute{g}^hmós$*, Schindler has to assume that an original "*$d^h_e\acute{g}^hmés$*", which yielded Hitt. *taknaš*, blended

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[11] Willi (2007: 181) now also reconstructs *$d^h\acute{g}^h$és*, which he rather analyses as *$d^h\acute{g}^h$-és*, "a genitive-ablative of a root noun which appears in thematised form in Goth. *dags* 'day' *< *d^hog^hos*".
[12] This scenario can perhaps be specified. Within the glottalic theory, the voiced stops are interpreted as preglottalized, which means that *d* in fact was *^ʔd*. In section (5) below, we will see that whenever *d* is dissimilated, it leaves a trace of its glottalization, which merges with the outcome of *h_1*. It is therefore possible that when dissimilation took place in *$d^h\acute{g}^h$diós*, the result was *$d^h\acute{g}^h h_1iós$*.

with a younger Lindeman variant "*$\acute{g}^h\mathring{m}es$" into "*$\acute{g}^h\acute{m}es$", yielding Skt. *jmás*. This seems unnecessarily complicated to me.

It cannot *a priori* be excluded that the separate daughter languages treated these clusters in a different way. It is therefore worthwhile to describe the treatment of the *TK*-clusters in the separate languages without any preconceived ideas about PIE developments.

In Anatolian, clusters of the shape *TK*- were retained as such in prevocal position (Hitt. *tagān* 'on the earth' < *$d^h\acute{g}^h\acute{o}m$, CLuw. *tiiamm(i)*- < *$d^h\acute{g}^h\acute{e}m$-)[13] as well as in preconsonantal position (Hitt. *taknaš* 'earth (gen.sg.)' < *$d^h\acute{g}^h m\acute{o}s$, HLuw. ("TERRA")*ta-ka-mi-i* /tkmī/ 'on the earth' < *$d^h\acute{g}^h m\acute{e}i$?). I am unaware of any Anatolian examples that reflect forms containing a cluster *TK*- before a syllabic nasal.[14]

TKV-　　　　> TKV
TKCV-　　　> TKCV-
TKNC-　　　> ?

In Tocharian, we find TochA *tkaṃ* and TochB *keṃ* 'earth', going back to PToch. *tken* < PIE *$d^h\acute{g}^h om$-. This example shows that the cluster *TK*- was retained in prevocalic position into Proto-Tocharian. In TochA, it was retained as such, but in TochB it was reduced to *K*-. Evidence for the outcome of *TK*- in preconsonantal position is lacking.

In Indo-Iranian, the cluster *TK*- was retained before vowels (e.g. Skt. *kṣay*-, Av. *šaē*- 'to live' < PIIr. *tćai*- < PIE *$tk^{\prime}ei$-; Skt. *kṣám*- 'earth' < PIIr. *$d^hj^h\acute{a}m$-[15] < PIE *$d^h\acute{g}^h\acute{e}m$-; Skt. *kṣi*-, GAv. *dōji*-,[16] YAv. *ji*-[17] 'to destroy' < PIIr. *d^hj^hi- < PIE *$d^h g^{wh}i$-)[18] but reduced to *K*- before consonants (Skt. *jmáḥ*, Av. *zəmō* 'earth (gen.sg.)' < PIIr. *$j^h m\acute{a}s$ < PIE *$d^h\acute{g}^h m\acute{o}s$; Skt. *śyená*-, Av. *saēna*- 'bird of prey' < PIIr. *ćiainá*- < PIE *$tk^{\prime}ieh_2in\acute{o}$-; Skt. *hyáḥ* 'yesterday' < PIIr. *$j^h Hi\acute{a}s$ < *$d^h\acute{g}^h h_1i\acute{o}s$ < PIE *$d^h\acute{g}^h di\acute{o}s$).[19] Before vocalic resonants, the cluster was retained, however (Skt. *kṣaṇóti* 'to hurt' < PIIr. *tćanáu*- < PIE *$tk^{\prime}\mathring{n}$-néu-, *kṣati*- 'damage' < PIIr. *tćati*- < PIE *$tk^{\prime}\mathring{n}$-ti-).[20] We can therefore set up the following chronology of developments for Proto-Indo-Iranian:

(1) Vocalization of *CNC* to *CaC*.
(2) Simplification of *TK*-clusters before consonants.

　　　　　　　　(1)　　　　　(2)
TKV-　　　　> *TKV　　　> TKV-
TKCV-　　　> *TKCV-　　> KCV-

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[13] Cf. section (9) below for a treatment of CLuw. *inzagān*, allegedly 'inhumated' < *"*en $d^h\acute{g}^h\acute{o}m$".

[14] Cf. footnote 33 for a treatment of Lyc. *sñta*, possibly 'hundred' < *$dk^{\prime}mt\acute{o}m$.

[15] In Avestan, nom.sg. *zā̊* 'earth' seems to reflect *$\acute{g}^h$-, and not *$d^h\acute{g}^h$- (as attested in Skt. nom.sg. *kṣā́ḥ*), which would have yielded *ž*-. We therefore must assume that in this form the anlaut of the oblique cases was generalized, where *$d^h\acute{g}^h m$- regularly lost its initial *d^h- and through *$j^h m$- further developed into *zəm*-.

[16] In GAv. *dōjīṯ.arəta*- 'destroying truth'.

[17] In YAv. *jiṯ.aša*- 'destroying truth'.

[18] Note that the reduction of PIIr. *TK* to *K*- in Avestan takes place at different periods depending on the nature of the cluster. PIIr. *tć*- was reduced to Av. *š*- in pre-Avestan times already (GAv. *šaēitī* < PIIr. *tćáiti*), whereas PIIr. *d^hj^h- was retained as such up to Gathic times (GAv. *dōji*- < PIIr. *d^hj^hi-), to be reduced to *j*- in Young Avestan times only (YAv. *ji*- < GAv. *dōji*- < PIIr. *d^hj^hi-).

[19] This means that Skt. *kṣiyánti*, Av. *šiiēiṇtī* 'they live' < PIIr. *tćiánti* < PIE *$tk^{\prime}i\acute{e}nti$* (and not Skt. **śyánti*, Av. **sēiṇtī* < PIIr. **ćiánti*) must be analogical after 1pl. *tćimás*, 2pl. *tćitHá* and the singular stem *tćái*-, where the initial cluster *tć*- < PIE *$tk^{\prime}$-* was regularly retained prevocalically.

[20] The case of Skt. *śatám*, Av. *satəm* 'hundred' < *$dk^{\prime}mt\acute{o}m$* will be treated in detail in section (5) below.

*TKNC-   > *TKaC   > TKaC-

In Greek, the cluster was retained before vowels (e.g. κτείνω 'to kill' < *tḱeni̯e/o-). On the basis of καίνω 'to kill' < *tḱn̥i̯e/o- it is often claimed that before a vocalic resonant the cluster was reduced to *Ḱ- (e.g. Schindler 1977: 31-2, cf. also above). This is contradicted by Gr. (Ion.) φθά̄νω 'to anticipate' < *dʰgʷʰn̥u̯e/o- (Skt. *daghnu-* 'to almost reach'), however, where the cluster *dʰgʷʰ-* was retained as such. Since καίνω 'to kill' < *tḱn̥i̯e/o- belongs with κτείνω 'id.' < *tḱeni̯e/o-, it is attractive to assume that these verbs once belonged to an athematic paradigm *tḱén-ti / *tḱn-énti. If we assume that at this time the cluster *TK-* was reduced before consonantal resonants, but not before vocalic resonants, the paradigm of *tḱen-* would have changed to *tḱén-ti / *ḱn-énti, whereas the preform *dʰgʷʰn̥u̯e/o-* was retained as such. A subsequent *-i̯e/o-derivation of the verb 'to kill' then yielded *tḱen-i̯e/o- > κτείνω as well as *ḱn-i̯e/o- > καίνω.[21] This scenario implies that the thematization of original *dʰgʷʰ-néu-ti / *dʰgʷʰ-nu-énti to *dʰgʷʰn̥u̯e/o- must have taken place before the reduction of *TKCV > *KCV.[22] If the reconstruction of χθιζός 'yesterday' < *dʰǵʰdiós is correct, it shows that before two consonants an epenthetic vowel emerged that protected the cluster *TK-. For Greek, we therefore can set up the following chronology of developments:

(1) Vocalization of *CNC to *Cə̃C.
(2) Rise of epenthetic -i- in initial clusters of the shape *CCCC-.
(3) Simplification of *TK- clusters before consonants.
(4) Metathesis of *TK- to KT-.
(5) Other developments, e.g. *Cə̃u̯V- > -CānV- and *Cə̃C > CaC

	(1)	(2)	(3)	(4)	(5)
*TKV-	*TKV-	*TKV	TKV-	KTV-	KTV-
*TKCV-	*TKCV-	*TKCV-	KCV-	KCV-	KCV-
*TKNC-	*TKə̃C-	*TKə̃C	TKə̃C-	KTə̃C-	KTaC-
*TKNu̯V-	*TKə̃u̯V-	*TKə̃u̯V-	TKə̃u̯V-	KTə̃u̯V-	KTānV-
*TKCC-	*TKCC-	*TKiCC-	TKiCC-	KTiCC-	KTiCC-

In Latin, the words *heri* 'yesterday' < *χés < *dʰǵʰés, *humī* 'on the earth' < *χom- < *dʰǵʰom- and *homō* 'man' < *χémōn < *dʰǵʰémōn all three show loss of the dental stop in pre-vocalic *TK-. For the words *sinō* 'to let be, to allow', *situs* 'placed, built', allegedly from *tḱi-* 'to create', and *sitis* 'thirst', *situs* 'neglect, disuse', allegedly from *dʰgʷʰi-* 'to perish', sometimes a metathesis of *TK- to *Kþ- > s- is assumed (e.g., most recently, by De Vaan 2008: 566, 568), but this assumption cannot be reconciled with the development

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[21] My colleague Lucien van Beek informs me that although κτείνω can be found throughout the Greek corpus, καίνω is virtually only attested in tragedies. This seems to indicate that καίνω originally belongs to a specific dialect. Apparently, when a *-i̯e/o-derivative was made form the original paradigm *tḱén-ti / *ḱn-énti, in this dialect the stem *ḱn- served as a basis for the derivation, whereas in all other dialects the stem *tḱen- was used.

[22] It also implies that Gr. χαμαί 'on the earth' cannot reflect *dʰǵʰm̥h₂ei (which would have yielded **χθαμαί), but rather must be an inner-Greek adaptation of original *χμεί < dat.-loc.sg. *dʰǵʰméi (Hitt. *taknī*).

*TK- > K- as found in *heri*, *humī* and *homō*. It is therefore better to assume that all these words have a different origin.[23]

The situation in Celtic is interesting. In OIr. *dú*, gen. *don* 'earth' < *$d^h\acute{g}^h\acute{\bar{o}}m$, *$d^h\acute{g}^hóm$- and OIr. *in-dé* 'yesterday' < *$d^h\acute{g}^hés$, the cluster *TK- seem to be reduced to *T- in prevocalic position. On the bilingual of Vercelli, [24] the Cisalpine Celtic word *Teuoχτonion* translates Lat. *deis et hominibus* 'to gods and humans', and must therefore be analysed as a compound of an element *Teuo-* < *deiuo-* 'god' and an element *-χτonio-*, which corresponds with OIr. *duine*, MW *dyn* 'human', going back to PCelt. *gdonịo-. This *gdonịo- must ultimately go back to PIE *$d^h\acute{g}^h$om-ịo- 'belonging to the earth, earthling' (cf. Gr. χθόνιος 'belonging to the earth'). This indicates that in Celtic, *TK- first was, just as in Greek, metathesized to *KT-, after which in Insular Celtic the initial velar was lost. Examples of *TK- in preconsonantal position are lacking.

In Balto-Slavic, all evidence points to an unconditional loss of the dental stop, both in prevocalic and preconsonantal position: e.g. OCS *zemlja*, Lith. *žẽmė*, Latv. *zeme*, OPr. *semmē* 'earth' < PBSl. *$\acute{g}$em- < *$d^h\acute{g}^h$em-; OLith. *žmuõ*, OPr. *smoy* 'man' < PBSl. *$\acute{g}m\acute{\bar{o}}n$ < *$d^h\acute{g}^hm\acute{\bar{o}}n$; OCS *zmija* 'snake' < PBSl. *$\acute{g}m$- < *$d^h\acute{g}^hm$-; Lith. *žuvìs*, Latv. *zuvs* 'fish' < PBSl. *$\acute{g}uH$- < *$d^h\acute{g}^huH$-.

In Germanic, the words for 'yesterday', PGerm. *gestra-* (Goth. *gistra-dagis*, OE *giestron*, OHG *gestre*) < *$d^h\acute{g}^hes$, and 'man', PGerm. *gumō* (Goth. *guma*, OHG *gomo*), a conflation of nom.sg. *gemō / obl. *gumn- < *$d^h\acute{g}^hémōn$ / *$d^h\acute{g}^hmn$-,[25] seem to show that the cluster *TK- lost its dental stop before vowels as well as before vocalic resonants. Yet, OE *dwīnan*, ON *dvína* 'to disappear' must reflect *d^hg^{wh}i-neH-, and here the dental stop seems to have been retained. Apparently, we have to assume that in pre-Germanic first the aspirated labiovelar *g^{wh} was weakened to *w, and that only later on the cluster *TK- was reduced to *K-, whereas *Tw- remained.

In Albanian, the words *dhe* 'earth' < *$\acute{g}\acute{\bar{o}}(m)$ < *$d^h\acute{g}^h\acute{\bar{o}}m$ and *dje* 'yesterday' < *$\acute{g}és$ < *$d^h\acute{g}^hés$ show that the cluster *TK- was reduced to *K- in prevocalic position. Evidence for the development of *TK- in preconsonantal position is lacking.

In Armenian, the initial stop of *cᶜin* 'kite' < *$t\acute{k}ih_2ino$- shows the same outcome as PIE *ks-. We therefore have to assume that *$t\acute{k}$- first yielded *ts-, which then became *cᶜ-. The word for 'fish', *jukn*, is ambiguous as both *$d^h\acute{g}^h$- and *$\acute{g}^h$- would yield *j-. On the basis of *cᶜin* it is nevertheless preferable to assume that before vowels the *TK-cluster was retained into pre-Armenian. We have no evidence for the development of *TK- in preconsonantal position, however.

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[23] Kortlandt (fthc.) connects *sitis* 'thirst' and *situs* 'neglect, disuse' with the root *g^wes- as found in Skt. *jásate* 'to be exhausted' and Gk. σβέννῡμι 'to extinguish'. The words *sinō* 'to let be, to allow' and *situs* 'placed, located' can be derived from a root *seh_1i- 'to let go, to release', cf. Lipp 2009: 205-16, 264-5 with references.
The development *TK > *Kþ > Lat. *s* would also be found in Lat. *ursus* 'bear', which is commonly derived from *$h_2r\mathring{t}\acute{k}o$- (Skt. *ŕ̥kṣa-*, Gr. ἄρκτος, Hitt. *ḫartakka-*). Although this etymology is in handbooks repeated over and over again, we need to always look at the evidence objectively. With the elimination of the other alleged evidence in favor of a development *TK > Lat *s*, the only thing that *ursus* and *$h_2r\mathring{t}\acute{k}o$- now have in common is the phoneme *-r-* and the thematic inflection (we would expect *$h_2r\mathring{t}\acute{k}o$- to have yielded Lat. **arcus*). This is in my eyes formally too weak a connection to uphold this etymology. We should rather reconstruct a pre-form like *urCso- (e.g. *$ur\acute{g}^h$-so- ~ Skt. *varh-* 'to tear'?).
[24] Cf. Lejeune 1988: 26-37 for an edition and interpretation of this inscription.
[25] Cf. Kroonen 2009: 8, with footnote 8.

As we see, the *TK-clusters have in most daughter languages (but not in Anatolian) undergone some simplifications, either by dropping one of the two stops, or by metathesis to *KT (Greek, Celtic). Nevertheless, none of these developments can be projected back to PIE: they are all language-specific.

(4) **Voiced stops?**

Most of the stems containing an initial cluster *TK- are of the structure *TKeR-. Some of these are clearly analyzable as a derivation of a root *TeK-. For instance, the verb *$d^hg^{wh}ei$- 'to wither, destroy' is commonly regarded as a derivative of the root *d^heg^{wh}- 'to burn'; the verbal stem *$tk̂ei$- 'to settle' is nowadays generally analyzed as an *i*-present to the root *$tek̂$- 'to create, to carpenter';[26] the noun $d^hĝ^hem$- 'earth', which for a long time was thought to be a root noun, turned out to be an *m*-stem *$d^heĝ^h$-m-, *$d^hĝ^h$-em-; the adverb $d^hĝ^hes$ 'yesterday' has above been interpreted as containing the zero grade of the root *$d^heĝ̂$- 'day'; etc. This indicates that in the other stems of the structure *TKeR- the cluster *TK- may also have to be regarded as the zero-grade form of a root *TeK-.[27]

As is well known, there are several PIE root constraints, limiting the possibilities of combination of stops in a given root. For instance, there is a constraint against the presence of both a voiceless and an aspirated stop, which means that *$teĝ^h$-, *teg^{wh}-, *$d^hek̂$- and *d^hek^w- could not occur. Moreover, there is a constraint against the presence of two voiced stops in a root, which means that *$deĝ$- and *deg^w- could not occur. So, the possible shapes of roots of the structure *TeK- are the following: *$tek̂$-, *$teĝ$-, *$dek̂$-, *$deĝ^h$-, *$d^heĝ$- and *$d^heĝ^h$- as well as *tek^w-, *teg^w-, *dek^w-, *deg^{wh}-, *d^heg^w- and *d^heg^{wh}-. It therefore is surprising that thus far our evidence only seems to permit the reconstruction of the following sets of correspondences:[28]

PIE	Skt.	Av.	Gr.
*$tk̂$-	kṣ-	š-	κτ-
*$d^hĝ^h$-	kṣ-	--[29]	χθ-
*tk^w-[30]	--	--	--
*d^hg^{wh}-	kṣ-	(d)j-[31]	φθ-

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[26] Which means that 'to settle' originally meant 'to build tents', p.c. Prof. Lubotsky.

[27] Already Brandenstein (1936: 28) argues that "alle Fälle von anlautendem Guttural + Spirant" must be interpreted "als schwundstufige entstandene Konsonantengruppen". Yet, his etymological connections of words with initial *TK- to *TeK- roots are almost all unattractive.

[28] In the earlier literature, we come across reconstructions with plain velar as well, *tk (e.g. Schindler 1977: 25). This is primarily based on an equation between Skt. kṣáyati, Av. xšaiia- 'to rule' and Gr. κτάομαι 'to acquire, to win'. Since a cluster *tk̂- yielded the correspondences Skt. kṣ ~ Av. š ~ Gr. κτ-, it was thought that Skt. kṣ ~ Av. xš- ~ Gr. κτ- must go back to *tk-, with a plain velar. Since the equation between the IIr. and the Greek verbs is not entirely ascertained (note that e.g. Lipp 2009: 299-300 rather reconstructs Skt. kṣáya- and Av. xšaiia- as *h_3k^w-s-eie-), I will leave these verbs out of consideration here.

[29] The expected outcome of *$d^hĝ^h$- in Avestan is ž-. Cf. footnote 15 for the reason why nom.sg. zā̊ 'earth' ~ Skt. kṣā́ḥ has z-.

[30] The expected outcomes of *tk^w- would be kṣ- in Sanskrit and ππ- in Greek (on the Avestan outcome I dare not speculate). For a long time, it was thought that this correspondence could be found in Skt. ákṣi- 'eye' ~ Gr. (Epidaurian) ὀπτίλλος 'eye' < *h_3etk^w-. Yet, since ὀπτίλλος has the variants ὀφθαλμός and (Boeotian) ὄκταλλος 'eye', it is likely that all these words are from substrate origin (Beekes 2010: 1133). Skt. ákṣi- must rather belong with Gr. ὄσσε 'eyes', ὄσσομαι 'to look' and reflect the root < *h_3ek^w- (apparently with suffix *-s-).

As we see, only clusters with either two voiceless stops (*tḱ-, *tkʷ-) or with two voiced aspirated stops (*dʰǵʰ-, *dʰgʷʰ-) are reconstructed. Also Schindler (1977: 25) noted the remarkable "absence of voiced unaspirate clusters" and states that whether this absence "is a systematic or an accidental gap has not as yet been established". Well, the absence of clusters with two voiced stops (**dǵ-, **dgʷ-) can be explained by the root constraint that two voiced stops cannot co-occur in one root. But what about clusters in which only one of the members was a voiced stop? On the basis of the PIE root constraints we would expect that clusters of the structure *TK- (being zero grades to roots of the structure *TeK-) could have the following shapes:

*tḱ-	*tkʷ-
*tǵ-	*tgʷ-
*dḱ-	*dkʷ-
*dǵʰ-	*dgʷʰ-
*dʰǵ-	*dʰgʷ-
*dʰǵʰ-	*dʰgʷʰ-

So why have we thus far found evidence for clusters of the structure *tḱ, *tkʷ and *dʰǵʰ, *dʰgʷʰ only? Did the clusters containing a voiced stop (*tǵ, *tgʷ, *dḱ, *dkʷ, *dǵʰ, *dgʷʰ and *dʰǵ, *dʰgʷ) in one way or another merge with these clusters? Or have they yielded as yet unidentified reflexes?

(5) 'Hundred'

The interesting thing is that we are quite well aware of the development of one of these clusters containing a voiced stop, since it occurs in a word that is well attested, namely the word for 'hundred'. This word can be reconstructed as *ḱmtóm on the basis of forms like Skt. śatám, Lat, centum, Lith. šim̃tas, etc. Yet, already from the beginning of IE linguistics it was clear that the word for 'hundred' must be a derivative from the word for 'ten', *déḱmt, and originally must have been *dḱmtóm, containing the initial cluster *dḱ-. As we have seen above, according to Schindler (1977: 31-2), *dḱm̥tóm was simplified to *ḱm̥tóm within PIE already, because *dḱ- stood before a syllabic nasal and followed the inner-PIE sound change *TKN̥C > *KN̥C. Nevertheless, in section (2) above, we have seen that both Indo-Iranian and Greek show evidence that the cluster *TK- was retained as such before a syllabic nasal (e.g. *tḱn̥neu- > Skt. kṣaṇó-; *dʰgʷʰn̥ue/o- > Gr. (Ion.) φθά̄νω), which means that the assumption of a PIE reduction of *TKN̥C > *KN̥C simply cannot be correct. Another possibility is to assume that in *dḱ-, initial *d- was lost unconditionally. Yet, this assumption would require an explanation why such an unconditional loss of the dental stop did not take place in *tḱ- and *dʰǵʰ-.

In fact, the question regarding the origin of the word for 'hundred' was already solved in 1983, by Kortlandt, in an article dealing with the Greek word for 'hundred', ἑκατόν. This word contains an enigmatic initial ἑ-, the origin of which has always been unclear. For instance, Frisk (1960-72: 1, 475) states that the element ἑ- "irgendwie mit ἕν 'eins' oder idg. *sm̥- (gr. ἁ-) zusammenhängen [muß]", which can hardly be called a solution. According to Kortlandt, this initial ἑ- must be a remnant of *d-, however. Kortlandt adheres to the glottalic theory and assumes that the PIE mediae in fact were pre-

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[31] Cf. footnote 18.

glottalized stops, *$^?b$, *$^?d$, *$^?g$, *$^?g^w$. In the case of ἑκατόν < *$dḱmtóm$ (i.e. *$^?dḱmtóm$), he assumes that "the buccal features of the initial consonant [of *$^?dḱmtóm$] were lost while its glottalic feature merged with the reflex of the PIE laryngeal *H_1 and yielded *e-" (1983: 98).[32] In other words, Kortlandt assumes that Gk. ἑκατόν reflects *$h_1ḱmtóm$, which at one point replaced older *$dḱmtóm$. He does not make explicit at what moment this development from *$dḱmtóm$ to *$h_1ḱmtóm$ must have taken place. Yet, a reconstruction *$h_1ḱmtóm$ would also account for Skt. *śatám* (not **$kṣatám$), Av. *satəm* (not **$šatəm$) and TochA *känt* (not **$tskänt$), which would indicate that the development of *$dḱmtóm$ > *$h_1ḱmtóm$ must at least have taken place before Tocharian split off from PIE.[33] One could argue that Skt. *śatám*, Av. *satəm* and TochA *känt* do not prove the existence of an initial *h_1-, and that the traditional reconstruction *$ḱmtóm$ would account for these words as well. Yet, if the only language on the basis of which preconsonantal laryngeals can be proven to have been present[34] has a form that shows a reflex of such a laryngeal, it is methodologically imperative to reconstruct it. Moreover, there are other examples where a *d seems to have yielded a *h_1.

The Indo-Iranian preverb *ui 'asunder, apart' (Skt. *ví*, Av. *vī̆*, OP *vi*) is traditionally thought to be etymologically connected with *dui 'entzwei' (e.g. Brugmann 1911: 11). Yet, a development *dui > IIr. *ui is not phonetically regular, cf. *$duis$ 'twice' > Skt. *dvíḥ*, Av. *biš* (~ Gk. δίς, Lat. *bis* (OLat. *duis*), etc.). In 1994, Lubotsky convincingly showed that the consistent long scansion of the augment of Skt. *ávidhat* 'he alloted' shows that the verbal root *vidh*- contained an initial laryngeal: *$Huidh$-. Since the root *vidh*- is a secondary root made up of the preverb *ví* and the verbal root *dhā*- 'to put', this means that Indo-Iranian *ui in fact was *Hui. According to Lubotsky, the initial laryngeal must be a remnant of the *d- of *dui, just as in *$dḱmtóm$ > *$h_1ḱmtóm$. Yet, the question remains why in this word we seem to find a development *dui > *Hui, whereas in e.g. *$duis$ > Skt. *dvíḥ*, Av. *biš* the *d- remained as such. Lubotsky presents the following solution. He argues that outside Indo-Iranian, the element *Hui- is only found in Goth. *wiþra*, OHG *widar* 'with, against, opposed', OCS *vьtorъ* 'second', which correspond to Skt. (RV) *vitarám* 'farther', Av. *vītarəm* 'aside', *vītara*- 'following, further' and now must be reconstructed *$Huitero$- < *$duitero$- and possibly in Lat. *vitium* 'mistake' and *vītricus* 'step-father'. According to Lubotsky, "[i]t is remarkable that outside IIr. the preverb is only attested before dentals in the next syllable", which indicates that *Hui is "due to dissimilatory loss of the initial *d- in forms like *dui-tero-" (1994: 203).[35] Thus,

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[32] He then has to assume that "[t]he aspiration was apparently taken from ἕν" (1983: 98).

[33] Unfortunately, evidence from Anatolian is inconclusive. Only in Lycian, the word for 'hundred' may be attested, namely in the word *sñta* (although some scholars argue that this word must mean 'ten', cf. Neumann 2007: 329-30 for references), which could in principle reflect *h_1kmt-. If so, this would mean that the development *$dḱmtóm$ > *$h_1ḱmtóm$ was PIE. Note, however, that since we know of no other words starting in *TK- in Lycian, it cannot be excluded that these unconditionally yielded Lycian *K- anyway, which would mean that *sñta* could also reflect PAnat. *$dḱmtóm$. In Hittite (where we would expect either **$takkattān$ < *$dḱmtóm$ or **$kattān$ < *$h_1ḱmtóm$) and in HLuwian (where we would expect either **$tazantan$ < *$dḱmtóm$ or **$zantan$ < *$h_1ḱmtóm$), the words for 'hundred' are only attested logographically.

[34] Of course, the other language where preconsonantal laryngeals have left traces is Armenian, but unfortunately the Armenian word for 'hundred', *hariwr*, has no good IE etymology, and clearly cannot be cognate with the other IE words for 'hundred'.

[35] Since in Indo-Iranian the preverb *Hui is also found in other environments than before dental stops, we must assume that it apparently spread form cases like *dui-d^hh_1- > *Hui-d^hH-.

we again have to assume that *d-, which within the glottalic theory must be regarded as a preglottalized stop *$^{\textstyle ?}d$-, lost its buccal part, after which only the glottal stop remained, which merged with *h_1-. Yet in this case, the loss of the buccal part of *d- is due to dissimilation with the dental stop that occurs further on in the word. This of course brings about the possibility that in *$dḱmtóm$ > *$h_1ḱmtóm$, the development of *d- > *h_1- is also due to dissimilation of the buccal part of *d- with the *-t- in the next syllable.[36] It therefore is not certain that an initial cluster *$dḱ$- yielded *$h_1ḱ$- unconditionally.[37] In order to establish that, we must search for other examples of the cluster *$dḱ$-. Before doing so, we need to embark on a little excursion, namely a discussion of the development of prothetic vowels in Greek.

(6) **Prothetic vowels in Greek**

As is well known, word-initial preconsonantal laryngeals yielded "prothetic" vowels in Greek: *h_1C- > ἐC-; *h_2C- > ἀC- and *h_3C- > ὀC- (Beekes 1969, Rix 1976: 69). There is one exception to this law, however, namely the word ἴσθι 'be!'. This word must be directly cognate with Av. *zdī* 'be!' and therefore reflect *h_1s-$d^hí$. It thus seems as if in this word an initial cluster *h_1C- yielded ἰC-. According to Rix (1976: 70), we are here dealing with a "nichtlautgesetzliche Assimilation" of *$h̥_1$- to the -ι of the next syllable, a clear *ad hoc* explanation. Another word that contains an enigmatic initial ι- is ἵππος 'horse' (Myc. *i-qo*). On the basis of Skt. *áśva-*, Lat. *equus*, etc. 'horse', this word is usually reconstructed as *$h_1éḱuo$-, which should regularly have yielded Gr. **ἔππος, however, with initial **ἐ-. Rix (1976: 93) therefore deems the initial ἱ- of ἵππος "unerklärt". In my *Etymological Dictionary of the Hittite Inherited Lexicon*, I have argued on the basis of the Anatolian words for 'horse' (Hitt. ANŠE.KUR.RA-*u*-, CLuw. ANŠE.KUR.RA-*u*-, HLuw. *azu*-, Lyc. *esb*-), which are all athematic *u*-stems, that the PIE word for 'horse' originally must have been an athematic, hysterodynamic *u*-stem: nom.sg. *$h_1éḱ$-$u(-s)$, acc.sg. *$h_1ḱ$-$éu$-m, gen.sg. *$h_1ḱ$-u-$ós$ (Kloekhorst 2008: 239).[38] This means

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[36] A similar scenario explains the word for 'twenty' (cf. Kortlandt 1983: 98f.). Although traditionally reconstructed as *$u̯ī́ḱmti$ (e.g. Pokorny 1959: 1177), the Greek form εἴκοσι (Hom. ἐείκοσι /e(w)īkosi/), points at an initial *h_1-, whereas long *-$ī$- in laryngealistic terms should go back to *-iH-: *$h_1uiHḱmti$. On the strength of Gr. πεντήκοντα '50' < *$penk^weh_1ḱomt$-, we may assume that the second laryngeal in *$h_1uiHḱmti$ is a *-h_1- as well, which means that we should reconstruct *$h_1uih_1ḱmti$. In analogy to *$Huitero$- (i.e. probably *$h_1uitero$-) < *$duitero$- and *$h_1ḱmtóm$ < *$dḱmtóm$ we may now assume that *$h_1uih_1ḱmti$ in fact goes back to *$duidḱmti$ (and *$penk^weh_1ḱomt$- to *$penk^we$-$dḱomt$-), in which the *d-s were dissimilated. As dissimilations do not always behave as normal sound laws in the sense that they are not always completely regular, it is difficult to determine the exact moment of dissimilation. The dissimilation of *$dḱmtóm$ > *$h_1ḱmtóm$ and of *$duitero$- > *$h_1uitero$- seems to have taken place in PIE already, and this may also be the case for *$duidḱmti$ > *$h_1uidḱmti$, although it is awkward that in Boeot. Ϝίκατι and Arm. *k^csan* 'twenty' no trace of *$h̥_1$- can be found. The dissimilation of *-$dḱmti$ > *-$h_1ḱmti$ seems to have taken place in Gr. εἴκοσι (Hom. ἐείκοσι /e(w)īkosi/) and Lat. *vīgintī*, which contain a long -$ī$- < *-ih_1-. OIr. *fiche*, MW *figgit* show a short *-i-, however, and also in TochA *wiki*, TochB *ikäṃ* no trace of a laryngeal is visible. We may have to assume that in these forms the *-d- in *-$dḱmti$- was entirely dissimilated, leaving no trace at all. The situation in IIr., where we find Av. *vīsaiti* besides Skt. *viṃśatí*-, is unfortunately rather unclear.

[37] In Skt. *dāśvā́ṃs*- 'devout, pious', which originally must have been a perfect participle to the root *daś*- and therefore must reflect *$deHḱuós$- < *de-$dḱ$-$u̯ós$- (Lubotsky 1994: 204), we can hardly be dealing with dissimilation. We therefore may assume that in word-internal position a cluster *-$dḱC$- regularly yielded *-$h_1ḱC$-.

[38] Taken over by De Vaan 2009: 201 (without references, however).

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that the thematization as seen in Gr. ἵππος, Skt. *áśva-*, Lat. *equus*, etc. must be a post-Anatolian development. De Vaan (2009: 200f.) argues that this thematization originally must have been based on the gen.sg. form *$*h_1ḱuós$, and that only at a later stage the full grade vowel of nom.sg. *$*h_1éḱu(s)$ was introduced into this stem, yielding *$*h_1eḱuo-$. According to De Vaan, the preform *$*h_1ḱuo-$ may explain the presence of ι- in ἵππος: just as in initial clusters of the type *$*CCC-$ an epenthetic -ι- developed in Greek (*$*ptnéh_2mi$ > πίτνημι 'to spread out', *$*skdnéh_2mi$ > σκίδνημι 'to scatter'), so did such a vowel develop in an initial cluster of the type *$*h_1CC-$. So, *$*h_1CC-$ yielded *$*h_1iCC-$ > ἰCC-.[39] This would mean that the developments of *$*h_1ḱuos$ > ἵππος[40] and of *$*h_1sd^hí$ > ἴσθι are phonetically regular.[41] It must be remarked that such a development did not take place in clusters of the type *$*h_1RC-$, just as it did not in clusters of the type *$*CRC-$. The vocalization of *$*h_1CV-$ to *eCV-* and of *$*h_1RC-$ to *eRC-* must then be a later development. We therefore arrive at the following relative chronology:

(1) Rise of epenthetic -*i*- in clusters of the shape *$*CCC-$.
(2) Rise of epenthetic -*e*- in clusters of the shape *$*h_1C-$ and *$*h_1R-$.
(3) Loss of *$*h_1-$.

	(1)	(2)	(3)
*$*CCC-$	*$*CiCC-$	*$*CiCC-$	$CiCC-$
*$*h_1CC-$	*$*h_1iCC-$	*$*h_1iCC-$	$iCC-$
*$*h_1CV-$	*$*h_1CV-$	*$*h_1eCV$	$eCV-$
*$*h_1RC-$	*$*h_1RC-$	*$*h_1eRC$	$eRC-$
*$*h_1RV-$	*$*h_1RV-$	*$*h_1eRV$	$eRV-$
*$*h_1iC-$	*$*h_1iC-$	*$*h_1iC-$	$iC-$

These new insights into the development of initial preconsonantal laryngeals in Greek offer some new possibilities for the etymological judgement of the Greek words ἰχθῦς 'fish' and ἰκτῖνος 'kite'.

(7) 'Fish' and 'bird of prey, kite'
The words for 'fish', Gk. ἰχθῦς, Arm. *jukn*, Lith. *žuvìs*, Latv. *zuvs*, are usually reconstructed as *$*d^hg^huH-$. Although this reconstruction would indeed account for the

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[39] Note that the fact that in *$*h_2CC-$ > ἀCC- (e.g. ἀστήρ 'star' < *$*h_2stḗr$) and *$*h_3CC-$ > ὀCC- (e.g. ὄσσομαι 'to look' < *$*h_3ḱi̯e/o-$) no epenthetic -*i*- emerged may be used as evidence in favor of the view that *$*h_1$ was a (glottal) stop, whereas *$*h_2$ and *$*h_3$ were (pharyngeal) fricatives (cf. the fact that the fricative *$*s$ in initial position does not count as a stop when it comes to the placement of the epenthetic vowel -*i*-, e.g. σπλήν 'spleen' < *$*splV$). This pattern can also be found when looking at the distribution of the laryngeals among the roots in LIV². In root-initial, preconsonantal position, *$*h_1$ only occurs in roots of the shape *$*h_1ReC-$ and *$*h_1TeR-$. Since these latter roots can be regarded as derivatives of roots of the structure *$*h_1eT-$ (cf. footnote 43), we see that in original roots *$*h_1-$ never occurs before stops, probably because it was a stop itself. This is different for *$*h_2$ and *$*h_3$, however, which not only occur in roots of the structure *$*h_{2/3}ReC-$ and *$*h_{2/3}TeR-$, but also of the structure *$*h_{2/3}Te(R)C-$ (*$*h_2teug̑-$, *$*h_3peus-$). Therewith they pattern as *$*s$ (*$*sReC-$, *$*sTeR-$ and *$*sTe(R)C-$), which would fit their identification as fricatives.
[40] The origin of the aspiration in ἵππος is unclear, but of no importance here.
[41] The only counter-examples to the rule *$*h_1CC-$ > ἰCC- would be the words ἐσμέν, εἰμέν 'we are' < *$*h_1s-mé$ (cf. Skt. *smáḥ*) and ἐστέ 'you are' < *$*h_1s-th_1é$ (cf. Skt. *sthá*). However, it is trivial to assume that when the PIE paradigm of 'to be', *$*h_1esmi$, *$*h_1esi$, *$*h_1esti$, *$*h_1smé$, *$*h_1sth_1é$, *$*h_1sénti$ yielded pre-Greek *$*ésmi$, *$*ési$, *$*ésti$, *$*ismén$, *$*isté$, *$*esénti$, the 1pl. and 2pl. forms were levelled out to *$*esmén$ and *$*esté$, yielding attested εἰμέν, ἐσμέν (with restored -σ-) and ἐστέ.

Armenian and the Baltic data, it cannot explain the initial ἰ- of Gr. ἰχθῦς, however, which is regarded as an "unetymologischer" prothetic vowel by Schwyzer (1939: 413).[42] In view of the newly found sound law *h_1CC- > Gk. ἰCC- as treated above, we now could also consider to reconstruct *$h_1dʰĝʰuH$-. This reconstruction faces two problems, however. First, we do not find a trace of initial *h_1- in Armenian, where it should have vocalized to *e-*. Of course, one could assume that, just as *TKV- has been reduced to *KV- in Armenian, a sequence *HTKV- was reduced to *KV-* as well, but there are no parallel cases to prove or disprove such an assumption. Secondly, if we assume that "thorn"-clusters are in fact zero grade forms of roots of the structure *TeK-, in this case we would have to assume a root *$h_1dʰeĝʰ$-, which is structurally unlikely.[43] Haye van den Oever (p.c.) comes up with an intriguing new reconstruction for the word for 'fish'. He reasons as follows. (1) The word for 'fish' must contain an initial cluster *TK-. (2) On the basis of Arm. *j-* the velar can be identified as *$ĝʰ$-. (3) The cluster *TK- must represent the zero grade of a root *TeK-. (4) Since there is a PIE constraint against roots containing both an aspirated and a voiceless stop, the dental cannot have been *t-. (5) Since an initial cluster *$dʰĝʰV$- regularly yields χθV- in Greek (*$dʰĝʰés$ > χθές), the dental cannot have been *$dʰ$-. (6) The only remaining possibility is that the dental was *d-. (7) The word for 'fish' must have been *$dĝʰuH$-. It needs to be stressed that this conclusion has been reached without any preconceived ideas on the phonetic realization of voiced stops. Nevertheless, taking into account that within the glottalic theory voiced stops are interpreted as preglottalized, in this case *$ˀdĝʰuH$-, it is attractive to assume that the initial ἰ- in Greek is in one way or another connected with the glottalization of initial *$ˀd$-. Apparently, the glottalic feature of *$ˀd$- merged with *h_1- at some point, after which the development *h_1CC- > Gr. ἰCC- took place. Since there is no evidence that word-initial *$ˀd$- yielded *h_1d- regularly (cf. Gr. δρῦς 'tree' < *dru-), we must assume a special development here. It seems obvious to me to connect this special development with the metathesis of *TK- to *KT-. I therefore assume that within the process of metathesis of *$ˀdĝʰ$-, the glottalization of *$ˀd$- was disconnected from its buccal part. Since in the glottalic theory the only difference between voiced stops (in fact preglottalized lenis stops) and aspirated stops (in fact unmarked lenis stops) was the glottalization, the fact that *$ˀd$ lost its glottalization automatically changed it into an unmarked lenis stop, which later developed into an aspirated stop. The glottalization of *$ˀd$- then merged with *h_1-, which was a glottal stop. So, *$dĝʰ$- = *$[ˀtk̂-]$ regularly developed into *$[ʔk̂t-]$ = *$h_1ĝʰdʰ$-. According to the rule *h_1CC- > ἰCC- as discussed above, this *$h_1ĝʰdʰ$- then regulary yielded Gr. ἰχθ-.

Already Brandenstein (1936: 29) connected the word for 'fish' with a root *$deĝʰ$-, which he translates as "eintauchen".[44] However, on the basis of OIr. *deug* (f.) 'drink, draught, potion' and Lith. *dažaĩ* 'liquid dye, paint', *dažýti* 'to paint', the nominal root *$deĝʰ$- may originally rather have meant 'liquid'. This would indicate that *$dĝʰ$-*uH*- originally meant 'the one belonging to liquid; fish'.[45]

Gr. ἰκτῖνος and Arm. *cʰin* 'kite' are often connected with Skt. *śyená-*, YAv. *saēna-* 'bird of prey', and reconstructed with initial *$tk̂$-. For instance, Schindler (1977: 32)

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[42] Cf. also Rix 1976: 58, who calls the ἰ- a "spontane[r] Vokalvorschlag".

[43] The only roots starting in *h_1 + stop are *$h_1ĝer$- 'to wake up' and *$h_1gʷʰel$- 'to wish', which may have to be analysed as derived stems, *$h_1ĝ-er$- and *$h_1gʷʰ-el$-, of original roots *$h_1eĝ$- and *$h_1egʷʰ$-, respectively.

[44] Going back to Walde (1930: 786), who cites a root "*deĝ(h)*- oder *dheĝ(h)*- „eintauchen, trinken"??".

[45] A similar semantic development can be found in PIE *udro-* 'otter', derived from *uodr* 'water'.

reconstructs a pre-form *tḱ-ieh₂-ino- / *tḱ-ih₂-ino-, which would be "derived from a devī-stem *téḱ-ih₂ : gen. *tḱ-i̯éh₂-s : instr. *tḱ-ih₂-éh₁". Although such a reconstruction would account for the Armenian and Indo-Iranian data, it does not explain the presence of ἰ- in Gr. ἰκτῖνος, however. Reconstructing an initial *h₁- (*h₁tḱi(e)h₂ino-) is unwarranted: Armenian does not show an initial e-, and a PIE root *h₁tek- would structurally be unlikely. Again, I follow Haye van den Oever (p.c.), who argues as follows. (1) The word must have contained initial *TK-. (2) On the basis of Skt. ś- the velar can positively be identified as *ḱ. (3) The cluster *TK- must represent the zero grade of a root *TeK-. (4) Since there is a constraint against roots containing a voiceless and an aspirated stop, the dental cannot have been *dʰ. (5) Since an initial cluster *tḱV- regularly yielded Gr. κτV- (e.g. *tḱ-i- > Gr. κτίζω 'to found, to build'), the dental cannot have been *t. (6) The only remaining possibility is *d. (7) The word for 'kite, bird of prey' must have been *dḱi(e)h₂ino-. The development of ἰ- in Greek must have developed along the same lines as in ἰχθῦς. Within the proces of metathesis, the preglottalization of *d became detached from its buccal part, which then became an unmarked lenis stop: *dḱ- = *[ˀtḱ:-] > *[ˀḱ:t-]. Since the combination of fortis stop (= voiceless stop) and lenis stop (= aspirated stop) did not exist, the cluster was reinterpreted as consisting of two fortis stops, *[ˀḱ:t:-], i.e. *h₁ḱt-. According to the rule *h₁CC- > ἰCC-, this *h₁ḱt- regularly developed into ἰκτ-.

If the reconstruction *dḱi(e)h₂ino- is correct, this would mean that formally the word for 'bird of prey; kite' is derived from a root *deḱ-. Semantically, this would perfectly fit the root *deḱ- that in LIV² is translated 'to observe': birds of prey characteristically hunt for food by observing the earth, scanning for prey. Note that the case of *dḱi(e)h₂ino- now also shows that an initial cluster *dḱ- does not yield *h₁ḱ- unconditionally. This means that the PIE development of *dḱmtóm > *h₁ḱmtóm 'hundred' must indeed be due to dissimilation of the initial *d- due to the following *-t-.

The words for 'fish' and 'kite' show that in Greek the metathesis of *TK- to *KT- must precede the rise of epenthetic -i- in initial clusters of the type *CCC-. We can therefore now link the two relative chronologies of section (3) and section (6) in the following way:

(1) Vocalization of *CNC to *Cə̃C.
(2) Rise of epenthetic -i- in initial clusters of the shape *CCCC-.
(3) Simplification of *TK- clusters before consonants.
(4) Metathesis of *TK- to KT- (including *ˀdK > *h₁KT-).
(5) Rise of epenthetic -i- in initial clusters of the shape *CCC-.
(6) Rise of epenthetic -e- in initial clusters of the shape *h₁C- and *h₁R-
(7) Loss of *h₁- and other developments, like *Cə̃u̯V- > -CānV- and *Cə̃C > CaC

PIE	(1)	(2)	(3)	(4)	(5)	(6)	(7)
*TKNC-	*TKə̃C-	*TKə̃C	*TKə̃C-	*KTə̃C-	*KTə̃C-	*KTə̃C-	KTaC-
*TKNu̯V-	*TKə̃u̯V-	*TKə̃u̯V-	*TKə̃u̯V-	*KTə̃u̯V-	*KTə̃u̯V-	*KTə̃u̯V-	KTānV-
*TKCC-	*TKCC-	*TKiCC-	*TKiCC-	*KTiCC-	*KTiCC-	*KTiCC-	KTiCC-
*TKRV-	*TKRV-	*TKRV-	*KRV-	*KRV-	*KRV-	*KRV-	KRV-
*TKV-	*TKV-	*TKV	*TKV-	*KTV-	*KTV-	*KTV-	KTV-
*ˀdKV-	*ˀdKV-	*ˀdKV-	*ˀdKV-	*h₁KTV-	*h₁iKTV-	*h₁iKTV-	iKTV-

*CCCV-	*CCCV-	*CCCV-	*CCCV-	*CCCV-	*CiCCV-	*CiCCV-	CiCCV-
*h₁CCV-	*h₁CCV-	*h₁CCV-	*h₁CCV-	*h₁CCV-	*h₁iCC-	*h₁iCC-	iCC-
*h₁CV-	*h₁CV-	*h₁CV-	*h₁CV-	*h₁CV-	*h₁CV-	*h₁eCV-	eCV-
*h₁RC-	*h₁RC-	*h₁RC-	*h₁RC-	*h₁RC-	*h₁RC-	*h₁eRC-	eRC-
*h₁RV-	*h₁RV-	*h₁RV-	*h₁RV-	*h₁RV-	*h₁RV-	*h₁eRV	eRV-
*h₁iC-	*h₁iC-	*h₁iC-	*h₁iC-	*h₁iC-	*h₁iC-	*h₁iC-	iC-

With the new reconstructions *dǵʰuH- 'fish' and *dḱi(e)h₂ino- 'bird of prey, kite', we have now discovered some words that contain *TK-clusters in which the first member is a voiced stop.[46] The question now arises whether we can also find evidence for *TK-clusters in which the second member, namely the velar, was a voiced stop.

(8) **'Earth'**

The PIE word for 'earth', reflected in Hitt. *tēkan*, Skt. *kṣám-*, Gr. χθών, etc., is since Kretschmer 1932 reconstructed with two aspirated stops, *dʰeǵʰ-m-*, *dʰǵʰ-em-*, *dʰǵʰ-m-*, which has been repeated ever since. There is one problem regarding this reconstruction, however, namely that the initial consonant of the Skt. oblique cases, gen.sg. *jmáḥ*, instr.sg. *jmā́*, loc.sg. *jmán*, is not an aspirated one. If these forms would go back to *dʰǵʰm-*, we would rather expect an outcome **hm-*, just as *dʰǵʰdios* yielded *hyáḥ* 'yesterday'. This problem was noticed by e.g. Schindler (1967: 205), who however suggests that "[v]ielleicht man doch *majmán-*, wenn "Größe" o.ä., gegenüber *mahā-* "groß" vergleichen [darf]". This comparison does not make much sense: the *-h-* in *mahā-* goes back to *-ǵh₂-*, so the cluster *-jm-* in *majmán-* must go back to *-ǵh₂m-* as well,[47] with which it cannot be used as a parallel for the alleged development of *ǵʰm- > Skt. *jm-* in *jmáḥ*, *jmā́* and *jmán*. Moreover, in forms like *bráhman-* 'brahman' < *bʰréǵʰ-mn-* and *jihmá-* 'oblique' < *dh₃ǵʰ-mó-* we do find a cluster *-hm-* < *-ǵʰm-*. In order to explain *jm-* < *ǵʰm-* < *dʰǵʰm-* 'earth', Milizia *apud* Lipp (2009: 89) therefore assumes a "speziell neben unsilbischem tautosyllabischem Segment eintretende Vereinfachung der aus Okklusion, spirantischem Abglitt und Aspiration bestehenden *dreiphasigen* und somit sehr komplexen Artikulation der aspirierten Affrikate *ǰʰ* [the PIIr. outcome of *ǵʰ*, A.K.] zu einer *zweiphasigen* Artikulation aus Okklusion und Abglitt entsprechend der Affrikate *ǰ*". It is not explained, however, why words like *hras-* 'to shorten' < *ǵʰres-*, *hrād-/hlād-* 'to hail, to sound' < *ǵʰleh₂d-*[48] and *hno-* 'to deny' < *ǵʰneu-*(?) then did retain their initial *ǵʰ-*, which regularly yielded *h-*. In fact, there is no additional evidence that speaks in favor of deaspiration of preconsonantal *ǵʰ*; all examples besides *jmáḥ*, *jmā́* and *jmán* speak against it. To my mind, this can only mean that the reconstruction of the oblique stem *jm-* needs to be adapted. I therefore want to propose that it reflects *dʰǵm-*, with a voiced unaspirated *ǵ*.

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[46] Another example might be Gr. ἴφθῑμος 'powerful, strong', which could now be reconstructed as *dgʷʰ-iH-. Could the corresponding root *degʷʰ- be found in Gr. δέφω 'to knead, to masturbate' < *degʷʰ-?

[47] The stem *majmán-* is only attested in the instr.sg. form *majmánā*, whereas the semantically identical stem *mahimán-* 'greatness' < *meǵh₂-mén-* occurs in all cases. Nussbaum (2010: 270) therefore argues that instr.sg. *majmánā* originally belonged to the paradigm of *mahimán-* as well. He argues that in the original instr.sg. form *m(e)ǵh₂mneh₁ the development *CHCC > CCC caused the disappearance of *h₂, yielding *meǵmneh₁ > *majmnā >> *majmánā.

[48] Cf. Kloekhorst fthc.a.

This new reconstruction with a voiced unaspirated velar, *d^heǵ-m-, *d^hǵ-m-, is supported by Hittite evidence. Recently, I have argued (Kloekhorst fthc.b) that in Old Hittite there was a phonemic opposition between long /ḗ/ and short /é/ in accented open syllables. The long /ḗ/ is in these syllables consistently spelled with a plene vowel, Ce-e-CV, whereas short /é/ is spelled with a plene vowel in only 50 percent of the cases, Ce-(e-)CV. Etymologically, long /ḗ/ goes back to *ḗ, *éh₁, *éi and *ói, whereas short /é/ reflects *é. There are three exceptions to this rule, however. In these words, an etymological short *é yields an unexpected OH long /ḗ/: *pédo- > pé-e-da- /pḗda-/ 'place'; *négʷment- > ne-e-ku-ma-an-t° /nḗgʷmant-/ 'naked'; and *d^héǵ^h(ō)m (as it is thus far reconstructed) > te-e-kán /tḗgan/ 'earth'. If we reconstruct tēkan as *d^héǵ-(ō)m, however, we see that all three words now have something in common: they all contain a PIE short *é followed by a voiced stop: *pédo-, *négʷment-, *d^héǵ-(ō)m. I therefore believe that the presence of the voiced stop is the crucial factor that caused the unexpected lengthening of the preceding short *é to OH long /ḗ/.

This lengthening of original short vowels by a following voiced stop is reminiscent of Winter's Law in Balto-Slavic (where a voiced stop causes acute intonation and often subsequently lengthening of a preceding vowel) and Lachmann's Law in Latin (where a voiced stop followed by a consonant causes lengthening of a preceding vowel). For both Winter's Law and Lachmann's Law it is crucial that PIE voiced aspirated stops do not affect the preceding vowel, and this is the case in Hittite as well: a PIE short *é before an aspirated stop remains short: *néb^{h}es- > ne-(e-)pí-iš /nébis-/ 'heaven', *d^héb^h-u- > te-(e-)pu- /tébu-/ 'little'. Winter's Law in Balto-Slavic is best explained by the glottalic theory: in the prehistory of Balto-Slavic, the glottalic element of voiced, i.e. pre-glottalized, stops merged with the outcomes of the PIE laryngeals, which is the reason why voiced stops cause acute intonation of the preceding vowel, just like laryngeals do.[49] For Hittite, we may therefore also assume that the glottalic element of the pre-glottalized stops at a certain pre-Hittite stage merged with the glottal stop that is the result of *h_1, which then caused lengthening of the preceding vowel: *d^héˀg-(ō)m > PAnat. *déˀgan > Hitt. tēkan /tḗgan/.

To sum up, both Sanskrit and Hittite provide evidence that the word for 'earth' contained a voiced unaspirated velar, *d^heǵ-m-, *d^hǵ-em-, *d^hǵ-m-. It cannot be denied, however, that other Indo-European languages seem to show a reflex of an aspirated *ǵ^h: Gr. χαμαί (not **γαμαί) 'on the earth' < *d^hǵ^{h}m-, Lat. humī (not **gumī) 'on the earth' < *d^hǵ^{h}om-, homō (not **gomō) 'human' < *d^hǵ^{h}ém-ōn, Goth. guma (not **kuma) 'man' < *d^hǵ^{h}m̥-n-. For these languages, we must therefore assume that the PIE cluster *d^hǵ- first changed to *d^hǵ^h-,[50] and that only later the dental stop was lost in certain environments. Since this development did not take place in Indo-Iranian, it cannot be projected back to PIE.[51]

In a recent article, Willi (2007) connects the word for 'earth' with the verbal root *(s)teǵ- 'to cover' (Gr. στέγω, Lat. tegō, ON þekja 'to cover'). Semantically, this connection is

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[49] E.g. Kortlandt 1988.

[50] This is not a matter of mere assimilation of *ǵ to *d^h. In the glottalic theory, aspiration was not a distinctive feature. Instead, the aspirated stops were in fact unmarked lenis stops, whereas voiced stops were pre-glottalized lenis stops: *d^hǵ- = *[tˀk̯-]. If we assume a simple loss of pre-glottalization between two occlusions, the outcome of this cluster is *[tk̯-], i.e. *d^hǵ^h-.

[51] Unless we assume that in PIIr. the full grade *d^hej- < *d^heǵ- was still present, on the basis of which the zero-grade stem *d^hj^h- was restored to *d^hj-, which then yielded Skt. j-.

attractive, but Willi's scenario to formally account for the origin of *$d^heǵ$-m- is unconvincing.[52] Perhaps one should assume an alternative scenario. If an s-mobile that is added to a PIE root with an initial voiced or voiced aspirated stop, really causes devoicing of that stop (a development known as Siebs' Law), then one could assume that the original root for 'to cover' was *$d^heǵ$-, from which the noun *$d^heǵ$-m- / *$d^hǵ$-em- / *$d^hǵ$-m- was derived, after which an enlargement with an s-mobile would transform the root into *(s)teǵ- in its verbal forms.

(9) CLuw. *inzagān*

In an article from 2003, Melchert argues that the CLuwian word *inzagān* should mean 'inhumations, things inhumated' and "represents a hypostasis of a univerbated prepositional phrase *en $d^hǵ^hǒm$ 'into the earth'" (2003: 148).[53] This would mean that in this word the cluster *$d^hǵ^h$ yielded Luwian [dzg]. According to Melchert, this outcome would prove the existence of a "thorn"-treatment of *TK-clusters, not only in Anatolian, but in PIE as well. He assumes that "PIE tautosyllabic */TK/ is realized as *[TSK]", just as "a sequence of two dental stops is realized as *[TST]" (2003: 154). There are several problems regarding these hypotheses. The first problem is that there are no indications whatsoever in the other IE languages that a cluster *TK would already in PIE regularly yield *TsK. In fact, as Lipp (2009: 61-70) clearly shows, there are some languages that clearly speak against such a development. For instance, Lipp (2009: 66) states that "bei einer aus dem Idg. ererbten Sequenz T^sK (als von Melchert postulierter Realisierung von tautosyllabischem *TK*) im Griechischen aber aufgrund der für eine Gruppe der Struktur *TsC* spezifischen Vereinfachung zu *sC* ausschließlich eine Vertretung der Struktur *sK* zu erwarten [wäre], nicht aber die tatsächliche Normalvertretung der Struktur *KT*". He therefore rather sees the affrication of *TK to *[TSK] as a specific Anatolian development. The second problem, however, is that within Anatolian all other words that contain a clusters *TK show an outcome *TK* and not [TSK]. Melchert must assume several *ad hoc* solutions to account for these. For instance, for *$h_2rtǩo$- > Hitt. *ḫartakka*- (not **ḫarzakka-) 'bear' it is argued that we are dealing with a non-tautosyllabic cluster here, "*$h_2rt.ǩo$-", in which the "thorn"-development did not take place. For *$d^hǵ^hǒm$ > Hitt. *tagān* (not **zagān) 'on the earth' it is argued that here the initial cluster *$d^hǵ^h$- is secondarily replaced by *$d^h_ǝǵ^h$- from gen.sg. *$d^h_ǝǵ^h$-m-és, where the anaptyctic vowel would be regular in *TKC- (following Schindler, cf. section (3) above). Also in CLuw. *tii̯amm(i)*- (not **zakamm(i)- or **zii̯amm(i)-) 'earth', which must reflect *$d^hǵ^hém$-, the initial cluster was according to Melchert secondarily replaced by *$d^h_ǝǵ^h$-. It is clear that Melchert must take recourse to some very unattractive secondary developments in order to account for all the counter-examples to his proposed development *TK > Anat. *[TSK]. The third and most serious problem is that the philological treatment of the word *inzagān* itself is flawed. In Kloekhorst 2008: 861-2, I have treated in detail the contexts in which

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[52] Willi reasons as follows. The original paradigm for 'earth' was *(s)tégōm, *(s)tg-m-és, *(s)tg-ém-i. Although Anatolian may reflect this original paradigm as such, in the other IE languages the oblique stems *(s)tǵm- and *(s)tǵém- were generalized, which through a stage *(s)t^hǵ- regularly developed into *(z)d^hǵ^h-. Yet, the assumption of PIE aspiration of *st- to *st^h- as well as PIE voicing assimilation of *(s)t^hǵ- to *(z)d^hǵ^h- is unwarranted, however, which makes Willi's scenario unacceptable.

[53] Of course, Melchert reconstructs the word for 'earth' with a *-ǵ^h-. In the following paragraph, in which I represent his views, I will therefore also reconstruct *-ǵ^h- instead of correct *-ǵ-.

inzagān occurs, and have shown that a translation 'inhumated' is unlikely. Instead, I have suggested that a translation 'tools' would better fit the context. Therewith, Melchert's basic assumption that CLuw. *inzagān* reflects a preform "**en dʰǵʰŏ̆m*" has become untenable. With the elimination of this etymology, the whole idea of a "thorn"-development in Anatolian must now be abandoned.

(10) Conclusions

Our main conclusions are the following. Clusters of the shape **TK* did not only consist of a combination of voiceless stop + voiceless stop (**tḱ*, **tkʷ*) or aspirated stop + aspirated stop (**dʰǵʰ* or **dʰgʷʰ*), but could contain voiced stops as well (e.g. **dḱ*, **dǵʰ*, **dʰǵ*). Apart from the PIE dissimilation of **dḱmt-* to **h₁ḱmt-* in the word for 'hundred' (**dḱmtóm > *h₁ḱmtóm*), clusters of the shape **TK* remained unaltered within PIE. There is no evidence whatsoever that within PIE these clusters would undergo any kind of "thorn"-treatment or other specific developments (reduction, anaptyxis). Only in the daughter languages, in accordance with language-specific rules, the **TK*-clusters were sometimes simplified, either by dropping one of the two stops, or by metathesis to **KT* (Greek, Celtic). The occurrence of some thus far unexplained prothetic vowels preceding **TK*-clusters in Greek (ἑκατόν, ἰχθῦς, ἰκτῖνος) can be perfectly accounted for within the framework of the glottalic theory. For Greek, Sanskrit and Avestan, the developments of the **TK*-clusters can be summarized thus (outcomes in square brackets are unattested, but can be inferred on the basis of the development of structurally comparable clusters):

PIE	Gr.	Skt.	Av.	PIE	Gr.	Skt.	Av.
*tḱV-	κτ-	kṣ-	š-	**tkʷV-*	[ππ-]	[kṣ-]	--
*tḱC-	[κ-]	[ś-]	s-	**tkʷC-*	[π-]	[k-]	--
*tǵV-	[κτ-]	[kṣ-]	--	**tgʷV-*	[ππ-]	[kṣ-]	--
*tǵC-	[κ-]	[j-]	--	**tgʷC-*	[π-]	[g-]	--
*dḱV-	ἰκτ-	[kṣ-]	--	**dkʷV-*	[ἰππ-]	[kṣ-]	--
*dḱC-	[κ-]?[54]	ś-	s-	**dkʷC-*	[π-]?	[k-]	--
*dǵʰV-	ἰχθ-	[kṣ-]	--	**dgʷʰV-*	ἰφθ-?	[kṣ-]	--
*dǵʰC-	[χ-]?	[h-]	--	**dgʷʰC-*	[φ-]?	[gh-]	--
*dʰǵV-	χθ-	kṣ-	--	**dʰgʷV-*	[φθ-]	[kṣ-]	--
*dʰǵC-	χ-	j-	z-	**dʰgʷC-*	[φ-]	[g-]	--
*dʰǵʰV-	χθ-	[kṣ-]	--	**dʰgʷʰV-*	φθ-	kṣ-	(d)j-[55]
*dʰǵʰC-	[χ-]	h-	--	**dʰgʷʰC-*	[φ-]	[gh-]	--

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[54] Since the development of PIE **dḱmtóm > *h₁ḱmtóm* is specific for this word (dissimilation of **d-* due to the following **-t-*), Gr. ἑκατόν cannot be used as evidence for the normal development of a cluster **dḱ-* in preconsonantal position. We may have to assume that just as in **tḱC- >* κ- and **dʰǵC- >* χ- the initial stop in **dKC-* was lost without a trace, including its glottalization. Evidence in favor of or against this assumption is lacking, however.

[55] When palatalized: GAv. *də̄jīṯ.arəta-*, YAv. *jiṯ.aša-* 'destroying truth' < **dʰgʷʰ-i-*.

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