Indo-European Phonology

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Syllabus

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Syllabus

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The IE sound system

Preliminaries

Notation:

*j (or *y), *w instead of *i̯, *u̯

ʱ (not ʰ) for „voiced aspiration“

Sometimes: *h, *χ, *ʁ for *h_1, *h_2, *h_3

IE vowels

Common vowel system reflected in earliest languages

*i	*u	*ī	*ū
*e	*o	*ē	*ō
*a		*ā	

The IE sound system

+ some vowels correspondences with zero, e.g.
i = a = a = Ø = Ø = a ... (between obstruents)
Ø = a = o = u = i = ə ... (with **l/r*)
Ø = a = a/e = u = i = ə ... (with **m/n*)

Distributional peculiarities:
**a* (and **ā*) rather rare and mostly confined to beginning or end of root
Long vowels with restricted occurrence

The IE sound system

PIE consonant system (neo-traditional)

	labial	dental	“palatal”	“velar”	“labiovelar”	”laryngeal”
stops: voiceless = tenues	*p	*t	*k̑	*k	*k^{w}	
voiced = mediae	(*b)	*d	*ĝ	*g	*g^{w}	
voiced aspirated = asperae	*b^{ɦ}	*d^{ɦ}	*ĝ^{ɦ}	*g^{ɦ}	*g^{wɦ}	
fricatives		*s				*h_1, *h_2, *h_3
glides			*j		*w	
liquids		*l, *r				
nasals	*m	*n				

1. Stop series: A. Reconstruction models of PIE stops

Main reflexes of stop series in IE branches, exemplified by dentals

	Continuation in IE branches									
T	Anat.	Toch.	Ind.	Iran.	Greek	Italic	Celtic	Germ.	B-Sl.	Alb.
t	t·	t	t,t^h	t,θ	t	t	t/t^h	θ	t	t
$d^ɦ$	d̥	t,ts<*$d^ɦ$	$d^ɦ$/d	d (θ)	t^h	f/ð	d	d/ð	d	d
d	d̥	ts<*d	d	d (θ)	d	d	d	t (t^h/ts)	:d	d

Balto-Slavic :d = voiced with lengthening/acute effect (Winter's Law)

A. Reconstruction models of PIE stops

Models of the PIE stop system, exemplified by dentals

T	H	G	N/V	K	Haider +
t	t	t^h~t	t^h	t	t
$d^ɦ$	$d^ɦ$/d	$d^ɦ$~d	d̥	$d̥^h$~d̥	d>$d^ɦ$
d	t'/t̰	t'	t'	d̰ [ˀd̰]	d́>d

(T = "neo-traditional/mainstream"; H = Hopper 1973/1977; G = Gamkrelidze 1973; N = Normier 1977, V = Vennemann 1984; K = Andreev 1957; Kortlandt 1978a, 1985; Haider 1983; Kümmel 2009/2012; Weiss 2009)
Kortlandt's "preglottalized lenis" = "voiceless/glottalized implosive" (cf. Maddieson 1984: 111ff.)

B. Data from within the system: alternations of consonants

1) „Final lenition“

Stop series distinctions neutralized word-finally to „mediae“ (at least when followed by a vowel):

*T > *D; *D̤ʰ > *D /_# (cf. Goddard 2007: 123f.)

Cf. 3s verbal ending *-t-i* > Latin *-t* vs. *-d* > Latin *-d*

2) Voicing assimilation

Clusters of obstruents must agree in laryngeal features (i.e., voicing, aspiration etc.). Normally assimilation is regressive: voiced stops are devoiced before voiceless stops and *s (but not before laryngeals!), voiceless stops and *s are voiced before voiced stops:

*D > *T /_T,s, cf. *χawg- ⇒ *χwek-s-

*T > *D; *s > *z /_D, cf. *pi-pd- > *pibd-; *si-sd- > *sizd-

B. Data from within the system: alternations of consonants

Directly attested in IE languages but synchronically productive ⇒ innovations possible

However: **dk̑* not assimilated to **tk̑*, cf. developments in decade numerals:

wi-dk̑m̥t-* > PII **win**ćat-*, PCelt. **wikant-*, **wīk̑°* ‘20’

tri-dkm̥t-* > PII **trin**ćat-*, PCelt. *trikant-*, **trīk̑°* ‘30’

**penk^{w}e-dk̑m̥t-* > **penk^{w}ēk̑°* > PII **panḱāćat-* ‘50’

Perfect **de-dk̑-* > **dēk̑-* > PII **dāć-* (also in other clusters, cf. Schumacher 2005)

Loss of syllable-final **d* with laryngeal-similar effects is sometimes called “Kortlandt effect”, cf. Kortlandt 1983 (cf. also possible Vedic *vā́$_a$r* ‘water’ < **wā́Hr̥* = Luw. *wār* < **wóHr̥* < **wódr̥*, Lubotsky 2013b)

Original exception with mediae? Cf. **-ná-* for **-tá-* in II verbal adjectives to avoid unharmonic clusters?

B. Data from within the system: alternations of consonants

3) Bartholomae's Law

Behind a (stem-final) aspirate assimilation is progressive: voiceless stops and *s become voiced and aspirated (for media after aspirata no evidence is available):

*T > D̤ʱ; *s > *z̤ʱ /D̤_

Clearly a productive rule in Proto-Indo-Iranian, Sanskrit, and Old Avestan (with relics in later Iranian), but elsewhere normally lost analogically (or never applied?).

4) Dental assibilation

Dental stops were assibilated preceding (heterosyllabic) dental stops:

*t > *ts /_t; *d > dz /_d; *d̤ > d̤z̤ /_d̤ʱ

Sometimes also assumed for the position before velars.

B. Data from within the system: alternations of consonants

5) Siebs' Law

Aspirates after initial **s* > (allophonically) voiceless aspirates?

a) **sk^{h}ejd-* > gr. *sk^{h}id-*

**sp^{h}ejg-* > gr. *sp^{h}igg-*

**sp^{h}erH-* > OIA *sphar-*, gr. *sp^{h}ur-* (but < **tsperH-* after Lubotsky)

**sp^{h}raχg-* > OIA *sphūrj-*, gr. *sp^{h}arag-*

However: No assured *s*-less cognates!

Ambiguous due to laryngeal:

**sk^{h}aχ-* > Gr. *sk^{h}a-* ~ **g^{h}aχ-* 'to yawn' > Gr. *k^{h}a-*

**sp^{h}eh-* > OIA *sphā-*

b) Certain variation without proof of aspiration: **sterb^h-* ~ **d^{h}erb^h-; *b^{h}eng-* ~ **speng-*

⇒ Voicing alternation assured, aspiration unclear! Cf. now Sturm 2016

B. Data from within the system: alternations of consonants

6) Distribution in formative types

	roots	particles	suffixes	endings
tenues	+	+	+	+
asperae	+	+	(+)	(+)
mediae	+	(+)	–	–

⇒ mediae more “marked”

7) Root structure constraints

Allowed: T_T-, $D^{ɦ}$_$D^{ɦ}$-; D_T-, T_D-, D_$D^{ɦ}$-, $D^{ɦ}$_D-; T_N$D^{ɦ}$-, sT_$D^{ɦ}$-

Forbidden: ~~T_$D^{ɦ}$~~-, ~~$D^{ɦ}$_T~~-, ~~D_D~~-

⇒ T + $D^{ɦ}$ (sensitive to voicing effects) | D

C. The “implosive” theory

„Aspirates“ = simple explosive stops **b, d, …
„Mediae“ = implosives, i.e. nonexplosive stops **ɓ, ɗ, … (not distinctively glottalized)

When these developed to explosives *b, d, …, the original explosives could remain distinct and developed to breathy voiced “aspirated” stops *b̤ʱ, d̤ʱ, …

System typology (Kümmel 2012a; 2015)

p | b | ɓ most frequent 3 stop system type with two „voiced“ series
⇒ most probable synchronically,
nevertheless rather unstable because of tendency ɗ > d

C. The “implosive” theory

Diachronic parallels (cf. Weiss 2009)

Proto-Thai *ɓ | *b > Cao Bang (Nord-Thai) b | $b^{ɦ}$
(in both systems : p, in Cao Bang also : p^h of different origin)
Intermediate stage in other Thai languages, too:
Thai, Lao, Saek *d >*$d^{ɦ}$ > *t^h | *ɗ > d elsewhere *d > t | *ɗ > d/ɗ/n/l

Mon-Khmer, viz. *Proto-Mon t | d | ɗ (> Mon t | t | ɗ)
> *t | $d^{ɦ}$ | d > Nyah Kur t | t^h | d.

Austronesian: Madurese *b, *d, *g > *$b^{ɦ}$, *$d^{ɦ}$, *$g^{ɦ}$ > p^h, t^h, k^h
vs. preserved *p, *t, *k | secondary b, d, g

C. The “implosive” theory

Distribution of implosives

Weiss: *b*-lacuna because of ***ƀ* > **w*

Kümmel: rather ***ƀ* > **m* (already Haider 1983 foll. Schindler),
cf. possible Uralic cognates with nasals:
PIE **jeg-i/o-* ‘ice’ = PU **jäŋi*
PIE **dek-* ‘to perceive’ = PU **näki-* ‘to see’?

Rareness of ancient (root-internal) clusters of nasal + media
compatible with cross-linguistic tendencies (Kümmel 2012b)

C. The “implosive” theory

Possible implications for IE rules

„Final voicing“ = nonexplosive articulation; perhaps also syllable-finally, preserved in **pi-bh_3$-V* etc. – isolated example(s) of older more general rule?

Cf. allophonies in Munda and SE Asia: final stops > „checked“ = preglottalized and unreleased, in Munda voiced before a suffix (Donegan & Stampe 2002: 117f.)!

Bartholomae’s Law = simple voicing assimilation with secondary aspiration

Cf. Miller 1977

⇒ Shift only post-PIE?

C. The “implosive” theory

Possible direct reflexes of implosives and the older system

„Aspiration“ of MA but assured in IIr., Greek, Armenian, Tocharian, Italic, (Germanic?)

⇒ central innovation: sound shift *ɗ > *d / *d > *d̤ʱ
vs. preservation in peripheral languages?

Sporadically *d (but never *dʱ?) > *l in Luvian: Hitt. *dā-* = luv. *lā-, lala-* ‘to take’?

Celtic *ɡʷ > *ɓ > *b vs. preserved *gʷ, *kʷ?

Secondarily phonologized glottalization in Balto-Slavic (cf. Kortlandt passim)?

2. Centum and Satem

A. Dorsal stops: What kind of and how many?

Main facts and general problems

Av. *satəm* = Lat. *centum* ['kɛntʊm] < PIE **k̑m̥tóm* ‘100’

„Satem“:	*k̑ > ś/s/θ	*k = *kʷ > k
„Kentum“:	*k̑ = k > k	*kʷ > kʷ (> p/t)

“Mixed” languages?

2. Centum and Satem

T	Gr	It	Ce	Ge	Hit	Luw	Arm	Alb	B	Sl	In	Ir	PIE
k,ʃ	k	k	k^h	x	k	k,c	s,ʦ^h	θ,k	ʃ (k)	s (k)	ʃ	s/θ	*c/k
						k,?	k^h,?	k,c,?	k	k,ʧ,ʦ	k,tʃ	k,x,	*k/q
k^w,ʃ	k^w>p,t	k^w	k^{wh}	x^w	k^w	k^w	k^h,ʧ^h	k,c,s					*k^w
k,ʃ	g	g	g	k	g	g,j	ʦ	ð,g	ʒ (g)	z (g)	dʒ	z/d	*ɟ/g
							k	g,ɟ,?	g	g,ʒ,ʤ	g,dʒ	g,dʒ	*g/ɢ
k^w,ʃ	g^w>b,d	g^w	b	k^w	g^w	w		g,ɟ,z					*g^w
k,ʃ	k^h	h	g	g	g	g,j	ʤ	d,ð	ʒ (g)	z (g)	ɦ	z/d	*ɟ^ɦ/$g^ɦ$
							g,?	g,ɟ,?	g	g,ʒ,ʤ	$g^ɦ$,ɦ	g,dʒ	*$g^ɦ$/$ɢ^ɦ$
k^w,ʃ	k^{wh}>p^h,t^h	f	gw	b	g^w	w	g,ʤ	g,ɟ,z					*$g^{wɦ}$

2. Centum and Satem

Examples (in distinctive environments)

ś = k < *k̑/k: Arm. *sirt*, Lith. *šìrd-*, Slav. **sьrd-* : Hitt. *ker*, Gr. *kẽr*, Germ. **xert-* < **k̑erd-/k̑r̥d-* 'heart'
OIA *śrī-*, Av. *sraiian-* ≈ Gr. *kréont-* < **k̑rejH-/*k̑riH-* '(to be) excellent'
OIA *aṣṭā́*, Lith. *aštuonì* = Gr. *oktṓ*, Lat. *octō* < **(H)ok̑tóH(-)* 'eight'
OIA *śúnas*, OLith. *šunès* ≈ Gr. *kunós*, OIr. *con* < **k̑unés/-ós* 'of the dog'

k = k^w < *k^w: Av. *ci-/ca-*, Slav. *čь/če-* : Hitt. *kui/kue-*, Lat. *qui-/que-* … < *k^wí-/k^wé-* 'who, what'
OIA *krī-*, ORuss. *krĭnj-* : Gr. *pría-*, Welsh *pryn-* < *k^wriχ-, k^wrinχ-* 'to buy'
OIA *nákt-*, Lith. *nakt-* : Gr. *nukt-*, Lat. *noct-* < *$nók^wt$-* 'night', Hitt. *nekut-* /nek^{w}t-/

2. Centum and Satem

Examples (in distinctive environments)

k = k < *k/q: Lith. *kas-*, Slav. **čes-* < **kes-* : Hitt. *kiss-* < **kes-* 'to comb'

OIA *kravíṣ*, Lith. *kraũjas* : Gr. *kréas*, Lat. *cruor* < **kreu̯χ-* 'blood, raw flesh'

OIA *rukta* = Hitt. *lukta* < **luk-tó* 'became light'

OIA *kup-* 'to shiver' = Lat. *cup-* 'to wish' < **kup-* 'to be excited'

Distributional peculiarities

No "labiovelars" beside **w/u*, no velars before **j/i*

Velars dominate after **s* and before **r*, frequent root-finally

No labiovelars in suffixes, in roots rarely before consonants

frequent delabialization neighbouring rounded vowels and before [-syll]

2. Centum and Satem

Threefold reflexes in „small inherited corpus“ languages?

Armenian *sirt* ‘heart’ < **k̑ērdi-*; *čʿorkʿ* ‘4’ < **kʷetores*; *kʿerē* ‘scratches’ < **kereti*

Albanian *tho(sh)-* ‘to say’ < **k̑ēs-*; *sorrë* ‘crow’ < **kʷērsnā-*; *korrë* ‘harvest’ < **kēr(s)nā-*
dimër ‘winter’ < **ĝʰ(e)imon-*; *zjarm* ‘warmth’ < **gʷʰermo-*; *gjind-* ‘to get’ < **gʰend-*

⇒ Palatalization of labiovelars only? (velars in Alb. very late)
Labiovelars more easily palatalized in Greek, Lycian

Luwian (= Lycian and Carian)
zi- /tsi-/ ‘to lie’ < **k̑ei-*; *kui-* /kʷi-/ ‘who, what’ < **kʷí-*; *kĭsa-* /kisa-/ ‘to comb’ < **kes-*

2. Centum and Satem

⇒ Palatalization of “palatals” only? Cf. Melchert, talks in Harvard 2008/Opava 2010 problematic: uncanonical conditioning before **w* in HLuv. *asu-* ‘horse’, *suwan-* ‘dog’ (if not loans from Indo-Aryan), before **(ə)R* in CLuv. *zurni-* ‚horn‘ < **krn-*, cf. OIA *śrṅ-ga-*, *zanta* ‚below, down‘ < **kNta*, cf. Gr. *katá*

NB: Exactly one example for nonpalatalized PIE „velar“ in contrastive environment (= before front vowel), namely *kisa-* ‘to comb’ - How to exclude analogical generalization of **k*, cf. the athematic verb in Hitt. *kiss-*, or a secondary vowel?

General problem: nonpalatalization may be analogical, cf. irregularly „preserved velars“ in OIA *kampa-, kāriṣ-, ghas-, skambh-, skánda-* (as in *kar-, gam-* with original labiovelar)
⇒ Counterexamples simply lacking by chance, considering that we know rather few inherited words in just these languages?

2. Centum and Satem

Armenian candidates for palatalized “velars” (cf. Pedersen 1906: 393; Woodhouse 1998: 46f. foll. Jahukyan): *čʿiłǰ* ‘bat’, *čim* ‘bridle’, *čmlel* ‘to squeeze’, *čiw* ‘paw, hoof’, *êǰ* ‘descent’

B. Explanations

A) Three original series

Palatals : velars : labiovelars (traditional)

Diachronically quite improbably

Main problem: palatal > velar in all Centum languages implausible, if not allophonic

⇒ „Palatals“ should continue velars which are simply preserved in Centum so „velars“ must have been something else (e.g., uvulars), if distinct

2. Centum and Satem

Velars : labiovelars : uvulars

Kümmel 2007

Main problem: uvulars nowhere (!) preserved

B) Only two original series

Problems for all accounts: Contrast root-initially before the vowel slot! Cf. **gemH-, *ɢem-, *g^{w}em-* = artefact of different generalizations?

1) Palatals vs. labiovelars, velars from neutralization, i.e. depalatalization or delabialization

Cf. Steensland 1973, Kortlandt 1978b

Main problem (as always): Distribution not complementary

2. Centum and Satem

Additional problem: presumed original system typologically rare (additional uvulars expected!)

a)Neutralization after **s*

Excursus: **sK* in Indo-Iranian

Standard theory: **sk* > PII. **sć* > OIA *cch*, Iran. *s*

**sq = sk*^{w} > PII. **sk* > OIA = Iran. *sk*, palatalized PII. **sḱ* > OIA *śc*, Iran. *sc*
cf. OIA *chand-* 'to appear', *skand-* 'to jump', *(ś)cand-* 'to shine'

But: *śc-* very rare

sk-presents normally „palatal" *-ccha- = -sa-*, but postconsonantally „velar" in Av. *ubjiia-, θβązja-, srasca-*; OIA *vr̥ścá-; ubjá-, bhr̥jjá-*

adverbs in *-cchā̃* and *-(ś)cā*

2. Centum and Satem

⇒ alternative theory (Zubatý 1892, Lubotsky 2001): **sk* > OIA Iran. *sk*, palatalized > **sḱ* > OIA *śc*, Iran. *sč* after consonants (stops?), elsewhere earlier palatalization > **sć* > OIA *cch*, Iran. **sc* > *s*
counterarguments of Lipp (2009: I 18f. fn. 30) not effective
Problem (not too grave): Motivation of early vs. late palatalization

In other satem languages no clear difference of **sk* vs. **sq*
Gorbachov 2014 only shows **sk^{j}* > Baltic *st* but does not prove contrast between **sḱ* and **sk*

**sk^{w}* practically absent in general (cf. doublets like **k^{w}er- : *sker-* 'to cut'), but no phonetic motive for delabialization ⇒ relic of older phonetics, viz. front velar : back velar? Or of old

2. Centum and Satem

b) Neutralization (delabialization) after **u*

Weiss 1995: no labiovelar vs. velar distinction adjacent to **u*

⇒ Neutralization of labialization?

Phonological process: rounding interpreted as coarticulatory rather than phonological, cf., e.g., Yazghulami (Eastern Iranian, Pamir): phonological labiovelars beside unrounded vowels only, with rounded vowels /k/ = [k^w]

Steensland: also no palatals in this environment – but some (not optimal) counterexamples: PII. **kruć-, *yuj́-*, Iran. **guz-*, OIA *tuś-*, Lith. *láuž-, pušìs*

Arm. generally only „palatals“ after *u*, also in cases of original labiovelars, cf. **ang^w-* > **awk^w-* > *awc-* ‘to’ ⇒ palatals = delabialized labiovelars = phonetic velars

Gr. *eĩpon* ‘said’ < **weyk^{w}o/e-* < **we-wk^{w}o/e-* (cf. PII **wawḱa-* > Av. *vaoca-*, OIA *voca-*) shows preservation of **uk^w* in Proto-Greek, later /wk^w/ [wk^w] > /wk/

Cf. Kümmel 2007: 310-327

2. Centum and Satem

c) Neutralization (depalatalization) before resonants
Before **r* (IIr., Balto-Slavic, Alb., Arm.)
Velars: **qr_wχ-/qruχ-, *qr_t(u)-, *ɢr_s-, *ɢʰr_bχ-*
Labiovelars clearly attested, but rare: **kʷr_jχ-, *kʷr_p-, *gʷrómo-*?
Palatals: **kr_jH-, *kr_mχ-, ?*kr_tH-, *gr_j-* (palatal only in IIr.)
Weise's Law in IIr.? Kloekhorst 2011: Palatals > velars before **r* (if not followed by **i/j*)
cf. *kravíṣ-, kr, gr*
vs. *śrav-, śray-, hray-* and *śrī-; jráyas = zraiiah-* vs. Hitt. *karait-*
But palatals also before **re* (at least), cf. Skt. *śram(i)-* 'become tired' = Greek *krema-* 'hang'; Skt. *śrath-* 'ro release' = Germ. **hreþ-* 'to rescue' etc.
⇒ either no such rule or palatal conditioned by all original front vowels

2. Centum and Satem

2) Velars + labiovelars (preserved in Centum)
Satem split of velars into palatals and velars
a) by „normal“ palatalization before following (resonant +) palatal vowel with analogical generalizations (Lipp 2009 I), viz. **kleu-* > **cleu-* ⇒ analogical **clu-* etc.
Problems:
– implausible analogies necessary: **χok-t°* ‘eight’ after semantically dissociated **χok-et-* (‘harrow’)
– unexpectedly few root variants with palatal ~ velar in Satem languages
b) contrastive differentiation of velars vs. delabialized labiovelars ⇒ no shift in non-contrastive environments, hence not after **u* and **s*; early shift in case of earlier delabialization, e.g., before **w*, **t* etc.?

2. Centum and Satem

Exceptions (older Uvularization?) before low back vowels and maybe **r* ⇒ „velars“
Advantage: matches actual distribution (at least mostly)

3) Front velars + back velars

Huld 1997; Woodhouse 1998; Bičovský 2010

Satem: general fronting, but front velars unfronted in some environments
Centum: general backing, strengthening and phonologization of concomitant labialization of back velars; contextual delabialization

Problem also here: actual distribution, otherwise identical to 2b).
Evidence for original labialization in Satem languages
(position after **u* in Armenian etc.)
⇒ rather pre-PIE

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

1) Traditional reconstruction of PII

Primary palatals (PP) > “palatal” sibilants **ś, *ź, *ź^{ɦ}*

Secondary palatals (SP) > palatoalveolar affricates **č, *ǰ, *ǰ^{ɦ}*

Nuristani (and other arguments) and shows, however: affricates rather than sibilants for PP
⇒ **ć, *ǵ, *ǵ^{ɦ}* rather than **ś, *ź, *ź^{ɦ}*

Cf. PII **dáća* ‘ten’ > Skt. *dáśa*, Av. *dasa*, OP *daθā*, Nur. k. *duc* /duts/
PII **ǵā́nu* ‘knee’ > Skt. *jā́nu*, Av. *zānu-*, Nur. k. *jõ* /dzõ/
PII **ǵ^{ɦ}ásta-* ‘hand’ > Skt. *hásta-*, Av. *zasta-*; OP *dasta-*
post-PIran. **dzasta-* > **dasta-* in Khot. *dastä* etc., likewise Nur. k. *dušt* /duʃt/

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

Cf. early iranian **ts* presupposed by Tocharian loanwords:

TB *tsain; tsainwa* ‘arrow’ < **tsainə-; tsainw-* ← **dzainu-*, cf. Arm. *zên/zinow-*, Av. *zaēna-* ‘weapon’

TB *etswe-* ‘mule’ (M. Peyrot, talk in Moscow last week) < **ætswæ-* ← **atswa-* ‘horse’

Counterarguments by Katz 1997 not decisive: Uralic **ś* in loanwords might come from dialects with later Indo-Aryan development – or rather, borrowed as **ć* and simplified within Uralic,

viz. **ćə̃tá-/*ćatá-* ‘100’ → PUr. **ćęta* > Saamic **čuotē*, Finn. *sata*, Mordva **śada*; Mari *süd̈ö*, Komi *śo*; Hung. *száz,* Mansi *šę̄t/šāt/sāt*, Chanty *sat*; for PU **ć* (preserved as such in Saamic) see now Zhivlov 2014

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

Cf. also old Iranian loans into Uralic with depalatalized affricates = PU *č (retroflex!) or *ks
e.g. *patsu- ‘animal’ → *poča(w)- ‘deer’, *päčV ‘reindeer calf’; *matsa- → *mača- ‘moth’; *atswa- ‘horse’ → *očwa ‘stallion’

Finn. *paksu* ‘thick’ ← *badzu-; *maksa-* ‘to pay’ ← *mandza- ‘give’

⇒ modern “standard” reconstruction PP = *ć, *ǰ, *ǰʰ vs. SP = *č, *ǰ, *ǰʰ

Impossible: Secondary palatals must have been less advanced on the path of (de)patalization than older series (see Lipp 1994; 2009; Kümmel 2000; 2007)
⇒ SP still palatal, not fronted, thus /c/, /ɟ/ and not *č, *ǰ

Cf. also Lubotsky 2001: “*č” = palatal

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

2) Ruki

RUKI-rule: **s/z* > (allophonic) **š/ž* after all non-anterior sounds,
i.e., **i/y*, **u/w*, **r*, any palatal or velar = retraction, not palatalization!

Phonologized by merger with result of anteconsonantal simplification of **ć*, **j́* > **ś*, **ź* > **š*, **ž*

⇒ contrast **s* vs. **š* in non-Ruki environment

**š* > Indo-Aryan „retroflex“ *ṣ* (articulated like *r* and alternating with it)
vs. Iranian “non-retroflex” *š*?

Reflexes of **š* retroflex in most of East Iranian, too (merging with *ṣ/ẓ* < *sr/zr*)
Even in Avestan, *š/ž* clearly less palatal than *c/j/ś*: do not cause fronting *ə* > *i*

⇒ “retroflex” = distinctly non-palatal character of old **š/ž* triggered by contrast to new more palatal sibilants wherever these appear (and remain distinct) in IIr

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

3) Thorn

Traditional: **kþ* etc. with **þ* > Greek, Celtic *t*; elsewhere *s*

Hittite + Tocharian: **tk* with metathesis > **kþ* in most languages

Younger variant: **tk* > **tsk* > **kts*

Alternative (Burrow, Lipp 2009, see below):

II sibilants from palatals, no metathesis

a) Skt. *kṣ*, MIA *kh/ch* = Iranian *š* = Greek *kt*, Hitt. *tk* … < IE **tḱ*

Skt. *ŕ̥kṣa-* = YAv. *arša-* = Gr. *árktos*, Hitt. *hart^{a}kka-* ‘bear’ < PIE **χŕ̥tḱo-*

Skt. *kṣé-/kṣi-* = Av. *šaē-/ši-* = Gr. *kti-* ‘live, settle’ < PIE **tḱ(e)i-*

Skt. *tákṣan-* = Av. *tašan-* = Gr. *tékton-* ‘carpenter’ < PIE **tétḱon-* (or **teḱs-*?)

Skt. *kṣaṇ-* ‘hurt’ = Gr. *kten-/kta(n)-* ~ *kan-/kon-* ‘kill’ < PIE **tḱen- (*tken-)*?

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

b) Skt. *kṣ*, MIA *gh/jh* = *Iranian *ž* = Greek $k^h t^h$, Hitt. Toch. *tk* … < IE $*d^ḥ ĝ^ḥ$

Skt. *kṣā́s, kṣā́m, kṣám-i* ~ *jm-ás*; Av. *zā̊, ząm, zəmi* ~ $z^ə mō$; Gr. $k^h t^h ón$, $k^h t^h óna$ ~ $k^h amái$;
Hitt. *tēkan, takn-*; PToch. **tkæn-* ‘earth < PIE $*d^ḥ ég^ḥ om$-/$d^ḥ ĝ^ḥ ém$-/$(d^ḥ) ĝ^ḥ m$-

c) Skt. *kṣ*, MIA *gh/jh* = Iranian *ǰ* = Greek $p^h t^h$ < IE $*d^ḥ g^{wḥ}$

Skt. *kṣi-* ‘perish, destroy’, MIA *jhi-* = Av. *ji-* = Greek $p^h t^h i$- < PIE $*d^ḥ g^{wḥ}(e)i$-
Skt. *ákṣiti śrávas, śrávas … ákṣitam* ‘imperishable’ ≈ Gr. *kléos* $áp^h t^h iton$

Skt. *kṣā́ya-* = MIA *jhāya-* ‘burn’, *kṣāmá-* ‘burnt, dried’, MIA *jhāma-* = Av. *jāma-* ‘black’
< PII $*dǵ^ḥ ā$- < PIE $*d^ḥ g^{wḥ}$-*eh-* ⇐ PIE $*d^ḥ eg^{wḥ}$- ‘burn’

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

Problematic:

d) Skt. *kṣ*, MIA *kh/ch* = Iranian *xš-* = Greek < IE **tk*?

Skt. *kṣā-, kṣáya-* = Av. *xšā-, xšaiia-* ‘rule, reign’ ?=? Greek *ktā-* ‘achieve, possess’ (~ *pā-* ‘id.’)

Skt. *kṣ*, MIA *gh/jh* = Iranian *gž-* = Greek $p^h t^h$ < IE $*d^{ɦ}g^{wɦ}$? (better $*g^w\hat{g}^{ɦ}$)

Skt. *kṣar-* = Av. *ɣžar-* ‘flow’ ?=? Greek $p^h t^h$*er-* ‘perish’

No IE “thorn” /θ/ or /ts/, not even peculiar allophone after dorsal stops; main arguments by Lipp 2009 (following Burrow)

Basic assumption: simplification of (palatal) affricates after stops

Cf. **pk̑* > PrePII. **pć* [pt̻ʃ] > **pś* [p̻ʃ] > **pš*, cf. **pk̑u-* ‘cattle’ > **pšu-* > Skt. *kṣú-*, Av. *fšu-* probably not heterosyllabic, cf. Skt. *virapśá-* < **wirap.ćwá-* < **wi(H)ra-pćw-á-*

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

Cf. *$k^w\hat{k}$ > PrePII. *kć > *kś > *kš?

Skt. *cakṣ-* may contain old *s* in all cases (contra Kümmel 2000, weak perfect stem *cakṣ-* from **ḱakćš-* < *$k^w ek^w\hat{k}s$-* rather than **ḱakš-* < **ḱakć-* < *$k^w ek^w\hat{k}$-*);
so heterosyllabic preservation, cf. Skt. *cakhy-*, Av. *caxs-* < **ḱa-k.ć-*
(generalized to root **kćā-*)

Similarly after dentals **tk̂* > **tć* > **tś* > **tš*, but here also heterosyllabic [t.t͡ʃ] > [t̪.t͡ʃ] > [t̪.ʃ] = /tš/, due to greater similarity of **t* and **ć*;
merged with **k̂s* > **ćš* [t͡ʃ.ʃ] > [t̪.ʃ] **tš*

PII **tš* > PIA **ṭṣ* > Skt. *kṣ*, MIA *ṭh/th/kh*;
PIran. postalveolar affricate **č* (distinct from palatal **ć*) > CIran. *š*
(Persian *s*; africate exceptionally preserved in Kurd. *hirç* ‘bear’)

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

PIE *χ̥ŕtḱo- > *h̥ŕtća- > PII *h̥ŕtša- > Skt. ŕkṣa-
= PIran. *hərča- > YAv. *arša-*, NP *xirs* ‘bear’

PIE *tḱéjti > *tćáiti > PII *tšáiti > Skt. *kṣéti* = PIran. *čaiti > YAv. *šaēiti* ‘settles’

PII *dž > PIA *ḍẓ^{h} > Skt. *kṣ*, *MIA *jh/gh*; PIran. postalveolar affricate *ǰ (distinct from palatal *j́) > CIran. *ž, though no clear Iranian examples (since ‘earth’ generalized simplified anlaut *j-)

PIE *d^{h}ĝ^{h}ém-i ‘on the earth’ > *d^{h}j́^{h}ámi > PII *dž^{h}ámi > Skt. *kṣámi*
= PIran. *ǰami → *jami > YAv. *zəmi*

With secondary palatals similar but slower development > different Iranian outcome

PII *tḱ = [tç] > PIA *ṭṣ > Skt. *kṣ*, MIA *ṭch/ch/kh*; PIran. palatal affricate *ć (merged with old simple *ć < *ḱ) > CIran. *č; no sure examples

B. Affricates and sibilants: Palatals, Ruki and “Thorn”

PII *dǵ^{ɦ} = [dʝ^{ɦ}] > PIA *ḍẓ^{ɦ} > Skt. *kṣ*, MIA *jh/gh*; PIran. palatal affricate *ǰ (merged with old simple *ǰ < *ǵ) > CIran. *ǰ̌*

PIE *d^{ɦ}g^{wɦ}i- > PII *dǵ^{ɦ}i- [dʝ^{ɦ}i-] > Skt. *kṣi-*, MIA *jhi-* = PIran. *ǰi- > Av. *ji-* ‘perish’

New approach by Jasanoff (ECIEC 2017), defending metathesis

3. Laryngeals

A. General assumptions about IE laryngeals (communis opinio)

PIE had three "laryngeals" $*h_1$, $*h_2$, $*h_3$

Preserved as segmental phonemes: $*h_2$, $*h_3$ (?) in Anatolian, elsewhere indirect evidence

Unspecific developments of all laryngeals:

Loss with compensatory lengthening after tautosyllabic vowels

Baltoslavic lengthening / acute intonation also in /R_C (Winter's Law)

Resonant gemination before *H: Anatolian and (?) Germanic

„Vocalization" between consonant and [-syll]: everywhere except perhaps Anatolian; initially only Greek-Phrygian-Armenian; finally after *i/u* only Greek-Armenian and Tocharian

A. General assumptions about IE laryngeals

Specific developments of different laryngals:

PIE „colouring“ *e > [a] /h_2; *e > *o /h_3 (but long *$\bar{e}$ more stable > uncoloured, „Eichner’s Law“)

Plosives aspirated by (at least) *h_2 in Indo-Iranian, perhaps in Greek

Lenis + *h_2 > *DD* (or *T?) in Anatolian

Sonorization *ph_3 > *bh_3?

Only Greek (and Phrygian?) fully distinct vocalic reflexes *h_1 > e, *h_2 > a, *h_3 > o

Tocharian „vocalization“ of *h_2=*h_3 > *a /#_R and /i,u_C

A. General assumptions about IE laryngeals

The phonetics of the laryngeals

Distribution: pattern like *s* (between stops and resonants) ⇒ fricatives

Anatolian [x-χ-q-k/ɣ-ʁ] (stops in Lycian and perhaps already Luwian, cf. Simon 2014; possibly also Lydian, cf. Melchert ; Oettinger p. c.) ⇒ dorsal obstruents

Anatolian lowering *u* > *o* (and *i* > *e*?) and PIE "colouring" speak for "faucal" uvular or pharyngeal articulation of $*h_2$ and $*h_3$

Aspiration effects point to later [h] easily derivable from *x/χ/ħ

$*h_1$ relatively „featureless" ⇒ glottal [ʔ] or [h], maybe allophone of velar [x]

A. General assumptions about IE laryngeals

The phonetics of the laryngeals

Voicing effect of $*h_3$ dubious, but weaker status in Anatolian still speaks for „lenis"
rounding effect and general distribution might be taken to point to labialized $*h_3$ (Dunkel 2001),
but missing labialization in Anatolian – where labialization is generally preserved – contradicts this;
distribution (only in roots) might also be accounted for by voicing

Therefore tentatively $*h_1 = *h$, $*h_2 = *\chi$, $*h_3 = *ʁ$

Possibly $*\chi$, $*ʁ$ < former uvular stops $**q$, $**ɢ$?
Cf. Kortlandt 2015; Kloekhorst, Talk Copenhagen 2017

B. Preservation of laryngeal consonants

1) Anatolian

*h_2: > fortis fricative *χ, at least /#_, /V_V, cluster *χw monophthongized > *$χ^w$ (Kloekhorst 2006: 98ff.; 2008a: 76f., 836ff.; Lycian *q*); lenited like fortis stops > *ʁ, *$ʁ^w$, but rules different from stops: e.g., lenited after *ó in contrast to stops (Melchert, p.c.), viz. *nóχei > *nṓʁi > Hitt. *nāhi* vs. *dókei > *dṓkki > Hitt. *tākki*; perhaps no lenition but rather fortition in other contexts, more similar to *s*?

*h_3: preserved as *ʁ>χ /#_V (also Lycian, s. Rasmussen 1992b = 1999: 519-526; Kloekhorst 2006: 85ff., 102f.; 2008a: 75f. contra Kimball 1987), and as *ʁ /_w (Melchert 2011), cf. *lãhu-* 'to pour' < *loh_3w-, and /R_V, cf. Hitt. *sarhie-* 'to attack' < *$sr̥h_3$- (Greek *rhṓomai*) ⇒ relative fortition beside *R? Cf. *ɣ > *x* /l,r_ in Cornish/Breton vs. loss elsewhere

B. Preservation of laryngeal consonants

*h_1: preserved as ʔ? (Kloekhorst 2004; 2006: 80f., 95; 2008a: 25, 32, 75f.)

HLuv. *á-* = /ʔ(a)/- vs. *a-* = /a-/, cf. *á-sa-ti* < *$h_1$ésti* vs. *a+ra/i-* 'year' < *jeh_1ro-*

But: Semitic (!) *Aššur-* = *a-sú+ra/i-* written without a glottal stop?

Frequently words with initial *á-* have older writings with „initial *a-* final" or "aphaeresis" (purely praphic according to Melchert), in earliest documents *a-*; cf. now Rieken with an accent-based solution

2) Armenian

Arm. *h-* < *h_2 = *h_3 if not preceding PIE (Ablaut-)**o* (Kortlandt 1983b; 1984; cf. Beekes 2003: 181ff.)?
= *h_2e-, *h_3e- > arm. *ha-, ho-*, but **Ho-* > arm. *o-* (> *a-*)

B. Preservation of laryngeal consonants

*h_2- > arm. *h*-: *han* ‘grandmother’, *haw* ‘grandfather’, *hat* ‘grain’, *haw* ‘bird’, *hayc‘el* ‘to seek’, *hatanel* ‘to cut off’, *harawunk‘* ‘sowing, seeds’, *hasanel* ‘to arrive’

*h_3- > arm. *h*-: *hot* ‘smell’, *?hoviw* ‘shepherd’, *hac‘/i* ‘ash tree’, *hum* ‘raw’

*h_2- > arm. *Ø*-: *ayg* ‘morning’, *aytnul* ‘to swell’, *ayc‘* ‘visit, inspection’, *?us* ‘shoulder’; *arǰ* ‘bear’, *arcat‘* ‘silver’, *argel* ‘obstacle’, *arawr* ‘plough’

*h_3- > arm. *Ø*-: *orb* ‘orphan’, *?ost* ‘branch’, *?oskr* ‘bone’; *aygi* ‘vineyard’, *orjik‘* ‘testicles’

Contradictory data: *hoviw* ⇐ **howi-* < **$h_2$owi-* ‘sheep’
(cf. **$h_2$awi-* in Toch.B *ā$_u$w*, plural *awi*)
but *oskr* ← **$h_2$ós*t- ‘bone’ (for **h_2 ° cf. **ast-* in MWelsh *ascwrn* ‘bone’, *assen* ‘rib’)

Armenian distribution rather ~ (pre-apocope) syllable structure:
h- /_V$CV but *Ø*- /_VC$C?

B. Preservation of laryngeal consonants

Exceptions: *arawr* with original *rh_3; *haycʿel* ‘to seek’ influenced by *harcʿanel* ‘to ask’?
⇒ loss of *h before a coda or rather h-epenthesis in onsets of open syllables?
Or conditioned preservation in open syllables?

3) Albanian

*h_2, *h_3 > h /_e; *H > Ø /_o Kortlandt (1986: 43ff.; 2010: 329f.) like in Armenian:

*h_2- > Alb. *h*-: *hut* ‘in vain’, *hidhët* ‘bitter’, *ha* ‘to eat’, *?hipënj* ‘to jump’; *h_3- > Alb. *h*-: *herdhe* ‘testicles’

*h_2- > Alb. *Ø*-: *athët* ‘sour, sharp’, *a(s)* ‘or’, *arë* ‘field’, *arí* ‘bear’, *?enj/ëj* ‘to swell’; *h_3- > Alb. *Ø*-: *amë* ‘smell, taste’, *?ah* ‘beech’, *?asht* ‘bone’

B. Preservation of laryngeal consonants

Good data for **H-* > *h-* only with **h₂e-*, 3 of 4 cases with **h₃-* have exactly the opposite development as in Armenian! Too little material to conclude anything.

4) (Indo-)Iranian

Preserved *h-* in peripheral Iranian "prothetic" *h-*?

Quite some words with Persian *h-/x-*, Kurd. Bal. Khot. *h-* corresponding to Av. = Skt. *Ø-* < PIE **H-* = „Vorgeschlagenes" *x-*, *h-* (Hübschmann 1895: 264f.; Horn 1901: 67, 97f.; Korn 2005: 154-159)

1a. Pers. *x-*, elsewhere normally *h-*

MP. *xāyag* 'egg' < **hāwya-(ka-)* < **h₂ōwjo-* || YAv. *aēm* etc.

MP. *xirs* 'bear', Kurd. *hirč*, Xwar. *hrs*, Zaz. *heš* < **hr̥tša-* < **h₂r̥tk̑o-* || Av. *arša-*; cf. Skt. *r̥kṣa-*, Hitt. *hartakka-*

B. Preservation of laryngeal consonants

MP p. *h'k'*, NP *xāk*, Bal. *hāk*, Zaz. *h(y)āg* < CIr. **āhaka-* 'dust, earth'
|| Kurd. *ax*; cf. Skt. *ā́sa-* 'ashes' < PII **hā́sa-* < PIE **$h_2$áh$_1$s-*, cf. Hitt. *hās, hass-*

NP *xastū* 'kernel' ~ *hasta* 'bone', Kurd. *hestî*
|| Av. *ast-* n. 'bone', MP m. *'st(g)*,
NP *ast(e)*, Khot. *āstaa-* ++; cf. Skt. *ásthi* < PII **hást(h)-* < PIE **$h_2$ást-/$h_2$ast-(h_2)-*, cf. Hitt. *hastāi*

MP p. *hyl*, m. *xyr/xʿyr*, Khot. *härа-* (cf. Bailey 1959: 71ff.) < PII **h̥rya-* < PIE **h_2r̥jo-*
(?) || Giran. **ərya-* 'possession, thing', MP p. *'yl*, pth. *ʿyr*, arm. *ir*

MP p. *h'm*, NP *xām*, Bal. *hāmag*, Khot. *hāma-* < Giran. **āma-* 'raw'
|| Pto. *om,* W. *ying*; cf. Skt. *āmá-* < PII **hāmá-* < PIE **HoHmo-*
(**h_2o$h_3$mó-*, Kortlandt 1981: 128?), cf. Arm. *hum*, Gr. ὠμός

B. Preservation of laryngeal consonants

1b. NP. *x-*, older *h-*

MP m. *hyš*, NP *xēš* < PII **hai(H)š-a-* < PIE **$h_2$ajH-s-* || Av. *aēša-* m.‘plough share’; cf. Slav. **ojes-*, **h_2iHs-áh$_2$-* > Skt. *īṣā́-*, Hitt. *hissā-*

2. Only *h-*, partly not before NP.

MP. *hanzūg-* 'narrow' < **hanju-* < **$h_2$amĝ^{h}ú-* || Arm. *anjuk*, cf. Av. *ązah-*

MP. p. *hēmag*, np. *hīme* 'fuel' < **haijmaka-*,
LW in OP **(h)aizma-*, MP. *hēzm*, NP. *hīzom* < **haijma-*
|| MP. m. *ēmag*, av. *aēsma-*

3a. *h-* elsewhere without clear Persian cognate

Khot. *häysä*, Bal. *hīz*, Talyshi *xəz* ‘leather’, Oss. D. *xizæ* < **hijã̄-* < **h_2iĝ-*
|| Av. *izaēna-* ‘made of leather’, cf. Greek *aig-*, Arm. *ayc* ‘goat’?

B. Preservation of laryngeal consonants

Av. *zaraθ-uštra-*, Parth. *zrhwšt* < **zarat-huštra-*? Kurd. *hêṣtir*, bal. *huštar* 'camel' < **húštra-* < LW? (OP. *uša-* might be **huša-*, MP. NP. LW) || Av. *uštra-*, cf. Skt. *úṣṭra-*

3b. *h-* elsewhere (mainly Kurd.) against Persian

Kurd. *hêr-* 'to grind', Bal. *hašš* 'millstone' || MP. *ārd* 'flour', NP. *ās* 'millstone' < **har(H)-* < **$h_2$alh-*

NB: *h-* rather unstable in Kurdish and Baloči; in Khotanese even *h-* < **s-* can be lost

4. Counterexamples with zero for **h_2-*

OP. *utā*, MP. *ud* 'and' < **hutá* < **h_2u-té*

OP. *ṇrdata-* 'silver' < **h(a)rjata-* < **h_2(a)rĝ̥ṇto-*

For others, Persian has or may have a LW,
e.g., MP. *az* 'goat' < **hajá-* < **h_2aĝó-* (Lith. *ožỹs*)

B. Preservation of laryngeal consonants

Possible solution: „Cockney situation“:
loss of old **h-* first in the East, like **s* > *h* (cf. Lipp 2009: 318-322)

Contact scenario

PIran.	*s-	*h-		*x-	
Dialect 1 (Western margin)	s-	h-	loans	x-	
Dialect 2 (Western)	s-	Ø-	x-	x-	(loss of h under Elamite influence?)
Dialect 3 (Eastern)	h-	Ø-	h-	x-	

B. Preservation of laryngeal consonants

c) Laryngeal “hardening” in PIE and later

*h_2s > *ks: Lat. *senex, senis* ‘old (man)’ < **seneks, *senh$_2$-* < ***sanaχ-s, **sanχ-*?
Cf. PII **sanak-s* → **sanaǵ-* > Skt. *sanáj-* ‘old’?

*$H+h_2$ > *k: Greek and Toch. *k*-extensions of **stah$_2$-* etc., normally not accepted

Germanic *H > *k /R_w, cf. **dah$_2$iwer-/dah$_2$jur-* > **dajh$_2$wer-/dajh$_2$ur-* ⇒ **taikur-*, **n̥hw°* > **unk^{w}°* ‘us/our (dual)’ (“Cowgill’s Law”, Ringe 2006: 69) and some other cases (**spaikul-, *aikur-*); but different explanation by Seebold (1983: 174ff., cf. Müller 2007: 116-119): **w* > **g* /R_u preceding Grimm’s Law?
also **k^{w}ik^{w}a-* ‘living’ < **g^{w}ih$_3$wó-* (Rasmussen 1994), but cf. **k^{w}iwa-* > Goth. *qius*

**h$_2$ost-/h$_2$ast-, *h$_2$aĝah$_2$-* in CSlav. **kȍstь* ‘bone’, **kozà* ‘goat’?
Rather borrowed ← Iranian (or iranoid?) **xasti, *xa(d)zā-*?
Cf. Andersen 2003: 65f.

C. Consonantal effects of laryngeals

1) Aspiration

Aspiration of **T* + **H* (assured for IIr) ⇒ most probable explanation **H* = [h]

Some general and typological facts about aspiration and *h* (cf. Kehrein 2002):

Aspiration = [+ spread glottis] or rather [+ positive VOT], feature of the onset/nucleus/coda rather than of individual sounds ⇒ all consonants in onset or coda must agree in aspiration

No contrast C^h vs. Ch within one syllable ⇒ C^h vs. Ch implies \$$C^h$ vs. C\$h

⇒ in a language with /h/ and /C^h/, tautosyllabic Ch must merge with C^h, heterosyllabic need not

C. Consonantal effects of laryngeals

1) Aspiration

Second possibility to explain aspiration: feature spreading: stop[-asp] > stop[+asp] /_fricative[+asp]

Cf. Greek writings like *k^hs, p^hs* (but cf. Clackson (2002) contra Vaux (1998); Vedic *kṣ* > *k^hṣ* > MIA *kk^h*

Presupposes [+asp] for pre-PII laryngeals

a) Assured cases

Indo-Iranian aspiration by following **h* < **h_2* (confirmed by non-IIr. evidence)

Skt. *máh-* 'big, great' < **máj-h-* < **még-h_2-*, cf. Gr. *méga-*, Hitt. *mekk-*

Skt. *prathimán-** < **pleth$_2$-mon-*, *pr̥thú-* 'broad' etc., cf. Gr. *Platamõn* etc.

Skt. 2pl present *-tha* = Av. *-θa* < **-tha* < **-th$_2$a*, cf. Gr. *-stha*, Toch. **-sta* etc.

C. Consonantal effects of laryngeals

?Skt. *sákhā* ‘friend, fellow’ = Av. *haxā* < **sákhā* < **sókʷh₂-ō(i̯)*
⇐ **sokʷ-(a)h₂-*, cf. Gr. **hopā̃-*
?Skt. *rátha-* ‘chariot’ = Av. *raθa-* < **rátha-* < **róth₂o-* ⇐ **rot-(a)h₂-*, cf. Lat. *rota*
Skt. *sthitá-*, *tí-ṣṭh-a-* ‘to stand’ < **sth-* < **sth₂-*,
by analogy *sthā-* ← **stā-* < **stah-* < **stah₂-*

b) Controversial cases

Indo-Iranian aspiration by original $*h_1$ (Beekes 1988: 87f.)?

Aspiration by $*h_1$ (already PIE)
proposed by Olsen 1988; 1993; 1994, Rasmussen 1992b = 1999: 490-504
but not generally accepted (though rarely explicitly refuted)

C. Consonantal effects of laryngeals

If $*h_1$ = [h] and PIE (or some post-PIE dialects) had $*D^{ɦ}$, aspiration of $*D$ preceding $*h_1$ would be unavoidable tautosyllabically ⇒ plausible idea

Grammatical elements: 2nd plural PE Skt. *-thá* = Av. *-θa* < **-tha* < **-th₁e*, cf. Greek etc. *-te*?

Aspiration in roots:

Root type **°eTH-*: $*h_2$ clearly overrepresented in LIV, but reconstruction of $*h_2$ often circularly reconstructed from IIr. aspiration only ⇒ some may have had $*h_1$

Root type **TeH-*: Skt. aspiration in *sthā-* < $*stah_2$- as well as in *sphā-* < $*speh_1$- 'become fat'

Interestingly, $*Teh_1$ roots typically have $*T = *D^{ɦ}$ (sole exception: $*deh_1$- 'to bind') while other **teH* roots may have any **T*

⇒ general situation rather speaks for aspiration by $*h_1$

C. Consonantal effects of laryngeals

No good counterexamples! Unaspirated stop + final *H only in 5 Vedic roots (vs. 15):

Skt. *pat(i)-* from *$*peth_1$-* unsure reconstruction (see EWAia II 71f., Hackstein 2002b: 140-143)

ved(i)- secondary laryngeal; *ati-, rodi-, vadi-* laryngal unknown

d) Greek

Difficult and controverisal: no Aspiration according to Cowgill 1965,

cf. πλατύς <*$*p\underset{\circ}{l}th_2ú$-

analogy after *$*plataw$- < *$*p\underset{\circ}{l}th_2w$- difficult: such forms unexpected or at least rare

2s perfect -st^ha generalized from special clusters

Peters 1991: aspiration before old vowels (in contrast to IIr. never in *THC*):

C. Consonantal effects of laryngeals

cf. ʼΟρεσθ-εύς ~ ʼΟρέστης < *-*sth*$_2$- ~ *-*stah*$_2$-, οἶσθα

nonaspiration from **CHC* contexts ⇒ **pl̥th*$_2$*ú-* must have had "non-proterokinetic" allomorph **pl̥th*$_2$*w-*

Example καθαρός 'pure' < **kratharós* = Skt. **śr̥thirá-* > *śithirá-* 'loose' etc. problematic

e) Armenian, Albanian, and Balto-Slavic

**kh*$_2$ > **k*^{h} > *x* (> Alb. *h*, balt. *k*) in some words:

Arm. *cʿax* (~ *cʿakʿ*) = Slav. **soxà* = Lith. *šakà*,

cf. Skt. *śā́khā-* 'branch', MPers. *šāx* ~ *šāg*

Arm. *xac-* 'to bite' = Iranian **xāz-* 'to drink/eat'

Alb. *ha* 'to eat' = Skt. *khād-* 'to chew' etc. (cf. Lith. *kánd-* 'to bite')

Instead of **k*^{h} assimilation **kx* > *x*?

C. Consonantal effects of laryngeals

2) Other effects

Desonorization by (PII) **h* in Iranian

Cf. Kümmel, Vienna 2012 = forthc. c; 2016

Iranian **dh* > **th* > **θ* in some words with **d+*h* < **h₂*:

CIran. **θai̯wár-* 'husband's brother' < **dhaiwár-* < PII. **dahiwár-* < **dah₂iwér-*, cf. Skt. *devár-*, Greek *dāér-*, BSlav **'dai'wer-*

CIran. **θãw-* 'to burn' < **dhau-* < **dahu-/dauh-* < **dah₂u-*, cf. Skt. *du-/dãv-*, Greek *dãu-*
[pace Werba 2006: 265ff. certainly no EIran. innovation]

likewise **f* < **ph* < **b+h*, cf. CIran. *nāf-* 'navel' ← **nāb-h-*, Skt. *nā́bhi-* < PII. **nābʰh-* ~ **nabʰah-* > Av. *nabā-* < **nobʰ-(a)h₂-*

C. Consonantal effects of laryngeals

CIran. **waf-/uf-* ‘to weave’ (and ‘to sing’?) < **wabh-*, cf. Skt. *-vábhi-* (*ubhnā́-*?)

**c* < **j+h*, cf. YAv. *mas-, masī-* vs. *mazā̊ṇt-* < CIran. **mac-, macī- ~ majā-* < **maj-h-(ī-) ~ *maj-ā̃h-* = Skt. *mah-, mahī́- (~ mahā́-,mahā́nt-)*, cf. Greek. *mega-* < **meĝ-h₂-* etc. [rather not from **mah₂k-* in Greek *makrós, mãkos* etc. with no clear reflex in IIr]

Maybe also YAv. (+) *isu-* ‘icy cold’ < **icu-* < **ij-h-u-* ⇐ **yajā-* ‘ice’ (Wakhi *yaz* ‘glacier’, Nur. k. *yuc* ‘cold’), cf. Hitt. *eka-* ‘ice’ < **jégo-*, *ikuna-* ‘cold’ < **igu-* (or **jegú-*?), Germ. **jekula-* > Icel. *jökull* etc.

**-dHi-* ‘seeing’ in YAv. *aiβiθiiō* (Cantera 2014) from **daHi-*, cf. *dāθa-* ‘wise’

Also with original **h₁*:
cf. “mysterious” YAv. (+) stem variant *daθ-* ‘to put/give’ < **dadh-*
vs. *daδā-* < **dádā̃h-* < **dʰédʰ(o)h₁-*

C. Consonantal effects of laryngeals

possibly YAv. (+) *ᵘruθ-* ‘to weep’ < **ruθ-* < **rudh-*, cf. Skt. *rodiṣi*
[also subjunctive **-h₁e/o-* in **waid-ha-* > YAv. *vaēθa-* ‘to know’?
Or rather variant derived from 1s **waiθa* < **wáidha* ‘I know’ < **wójd-h₂a*?]

⇒ **Dh-* from original **Dahi/u-* or internal **VD$hV-*
= where PIran **Dh* can have been distinct from original **Dʰ*
presupposes post-PII preservation of „aspirating“ laryngeals, i. e. **h*

Problem: Old Avestan only *maz-, dad-* etc. analogical?
Or reflecting original very archaic **Dh*?
Then desonorization rather late in Common Iranian

C. Consonantal effects of laryngeals

3) Prosodic effects: metrical evidence

Laryngeals can leave hiatus I both Vedic and Old Avestan (alread mentioned above), most prominently in gen. pl. *-ām* /*-ąm* = *{-aʾam}* (always in OAv., 1/3 in Vedic)
⇒ rather late loss in (P)IIr

= Preserved in Old Avestan and partly in Vedic
⇒ PII merger in phonemic *glottal stop* (Beekes 1988: 50, 83ff.)?
However: hiatus ≠ [ʔ] ≠ /ʔ/ (cf. automatic glottal stop in German) ⇒ not conclusive

As per Kuryłowicz (1927); Schindler; Holland (1994); Gippert (1997, 1999), short syllables may still count as long in Vedic, if originally closed by following laryngeal: *a$C* < **aC$H*
Brevis in longo scansion = BiL

C. Consonantal effects of laryngeals

Cf. *ávasā, savitā̃* in place of –È× < **áwHasā, *sawHitā̃*; *jánās* for –× < **j́ánHās*

However (unfortunately): no clear difference in distribution and behaviour between such cases and other words of the same structural type without original **CH* (e.g., *ajára-, udára-, mánasā …*), cf. Kümmel 2014 and also Gunkel 2010

⇒ rather difficult to draw conclusion for sound change chronology

D. Vocalization problems

Laryngeals in clusters could be „vocalized“, i.e., were lost after insertion of anaptyctic vowel

1) Internal position

Frequent presupposition: Skt. *duhitár-* < **duǵ^{h}ĭtár-* with PII. palatalization

But why not simply *duhitár-* < **dughitár-*?
Cf. *hitá-* < **d^{h}itá-, ihí* < **id^{h}í* etc. (Lubotsky 1995; Kobayashi 2004: 84-91)

– no other example of palatalizing secondary *ĭ*
– no other case of preserved *ghi* (*drā́ghīyas-* must be analogical)
– other probable cases of *h* < **gh*: PN *Ráhūgaṇa-*, *Jahnu-* (Mayrhofer 2003: 75; Remmer 2006: 166-7 with n. 162); *mastr̥han-* ‘brain’ = iran. **mastərgan-* < **mastr̥g^{h}an-* rather than **mastr̥ǵ^{h}an-*

D. Vocalization problems

Prasun *lüšt* can continue **dujĭtā* < **dugitā* (pace Lipp 2009)
⇒ No compelling reason for assuming early epenthesis
with subsequent loss of **ĭ* in Iranian
Cf. Pinault 1982: 265; Kobayashi 2004: 136-139; Werba 2005; Kümmel 2016aSkt.
Skt. *duhitár-* < **dug^{ɦ}itár-* < **dug^{ɦ}Hi.tár-* < **dug^{ɦ}h.tár-* < **dug^{ɦ}.htár-* < **d^{ɦ}ug.htár-*
< PIE **d^{ɦ}ugh$_2$tér-*
Iran. **dugdar-* < **dug.d^{ɦ}ar-* < **dug^{ɦ}.tar-* < **dug^{ɦ}h.tár-* < **d^{ɦ}ug.htár-*
< PIE **d^{ɦ}ug.h$_2$tér-*
Iran. **duxθr-* < **duktr-* < **d^{ɦ}ugtr-* < **d^{ɦ}ugh$_2$tr-*
Or maybe rather (cf. **dh* > **θ* above)
**duxtar-* < **dukhtar-* < **dug.htár-* < **dug^{ɦ}.htár-* < **d^{ɦ}ug.htár-* < PIE **d^{ɦ}ug.h$_2$tér-*
Iran. **dugdr-* < **dugd^{ɦ}r-* < **dug^{ɦ}tr-* < **dug^{ɦ}h.tr-* ← **duktr-* < **d^{ɦ}ugtr-* < **d^{ɦ}ugh$_2$.tr-*

D. Vocalization problems

2) Final position

Vedic **CHC# > CīC#* (Jamison 1988) presupposes early **CiHC#* (cf. Praust 2004), possibly < **CHiC#* via "laryngeal metathesis" (Kümmel 2016a)

**CHiC > *CiHC*, cf. **pHi-tá- > *piH.tá- > *pī.tá-* > Skt. *pītá-* 'drunk'

**CiHuC > *CyuHC*, cf. **siHu-tá- > *syuH.tá- > *syū.tá-* > Skt. *syūtá-* 'sewed' (cf. Lubotsky 2011)

No such development with *CHaC* ⇒ not motivated by syllable structure

**H* = [h] or dorsal fricative: high phonetic probability of palatalization / labialization (cf. Kümmel 2007: 161, 272; 2016a; **hy, *hw* > Av. *x́/x*^{v} etc.)

**CHiC > *CH*^{j}*iC > *CH*^{j}*C > *CiH*^{j}*C > *CiHC > *CīC*

**C(i)HuC > *C(i)H*^{w}*uC > *C(i)H*^{w}*C > *C(y)uH*^{w}*C > *C(y)uHC > *C(y)ūC*

D. Vocalization problems

3) Initial postion

*THT-	+-V-	+-R-
Beekes, Byrd	TT-	TiT-
Tichy	THĭT-, accented TiT-	THĭT-
Tremblay 2003	disyllabic TiT-, trisyllabic TT-	TT- (?)
Lipp	TĭHT- > TiT-	TT-

Av. *tū^{i}riia-*, Xwar. *ʾfcwr*, Pto. *trə* ‘father’s brother’ < **ftərwya-* < **ptr̥wya-* < **pHtr̥wya-*

⇒ Iranian **THTV-* > *TTV-*, therefore only **THTR-* > **TTR-* > **TiTR-*
Original Iranian distribution **ptar-* ~ **pitr-* > **ftar-* ~ *piθr-*

⇒ Indo-Aryan possibly **THT(R)-* > *TT(R)-* > *TiT(R)-*

Cf. Kümmel 2016a

E. Compensatory lengthening (or not)

General assumption: Common IE *VH* > *V* /_[-syll] + *VHCV* = *VH.CV*

Cf. **wihró-* > **wiH.rá-* > Skt. *vīrá-* ‘man’; **gʷiɣwó-* > **ǵiH.wá-* > Skt. *jīvá-* ‘living’;
**duh₂ró-* > **duH.rá-* > Skt. *dūrá-* ‘far’; **dóɣ.no-* > **dáH.na-* > Skt. *dā́na-* ‘gift’

However: short **i, u* in much of (Eastern) Iranian

A) Only short reflexes in some languages:

Khot. *puva-*, Osset. D. *fud*, Yazg. *pod* 'rotten' < **puta-* (< **pūta-*) < **puHtá-*
like Khot. *tsuta-/tsva-*, Oss. D. *cud*, Yazg. *šod* ‘gone, went’ < **ćyuta-*
Cf. also gen. pl. Khot. *-änu* < **-inam* < **-inām* < **-iHnām* vs. Skt. *-īnā́m*

Secondary merger of **ī/ū* with **i/u*?

E. Compensatory lengthening (or not)

B) **ĭ, ŭ* before sonorants

Sogdian light stems *šyr-* (*śir-*) ‘good’; *wyr-* ‘man’; *žw-* ‘to live’ < **srira-, *wira-, *ǰiwa-*
vs. Skt. *śrīrá-*; *vīrá-, jī́va-* < **ćriHrá-, *wiHrá-, *ǵiHwá-*

Paṣto *stən* ‘pillar’, *nən* ‘now’, *nˈəre* ‘far’, *stər* ‘big’; *žər/zər* ‘fast’
< **stunā-, *nunam, *durai, *stura-; *ǰira-*
vs. Skt. *stū́ṇā-*, *nūnám, dūré, sthūrá-; jīrá-*

However, regular length before obstruents,
cf. Sogd. *nyt* /nīt/ ‘led’ < **nīta-*, Pto. *lid-* ‘saw’ < **dīta-*;
Sogd. *ɣwδ* /ɣūθ/, pto. *ɣul* ‘dung’ < **ǵūθa-*
vs. Sogd. *δβt-*, Pto. *bəl* < **dwita-*;
Pto. *ṣəl* < **srita-*; Sogd. *kwt-* /k^{w}t-/ ‘dog’ < **kuta-*

E. Compensatory lengthening (or not)

No counterexamples in Pto., but some in Sogdian:
heavy stems in *βwm* ‘earth’ < **būmi-* < **b^{ɦ}uHmi-*, *δwr* ‘far’ < **dūra-* < **duHrá-*

C) length in all cases: Waxi, Western Iranian

Cf. **ī* in W. *vrin-*, MP *brīn-* ‘to cut off’ < **brīHn-* ← **brin-*; MP *wīr* ‘man’ < **wiHrá-*
**ū* in W. *(i)stin*, MP *stūn* ‘pillar’ < **stuHnā-*; **dūra-* > W. *δir*, MP *dūr* ‘far’ < **duHrá-*

vs. **i* in W. *yəm*, MP *im* ‘this’ < **imá-*;
MP *dam-* ‘winter’, W. *zəm* ‘snow’ < **dim-* < **j́^{ɦ}im-*
W. *zən-* ‘to take’ < **j́inaH-*;
**u* in MP *hun-* ‘to press out’ < **sunu-*; *bun* ‘ground’ < **budna-*;
hur ‘liqueur’ < **surā-*; W. *x̌urs* < **x^{w}osr-* < **hwasura-*

E. Compensatory lengthening (or not)

Before obstruents: W. *pit* ‘drank’ < **piHtá-*; MP. *dīd* ‘saw’ < **diHtá-*
W. *δit*, MP *dūd* ‘smoke’ < **duHtá-*; W. *pitk*, MP *pūdag* ‘rotten’ < **puHta-ka-*
vs. **i* in W. *bət* ‘second’, MP *did°* < **dwitá-*; MP *pid* ‘father’ < **pitā̃*
**u* in W. *θət* ‘burnt’ < **θutá-* < **dhuta-*,
MP *ǰud* ‘separate’ < **yutá-*, *šud* ‘went’ < **ḱyutá-*
W. *pətr* ‘son’, MP *pus* < **puθra-*
[caution: MP lengthening in second final syllables, see Korn 2009]

D) Avestan?

hunu- ‘son’; *hunara-* ‘skilfulness’; *-uru-* ‘thigh’
< **suHnú-, *su-Hnára-, *uHrú-* vs. Skt. *sūnú-*; *sūnára-*; *ūrú-*

juua- ‘living’, *juua-* ‘to live’; *piuuas-* ‘fat’
< **ǰiHwá-/ǰíHwa-*; **píhWas-* vs. Skt. *jīvá-, jī́va-*; *pī́vas-*

E. Compensatory lengthening (or not)

Optatives *ma^{i}nimadicā, var^{ə}zimācā, vaozirem* with **-iH-*
(left unexplained by de Vaan 2003: 249f.)

Gen. pl. *-inąm, -unąm* (but also *-anąm, -aŋhąm*): secondary shortening possible

vīra- 'man' may show secondary lengthening (cf. *vīspa-* 'all' < **wispa-*)
likewise most other cases of length before *m, n, r*:
cf. *ūna-* 'defective'; *dūra-* 'far' like *sūn-* 'dog' < **sun-*; *zūra-* 'false' < **zura-*

Synchronic contrast in some cases of prenasal *ī*?
jinā- 'to destroy', *zinā-* 'to take away' vs. *frīnā-* 'to please', *-brīna-* 'to shave'
= Skt. *kṣiṇā̆-, jinā̆-* vs. *prīṇā̆-, bhrīṇā-, krīṇā̆-*
But derivation and Vedic metre point to **priṇ°, *bhriṇ°, *kriṇ°*
< **pri-n(a)H-, *b^{h}ri-n(a)H-* etc.

E. Compensatory lengthening (or not)

⇒ secondary length, taken over from other forms with **iH*, maybe enhanced by preceding *r*?

Preserved contrast before obstruents suggested by
srita-, pitu-, θrita-; masita-, raoiδita-
vs. *jīti-, -dīta-, dīti-, -nīti-*; optative *-īṯ, -īta, -ītəm, -īša*

but also *frita-, friti-* < **priH-t°* (by analogy to *friia-*?);
nisrīta, -ɣnīt- < **-srita-, -gnit-*; *sīša-* < **siša-*
No real minimal pairs!

**u* > *ū* in first open syllables after consonants other than *h, k, dr* and sometimes before *θr, δr, zr, žC*; elsewhere *u* (cf. de Vaan 2003: 284-297) ⇒ „retention“ of old *ū* possibly significant only in *ūθa-, ūna-; hūxta-* < **hu-uxta-, hūrō*
= very small basis for conclusions

E. Compensatory lengthening (or not)

In Gathic metre (cf. Kümmel forthc. c) **iHR/uHR*
mostly in positions where light syllable is preferred, viz. Y. 45,9 *vīrāṇg* = ∪ — |
⇒ Original Avestan possibly like Sogdian, Paṣtō – or like Khotanese, Ossetic?

Possible explanation:
– Group B syllabification **I.HRV* ⇒ no compensatory lengthening
parallel to „Dybo's Law" in Western IE (cf. Neri 2011: 191-207 with ref.)
cf. Celtic, Germ. **wiro-* < **wih₁ró-* 'man',
Celtic **biwo-*, Germ. **kʷiwa-* < **gʷih₃wó-* 'alive'
Germ. **sunu-* < **suHnú-* 'son'
– In group A also generally **I.HCV*, like *V.TCV* in other obstruent clusters?
Cf. later on syllable structure

E. Compensatory lengthening (or not)

Alternative: secondary shortening only before sonorants?
Typologically improbable: sonorants tend to favour length

Implication: preservation of laryngeals in PII and even Proto-Iranian after high vowels, at least before sonorants

Why just here? Palatalized/labialized ⇒ auditive strengthening, viz. **ih* > **ih*^{j} > [iç]; **uh* > *uh*^{w} > [uʍ]

⇒ Later loss only after different developments of syllabification:

Indic, Waxi, Western Iranian: *IHC* = *IH.C* > *ĪC*

Sogdian, Pashto, Avestan?, …: *IHT* = *IH.T* > *ĪT* vs. *IHR* = *I.HR* > *IR*

Saka, Alanic, Pamiri, Avestan?, …: *IHC* = *I.HC* > *IC*

F. Early loss of laryngeals

1) “Pinault’s Law”

Pinault 1982: regular loss of **H* in /C_j
cf. Ved. *sakhyá-* < **sakHyá-* < **sok^{w}h$_2$jo-*;
Celtic **arje-*, Lith. *ãria-* from *árti* ‘to plough’ < **h$_2$arh$_3$jo-*
However: Greek *aróe-*, Italic **araje-* ‘to plough’

Lipp 2009; Verhasselt 2016: only partially einzelsprachlich, not PIE

2) “Hackstein’s Law”

Hackstein 2002b (following Schmidt 1973): Regular loss in (pretonic?) **CHCC*, cf.
**d^{h}ugh$_2$tr-* > **d^{h}ugtr-* > **d^{h}uktr-* > Arm. *dustr*, Gaulish *duχtir*

Cf. also **d^{h}h$_1$-ské-* > **d^{h}ské-* > Hittite /tské-/ <za-aš-ki-, zi-ik-ki-> ‘to put’

F. Early loss of laryngeals

Lipp 2009: exception in **RHsR*, cf. **temh$_2$sro-* > Skt. *támisra-*

Byrd (2010ab; 2012): only TH.CC > T.CC due to problematic sonority sequencing while RH.TR is unproblematic

3) Loss in composition, reduplication etc.

Cf. Skt. *gurú-* < **g^{w}r̥h$_2$-ú-* 'heavy' vs. *gru-muṣṭí-, a-grū-* < **g^{w}rú-/-g^{w}ru-*
Gr. *astér-* vs. *steropḗ* < **h$_2$ster-*
Av. *-sna-*, Gr. *-gnós*, Lat. *-gnus* < **-ĝno-* < **-ĝn̥h$_1$o-* 'born'
Gr., Lat. *gigne-* < **ĝíĝne-* < **ĝí-ĝn̥h$_1$o-*

Rather failing vocalization/epenthesis than real loss
Balles 2012, Lubotsky 2013: most examples not probative;
no real loss of IE consonants

F. Early loss of laryngeals

4) The “Saussure Effect”

Cf. Nussbaum 1997

Loss in 1) *#HRo and 2) oRHC

Greek *omeíchein* ‘to urinate’ vs. *moichós* ‘adulterer’ from *$*h_3mejg^ɦ$-/$(h_3)mojg^ɦ$-*

Greek *$*awersā$-/$ewersā$-* ‘dew’ vs. *$*worséje$- > *ourée-* ‘to urinate’;
Hittite *warsa-* ‘fog’ from *$*h_2wers$-/$(h_2)wors$-*

Greek *telamõ̃n* vs. *tólmā* ‘boldness’ from *$*telh_2$-/$tol(h_2)$-*;
pera- ‘to sell’ vs. *pórnē* ‘whore’ from *$*perh_2$-/$por(h_2)$-*

Perhaps in *$*dóm$-* ‘house’ from *$*demh_2$-*?
Rather primary *$*dem$-* with suffix *$*-h_2$-*

F. Early loss of laryngeals

Phonetic motivation?

Dissimilation of some kind of low back feature present in laryngeals and **o*?

Originally quantitative constraints (Kümmel 2012a)? Cf. below

Counterexamples (not really compelling):

Greek *ónukh-* 'nail, claw' < $*h_3nog^{wh}$-

erōẽ 'rest' < $*h_1roh_1wáh_2$-

Against the reality of the effect see Pronk 2011; van Beek 2011

4. PIE vocalism

A. The question of */a/

Lubotsky 1981; 1989: all cases of **a* must be explained by **h₂* (or not be PIE)

**ĝʰans-, *nās-/nas-, *bʰag-, *maḱ-* or **ĝʰh₂ans-, *nah₂s-/nh₂as-, *bʰah₂g-, *mah₂ḱ-*
[mas-/maθ- 'long'? No: 'big, large', only variant of *maz-/mad-]*

bʰag-, *ĝar-, *ĝʰan-, *Hjaĝ-, *h₁aĝ-, *h₁aj-,* ?h₁ar-, *h₃wath₂-, *ḱad-, *ḱwas-, *kagʰ-,*
kamp-, *kan-,* ?mad-, *maĝ-, *magʰ-, *rasd-, *skabʰ-, *tag-, *wagʰ-*
nominal **nás-, *ĝʰans-, *ḱasó-, *sál-*, particles ?**ap-*, ?**ad*, ?**au*
Few minimal pairs: **bʰag- : *bʰeg-, *tag- : *(s)teg-*

Lubotsky's Law

Lubotsky 1981: dissimilation of [ʔ] preceding **ˀD$ ⇒ "shortening" = no compensatory lengthening, cf. *pajrá-* 'firm' vs. *pā́jas-* '(front) side' < **pah₂ĝ-*

A. The question of */a/

But: Data do not really match (see now Lipp 2009: I 161ff.)

Nonglottalistic explanation: no compensatory lengthening / differen syllabification?

VHCC = VH.CC, cf. Ved. *āptá-, -bā́dhya, śāstár-, śvātrá-, ādhrá-, ātmán-, rā́trī-, vāśrā́-, pā́trā-* (*śā́sti, ā́ste, ábhrāṭ, rā́ṣṭi, *árāt* maybe analogical); but **VHDC* = VHD.C? Counterexample only av. *sādra-* in RV only *svâdma, svādmân-, (svādvî, râjñ-)*

De Lamberterie 1996, 1999: very old loss by „glottal“ dissimilation:

cf. Lat. *pignus*, Ved. *pajrá-* < **peg-r/n-* from **peh$_2$g-*

Lat. *signum* < **segno-* from **sah$_2$g-*; Ved. *bhadrá-* < **b^{h}edró-* from **b^{h}eHd-*

Gr. *kednós* ‘dear, true’ to *kḗdistos*, **kah$_2$d-*

Av. *x^{v}aṇdra-* ← **swed-ró-*, *hudəma-* < **sud-mó-*, gr. ἐδανός ‘suave’ < **swednó-* from **swah$_2$d-/suh$_2$d-*

**med-* from **meh$_1$-d-*

A. The question of */a/

All may be explained by „Wetter-Regel“

VHCR'V > VCR'V as in *h_2weh_1-*tró-* > *$h_2$wetró-* > Germ. *wedra-* ‘weather’

Cf. Schindler apud Peters 1999: 447; Neri 2011

Real loss or just no compensatory lengthening (i.e., VHC.RV > VC.RV) in post-PIE?

Reversal of “colouring” in Lat. *signum* etc. and wide distribution favour real loss

But then **a* is not explained

Original ***a* > [æ] ~ [ɑ] > (post-)PIE */*e*/ : */*a*/

Conditions for back allophone?

certain /h_2/, maybe also [-cor]_[-cor]? Cf. *$b^{ɦ}$ag-, *$kag^{ɦ}$-, *$mag^{ɦ}$-

Countexamples with later analogical **e*? Phonologized in PIE or later?

A. The question of */a/

Difference between **o* from **h_3e* and original **o*?
I.e. **/h_3e/* or */h_3a/* vs. /**o*/ with later merger

Not lengthened by Brugmann's Law (Lubotsky)?
Cf. *ánas-*, *ápas-* = Lat. *onus, opus*, if < **h_3é°*
reconstruction not completely sure

Luwian *harran-* '?' = Hitt. *hāran-* 'eagle' < **$h_3$áron-*, cf. Greek *orn-*
with Čop's Law = gemination after accented short vowel
as after **é* but not after **ó* (lengthened in Anatolian)

B. Vowel length

1) Caused by laryngeal: not really PIE, see above

2) Real length: lengthened grade **ē, *ō*

Mainly found in:

- Nominatives of athematic nouns (especially sonorant stems)
- S-aorists (at least in indicative singular)
- “Narten”-presents (and aorists)
- Some locatives: *i*-stem **-ēj* (*u*-stem **-ēw*?); **dḗm* ‘in the house’

1) Monosyllabic lengthening?

Proposed by Wackernagel 1896: 66ff.; Kortlandt 1975: 84ff. (and passim); Pronk 2014 and others

B. Vowel length

Cf. **pṓds* vs. **pódm̥, *pódes*; **gʷṓws* vs. **gʷówes*; **h₂nḗk̑-s* vs. **h₂nék̑-s-m̥*?

**mûs* ‘mouse’, **wîs* ‘poison’ from **mus-, *wis-*?

But: no general constraint against short vowels in monosyllables,
cf. **só, *nú, *dwís, *trís*; vocative **djéw, *h₂nér*; genitive **nékʷts, *déms, *gʷéws;* locative **dʰĝʰém(-i), *djéw(-i)*

Against it, see Dunkel 2014: 86f.; Kümmel 2012c; 2015b

2) Lengthening before final sonorant

Beekes/Kortlandt

Cf. **ph₂tḗr, *h₂uksḗn* < ***ph₂tér, **h₂uksén*

But: no such lengthening in vocatives and locatives

B. Vowel length

3) Szemerényi's Law

VRs# > VRR# > V:R#

Cf. **ph$_2$tḗr, *h$_2$uksḗn < **ph$_2$tér-s, **h$_2$uksén-s*

Originally already proposed by Schleicher, but re-proposed by Szemerényi 1962 and widely applied since then; cf. Keydana 2014; Sandell & Byrd 2015

Not a synchronic law, cf. genitive **déms*, **-ejs*, **-ews*

Extended to *Rh$_2$* by many, cf. n. pl. **wedor-h$_2$ > wedōr* 'waters'
Phonetically rather problematical (maybe rather plural ***-s*?)

Against see Beekes, Kortlandt passim

B. Vowel length

4) Stang's Law

Stang 1965: accusative **djḗm, *gʷṓm* < **djéw-m, *gʷów-m*; Vaux 2002

Originally regular for other words, too:

cf. **-ām* in OAv. *hiθąm* (Geldner 1890; Tremblay 1998; Cantera 2007)
to nom. *hiθāuš* 'fellow'
Av. *vaiiąm* (Remmer 2011: 15f.) from *vaiiu-* 'wind', Ved. *vāyú-*
vs. innovative YAv. *-aom/-āum*, OP-*āum, -āvam* (cf. Cantera 2007: 17ff.)
Greek Arkado-Cypriot generally *-ēs, -ēn* for *-eús*, *-ẽ̄a*
cf. also *arēn* 'destruction', *Arēs* ~ *Areus* from root *areu-* < **h₂rew-* (Willi 2014)

B. Vowel length

Contra Meiser 1998: 139f., 141; Cantera 2007 **not** regular for *i*-stems,
cf. OAv. *haxāim*, YAV. *kauuaēm*
Single example of YAv. *raɣa, raɣąm* ~ *rajōiṯ̰* not compelling

Often also assumed for **-VHm*, cf. **-ām* from stems in **-ah$_2$-*
phonetically very difficult; cf. PII **pántaHam* > Av. *paṇtąm* = Ved. *pántha$_a$m* etc.
see Pronk 2016: 20-27 for analogical explanation

Pronk 2016: **djēm, *g^{w}ōm* < **djēwm, *g^{w}ōwm* with monosyllabic lengthening;
polysyllabic cases analogical

Similar process: loc. sg. **-ej-i* > **-ēj*; maybe instr. pl. **-oj-is* > **-ōjs* (Jasanoff 2007)

B. Vowel length

5) Simplification of clusters

**de-dk̑-* > **dēk̑-* > Skt. *dāś-*; **g^{h}e-g^{h}d-* > **g^{h}ēd-* > Germ. **gēt-* (pret. plural)
cf. **penk^{w}e-dk̑(o)mt-* > **penk^{w}ēk̑(o)mt-* '50'
Origin of long-vowel perfects

Also **tetk̑-C* > **tēk̑-C*? Origin of "Narten" type?

Cf. Schumacher 2005; Sandell 2014
cf. the "Kortlandt effect" (**d* > **H* before consonants? Kortlandt 1983)

C. Qualitative ablaut

Traditional theory: zero grade from syncope of unaccented **e*

Also **o* unaccented for **e*, but under which conditions?

Famous example Ved. *pitár- : tvát-pitār-* = Greek *patér- : eu-pátor-*
Dubious "equation", cf. Lundqvist 2016; no such rule in early Vedic

Strong *o*-grade vs. weaker *e*-grade in ablaut type **o ~ e* alternating with **o ~ Ø*,
cf. **pód- ~ *ped-, *dóm- ~ *dem-*
**d^{ĥ}wór- ~ *d^{ĥ}ur-, *wójd- ~ *wid-, *memón- ~ *memn-* etc.
⇒ **o* rather „stronger" than **e/a*

Typological evidence: frequent *o* < **ā*; **e* < **ă* ⇒ original quantity distinction?

C. Qualitative ablaut

Kümmel 2012a (cf. Viredaz 1983: 35ff.; Woodhouse 2012: 2 n. 1; 2015: 6-9):
Original (pre-PIE) ***ā* > **o* vs. ***a* > **e* [æ~a~ɑ]
> PIE/CIE **e : *a : *o*

Consequences:

**pód- ~ *ped- < **pâd- ~ pad- < **pâd- ~ pād-*
Variant **wójd- ~ *wid- < **wâjd- ~ wid- < **wâjd- ~ wajd- < **wâjd- ~ wājd-*
(with shortening in closed syllable)

Thematic **-ó- < **-â-* but vocative **-e < **-a < **-ā*
originally **CóCo-* vs. **CeCó- < *CâCā-* vs. **CaCâ- < *CâCā-* vs. **CāCâ-*

Verb **-o- ~ *-e- < **-ā- ~ *-a- < **-ā-* with shortening before **t/s*

C. Qualitative ablaut

Interrogative substantival *k^wé- < **k^wá-
derivative *k^wó- < **k^wâ- < **k^wa-á-

Saussure effect from shortening in *CāRH.C > *CāR.C?

Brugmann's Law = lengthening of *o in non-final open syllables

Or rather retention of length vs. shortening?

Cf. similar length(ening) in Anatolian (Melchert 1994; Kloekhorst 2008)
*ó > ō even in closed syllables

So maybe still PIE/pre-PII *a [æ~ɑ~ɒ] vs. *ā [ɒː]?
*a > [æ] in most environments vs. [ɑ] /h_2=χ

C. Qualitative ablaut

PIE/CIE **ā* > (overlong) *ã̄* vs. **a* [æ] > **ǣ*
by old lengthening (Szemerényi's and Stang's laws or otherwise)

Indo-Iranian development:

**ā* [ɒː] > **a* [ɒ] /_CC, /_#; **ã̄* and **ǣ* preserved

**ə̃* > **ã* > **a*

**æ* > **ǣ*; **a* > *ā* by younger lengthening

Palatalization

Late merger **æ=a* > **a, ǣ=ā* > **ā*

Anatolian developments: similar with less shortening of **ā*?
Depends on whether Lycian really preserves **o* distinct from **a*

C. Qualitative ablaut

Tocharian? Cf. *o > *æ stronger than *e > *^{y}ə
arguments for original rounding of *o

Elsewhere/Western developments:

*ā > *ō in general

*ō > *o /_#: *só ‘that’, 3s middle *-tó, *pró ‘forth’

*ō > *o /_ except in accented monosyllables: *pṓ(d)s ~ *pódm ‘foot’
and/or *ṓ preserved?

Secondary lengthenings as in II, producing *ē

5. Syllable structure

Cf. now Byrd 2010a; 2010b; 2015

VCV = V.CV; VCCV = VC.CV; VCCCV = VC.CCV, but VCC.-CV-
Cf. Sievers' Law: VRT-jV = VRT.jV > VRT.i(j)V vs. VR-TjV = VR.TjV (Byrd 2010; 2015)

Special rules for *sT, *HT (extrasyllabic fricatives)

Problem: Greek = Vedic = Latin = PIE?

But what about Baltic, Slavic, Iranian? Typological differences

- No gemination (as PIE, cf. /*h_1*ési*/ for //*h_1*és-si*//!)
- Cluster syllabification: .TC (or at least weightless coda obstruents) vs. T.C
- Fewer restrictions on clusters

5. Syllable structure

Baltic

"Open syllable lengthening" of accented *a/e* before single consonants and clusters starting with obstruents, cf. *kãklas, ãkmenį, ãkštas, ẽglė, mãzgas, vãškas*

Exception: words with transparent productive morphological boundary within the cluster, e.g. infinitive *nèš-ti, lès-ti* with supine *nèš-tų, lès-tų*; participle *nèš-tas* etc.

TR- and ST-clusters mostly preserved and not targeted by "open syllable conspiracy" removing allmost all RC-clusters in Common Slavic

Generally **.Cj* > **.C^{j}*, cf. **medjā-, *dausjā-, *ezja-* > **meďā-, *dōšā-, *ježa-* > *mežda, duša, ježь*

OCS *nesti, voskъ, teplъ, modrъ, ogńь, osmъ, ostrъ* < **ne.stī, *wa.ska-, *te.pla-, *bu.dra-, *a.gnj-a-, *a.sma- *a.stra-*

5. Syllable structure

**tl; *dl* > Pskov North Russian *kl, gl*; West Slavic *tl, dl*; elsewhere simplified to *l*

Only TS/TT simplified (without CL): **kt, *pt > t; *ps > s, *ks > *(k)ṣ > x*

⇒ Balto-Slavic VR.TV vs. V.TCV

Iranian

Sievers' Law not really attested, cf. **jantwa- > *janθwa-* > Av. *jąθβa-* 'to be hit' (vs. Skt. *hánt$_u$va-*)

Many complex and unusual clusters:

- Anlaut: Av. ***xš**aθra-*, ***pt**ā*, ***fᵊδr**- /fθr-/*, ***ruu**aθa- /rwaθa-/*, ***mr**ū-*, ***fšt**āna-*
- Inlaut: Av. *a^{i}βii**āxštr**a-*, *xra**fstr**a-*, *ra**fᵊδr**a-*, *ha**xᵊδr**a-*, *du**gᵊdr**-*
- Auslaut: Av. *ā**fš**, va**xšt**, dā**rᵊšt***

5. Syllable structure

Sogdian: heavy syllables only with R.C; light syllables in cases like *a.sp-* ‘horse’, *a.βt-* ‘seven’

Middle Persian: light syllables in **páwa.stā-* > *pōst* ‘skin’; **ēwáka.hya* > **ēwak* > *ē(w)k* ‘one’

No compensatory lengthening in cases like **puθra-* > MP *pus*; **hwasrū-* > Wakhi *x̌aṣ*

Avestan: “open syllable” allophone *aē* preceding *st, št* and partly *θr* (Fortson 1996)
Old Avestan metre becomes more quantitatively regular (mostly iambic with anapaestic cadences),
if Sogdian syllabification is applied (cf. Kümmel 2016b; forthc. a),
leading to more light syllables
variable weight of TC (necessarily) would allow even more regularity

4+7 line	VT.C	—	×	×	—	|	×	—	×	×	∪	∪	×	‖
	V.TC	∪	×	∪	—	|	∪	—	×	×	∪	∪	×	‖
	V.T.C	∪	—	∪	—	|	∪	—	×	—	∪	∪	×	‖
	ideal	∪	—	∪	—	|	∪	—	∪	—	∪	∪	×	‖

7+7 line	VT.C	×	∪	×	—	∪	∪	—	|	×	×	∪	×	—	×	×	‖
	V.TC	×	∪	×	—	×	∪	×	|	×	∪	∪	∪	—	×	×	‖
	V.T.C	—	∪	×	—	×	∪	—	|	∪	—	∪	∪	—	∪	×	‖
	ideal	—	∪	∪	—	∪	∪	—	|	∪	—	∪	∪	—	∪	×	‖

Y. 44,3 *taṯ̰. θβā. pərəsā. ərəš.mōi. vaocā. ahurā.*
kasnā. zą̨θā. ⁺ptā. aṣ̌ahiiā. ⁺paouruiiō.
kasnā. xᵛāṇg. ⁺strāmcā. dāṯ̰. aduuānəm.
kā. yā. mā̊. uxšiieitī. nərəfsaitī. θβaṯ̰.
tācīṯ̰. mazdā. vasəmī. aniiācā. vīduiiē.

VT.C	V.TC
— —, ∪ ∪ | — —, — ∪, ∪ ∪ ×	∪, —, ∪ ∪ | ∪ —, — ∪, ∪ ∪ ×
— —, — — | ∪, ∪ — ∪, — ∪ ×	∪ —, — — | ∪, ∪ ∪ ∪, ∪ ∪ ×
— —, ∪ — | ∪ — ∪, —, — — ×	∪ —, ∪ — | ∪ — ∪, —, ∪ — ×
—, —, ∪ — | — ∪ ∪, — ∪ —, ×	∪, —, ∪ — | ∪ ∪ ∪, ∪ ∪ ∪, ×
— —, — — | — ∪, — — ∪, — ×	— ∪, ∪ — | ∪ ∪, ∪ — ∪, ∪ ×

Y. 51,18 *tąm. cistīm. dājāmāspō. huuō.guuō. ištōiš. xᵛarənā̊. aṣ̌ā. vərəṇtē. taṯ̰. xšaθrəm. manaŋhō. vaŋhāuš. vīdō. taṯ̰. mōi. dāidī. ahurā. hiiaṯ̰. mazdā. rapān. tauuā.*

VT.C

—, — —, — ∪ — × | — ∪ ∪, — —, — × ||
∪ —, — —, —, — × | ∪ ∪ —, ∪ —, ∪ × ||
— —, — ∪, ∪ ∪ × | —, — —, ∪ —, ∪ × ||

V.TC

—, ∪ —, — ∪ ∪ × | — ∪ ∪, ∪ —, — × ||
∪ —, — —, ∪, ∪ × | ∪ ∪ ∪, ∪ —, ∪ × ||
∪ —, — ∪, ∪ ∪ × | ∪, ∪ —, ∪ —, ∪ × ||

5. Syllable structure

Indic exceptions to Sievers' Law with TT-clusters: *mátsya-, vakṣyá-, yuktvā̃* (Schindler 1977b: 60f.; Byrd 2010a: 50f.) presuppose that TT-clusters did not behave like RT-clusters

⇒ PII and PIE may have differred from Vedic and Greek
– preferring complexity in onsets over codas
– avoiding obstruent codas

But cf. common IE *VH.CV > V:.CV, speaking for T.T syllabification

What about Anatolian?