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The Syllabic Structure of Proto–Indo–European
In memory of Jochem Schindler

The recent advances in the reconstruction of the lexicon and the phonological system of PIE allow us to posit some syllable–building rules for the Protolanguage. In this paper a reconstruction of the PIE syllable structures is attempted within the framework of autosegmental phonology.

1. INTRODUCTION

After many decades of relative neglect, the syllable plays again an important role in contemporary phonology[1]. The syllabic structure of a language is considered as an essential part of its phonological representation, and the interface between the rules of syllabification and other phonological rules, such as stress assignment, is a matter of serious studies, especially within the framework of autosegmental phonology (e. g. Goldsmith 1990). The investigation of syllable structures in various languages has yielded many valuable typological generalizations, especially with respect to the possible types of syllables, and the relations of sonority and moraicity of segments in different languages (see, e. g. Zec 1995). It is therefore very disappointing that so little has been written about the syllable in Proto–Indo–European, especially since it appears that syllabification rules played an important role in that proto–language. However, in the standard handbooks of PIE phonology (e. g. Lehmann 1952, Mayrhofer 1986) the syllable is hardly mentioned at all; whereas of all the still usable compendia of IE linguistics (Meillet 1937, Gamkrelidze & Ivanov 1984, Szemerényi 1989, Beekes 1995) only Meillet's and Szemerényi's contain chapters on syllables[2], but these chapters deal mostly with Sievers' law and the related

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1   See, e. g., Vennemann 1972, Kahn 1980, Giegerich 1992, chapter 6.

2   Of earlier comparative works dealing with syllable structures in IE languages, we can mention only Hermann's outdated monograph (1923).

matters. The discovery of the role of the laryngeals in the phonological system of PIE, new insights into IE accentology, and the increase of our knowledge of the different patterns in IE noun inflection have deeply changed our intuitive view about the syllable structure of PIE, but this view has still not been stated explicitly, nor has it found its way into synthetic textbooks. I believe that it is the comparative linguist's task to answer such questions as — which segments were syllabic in PIE, and which were moraic? Which syllable structures were permitted in the proto–language, and what role these structures played (if any) with respect to stress assignment? Were the laryngeals ever syllabic, moraic, or both? What is the role of syllable structure in morphological alternations in PIE declension and conjugation? The fact that such questions have seldom been asked is probably the reason why it is difficult to say *how* the syllabic structure of the proto–language should be reconstructed. Obviously one cannot rely on "sound correspondences" in the usual sense: in different daughter languages different onsets and rhymes are possible, and the rules of syllabification are also different. A reasonable course to take seems to be the following: we shall look at the most plausible reconstructions of PIE words and analyze their syllabic structure. Then we shall use the results to formulate generalizations, if any can be attained. We cannot hope to be exhaustive, and the analysis offered here shall perhaps even be inadequate in some cases. A detailed analysis of the syllabic structure of PIE will remain as an unwritten chapter of IE comparative phonology: the following study should be viewed as only a preliminary sketch of that chapter.

We shall start by examining the structure of the onset, by assuming that onsets possible word–initially are also permitted word–medially, in accordance with the "maximal onset principle" (on which see, e. g., Goldsmith 1990: 137). Then we shall analyze the structure of the rhyme, and establish the maximal number of segments that it could contain. This will enable us to reconstruct the permitted syllable templates for PIE.

We shall use the following cover symbols for various classes of PIE segments:

H– laryngeal ($*h_1$, $*h_2$, $*h_3$); we assume that "laryngeals" form a natural class in PIE, and that all these segments share a feature that we shall conventionally call "laryngeal";

R– resonant (*m, *n, *l, *r, *y, *w);

O– occlusive;

V– vowel (*e, *o); I deny the existence of PIE *a; this vowel segment either did not exist in PIE, or it was marginal, and was not involved in any phonological or morphological process (cp. Matasović 1995, Lubotsky 1989).

V: – long vowel;

C–consonant;

P– labial;

T– alveolar;

K– velar;

K^w– labiovelar;

C^h– aspirated;

2. POSSIBLE ONSETS

1. PIE syllables could have zero–onsets, but only if a resonant was in the nucleus, i. e., PIE syllables could not begin with a vowel. This rule appears to hold generally for all nouns and verbs. All words that seem to contradict it can be shown to have contained a laryngeal (e. g. one should reconstruct *$h_1$esti "he is", *$h_2$egoh$_2$ "I drive", *$h_1$ekwos "horse"). The possible exceptions to this rule are various particles and pronouns, where laryngeals need not be assumed for structural reasons, e. g. *ed "that". It is, of course, quite possible that these words also had an initial laryngeal. Thus, the attested words where zero–onsets are certainly established begin with resonants: *ish$_2$ros "strong, holy" > G (Dor.) ἁρός[3], Olnd. *išira–*, PIE mg\$h$_2$és (the original gen. sg. of *megh$_2$ "great", G μέγα, ἄγαν, Olnd. *mahi,* cp. Mayrhofer 1986).

2. Every single consonant can be in the onset of a syllable, e. g. H– *h_3e\$wis "sheep" (L *ovis,* G ὄϊ ᾇ, Luv. *hawi–*), R– *meli(t) "honey", (L *mel,* G μέλι), O– *po\$dés "foot (g. sg.)" (L *pedis,* G ποδός), s– *senos "old" (Olnd. *sana–,* G ἷνος). PIE *r–, which could not appear word–initially (Matasović 1992, Beekes 1995), was a possible onset word–medially (e. g., in the PIE preposition *pe\$ri > Olnd. *pari,* G περί).

3. The following combinations of consonants are permitted in syllable onsets:

OR: all onsets of this structure seem to be possible, except for those containing homorganic combinations of occlusive and sonorant: **b^hm–, **bm–, **pm–, **d^hn–, **dn–, **tn–. Combinations of such consonants are possible, if they belong to different syllables, e. g. *sup\$mos > L *summus,* *$h_2$et\$nos "year" > L *annus,* Goth. *aþna,* *pot\$nih$_2$ "lady" > Olnd. *patnī,* G πότνια, *b^hud^h\$nos "bottom" > Olnd. *budhná–,* OE *bodan,* L *fundus.*

RR: very few combinations of resonants are possible; we find syllables beginning with *w: *wl– and "wr– (PIE *wloyskeh$_2$ "rod" > OCS *lěska,* OIr. *flesc;* *wrotom "oath, promise" > Olnd. *vrata–,* OCS *rota;* PIE *wrehg– "break", G ῥήγνυμι, OCS *rězati*). Onsets with PIE *m– are problematic: we seem to have *ml– in PIE *mlewh– "speak", Olnd. *bravīti,* Russ. молвá. On the other hand, L *brevis,* Av. *mərəzu–* G βραχ⬜ᵈ seem not to come from a PIE **mre\$g^{wh}u–, but from mr–g^{wh}u–, because the u–stem adjectives had zero–grade (cp. *plth$_2$u– "broad")[4]. Perhaps *mn– should be admitted, because of the correspondence of Olnd. *mnā– "to mention" and G μνη– in μνόμα "memory" < PIE *mneh$_2$–. However, these could also be parallel, not inherited formations. Olnd. g. sg. *aśnas* (of *aśmā,* "stone", G, ἄκμων), which must be old, seems to imply that the syllabification **$h_2$ek\$mnos was impossible; if so, then there are serious reasons to exclude *mn– from the list of well–formed onsets.

The combination *wy– is very doubtful: Olnd. *vyath– "totter, stagger", *vyaj– "cover, envelop" do not have certain IE etymologies (Mayrhofer). Word–internally, the onset **wy– of, say, **deywyo– "divine" (adjective derived from *deywos "god", Olnd. *deva– etc.) was impossible because of the application of Sievers' law (on which see below). Thus **dey\$wyo– was reinterpreted as

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3   The Attic form ἁρός is probably based on analogy with adjectives such as ἐλε⬜θερος, γλυ–κερός, etc.

4   On L *brevis,* which is a younger formation with the full grade of the root, see Mayrhofer 1987: 103 and the literature cited there.

*dey\$wi\$yo–. Other combinations are almost certainly not permitted (**rl–, **rm–, **rn–, **ry–, **rw–, **lm–, **ln–, **lr–, **ly–, **lw–. The onsets **wm– and *mw– can be excluded by a more general rule mentioned earlier: homorganic consonants (including resonants) cannot be in the onset of a syllable. On the other hand, *w and *m can stand next to each other, if they belong to different syllables, cp. *srew\$mn "stream" > G ῥεᾶμα OIr. *srúaim*, or PIE *stē\$mi "I praise" (Olnd. *stāumi*, G στεᾶμαι). The fact that only *w– and *m– of all resonants are permitted in complex onsets in PIE is perhaps related to the scarcity of word–initial *b, and its non–existence in complex onsets (cp. Matasović 1992). Some (or all?) instances of *w and *m in such onsets perhaps represent earlier word– and syllable initial *b–. Such a hypothesis, however, cannot be proved.

RH: It appears that such onsets were impossible. As far as I can tell, no RHV– structures should be posited for PIE. In RHC– structures, it seems that it was the laryngeal that was vocalized (Beekes 1988), cp. n. sg. *neh$_2$s(s) "nose" (Lith. *nósis),* gen. sg. *nh$_2$sés (from which, by thematization, OCS *nosъ*), i. e., a (non–phonological) prop–vowel was introduced between the laryngeal and the preceding consonant.

RC: there are no examples of such onsets. Word–initially, resonants are vocalized (i. e., they are in the nucleus) before stops (cp. *ngnis "fire" > Olnd. *agni–,* L *ignis,* Lith. *ugnis < ungnis,* *nb^{h}ros "cloud" > Olnd. *abhra–,* G ἀφρός) and *s (cp. nsi– "sword" > Olnd. *asi,* L *ensis*)[5].

HR: since the discovery that Greek and Armenian "prothetic vowels" are reflexes of laryngeals, we know that such onsets are possible word–initially, and there is no need to doubt in their existence word–medially, cp. *h$_2$nēr "man" > G ἀνήρ, Olnd. *sūnara–* "possessing good, manly force".

CH– Such onsets seem to be impossible word–initially, and, therefore, probably also word–medially. If one accepts this, then the mechanism of "laryngeal metathesis" (Mayrhofer 1986: 174) becomes understandable immediately. Olnd. participle *pīta–* (from the PIE root *peh$_3$y– "drink" can be derived from the expected form *ph$_3$i–to– if one assumes the following rule for avoiding impermissible onsets:

(1)

O   Rh

X   X   N X   C X

[–sonorant]   [–sonorant]   [+sonorant]
[–continuant]   [+laryngeal]

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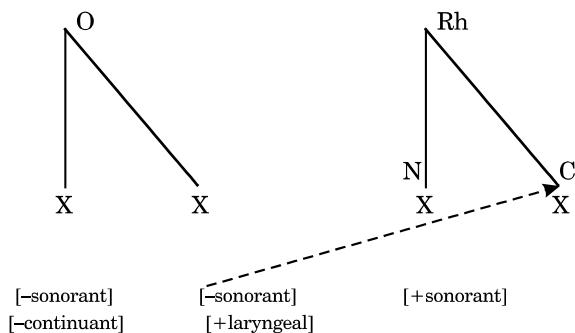
5   If Palaic *hašira–* "dagger" is related, this word should be reconstructed as *h$_2$nsi– (see Eichner 1980: 127).

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This answers the question raised by Lindeman (1987: 73) — why PIE $*h_3$ did not voice the preceding stop in the participle $*ph_3ito$– "drunk": h_3 caused the voicing (or glottalization, if one accepts the glottalic theory) of the preceding voiceless stop in $*pi–p\$h_3–e–ti$ > OInd. *pibati* "drinks", because there $*p$ and $*h_3$ were adjacent, as $*h_3$ was in the onset of the following syllable. On the other hand, in $*pih_3to$– the voicing did not apply, because the voicing rule (2) was ordered after the resyllabification rule (1).

(2)
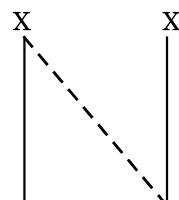
[–sonorant]   [+voiced]
[–continuant]

The same rule will explain the relationship between OInd. *kāru*– "poet" (G κόρυξ "messenger") < $*keh_2ru$–, and *kīri*– "praiser, poet" < $*kr\$h_2i$ < $**kh_2r\$i$–, as well as the different stems in the paradigm of the PIE word for "sun": n. sg. $*seh_2wōl$ (Lith. *saulė*, L *sōl*), g. sg. $*sh_2wles$ > $*suh_2les$ (OInd. *sūrya*–, OIr. *súil* "eye"). Similarly, the word for "fire" can be reconstructed as $*peh_2\$wr$ (Hitt. *pahhur*), g. sg. $*puh_2éns$ (or $*puh_2nés$), which will account for the long vowel of G πᾶρ, OIc. *fūrr*, etc.

However, the PIE 2 sg. perfect ending $*–th_2e$ seems to be a problem. We must ask ourselves, how was a word such as $*woyd–th_2e$ "you know" (G οἶσθα, OInd. *vettha*, Goth. *waist*) syllabified? As we shall see below, there are reasons to believe that coronal obstruents were in many ways "resistent" to syllabification rules, i. e., they were permitted as "extrasyllabic" segments. Having this typologically well–established claim in mind, we can suggest that the correct syllabification of such 2 sg. perfect forms was $*woyd\$–t–\$h_2e$, with $*–t–$ as an extrasyllabic element.

HO– A plausible example of such an onset is found in PIE $*h_1donts$ "tooth", G ἠδο□ϲ, OInd. *dant*–, which is probably related to $*h_1ed$— "to eat"[6]. Rix (1976) is not explicit about "prothetic vowels" before stops in Greek, but I think that Beekes' (1969) argumentation should be accepted at least for ἤγείρω < $*h_1geryoh_2$ "awaken, rouse". The initial laryngeal is firmly established here on the basis of pf. ἤγρήγορα, νη– in νήγρετος, and the long reduplicated vowel in OInd. pf. *jāgara*.

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6   The presence of a laryngeal in this root is confirmed by G νόστις < $*nh_1dtis$ "who does not eat, fasting" (cp. Hamp 1976: 261). The ἤ– of G ἠδο□ϲ, ὑδών, etc. requires of us to suppose an assimilation: $*e... o$ > $o... o$ in proto–Greek (see also Beekes 1969 for discussion).

Hs– also seems to be possible, cp. PIE *$h_1$su– "good" > G ε□ Hitt. *assu.*

sH– is probably impossible: In Hittite, initial *sh– gets a prothetic i–[7], whereas in other languages there are no examples where a *sh– should be posited: e. g. PIE *sh_2em– "sing" > Hitt. *išhamai,* cp. *seh_2mn > Olnd. sāman "hymn"[8].

OO: it appears that onsets with this structure are impossible: In the first syllable of a word we never find such onsets, whereas in the medial syllables a different syllabification is always possible. Here is how the possible counter–examples can be accounted for: PIE PIE TK– clusters first undergo a metathesis (TK– > KT)[9], and the second segment is then fricativized, so that they did not represent instances of onsets with two stops: thus PIE *$g^{wh}d^h$– was replaced by *g^{wh}ð– (e. g. in *g^{wh}ðiti– "decay", G φθίσις, Olnd. *kšiti*–), which was a possible onset (see below). Moreover, roots of the form OVO– do not have certainly attested zero–grades word–initially: PIE *pēds "foot" should have a zero–grade in its oblique cases[10], but it does not (cf. G πο□ḓ, ποδός, L *pēs, pedis.* On the other hand, the zero–grade of the same root is possible word–internally, where a different syllabification is probable, cf. G ἠπίβδα "the day after (the festival)". From PIE *peku– "(small) cattle" (L *pecu,* OPr. *pecku*) we get a zero–grade of the root only in Avestan *fšu*–, where both initial stops became fricatives (and perhaps in Olnd. *kšu–mant*–, which became possible after the assibilation of the PIE velars). PIE *pet– "fly" (Olnd. *patati,* G πέτομαι), seems to have a zero–grade in G πτερόν "feather". However, this Greek formation does not seem to have parallels with initial *pt*– in other IE languages. Rather, the comparison with L *penna* < *$petneh_2$, Olnd. *pátra*–, OCS *pero* seems to imply that the word was a heterocliton in PIE, and perhaps had a static inflecton; thus its n. sg. was *pōtr (cp. the length in OIr. *áis*[11] "*pinna*") g. sg. pétnos. PIE *potis "master (Olnd. *pati*–) does not have a zero grade, except when it occurs as an enclitic particle in L –*pte* (e. g. *in eopte = in eo ipso*), when a different syllabification was possible[12]. On the other hand, even if we accept PIE branching onsets with two stops, this will not affect other generalizations about the structure of PIE syllable offered in this paper.

4. Combinations of three consonants: PIE *$h_2$stēr (G ἀστήρ, L *stella,* Hitt. *ha–aš–te–er–za*) seems to imply that a threefold onset (*h_2st–) was possible.

7   For a different opinion, see Ivanov 1963: 65. Ivanov thinks that the *prothetic i– in such cases was not pronounced, but only a spelling convention.

8   I see no reason to relate this PIE root to G οﬁμη < *sh_2oymeh_2 "song", as some scholars do (e. g. Bader 1989). G οﬁμη is from PIE *$soymeh_2$, and it is obviously related to οἶμος "path", cp. ON *seimr* "thread" OIr. *sim* "chain".

9   This is the well–known PIE "thorn"–rule, on which see Mayrhofer 1986. Its importance for PIE syllabification is discussed below, under 4.

10   Unless the word had static inflection (Beekes 1995), which I doubt.

11   This word, cited by Walde–Pokorny s. v. *pet*– cannot be traced neither in the R I A's "Dictionary of the Irish Language", nor in Vendryès's "Léxique étymologique de l' irlandais ancien". Thus, this example is open to doubt.

12   As to the meaning, cp. Lith. *pats "ipse"*. It is possible, however, that the vowel was simply sincopated in L –*pte.*

However, this particular example is rather isolated, and it involves a dental fricative /s/, which is in many languages "indifferent" to syllabification rules (i. e., no rules apply to it and thence it can appear in any position in the syllable)[13]. A similar explanation is possible for PIE 3rd p. sg. of the present optative of *$h_1$es– "to be", *$h_1$syeh$_1$t (Olnd. *syāt*, OL *siēt*). Here, we can also say that segments characterized as [+continuant, –laryngeal] can be added to otherwise well–formed onsets. Our claim that consonant clusters containing *s behave with respect to syllabic structure like single consonants is backed by a rule of reduplication in PIE (cp. Sihler 1995: 488): in PIE perfects of roots beginning with a *s followed by a stop both consonants were reduplicated, cp. Goth. *skaiskaiþ* "cut", *gastaistald* "procured", L *spopondī* "pledged", etc. A similar solution applies to the three–segment clusters involving the PIE "thorn" segments. Thus, PIE *d^heg^{h}ōm "earth" (Hitt. *tekan*) had g. sg. *g^{h}ðmés (from which, by reshaping, G χθών, Olnd. *kšam–*, Av. *zå*, etc.). The segments *ð, *þ, and *s, of which only *s was a phoneme, were all [+continuant, –laryngeal], so that they satisfied the structural description of a special syllabification rule (3) permitting such segments to appear in any place within otherwise well–formed syllables. The rule can be stated as a condition on the well–formedness of onsets:

(3)

$$X \qquad\qquad X$$

Onset]

[+back]   [+coronal]

[–cont.]   [–cont.]
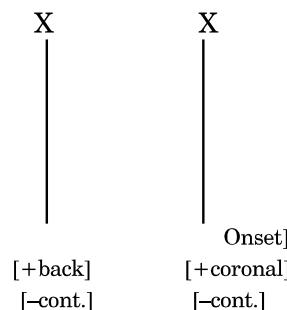
Our account of the "thorn–problem", therefore, does not differ much from Schindler's (1977a): PIE KÞ represents both TK and KT in tautosyllabic position. However, the general principles of syllabification in PIE stated in this article will show that KÞ was only possible in the onset, precisely because combinations of two stops were impossible.

Another example possibly involving a threefold onset is the PIE word for "eye–brow", *h_3b^{h}ruh$_2$s: G ἠφρ□, Proto–Slav. *bry (gen. *brъve), Olnd. *bhrū–* (cp. Beekes 1969: 56). I think, however, that OIr. *abrae* (gen. *abrat*), and Proto–Slavic variant *obry (Croat. *obrva*) show that the word was bisyllabic already in PIE, i. e., there was a prop–vowel before the laryngeal to avoid an impossible onset. Similarly, in a form such as *ph$_2$tēr, the threefold onset is impossible, so a prop–vowel will be introduced after the first consonant, yielding

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13   This is the case, e. g., in English (see Giegerich 1992).

*$p_e h_2 t\bar{e}r$[14]. The same rule will explain why the laryngeal appears to be vocalized in L *aptus* < PIE *$h_2 p\$tos$[15]. Moreover, from PIE *$pek(t)$— "to browse", we have L *pecten* "comb" in the face of G κτεὁς. In both words a reflex of PIE *$p_e kten(s)$ is preserved, with a prop–vowel after the first stop. Other cases of prop–vowel insertion, such as *$ptneh_2 mi$ "spread out" > *$p_e tneh_2 mi$ (G πίτνημι, L *pando*), or *$k^w tru$– "four–" > *$k^w_e tru$– (L *quadru*–) can also be explained by our syllabification rule[16]. All these cases are consequences of the principle that appears to hold not only in PIE, but also universally: branching onsets with three segments specifiable for place of articulation are not permitted. We shall state this rule as follows:

(4)
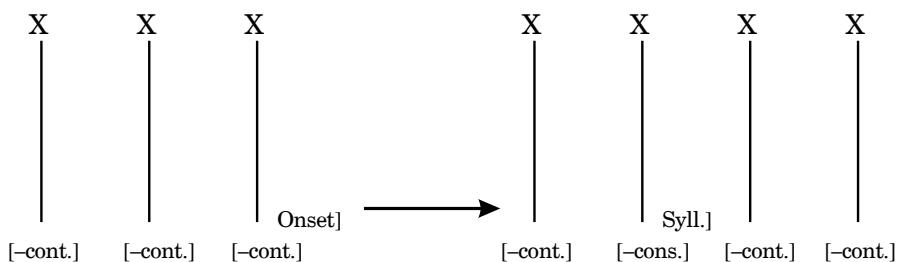
Impossible onsets are removed by introducing a "default vowel" after the maximal possible onset, i. e. after the consonant, or a consonant group that can form a permitted onset; the input form is thus re–syllabified. The "default vowel" was phonetically probably akin to a "schwa", which is typologically the "default vowel" in most languages: *$ph_2 t\bar{e}r$ > *$p_e h_2 t\bar{e}r$ [$p\partial h_2 t\bar{e}r$]. However, PIE *$d^h ug\$h_2 t\bar{e}r$ was bisyllabic, if onsets of the form HO– were permitted. The trisyllabic realizations of G θυγάτηρ and Olnd. *duhitā* should be accounted for by assuming a generalization of the resyllabification rule, which occured in these languages: laryngeals developed a prop–vowel between any two consonants, not only in syllabically impossible onsets.

If we now relate various PIE segment classes with respect to their sonority, we can say that in PIE only branching onsets consisting of elements with increasing sonority were possible. We assume that the relative sonority of PIE segments was as follows:

(5) (H, O), (m, n), (r, l), (w, y), V.

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14 The assumption of such a prop–vowel also explains why the voiceless stop was not aspirated before *h_2 in OInd. *pitā* (cp. Mayrhofer 1986).

15 Cp. Hitt. happ– "sich fügen, passen", see also Ofitsch 1995: 19).

16 A similar rule (OORV— > OVORV–) was proposed by Schindler (1977a: 31) without involving the notion of syllable. Thus, his formulation cannot be regarded as a consequence of the general syllable–building principles of PIE, and is therefore *ad hoc*.

This is quite in accordance with the universal sonority scale (cp., e. g., Zec 1995), with only the relation of laryngeals and stops being unclear. One should remember that the question whether onsets of the form HC were possible could not be answered definitely. If it is assumed that H and O had equal sonority in PIE, it would follow that HC–onsets contradict our principle of the well–formedness of onsets. However, if laryngeals were inherently less sonorous than stops — a hypothesis for which additional arguments should be adduced — then the principle can be retained as it stands. The only other counter–example to the general principle we have stated seems to be the onset *mn– discussed above, where both elements are of equal sonority, but even the existence of this onset structure is doubtful (see above). Besides that, a [+ coronal +continuant] segment was not sensitive to the onset–forming rules, i. e., it was permitted everywhere within the onset.

3. THE RHYME

As in all languages, the PIE rhyme consisted of two elements: a nucleus (N) and a coda (C)[17]. Our task is, then, to establish which segments could appear in the nucleus (i. e., which elements were syllabic in the traditional sense), and which segments, and in which order, could appear in the coda. From what we have already said, it is clear that we consider the two vowels (*e and *o) and the resonants (*m, *n, *l, *r, *y and *w) as having syllabic allophones, which is to say that they were permitted in the nucleus[18]. Laryngeals were never syllabic themselves[19], but there was a rule which introduced a prop–vowel before them (as well as before stops) in configurations that could otherwise not be syllabified. In our view, this non–phonemic prop–vowel was actually an "empty" nucleus[20]. A nucleus was either monosegmental or bisegmental in PIE. We assume that any segment which was permitted in the nucleus at all, was also permitted as the second element of the nucleus[21]. Thus, a bisegmental nucleus could have two different structures: V: or VR. A bisegmental nucleus with a long vowel could occur only in some morphological categories, which required a "lengthened grade", such as the sigmatic aorist, the "Narten"

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17 Of course, as in all languages, coda is optional, i. e. open syllables are possible.

18 The feature +/– syllabic is no longer considered as necessary in the inventory of phonological features. Perhaps it is time for IE linguistics to acknowledge this discovery of the phonological theory.

19 Though there appear to be languages in which *every* segment can be in the nucleus (i. e. "syllabic"), e. g. Imdlawn Tashlhiyt Berber (Dell & Elmedlaoui 1985), no languages are attested in which vowels, resonants and "laryngeal" consonants can be in the nucleus, but stops and /s/ cannot (cp. also the discussion in Schmitt–Brandt 1973: 34ff). Thus, the "syllabic" laryngeals must be rejected for typological reasons.

20 This is typologically very common: empty nuclei are filled with "shwas" to prevent impossible syllabic structures from occuring, see Goldsmith 1990: 165ff. on such a rule in Yup'ik.

21 However, not also in the first. Resonants could never be the first element of the nucleus, i. e., there were nuclei such as *ey, or even *em, but no nuclei such as **ye or **me. This is to say, the second element of a nucleus could only have been less sonorous than the first.

present, etc. Thus, the two positions on the skeletal tier that were associated to such a branching nucleus were always associated to a single vowel on the phonemic tier. The second segment us was thereby always introduced by a rule, whenever morphology required a "lengthened grade"

(6)

(applies in the morphological conditions for the lengthened grade)
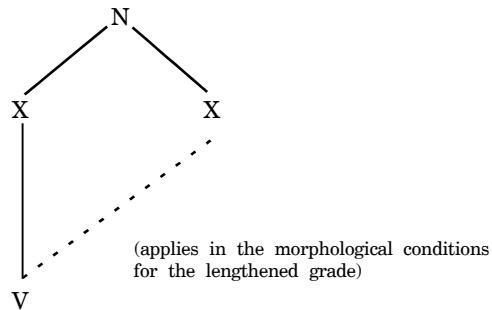
On the other hand, it is much more difficult to determine the permitted structures of the coda. I shall try to defend a view that only non–branching codas were permitted, but that additional extrasyllabic elements could appear at the end of a word. This presupposition is justified by the fact that such extrasyllabic elements are predictable in terms of point of articulation and voice. Thus, I think it is enough to postulate codas containing one of the following elements: O (*$pēd_R$ –s "foot"), H (pod–eh_{1R} = I sg. of "foot", R (–$ōm_R$, g. pl. ending of thematic nouns)[22]. Besides these non–branching codas, the PIE syllable also permitted extrasyllabic elements, or appendices. The appendices were permitted at the end of a word, and they were predictably [+ coronal, — voiced], i. e., only *t and *s were possible appendices: *$b^he\$ron\$t_{app}$. ("they carried", with a 3. pl. "secondary ending"), *$pēd\$s_{app}$. The 2 sg. perfect ending *–th_2e seems to imply that an appendix was also possible word–internally (see above). A PIE word could have as many as two appendices, as in *nok^wts (monosyllabic) "night" (L *nox*, G v☐, Hitt. *nekuz* < g. sg. *nek^wts). These presuppositions about the structure of the PIE rhyme shall be tested below, in our discussion of polysyllabic words.

To say which segments were possible in the nucleus and rhyme, however, is not the same thing as to say which segments were moraic, i. e., which segments contributed to the heaviness of a syllable. In some languages, of course, only vowels are moraic, i. e., there is no distinction between "light" and "heavy" syllables. In still others, any segments occurring in the rhyme are moraic, so that every syllable ending in a consonant (*any* consonant) is heavy (i. e. bimoraic). However, there are languages, such as Lithuanian, where only a subset of all consonantal segments are moraic. In Lithuanian, only resonants are moraic, in that their occurrence in the rhyme makes the syllable heavy, and it is only in the heavy syllables that a contrast in intonations is possible.

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22   R denotes the end of the rhyme, app. the appendix.

At the same time, Lithuanian resonants are never syllabic, i. e., they can occur in the coda, but not in the nucleus of a syllable. On the evidence of Greek and Latin metrics, where any segment in the rhyme makes a syllable long, we could conclude that all segments were moraic in PIE. However, a different reconstruction, based upon Schindler's (1977b) formulation of Sievers' law, is also possible (see 9 below). Thus, we shall be able to claim that Lithuanian, and not the classical languages, preserves the PIE rule according to which only vowels and resonants were moraic, so that there was a distinction between a bimoraic "heavy rhyme" (7) and a monomoraic "light rhyme" (8):

(7) "heavy rhyme"   (8) "light rhyme"

[+sonor.]   [+sonor.]   [+sonor.]   [–sonor.]

μ   μ   μ
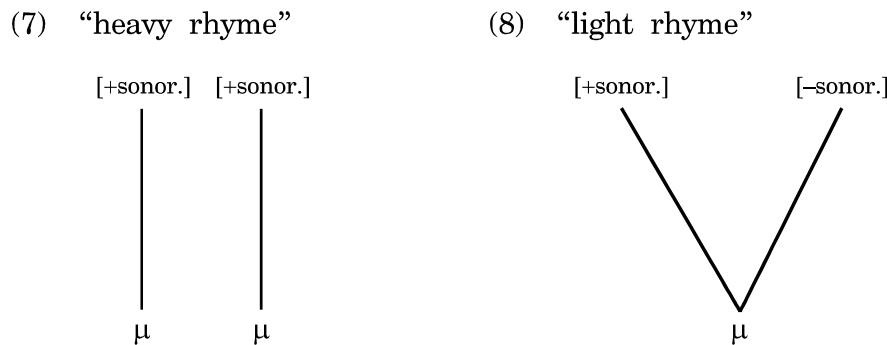
4. THE SYLLABLE

It follows from what has been said that the PIE language had the following types of syllables:

a) light open syllables: *ne– in *ne\$b^{h}os "cloud", G νέφος, Hitt. *nepiš,* OCS *nebo.*

b) light closed syllables: *–b^{h}os in the preceding example.

c) heavy open syllables: *–rō– *b^{h}e\$rō\$mes "we carry (subjunctive)", G φέρωμεν, Olnd. *bharāmas.*

d) heavy closed syllables (or "superheavy" syllables). Although languages with such syllables are typologically rather scarce, it seems that PIE was one of them, because "superheavy syllables" appear in several morphological categories: 1. Perfect tense of roots containing diphthongs (*b^{h}e\$b^{h}oydh\$h$_2$e > G πέποιθα); 2. N sg. of m. and f. nouns ending in a consonant (e. g. *–tēr in *ph$_2$tēr "father"); 3. "Narten praesentia", e. g. *stēw\$ti "he praises" (Olnd. *stauti,* G στεᾶται); 4. G pl. of thematic nouns *–ōm (G –ων); 5. D sg. of thematic nouns –ōy (G –ῳ); 6. N sg. of root nouns, e. g. *wēk^{w}s "sound, word" (Olnd. *vāk,* L *vox*); 7. A. sg. of diphthongal root–nouns, cp. *dyēm "sky" (Olnd. *dyām,* G Ζήν), *g^{w}ōm "cow" (Olnd. *gām*).

The last named words are also instances of Stang's law (Mayrhofer 1986), which can be formulated as a rule operating within the rhyme:
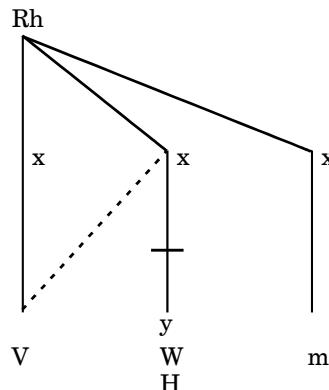
The rule says that the preceding vowel will be lengthened when a glide or a laryngeal are in the rhyme of a syllable that ends with a *m. Thus, from PIE *wl\$$h_2neh_2$m (accusative of *wlh$_2neh_2$ "wool", L *lana*, G ἤλήνη, Olnd. *ūrṇā*) we get *wl\$$h_2$nm, where the long vowel will be realized phonetically as [a:], due to the coloring of the laryngeal that had dissapeared in the derivation. The rule does not apply to syllables ending with *n: such forms must be resyllabified, if one can judge by the PIE word for "nine", *ne\$wn (Olnd. *nava*, Goth. *niun*, L *novem*[23]).

Heavy syllables (c and d) are by definition those that contained at least two moraic segments, i. e. either a long vowel (underlyingly a single vowel associated with two positions on the skeletal tier), or a vowel followed by a resonant (but not by other consonants). Heavy syllables have in common that they cannot appear before the accented syllable (Matasović 1995): i. e. there are no such words with the structure **CV:Cós, **CV:CCós, **CVRCCHós, CVRCOO-ós, or **CV:RCCHós[24]. The only counter–examples to this rule could be some vrddhi–formations, such as G πηδόν "oar", which are probably dialectal, not Common IE.

It is probable, though not strictly provable, that heavy syllables also triggered Sievers' law[25]. Schindler (1977b) has shown that the law probably did not apply after combinations of obstruents (O, H and *s), i. e., after combinations of monomoraic segments; thus, Olnd. *matsya–* "fish" should never be read as *matsiya in the RV, because the sequence CyV–, to which Sievers' law regularly applies, follows a closed, but light syllable in that example. Similarly, *ūrdhva–* "upright" is never *ūrdhuva–, because the syllable preceding the PIE sequence *–d^{h}w– was light (PIE *h$_3$rh\$d^{h}wo–). On the other hand, *kartva–* is regularly *kartuva–*, as *–tw– was preceded by a bimoraic syllable in PIE (*k^{w}er\$two–). Thus, Sievers law can be formalized as a rule that inserts an

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23 L *novem* instead of *noven* is due to the analogy with *decem*.

24 The restriction against pre–accentual length is typologically well–attested. Such a restriction holds, e. g., in Standard Literary Croatian.

25 For a thorough discussion of Sievers' law cp. Seebold 1972, Collinge 1985, Schindler 1977b).

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empty nucleus between a glide and a consonant, whenever such a sequence occurs after a bimoraic rhyme (9):
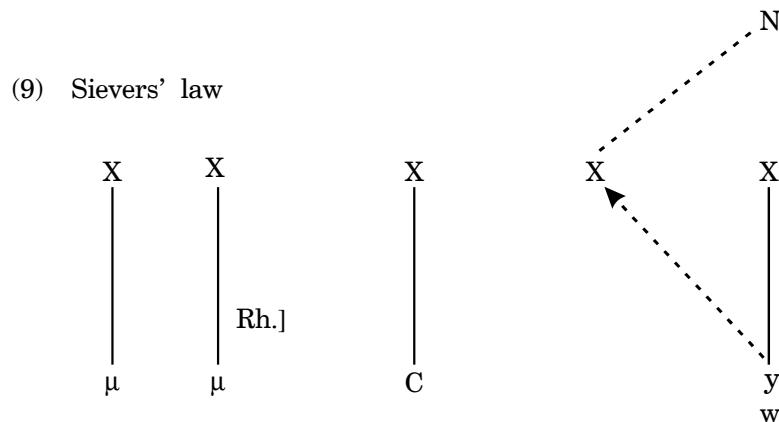
(9)   Sievers' law

The rule, as stated above, implies also that *y and *w will be realized as *i and *u, respectively, after its application, because they will be in the nucleus. However, the formulation of Sievers' law offered here is only tentative, and its adequacy should be tested against a large sample of data.

5. CONCLUSION

On the basis of the preceding discussion, we can now reconstruct the syllable template for PIE (10). It need not be repeated that this reconstruction is provisional, and based on several assumptions that should be further investigated.

(10)   The syllable template of PIE
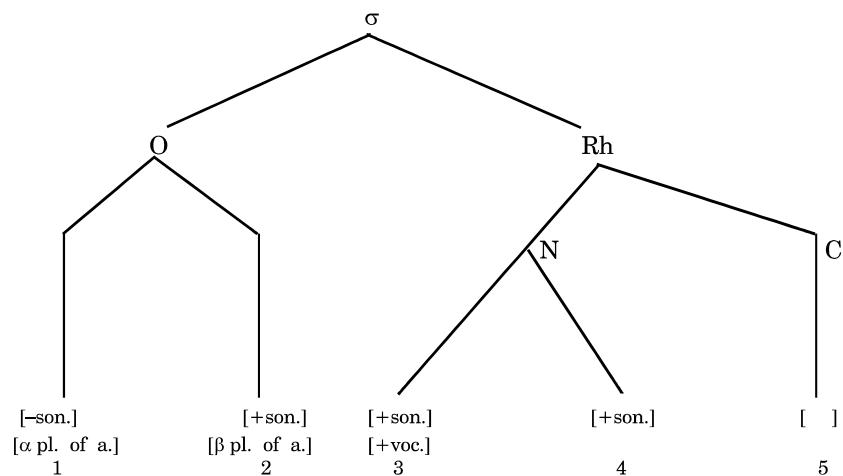
Positions 1 and 2 need not be realized, i. e., a syllable can begin with a nucleus, but then the element 3 is also lacking (i. e., the nucleus contains a syllabic resonant). Whenever both 1 and 2 are realized, they must be arranged exactly in that order. Whenever both 3 and 4 are realized, they must also appear in that order. Position 5 (coda) is optional.

We have been able to show that –sonorant and +coronal segments (*s, *t and the non–phonemic *þ) were in two ways "resistent" to the syllabification rules: (1) they could appear as extrasyllabic elements or appendices, (i. e., they could appear after the position 5), and (2), *s and *þ could appear between the positions 1 and 2, and *s could appear even before the position 1.

Our approach to the reconstruction of the PIE syllable structure has the merit of relating several previously independently considered phenomena; if only a few general principles about the syllabic structure of the Proto–language are accepted, one sees how the rules of laryngeal metathesis, "schwa secundum", and the realization of the so–called "thorn" segments follow as consequences. However, I am aware that the approach advocated here is open to several objections, the most principled of which is the claim that we can never know which structures (including the syllabic structures) were impossible in the Proto–language, simply because it is possible that relevant data are lacking. Of course, we reconstruct only what *was* in the Proto–language, not what was not there; thus, our conclusions are valid only insofar as our present knowledge permits us to reach general — including negative — conclusions about PIE.

The reconstruction of the syllable structure of the Proto–language offered here opens up interesting epistemological and methodological issues. It appears that our reconstruction does not involve any new discoveries, no new sound correspondences or new data, but only a new presentation of the data. However, it requires of a historical linguist to shift his attention from the reconstruction of segments, and arrays of segments that constitute words, to the reconstruction of rules that operated within the proto–language[26]. This is in accordance with the emphasis that the contemporary linguistic theory puts on the role of syllabic structures, and the rules of syllabification, in the phonological representation of languages. It is my firm belief that, if IE comparative linguistics is going to make some progress in the next millenium, that progress will have to follow the development of current linguistic theory and typology.

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26 Such an approach is advocated, e. g., in Kiparsky 1973.

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Slogovna struktura indoeuropskoga prajezika

Rekonstruirani leksik i fonološki sustav indoeuropskoga prajezika dovoljno dobro su poznati da bi se mogla formulirati osnovna pravila slogovne strukture indoeuropskoga prajezika. U ovom radu ta su pravila formulirana u okviru autosegmentalne fonološke teorije.