II.1. PHONETIC RECONSTRUCTION

II.1.1. PROTO-INDO-EUROPEAN SOUND LAWS

A few sound-laws can be reconstructed that may have been effective prior to the final breakup of PIE by internal reconstruction.

- Sievers' Law (Edgerton's Law, Lindeman's option)
- Grassman's Law
- Bartholomae's Law

A. SIEVERS' LAW

Sievers' Law in Indo-European linguistics accounts for the pronunciation of a consonant cluster with a glide before a vowel as it was affected by the phonetics of the preceding syllable. Specifically it refers to the alternation between *i̯j and *j, and possibly *uw and *u, in Indo-European languages. For instance, Proto-Indo-European *kor-jo-s became Gothic harjis “army”, but PIE *kerdh- jo-s became Proto-Germanic *herdijas, Gothic hairdeis [herdīs] “shepherd”. It differs from an ablaut in that the alternation is context-sensitive: PIE *i̯j followed a heavy syllable (a syllable with a diphthong, a long vowel, or ending in more than one consonant), but *j would follow a light syllable (i.e. a short vowel followed by a single consonant). This was first noticed by Germanic philologist Eduard Sievers, and his aim was to account for certain phenomena in the Germanic languages. He originally only discussed *j in medial position. He also noted, almost as an aside, that something similar seemed to be going on in the earliest Sanskrit texts (thus in the Rigveda dāivya- “heavenly” actually had three syllables in scansion (dāivya-) but say satya- “true” was scanned as written). After him, scholars would find similar alternations in Greek and Latin, and alternation between *uw and *u, though the evidence is poor for all of these. Through time, evidence was announced regarding similar alternations of syllabicity in the nasal and liquid semivowels, though the evidence is extremely poor for these, despite the fact that such alternations in the non-glide semivowels would have left permanent, indeed irreversible, traces.

The most ambitious extension of Sievers’ Law was proposed by Franklin Edgerton in a pair of articles in the journal Language in 1934 and 1943. He argued that not only was the syllabicity of prevocalic semivowels by context applicable to all six Indo-European semivowels, it was applicable in all positions in the word. Thus a form like *djēus, “sky” would have been pronounced thus only when it happened to follow a word ending with a short vowel. Everywhere else it would have had two syllables, *dijēus.
The evidence for alternation presented by Edgerton was of two sorts. He cited several hundred passages from the oldest Indic text, the Rigveda, which he claimed should be rescanned to reveal hitherto unnoticed expressions of the syllable structure called for by his theory. But most forms show no such direct expressions; for them, Edgerton noted sharply skewed distributions that he interpreted as evidence for a lost alternation between syllabic and nonsyllabic semivowels. Thus say śīras “head” (from *śīros) has no monosyllabic partner *śras (from *śros), but Edgerton noted that it occurred 100% of the time in the environments where his theory called for the syllabification of the *r. Appealing to the “formulaic” nature of oral poetry, especially in tricky and demanding literary forms like sacred Vedic versification, he reasoned that this was direct evidence for the previous existence of an alternant *śras, on the assumption that when (for whatever reason) this *śras and other forms like it came to be shunned, the typical collocations in which they would have (correctly) occurred inevitably became obsolete pari passu with the loss of the form itself. And he was able to present a sizeable body of evidence in the form of these skewed distributions in both the 1934 and 1943 articles.

In 1965 Fredrik Otto Lindeman published an article proposing a significant modification of Edgerton’s theory. Disregarding Edgerton’s evidence (on the grounds that he was not prepared to judge the niceties of Rigvedic scansion) he took instead as the data to be analyzed the scansion in Grassmann’s Wörterbuch zum Rig-Veda. From these he concluded that Edgerton had been right, but only up to a point: the alternations he postulated did indeed apply to all semivowels; but in word-initial position, the alternation was limited to forms like *dże/sdjęvw “sky”, as cited above—that is, words where the “short” form was monosyllabic.

B. GRASSMANN’S LAW

Grassmann’s law, named after its discoverer Hermann Grassmann, is a dissimilatory phonological process in Ancient Greek and Sanskrit which states that if an aspirated consonant is followed by another aspirated consonant in the next syllable, the first one loses the aspiration. The descriptive (synchronic) version was described for Sanskrit by Panini.

Here are some examples in Greek of the effects of Grassmann’s Law:

- [tʰu-ο:] θ’οω ‘I kill an animal’
- [e-tu-tʰe:] έτυθη ‘it was killed’
- [tʰrik-s] θριξ ‘hair’
- [tri₃kʰ-es] τριχές ‘hairs’
- [tʰap-sai] θάψαι ‘to bury (aorist)’
- [tʰap-tʰein] θάπτειν ‘to bury (present)’
- [tʰapʰ-os] τάφος ‘a grave’
- [tʰapʰ-e] ταφή ‘burial’
In the reduplication which forms the perfect tense in both Greek and Sanskrit, if the initial consonant is aspirated, the prepended consonant is unaspirated by Grassmann’s Law. For instance [pʰu-o:] φῦο ‘I grow’: [pe-pʰu:-ka] πεφυκα ‘I have grown’.

**DIASPIRATE ROOTS**

Cases like [tʰrik-s] ~ [trikʰ-es] and [tʰap-sai] ~ [tapʰ-ein] illustrates the phenomenon of *diaspirate roots*, for which two different analyses have been given.

In one account, the “underlying diaspirate” theory, the underlying roots are taken to be /tʰrikʰ/ and /tʰapʰ/. When an /s/ (or word edge, or various other sounds) immediately follows, then the second aspiration is lost, and the first aspirate therefore survives ([tʰrik-s], [tʰap-sai]). If a vowel follows the second aspirate, it survives unaltered, and therefore the first aspiration is lost by Grassmann’s Law ([trikʰ-es], [tapʰ-ein]).

A different analytical approach was taken by the ancient Indian grammarians. In their view, the roots are taken to be underlying /trikʰ/ and /tapʰ/. These roots persist unaltered in [trikʰ-es] and [tapʰ-ein]. But if an /s/ follows, it triggers an “aspiration throwback” (ATB), in which the aspiration migrates leftward, docking onto the initial consonant ([tʰrik-s], [tʰap-sai]).

Interestingly, in his initial formulation of the law Grassmann briefly referred to ATB to explain these seemingly aberrant forms. However, the consensus among contemporary historical linguists is that the former explanation (underlying representation) is the correct one.

In the later course of Sanskrit, (and under the influence of the grammarians) ATB was applied to original monoaspirates through an analogical process. Thus, from the verb root *gah ‘to plunge’, the desiderative stem *jighakʰa- is formed. This is by analogy with the forms *bubhutsati (a desiderative form) and *bhut (a nominal form, both from the root *budh ‘to be awake’, originally PIE *[bʰudʰ-].

**C. BARTHOLOMAE’S LAW**

**Bartholomae’s law** is an early Indo-European sound law affecting the Indo-Iranian family, though thanks to the falling together of plain voiced and voiced aspirated stops in Iranian, its impact on the phonological history of that subgroup is unclear.

It states that in a cluster of two or more obstruents (s or a stop (plosive)), any one of which is a voiced aspirate anywhere in the sequence, the whole cluster becomes voiced and aspirated. Thus to the PIE root *bhudʰ “learn, become aware of” the participle *bhudʰ-to- “enlightened” loses the aspiration of the first stop (Grassmann’s Law) and with the application of Bartholomae’s Law and regular vowel changes gives Sanskrit buddha- “enlightened”.
A written form such as -ddh- (a literal rendition of the devanāgarī representation) presents problems of interpretation. The choice is between a long voiced stop with a specific release feature symbolized in transliteration by -h-, or else a long stop (or stop cluster) with a different phonational state, “murmur”, whereby the breathy release is an artifact of the phonational state. The latter interpretation is rather favored by such phenomena as the Rigvedic form gdha “he swallowed” which is morphologically a middle aorist (more exactly ‘injunctive’) to the root ghas- “swallow”, as follows: ghs-t-a > *gzdha whence gdha by the regular loss of a sibilant between stops in Indic. While the idea of voicing affecting the whole cluster with the release feature conventionally called aspiration penetrating all the way to the end of the sequence is not entirely unthinkable, the alternative—the spread of a phonational state (but murmur rather than voice) through the whole sequence—involves one less step and therefore via Occam’s Razor counts as the better interpretation.

Bartholomae’s Law intersects with another Indic development, namely what looks like the deaspiration of aspirated stops in clusters with s: descriptively, Proto-Indo-European *leigh'-si “you lick” becomes *leiksi, whence Sanskrit leksi. However, Grassmann’s Law, whereby an aspirated stop becomes non-aspirated before another aspirated stop (as in the example of buddha- , above), suggests something else. In late Vedic and later forms of Sanskrit, all forms behave as though aspiration was simply lost in clusters with s, so such forms to the root dugh- “give milk” (etymologically *dhugh-) show the expected devoicing and deaspiration in, say, the desiderative formation du-dhuks-ati (with the root-initial dh- intact, that is, undissimilated). But the earliest passages of the Rigveda show something different: desiderative dudukṣati, aor. dukṣata (for later dhukṣata) and so on. Thus it is apparent that what went into Grassmann’s Law were forms like *dhugzhata, dhudhugzha- and so on, with aspiration in the sibilant clusters intact. The deaspiration and devoicing of the sibilant clusters were later and entirely separate phenomena— and connected with yet another suite of specifically Indic sound laws, namely a ‘rule conspiracy’ to eliminate all voiced (and murmured) sibilants. Indeed, even the example ‘swallowed’ given above contradicts the usual interpretation of devoicing and deaspiration: by such a sequence, *ghs-to would have given, first, *ksto (if the process was already Indo-European) or *ksta (if Indo-Irano-Iranian in date), whence Sanskrit *kta, not gdha.

II.1.2. CONSONANTS

1 After vowels. 2 Before a plosive (p, t, k). 3 Before an unstressed vowel (Verner’s Law). 4 After a (Proto-Germanic) fricative (s, f). 5 Before a (PIE) front vowel (i, e). 6 Before or after a (PIE) u. 7 Before or after a (PIE) o, u. 8 Between vowels. 9 Before a resonant. 10 Before secondary (post-PIE) front-vowels. 11 After r, u, k, i (RUKI). 12 Before a stressed vowel. 13 At the end of a word. 14 After u, r or before r, l. 15 After n.
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## II.1.3. VOWELS AND SYLLABIC CONSONANTS

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¹ Before *wa. ² Before *r, *h. ³ The existence of PIE non-allophonic *a is disputed. ⁴ In open syllables (Brugmann's law). ⁵ Under stress. ⁶ Before palatal consonants. ⁷ The so-called breaking is disputed (typical examples are *proti- *h₃kwo- > Ved. práńkam ~ Gk. πρωντός; *gh₃h₃u- > Ved. jivá- ~ Arm. keank, Gk. ἰεκάς; *duh₂ro- > Ved. důrá- ~ Arm. erkar, Gk. ἐξόρος) ⁸ In a final syllable. ⁹ Before velars and unstressed. ¹⁰ Before ā in the following syllable. ¹¹ Before i in the following syllable. ¹² In a closed syllable. ¹³ In the neighbourhood of labials. ¹⁴ In the neighbourhood of labiovelars.
II.2. DORSALS: THE PALATOVELAR QUESTION

1. Direct comparison in early IE studies, informed by the Centum-Satem isogloss, yielded the reconstruction of three rows of dorsal consonants in Late Proto-Indo-European by Bezzenberger (1890), a theory which became classic after Brugmann (Grundriss, 1879) included it in its 2nd Edition. The palatovelars [kʃ], [ɡʃ], and [ɡ̊h] were supposedly [k]- or [ɡ]-like sounds which underwent a characteristic phonetic change in the satemized languages – three original “velar rows” had then become two in all Indo-European dialects attested.

NOTE. It is disputed whether Albanian shows remains of two or three series (cf. Öberg 1976, Kortlandt 1980, Pänzer 1982), although the fact that only the worst known (and neither isolated nor remote) IE dialect could be the only one to show some remains of the oldest phonetic system is indeed very unlikely.

After that original belief, then, The centum group of languages merged the palatovelars [kʃ], [ɡʃ], and [ɡ̊h] with the plain velars [k], [ɡ], and [ɡ̊h], while the satem group of languages merged the labiovelars [kʷ], [ɡʷ], and [ɡ̊hʷ] with the plain velars [k], [ɡ], and [ɡ̊h].

NOTE. Such hypothesis would then support an evolution [kʃ] > [k] of Centum dialects before e and i, what is clearly against the general tendency of velars to move forward its articulation and palatalize in these environments.

2. The existence of the palatovelars as phonemes separate from the plain velars and labiovelars has been disputed. In most circumstances they appear to be allophones resulting from the neutralization of the other two series in particular phonetic circumstances. Their dialectal articulation was probably constrained, either to an especial phonetic environment (as Romance evolution of Latin [k] before [e] and [i]), either to the analogy of alternating phonetic forms. However, it is difficult to pinpoint exactly what the circumstances of the allophony are, although it is generally accepted that neutralization occurred after s and u, and often before r.

Many PIE linguists still believe that all three series were distinct in Late Proto-Indo-European, although newest research show that the palatovelar series were a later phonetic development of certain Satem dialects, later extended to others; this belief was originally articulated by Antoine Meillet in 1893, and was followed by linguists like Hirt (1899, 1927), Lehman (1952), Georgiev (1966), Bernabé (1971), Steensland (1973), Miller (1976), Allen (1978), Kortlandt (1980), Shields (1981), Adrados (1995), etc.

NOTE. There is, however, a minority who consider the labiovelars a secondary development from the pure velars, and reconstruct only velars and palatovelars (Kuryłowicz), already criticized by Bernabé, Steensland, Miller and Allen. Still less acceptance had the proposal to reconstruct only a labiovelar and a palatal series (Magnusson).

3. The original (logical) trend to distinguish between series of “satemizable” dorsals, called ‘palatovelars’, and “non-satemizable” dorsals, the ‘pure velars’, was the easiest explanation found by
neogrammarians, who apparently opened a different case for each irregularity they found. Such an initial answer should be considered erroneous today, at least as a starting-point to obtain a better explanation for this “phonological puzzle” (Bernabé).

NOTE. “Palatals” and Velars appear mostly in complementary distributions, what supports their explanation as allophones of the same phonemes. Meillet (1937) establishes the contexts in which there are only velars: before a, r, and after s, u, while Georgiev (1966) states that the palatalization of velars should have been produced before e, i, j, and before liquid or nasal or w + e, i, offering statistical data supporting his conclusions. The presence of palatalized velar before o is then produced because of analogy with roots in which (due to the apophonic alternance) the velar phoneme is found before e and o, so the alternance *kie/*ko would be leveled as *kie/*kio.

Arguments in favor of only one series of velars include:

A) The existence of vacillating results between different so-called “Satem dialects”, as e.g.:

- ak/ok, sharp, cf. Lith. akúotas, O.C.S. ostru, O.Ind. asrís, Arm. aseln, but Lith. asrùs.
- akmn, stone, cf. Lith. akmuò, O.C.S. kamy, O.Ind. ásma, but Lith. âsmens.
- bhleg, shine, cf. O.Ind. bhárgas, Lith. balgans, O.C.S. blagu, but Ltv. blâzt.
- gherdh, enclose, O.Ind. grhá, Av. gərəda, Lith. gardas, O.C.S. gradu, Lith. zardas, Ltv. zârdas.
- swékuros, father-in-law, cf. O.Sla. svekry, O.Ind. śvašru.
- etc.

B) The existence of different pairs (“satemized” and “not-satemized”) in the same language, as e.g.:

- selg, throw, cf. O.Ind. srjáti, sargas
- kau/keu, shout, cf. Lith. kaukti, O.C.S. kujati, Russ. sova (as Gk. kauax); O.Ind. kauti, suka-.
- kleu, hear, Lith. klausýti, slove, O.C.S. slovo; O.Ind. karnas, sruti, srósati, šrnóti, sravas.
- leuk, O.Ind. rokás, rušant-.
- etc.

NOTE. The old argument proposed by Brugmann (and later copied by many dictionaries) about “Centum loans” is not tenable today. For more on this, see Szemerény (1978), Mayrhofer (1952), Bernabé (1971).

C) Non-coincidence in periods and number of satemization stages; as, Old Indian shows two stages, 1) PIE k > O.Ind. s, and 2) PIE qe, qi > O.Ind. ke, ki, & PIE ske, ski > O.Ind. c (cf. cim, candra, etc.). In Slavic, however, three stages are found, 1) PIE k > s, 2) qe, qi > č (čto, čelobek), and 3) qoi > koi > ke gives ts (as Sla. tsená).
D) In most attested languages which present aspirated as result of the so-called “palatals”, the palatalization of other phonemes is also attested (e.g. palatalization of labiovelars before e, i, etc.), what may indicate that there is an old trend to palatalize all possible sounds, of which the palatalization of velars is the oldest attested result.

E) The existence of ‘Centum dialects’ in so-called Southern dialects, as Greek and some Paleo-Balkan dialects, and the presence of Tocharian, a ‘Centum dialect’, in Central Asia, being probably a northern IE dialect.

4. It is generally believed that Satemization could have started as a late dialectal ‘wave’ (although not necessarily), which eventually affected almost all PIE dialectal groups. The origin is probably to be found in velars followed by e, i, even though alternating forms like gen/gon caused natural analogical corrections within each dialect, which obscures still more the original situation. Thus, non-satemized forms in so-called Satem languages are actually non-satemized remains of the original situation, just as Spanish has feliz and not *heliz, or fácil and not hácil, or French uses facile and nature, and not *fêle or *nüre as one should expect from its phonetic evolution. Some irregularities are indeed explained as borrowings from non-satemized dialects.

5. Those who support the model of the threefold distinction in PIE cite evidence from Albanian (Pedersen) and Armenian (Pisani) that they treated plain velars differently from the labiovelars in at least some circumstances, as well as the fact that Luwian apparently had distinct reflexes of all three series: *kʲ > z (probably [ts]); *k > k; *kw > ku (possibly still [kw]) (Craig Melchert).

NOTE. Also, one of the most difficult problems which subsist in the interpretation of the satemization as a phonetic wave is that, even though in most cases the variation *kʲ/𝑘 may be attributed either to a phonetic environment or to the analogy of alternating apophonic forms, there are some cases in which neither one nor the other may be applied. Compare for example okitō(u), eight, which presents k before an occlusive in a form which shows no change (to suppose a syncope of an older *okitō, as does Szemerényi, is an explanation ad hoc). Other examples in which the palatalization cannot be explained by the next phoneme nor by analogy are swekrū-, husband’s mother, akmon, stone, peku, cattle. Such (still) unexplained exceptions, however, are not sufficient to consider the existence of a third row of ‘later palatalized’ velars (Bernabé, Cheng & Wang), although there are still scholars who come back to the support of the three velar rows’ hypothesis (viz. Tischler 1990).

6. A system of two gutturals, Velars and Labiovelars, is a linguistic anomaly, isolated in the PIE occlusive subsystem – there are no parallel oppositions bʷ-/b, pʷ-/p, tʷ-/t, dʷ-/d, etc. Only one feature, their pronunciation with an accompanying rounding of the lips, helps distinguish them from each other. Labiovelars turn velars before -u, and there are some neutralization positions which help identify labiovelars and velars; also, in some contexts (e.g. before -i, -e) velars tend to move forward its articulation and eventually palatalize. Both trends led eventually to Centum and Satem dialectalization.
II.3. THE LARYNGEAL THEORY

1. The **laryngeal theory** is a generally accepted theory of historical linguistics which proposes the existence of a set of three (or up to nine) consonant sounds that appear in most current reconstructions of the Proto-Indo-European language (PIE). These sounds have since disappeared in all existing Indo-European languages, but some laryngeals are believed to have existed in the Anatolian languages, including Hittite.

   NOTE. In this Modern Indo-European grammar, such uncertain sounds are replaced by the vowels they yielded in Late PIE dialects (an -a frequently substitutes the traditional *schwa indogermanicum*), cf. MIE *patēr* for PIE *ph₂tēr*, MIE *ōktō(u)*, *eight*, for PIE *h₁ektēh₃*, etc. Again, for a MIE based on the northwestern dialects, such stricter reconstruction would give probably a simpler language in terms of phonetic irregularities (*ablaut* or *apophony*), but also a language phonologically too different from Latin, Greek, Germanic and Balto-Slavic dialects. Nevertheless, reconstructions with laryngeals are often shown in this grammar as ‘etymological sources’, so to speak, as Old English forms are shown when explaining a Modern English word in modern dictionaries. The rest of this chapter offers a detailed description of the effects of laryngeals in IE phonology and morphology.

2. The evidence for them is mostly indirect, but serves as an explanation for differences between vowel sounds across Indo-European languages. For example, Sanskrit and Ancient Greek, two descendents of PIE, exhibit many similar words that have differing vowel sounds. Assume that the Greek word contains the vowel [e] and the corresponding Sanskrit word contains [i] instead. The laryngeal theory postulates these words originally had the same vowels, but a neighboring consonant which had since disappeared had altered the vowels. If one would label the hypothesized consonant as [h₁], then the original PIE word may have contained something like [eh₁] or [ih₁], or perhaps a completely different sound such as [ah₁]. The original phonetic values of the laryngeal sounds remain controversial (v.i.)

3. The beginnings of the theory were proposed by Ferdinand de Saussure in 1879, in an article chiefly devoted to something else altogether (demonstrating that *a* and *o* were separate phonemes in PIE). Saussure's observations, however, did not achieve any general currency until after Hittite was discovered and deciphered in the early 20th century. Hittite had a sound or sounds written with symbols from the Akkadian syllabary conventionally transcribed as ḫ, as in *te-iḥ -ḫi* , “I put, am putting”. Various more or less obviously unsatisfactory proposals were made to connect these (or this) to the PIE consonant system as then reconstructed. It remained for Jerzy Kuryłowicz (*Études indoeuropéennes I*, 1935) to propose that these sounds lined up with Saussure's conjectures. Since then, the laryngeal theory (in one or another form) has been accepted by most Indo-Europeanists.

4. The late discovery of these sounds by Indo-Europeanists is largely due to the fact that Hittite and the other Anatolian languages are the only Indo-European languages where at least some of them are attested directly and consistently as consonantal sounds. Otherwise, their presence is to be seen mostly
through the effects they have on neighboring sounds, and on patterns of alternation that they participate in; when a laryngeal is attested directly, it is usually as a vowel (as in the Greek examples below). Most Indo-Europeanists accept at least some version of laryngeal theory because their existence simplifies some otherwise hard-to-explain sound changes and patterns of alternation that appear in the Indo-European languages, and solves some minor mysteries, such as why verb roots containing only a consonant and a vowel have only long vowels e.g. *dō- “give”; re-reconstructing *deh₂- instead not only accounts for the patterns of alternation more economically than before, but brings the root into line with the basic consonant - vowel - consonant Indo-European type.

5. There are many variations of the Laryngeal theory. Some scholars, such as Oswald Szemerényi, reconstruct just one. Some follow Jaan Puhvel's reconstruction of eight or more (in his contribution to Evidence for Laryngeals, ed. Werner Winter). Most scholars work with a basic three:

- *h₁, the “neutral” laryngeal
- *h₂, the “a-colouring” laryngeal
- *h₃, the “o-colouring” laryngeal

Many scholars, however, either insist on or allow for a fourth consonant, *h₄, which differs from *h₂ only in not being reflected as Anatolian ḫ. Accordingly, except when discussing Hittite evidence, the theoretical existence of an *h₄ contributes little. Another such theory, but much less generally accepted, is Winfred P. Lehmann's view that *h₁ was actually two separate sounds, due to inconsistent reflexes in Hittite. (He assumed that one was a glottal stop and the other a glottal fricative.)

Some direct evidence for laryngeal consonants from Anatolian:

PIE *a is a rarish sound, and in an uncommonly large number of good etymologies it is word-initial. Thus PIE (traditional) ant₁, in front of and facing > Greek anti “against”; Latin ante “in front of, before”; (Sanskrit ánti “near; in the presence of”). But in Hittite there is a noun ḫants “front, face”, with various derivatives (ḥantezzi “first”, and so on, pointing to a PIE root-noun *h₂ent- “face” (of which *h₂ent would be the locative singular).

NOTE. It does not necessarily follow that all reconstructed PIE forms with initial *a should automatically be rewritten as PIE *h₂e.

Similarly, the traditional PIE reconstruction for ‘sheep’ is *owi₁-, whence Skt ávi₁-, Latin ovis, Greek ói₁s. But now Luvian has ḫawi₁-, indicating instead a reconstruction *h₃ewi₁-.

But if laryngeals as consonants were first spotted in Hittite only in 1935, what was the basis for Saussure's conjectures some 55 years earlier? They sprang from a reanalysis of how the patterns of vowel alternation in Proto-Indo-European roots of different structure aligned with one another.
6. A feature of Proto-Indo-European morpheme structure was a system of vowel alternations christened ablaut (‘alternate sound’) by early German scholars and still generally known by that term, except in Romance languages, where the term *apophony* is preferred. Several different such patterns have been discerned, but the commonest one, by a wide margin, is *e/o/zero* alternation found in a majority of roots, in many verb and noun stems, and even in some affixes (the genitive singular ending, for example, is attested as -es, -os, and -s). The different states are called ablaut grades; *e*-grade or “full grades”, *o*-grade and “zero-grade”.

Thus the root *sed-*, “to sit (down)” (roots are traditionally cited in the *e*-grade, if they have one), has three different shapes: *sed-*, *sod-*, and *sd-*. This kind of patterning is found throughout the PIE root inventory and is transparent:

- *sed-*: in Latin *sedeō* “am sitting”, Old English *sittan* “to sit” < *set-ja- (with umlaut) < *sed-; Greek *hédrā* “seat, chair” < *sed-.
- *sod-*: in Latin *solium* “throne” (Latin *l* sporadically replaces *d* between vowels, said by Roman grammarians to be a Sabine trait) = Old Irish *suideⁿ* /suð’e/ “a sitting” (all details regular from PIE *sod-jo-m*); Gothic *satjan* = Old English *settan* “to set” (causative) < *sat-ja- (umlaut again) < PIE *sod-eje-*. PIE *se-sod-e* “sat” (perfect) > Sanskrit *sa-sād-a* per Brugmann’s law.
- *sd-*: in compounds, as *ni- “down” + *sd- = *nisdos “nest”: English *nest* < Proto-Germanic *nistaz*, Latin *nīdus* < *nizdos* (all regular developments). The 3pl (third person plural) of the perfect would have been *se-sd-ṛ* whence Indo-Iranian *sazdṛ*, which gives (by regular developments) Sanskrit *sedur* /sēdur/.

Now, in addition to the commonplace roots of consonant + vowel + consonant structure there are also well-attested roots like *dʰē- “put, place”: these end in a vowel, which is always long in the categories where roots like *sed-* have full grades; and in those forms where zero grade would be expected, before an affix beginning with a consonant, we find a short vowel, reconstructed as *ə, or schwa (more formally, schwa primum indogermanicum). The cross-language correspondences of this vowel are different from the other five short vowels.

**NOTE.** Before an affix beginning with a vowel, there is no trace of a vowel in the root, as shown below.

Whatever caused a short vowel to disappear entirely in roots like *sed-/*sod-/*sd-, it was a reasonable inference that a long vowel under the same conditions would not quite disappear, but would leave a sort of residue. This residue is reflected as *i* in Indic while dropping in Iranian; it gives variously *e, a, o* in Greek; it mostly falls together with the reflexes of PIE *a* in the other languages (always bearing in mind that short vowels in non-initial syllables undergo various adventures in Italic, Celtic, and Germanic):
• *dō- “give”: in Latin dōnum “gift” = Old Irish dān /dān/ and Sanskrit dāna- (ä = ā with tonic accent); Greek di-dō-mi (reduplicated present) “I give” = Sanskrit dādāmi. But in the participles, Greek dotós “given” = Sanskrit dītā-, Latin datus all < *dā-tō-.
• *stā- “stand”: in Greek hístēmi (reduplicated present, regular from *si-stā-), Sanskrit a-sthāt aorist “stood”, Latin testāmentum “testimony” < *ter-stā- < *tri-stā- (“third party” or the like). But Sanskrit sthitā-“stood”, Greek stasis “a standing”, Latin supine infinitive statum “to stand”.

Conventional wisdom lined up roots of the *sed- and *dō- types as follows:

<table>
<thead>
<tr>
<th>Full Grades</th>
<th>Weak Grades</th>
<th>“sit”</th>
<th>“give”</th>
</tr>
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<tbody>
<tr>
<td>sed-, sod-</td>
<td>sd-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dō-</td>
<td>da-, d-</td>
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</tbody>
</table>

But there are other patterns of “normal” roots, such as those ending with one of the six resonants (*j w r l m n), a class of sounds whose peculiarity in Proto-Indo-European is that they are both syllabic (vowels, in effect) and consonants, depending on what sounds are adjacent:

Root *bhūr-/bhūr-/bhūr- ~ bhū- “carry”

• *bhūr-: in Latin ferō = Greek pherō, Avestan barā, Old Irish biur, Old English bera all “I carry”; Latin ferculum “bier, litter” < *bhūr-tlo- “implement for carrying”.
• *bhūr-: in Gothic barn “child” (= English dial. bairn), Greek phorēō “I wear [clothes]” (frequentative formation, *”carry around”); Sanskrit bhāra- “burden” (*bhūr-o- via Brugmann’s law).
• *bhūr- before consonants: Sanskrit bhūr-ti- “a carrying”; Gothic gabaurþs /gaborþs/, Old English gebyrd /yebúrd/, Old High German geburt all “birth” < *gaburdi- < *bhūr-ti-
• *bhūr- before vowels: Ved bibhrati 3pl. “they carry” < *bhūr-ṇti; Greek di-phrós “chariot footboard big enough for two men” < *dwi-bhūr-o-.

Saussure’s insight was to align the long-vowel roots like *dō-, *stā- with roots like *bhūr-, rather than with roots of the *sed- sort. That is, treating “schwa” not as a residue of a long vowel but, like the *r of *bhūr-/bhūr-/bhūr-, an element that was present in the root in all grades, but which in full grade forms coalesced with an ordinary e/o root vowel to make a long vowel, with ‘coloring’ (changed phonetics) of the e-grade into the bargain; the mystery element was seen by itself only in zero grade forms:
Saussure treated only two of these elements, corresponding to our *$h_2$ and *$h_3$. Later it was noticed that the explanatory power of the theory, as well as its elegance, were enhanced if a third element were added, our *$h_1$. which has the same lengthening and syllabifying properties as the other two but has no effect on the color of adjacent vowels. Saussure offered no suggestion as to the phonetics of these elements; his term for them, “œifficicants sonantiques”, was not however a fudge, but merely the term in general use for glides, nasals, and liquids (i.e., the PIE resonants) as in roots like *$b^h$er-.

As mentioned above, in forms like *$dwi$-$b^h$or-o- (etymon of Greek diphros, above), the new “œifficicants sonantiques” (unlike the six resonants) have no reflexes at all in any daughter language. Thus the compound *$mns$-$d^h$eh- “to fix thought’, be devout, become rapt” forms a noun *$mns$-$d^h$o- seen in Proto-Indo-Iranian *$mazdha$- whence Sanskrit medhá- /mēdha/ “sacrificial rite, holiness” (regular development as in sedur < *$sazdur$, above), Avestan mazda- “name (originally an epithet) of the greatest deity”.

There is another kind of unproblematic root, in which obstruents flank a resonant. In the zero grade, unlike the case with roots of the *$b^h$er- type, the resonant is therefore always syllabic (being always between two consonants). An example would be *$b^h$endh- “tie, bind”:

- *$b^h$endh-: in Germanic forms like Old English bindan “to tie, bind”, Gothic bindan; Lithuanian beñdras “chum”, Greek peĩsma “rope, cable” /pēsma/ < *phenth-sma < *$b^h$endh-smn.
- *$b^h$ondh-: in Sanskrit bandhá- “bond, fastening” (*$b^h$ondh-o-; Grassmann’s law) = Old Icelandic bant, OE bænd; Old English bænd, Gothic band “he tied” < *(b$e$)b$^h$ondh-e.
- *$b^h$n$^h$dh-: in Sanskrit baddhá- < *$b^h$n$^h$dh-tó- (Bartholomae’s law), Old English gebunden, Gothic bundan; German Bund “league”. (English bind and bound show the effects of secondary (Middle English) vowel lengthening; the original length is preserved in bundle.)

This is all straightforward and such roots fit directly into the overall patterns. Less so are certain roots that seem sometimes to go like the *$b^h$er- type, and sometimes to be unlike anything else, with (for example) long syllabics in the zero grades while at times pointing to a two-vowel root structure. These roots are variously called “heavy bases”, “dis(s)yllabic roots”, and “ṣṭ roots” (the last being a term from Pāṇini’s grammar. It will be explained below).

For example, the root “be born, arise” is given in the usual etymological dictionaries as follows:
A. *gen-, *gon-, *gṇṇ-

B. *gen-ā, *gon-ā, *gī- (where ā = a long syllabic ā)

The (A) forms occur when the root is followed by an affix beginning with a vowel; the (B) forms when the affix begins with a consonant. As mentioned, the full-grade (A) forms look just like the *bher- type, but the zero grades always and only have reflexes of syllabic resonants, just like the *bendh- type; and unlike any other type, there is a second root vowel (always and only *a) following the second consonant:

*gen(ā)-

- PIE *genos- neut s-stem “race, clan” > Greek (Homeric) génos, -eos, Sanskrit jānas-, Avestan zanā, Latin genus, -eris.

*gon(e)-

- Sanskrit janayati “beget” = Old English cennan /kennan/ < *gon-eje- (causative); Sanskrit jāna- “race” (o-grade o-stem) = Greek gónos, -ou “offspring”.
- Sanskrit jajāna 3sg. “was born” < *ge-gon-e.

*gṇṇ-/*gī-

- Gothic kuni “clan, family” = OE cynn /kynn/, English kin; Rigvedic jajanúr 3pl.perfect < *ge-gṇṇ- (a relic; the regular Sanskrit form in paradigms like this is jajñur, a remodeling).
- Sanskrit jātā- “born” = Latin nātus (Old Latin gnātus, and cf. forms like cognātus “related by birth”, Greek kasi-gnētos “brother”); Greek gnēsios “belonging to the race”. (The ē in these Greek forms can be shown to be original, not Attic-Ionic developments from Proto-Greek *ā.)

NOTE. The Pāṇinian term “set” (that is, sa-i-t) is literally “with an /i/”. This refers to the fact that roots so designated, like jan- “be born”, have an /i/ between the root and the suffix, as we’ve seen in Sanskrit jānitar-, jāniman-, janitva (a gerund). Cf. such formations built to “anit” ("without an /i/") roots, such as han- “slay”: hántar- “slayer”, hanman- “a slaying”, hantuva (gerund). In Pāṇini’s analysis, this /i/ is a linking vowel, not properly a part of either the root or the suffix. It is simply that some roots are in effect in the list consisting of the roots that (as we would put it) ‘take an -i’.

The startling reflexes of these roots in zero grade before a consonant (in this case, Sanskritī, Greek nē, Latin nā, Lithuanian įn) is explained by the lengthening of the (originally perfectly ordinary) syllabic resonant before the lost laryngeal, while the same laryngeal protects the syllabic status of the preceding resonant even before an affix beginning with a vowel: the archaic Vedic form jajanur cited above is structurally quite the same (*ge-gṇṇḥ₁-ṝ) as a form like *da-dṛś-ur “they saw” < *de-dṛk-ṝ.
Incidentally, redesigning the root as *genh- has another consequence. Several of the Sanskrit forms cited above come from what look like o-grade root vowels in open syllables, but fail to lengthen to -ā- per Brugmann’s law. All becomes clear when it is understood that in such forms as *gonh- before a vowel, the “o” is not in fact in an open syllable. And in turn that means that a form like O.Ind. jajāna “was born”, which apparently does show the action of Brugmann’s law, is actually a false witness: in the Sanskrit perfect tense, the whole class of setḥ roots, en masse, acquired the shape of the aniṭ 3 sing. forms.

There are also roots ending in a stop followed by a laryngeal, as *pleth₂-/*pḷth₂- “spread, flatten”, from which Sanskrit prṭhú- “broad” masc. (= Avestan pṛṇṭdu-), prṭhivī- fem., Greek platús (zero grade); Skt. prathimán- “wideness” (full grade), Greek platamón “flat stone”. The laryngeal explains (a) the change of *t to *th in Proto-Indo-Iranian, (b) the correspondence between Greek -a-, Sanskrit -i- and no vowel in Avestan (Avestan pṛṇṭdvī “broad” fem. in two syllables vs Sanskrit prṭhivī- in three).

Caution has to be used in interpreting data from Indic in particular. Sanskrit remained in use as a poetic, scientific, and classical language for many centuries, and the multitude of inherited patterns of alternation of obscure motivation (such as the division into seṭ and aniṭ roots) provided models for coining new forms on the “wrong” patterns. There are many forms like trṣīta- “thirsty” and tāṇman-“slendernes”, that is, seṭ formations to to unequivocally aniṭ roots; and conversely aniṭ forms like pīparti “fills”, prṭa- “filled”, to securely seṭ roots (cf. the ‘real’ past participle, pūrṇā-). Sanskrit preserves the effects of laryngeal phonology with wonderful clarity, but looks upon the historical linguist with a threatening eye: for even in Vedic Sanskrit, the evidence has to be weighed carefully with due concern for the antiquity of the forms and the overall texture of the data.

Stray laryngeals can be found in isolated or seemingly isolated forms; here the three-way Greek reflexes of syllabic *h₁, *h₂, *h₃ are particularly helpful, as seen below.

- *h₁ in Greek ánemos “wind” (cf. Latin animus “breath, spirit; anger”, Vedic aniti “breathes”) < *anə- “breathe; blow” (now *h₂enh₁-). Perhaps also Greek híeros “mighty, super-human; divine; holy”, cf. Sanskrit iṣirā- “vigorous, energetic”.
- *h₂ in Greek pater “father” = Sanskrit pītār-, Old English fæder, Gothic fadar, Latin pater. Also *megh₂ “big” neut. > Greek méga, Sanskrit māhi.
- *h₃ in Greek ārotron “plow” = Welsh aradr, Old Norse arðr, Lithuanian árklas.

The Greek forms ánemos and ārotron are particularly valuable because the verb roots in question are extinct in Greek as verbs. This means that there is no possibility of some sort of analogical interference, as for example happened in the case of Latin arātrum “plow”, whose shape has been distorted by the verb arāre “to plow” (the exact cognate to the Greek form would have been *aretrum). It used to be
standard to explain the root vowels of Greek *thetós, statós, dotós* “put, stood, given” as analogical. Most scholars nowadays probably take them as original, but in the case of “wind” and “plow”, the argument can’t even come up.

Regarding Greek *hieros*, the pseudo-participle affix *-ro-* is added directly to the verb root, so *išh₁-ro-* > *isero-* > *ihero-* > hieros (with regular throwback of the aspiration to the beginning of the word), and Sanskrit isirá-. There seems to be no question of the existence of a root *ejsh-* “vigorously move/cause to move”. If the thing began with a laryngeal, and most scholars would agree that it did, it would have to be *h₁-, specifically; and that’s a problem. A root of the shape *h₁ejsh₁-* is not possible. Indo-European had no roots of the type *mem-, *tet-, *d₁red₁h-, i.e., with two copies of the same consonant. But Greek attests an earlier (and rather more widely-attested) form of the same meaning, hiaros. If we reconstruct *h₁ejsh₂-, all of our problems are solved in one stroke. The explanation for the hieros/hiaros business has long been discussed, without much result; laryngeal theory now provides the opportunity for an explanation which did not exist before, namely metathesis of the two laryngeals. It's still only a guess, but it's a much simpler and more elegant guess than the guesses available before.

The syllabic *ḥ₂ in *ph₂ter- “father” is not really isolated. The evidence is clear that the kinship affix seen in “mother, father” etc. was actually *-h₂ter-. The laryngeal syllabified after a consonant (thus Greek patēr, Latin pater, Sanskrit pitār-; Greek thugatēr, Sanskrit duhitār- “daughter”) but lengthened a preceding vowel (thus say Latin māter “mother”, frāter “brother”) — even when the “vowel” in question was a syllabic resonant, as in Sanskrit yātāras “husbands' wives” < *j̥nt- < *j̥n₂h₂ter-).

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**INFLUENCE IN MORPHOLOGY**

Like any other consonant, Laryngeals feature in the endings of verbs and nouns and in derivational morphology, the only difference being the greater difficulty of telling what’s going on. Indo-Iranian, for example, can retain forms that pretty clearly reflect a laryngeal, but there is no way of knowing which one.

The following is a rundown of laryngeals in Proto-Indo-European morphology.

*ḥ₁ is seen in the instrumental ending (probably originally indifferent to number, like English expressions of the type by hand and on foot). In Sanskrit, feminine i- and u-stems have instrumentals in -i, -u, respectively. In the Rigveda, there are a few old a-stems (PIE o-stems) with an instrumental in -ā; but even in that oldest text the usual ending is -enā, from the n-stems.

Greek has some adverbs in -ē, but more important are the Mycenaean forms like e-re-pa-te “with ivory” (i.e. elephantē? -ē?)
The marker of the neuter dual was *-ih, as in Sanskrit bharati “two carrying ones (neut.),” nāmanī “two names”, yuge “two yokes” (< yuga-ī? *yuga-ī?). Greek to the rescue: the Homeric form ósse “the (two) eyes” is manifestly from *h₂ekʷ-ih₁ (formerly *okʷ-ī) via fully-regular sound laws (intermediately *okʷje).

*-eh₁- derives stative verb senses from eventive roots: PIE *sed- “sit (down)”: *sed-eh₁- “be in a sitting position” (> Proto-Italic *sed-ē-je-mos “we are sitting” > Latin sedēmus). It is clearly attested in Celtic,Italic, Germanic (the Class IV weak verbs), and Baltic/Slavic, with some traces in Indo-Iranian (In Avestan the affix seems to form past-habitual stems).

It seems likely, though it is less certain, that this same *-h₁ underlies the nominative-accusative dual in o-stems: Sanskrit vṛkā, Greek lúkō “two wolves”. (The alternative ending -āu in Sanskrit cuts a small figure in the Rigveda, but eventually becomes the standard form of the o-stem dual.)

*-h₁s- derives desiderative stems as in Sanskrit jighāṁsati “desires to slay” < *gʰuh₁-gʰy₁h₂s-e-ti- (root *gʰuh₁̣, Sanskrit han- “slay”). This is the source of Greek future tense formations and (with the addition of a thematic suffix *-je/o-) the Indo-Iranian one as well: bharīṣyati “will carry” < *bher-ḥ₁s-je-ti.

*-jeh₁/-*ih₁- is the optative suffix for root verb inflections, e.g. Latin (old) siet “may he be”, sīmus “may we be”, Sanskrit syāt “may he be”, and so on.

*h₂ is seen as the marker of the neuter plural: *-h₂ in the consonant stems, *-eh₂ in the vowel stems. Much leveling and remodeling is seen in the daughter languages that preserve any ending at all, thus Latin has generalized *-ā throughout the noun system (later regularly shortened to -a), Greek generalized -ā < *-h₂.

The categories “masculine/feminine” plainly did not exist in the most original form of Proto-Indo-European, and there are very few noun types which are formally different in the two genders. The formal differences are mostly to be seen in adjectives (and not all of them) and pronouns. Interestingly, both types of derived feminine stems feature *h₂: a type that is patently derived from the o-stem nominals; and an ablauting type showing alternations between *-jeh₂- and *-ih₂- . Both are peculiar in having no actual marker for the nominative singular, and at least as far as the *-eh₂- type, two things seem clear: it is based on the o-stems, and the nom.sg. is probably in origin a neuter plural. (An archaic trait of Indo-European morpho-syntax is that plural neuter nouns construe with singular verbs, and quite possibly *jugeh₂ was not so much “yokes” in our sense, but “yokage; a harnessing-up”.) Once that much is thought of, however, it is not easy to pin down the details of the “ā-stems” in the Indo-European languages outside of Anatolia, and such an analysis sheds no light at all on the *-jeh₂/*-ih₂-
stems, which (like the *eh₂-stems) form feminine adjective stems and derived nouns (e.g. Sanskrit devī- “goddess” from deva- “god”) but unlike the “ā-stems” have no foundation in any neuter category.

*-eh₂- seems to have formed factitive verbs, as in *new-eh₂- “to renew, make new again”, as seen in Latin novāre, Greek neáō and Hittite ne-wa-ah-ḫa-an-t- (participle) all “renew” but all three with the pregnant sense of “plow anew; return fallow land to cultivation”.

*-h₂- marked the 1st person singular, with a somewhat confusing distribution: in the thematic active (the familiar -ō ending of Greek and Latin, and Indo-Iranian -ā(mi)), and also in the perfect tense (not really a tense in PIE): *-h₂e as in Greek oîda "I know" < *wojd-h₂e. It is the basis of the Hittite ending -ḫḫi, as in da-ah-ḫi “I take” < *-ḫa-i (original *-ḫa embellished with the primary tense marker with subsequent smoothing of the diphthong).

*-eh₃ may be tentatively identified in a “directive case”. No such case is found in Indo-European noun paradigms, but such a construct accounts for a curious collection of Hittite forms like ne-pi-ša “(in)to the sky”, ták-na-a “to, into the ground”, a-ru-na “to the sea”. These are sometimes explained as o-stem datives in -a < *-ōj, an ending clearly attested in Greek and Indo-Iranian, among others, but there are serious problems with such a view, and the forms are highly coherent, functionally. And there are also appropriate adverbs in Greek and Latin (elements lost in productive paradigms sometimes survive in stray forms, like the old instrumental case of the definite article in English expressions like the more the merrier): Greek ánō “upwards”, kátō “downwards”, Latin quō “whither?”, eō “to that place”; and perhaps even the Indic preposition/preverb ā “to(ward)” which has no satisfactory competing etymology. (These forms must be distinguished from the similar-looking ones formed to the ablative in *-ōd and with a distinctive “fromness” sense: Greek ópō “whence, from where”.)