Study of Languages and Cultures of Asia and Africa Monograph Series 42

# Historical Phonology of Old Indo-Aryan Consonants

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WITH A FOREWORD BY
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2004

First published 2004

Research Institute for Languages and Cultures of Asia and Africa
Tokyo University of Foreign Studies
3-11-1 Asahi-chô, Fuchû-shi
Tôkyô 183-8534
JAPAN

ISBN 4-87297-894-3

Kobayashi, Masato, 1970—
Historical Phonology of Old Indo-Aryan Consonants / Masato Kobayashi.
(Study of Languages and Cultures of Asia and Africa Monograph Series, No. 42)

Printed in Japan

# Foreword

The historical phonology of Indo-Aryan has been and remains an area of intense study. Starting with what remains an extraordinarily thorough treatment of the Old Indo-Aryan data, in the first volume of Wackernagel's *Altindische Grammatik*, there has been a steady flow of scholarship that has included not only attention to the facts of early Indo-Aryan and possible historical explanations that would explain them, but also, in modern times, considerations of various phonological theories and how they could account for these data as well as the historical developments they reflect. Some major areas have attracted particular attention. There is, to begin with, the development of contrastive retroflex consonants. Scholars have argued at length over the scope of retroflexion, how best to describe synchronically the occurrence of retroflex consonants which are associated with phonological rules, and how much of the range of retroflex consonants can be accounted for through regular developments from Proto-Indo-European. The last issue brings into play the kinds of relations early Indo-Aryan speakers may have had with speakers of other languages of the subcontinent, such as Dravidian languages. Moreover, the very existence of contrastive retroflex consonants in the earliest Vedic texts has been called into question. Another area of concern and continued discussion is that of so-called diaspirate verbal bases such as Proto-Indo-European *$b^h$e$\underset{\frown}{u}d^h$, *$d^h$e$\underset{\frown}{u}g^h$. The principal point at issue is whether direct reflexes of such roots, with two aspirates, are to be posited as basic elements not only for Indo-Iranian but also in later Indo-Aryan, or whether, in accordance with Pāṇini's description of Old Indo-Aryan, the Sanskrit data are better accounted for if one operates with bases of the type *$bud^h$*, *duh* and what has been called aspiration throwback. A related issue is that of Grassmann's law of deaspiration, particularly with regard to when this ceased to be a purely phonological rule and acquired the status of a rule operating on members of a particular grammatical category. Each successive theory of phonology in modern times has confronted the pertinent data—generally culled from standard sources such as Wackernagel's and Whitney's grammars—and tried to account for them in a manner demonstrating that the particular theory at issue does this better than other theories. In quite recent times, attention has also focused again on possible parallels between Indo-Aryan and Dravidian concerning general features that govern consonant assimilation and syllable structures, including the degree to which syllable with long vowels followed by consonant clusters are permissible.

Masato Kobayashi's work covers such issues with admirable thoroughness and precision. The author takes into consideration not only the original data and various positions taken in modern western scholarship but also, and to a greater extent than is usually found in works on phonology, the descriptions of early Indian scholars in prātiśākhya works and in Pāṇini's Aṣṭādhyāyī. The discussions to be found in Dr. Kobayashi's work are painstakingly thorough and judicious, and the author is refreshingly frank when it

comes to points concerning which he is not certain. I think this work is an important contribution to Indo-Aryan linguistics, including theoretical phonological considerations of Indo-Aryan and its relations to other languages of the subcontinent. I welcome its publication and sincerely hope it receives the welcome and attention it deserves.

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# Contents

# Chapter I. Introduction

## §1 Goal of this work

Old Indo-Aryan is a branch of the Indo-Iranian subfamily of the Indo-European family of languages. Its earliest layer is represented most amply by the Vedic Saṃhitās, particularly by the oldest among them, the Ṛgveda. The primary objective of this monograph is to highlight characteristic features of Old Indo-Aryan consonants, particularly those which are not reconstructed for Proto-Indo-European or Proto-Indo-Iranian. I will try to describe the phonological developments of Old Indo-Aryan consonants from Proto-Indo-Iranian, treating the alternation patterns within early Old Indo-Aryan as a synchronic system.

Compared with other Indo-European daughter languages, the sound changes between Proto-Indo-European and Sanskrit are relatively straightforward. As far as consonants are concerned, Sanskrit retains more phonemic contrasts than most of the other Indo-European languages, and its phonological alternations are well described already in the late Vedic period by native grammarians. Despite the apparent conservatism and transparency of Sanskrit phonology, I find that there are also unique restrictions and rules which are demonstrably Indo-Aryan innovations. Take consonant clusters, for example: While other Indo-European languages, insert an *s between two successive dental stops *-tt- and *-dt- (Meillet 1922:61, Mayrhofer 1986:110f.), Sanskrit deleted the *s in this environment, due to a development after its divergence from Proto-Indo-Iranian.

In each chapter of this monograph, I will reexamine the evidence for phonological developments from Proto-Indo-European to Vedic, and I will define Indo-Aryan peculiarities in concise rules and parametric expressions. I am particularly interested in introducing subsegmental viewpoints into what appears simply to be a change from one segment into another, and in seeing a conspiracy-like tendency behind apparently unrelated phenomena. Having established the patterns and the parametrized characteristics of Indo-Aryan consonants, I will sort out the innovations of Indo-Aryan from Proto-Indo-European phonology, and I will also compare them with their equivalents, if any, in early Dravidian phonology.

The hypothesis regarding an Indian linguistic area proposes that the languages of the Indian subcontinent came to share syntactic, morphological and phonological features due to mutual borrowing and bilingualism. The phonological similarities of Indo-Aryan to Dravidian, such as the increasing occurrence of retroflex consonants in Indo-Aryan, have long been discussed, but the lack of conclusive evidence has hindered further treatment of the subject. For example, it is easy to point out similarities such as the lack of gemination of /r/ in Old Indo-Aryan and reconstructed Dravidian. It is impossible, however, to prove these to be the result of convergence as long as our discussion is limited to the phonemic or segmental level. If, on the other hand, this prohibition of double /r/ could be analyzed as an interaction of more basic phonological or phonetic principles shared by Indian languages, but not found among languages outside the Indian subcon-

tinent, then we would have firmer grounds for calling this an areal feature.

## §2 Previous works

Much work has been done on Sanskrit phonology over the last century and a half. Still the most extensive, balanced and detailed treatment of the whole field is Wackernagel (1896) with Debrunner's supplements (Debrunner 1957). Wackernagel's presentation is sometimes eclectic because of his effort to cover foregoing studies encyclopedically, but his intuition into speech sounds in general is rarely surpassed. The works of Bartholomae, who makes keen observations from the viewpoint of Iranian philology, are highly valuable when read in comparison with Wackernagel. Classic diachronic treatments of Indo-Aryan phonology, such as Beames (1872–79), Turner (1966), Bloch (1934) and Pischel (1900), are also indispensable, although the present monograph treats only the earliest period of Indo-Aryan.

Thumb (1905) and Burrow (1965) are less voluminous descriptions of Sanskrit phonology in general. The former organizes everything concisely as changes from segments to segments, and the latter is interspersed with creative ideas. B. G. Misra's 1967 Cornell dissertation is a superb segment-based treatment of the historical development of Indo-Aryan sounds with extensive reference to native grammarians. Also important is the phonotactic analysis of Vedic by Elizarenkova (1974). Görtzen (1998) contains a painfully condensed but informative discussion of Sanskrit dental obstruents. Outlines of Sanskrit historical phonology are also given by Uhlenbeck (1898), Chatterji (1926:239ff.), Edgerton (1946), Gray (1965) and Masica (1991). Zwicky (1965) presents the first extensive treatment of Sanskrit phonology based on distinctive features within the theoretical framework of Jakobson and Halle (1956:28ff).[1] Works such as Sievers (1885) or Grammont (1933) are treatises on phonology in general, but contain a number of references to Sanskrit. Bloomfield and Edgerton (1932), and Turner and Turner (1971), painstakingly collect phonological variants in the Vedic literature and phonotactic combinations in Old Indo-Aryan respectively.

This monograph has benefited substantially from previous studies on individual topics, of which only a few can be mentioned here. Whitney (1862) and Whitney (1868) are more than just translations of Prātiśākhyas, but include useful insights into phonology. This tradition is critically developed by Deshpande (1997), with his broad knowledge of traditional grammar. Varma (1929) and Allen (1953) are the classical, but still the most useful treatments of native grammarians' observations on phonetics in general. Since the latter treats the Prātiśākhyas as a whole, however, dialectal variation is not discussed in detail there. The same author also makes sharp-witted observations in his work on sandhi (Allen 1962). On dialectal variation in the Vedic language, Witzel (1989, 1990, 2000) has proposed ambitious hypotheses on early and late Vedic. In his yet unpublished manuscript on anusvāra, Cardona portrays dialectal variation by reorganizing the materials of traditional grammarians.

[1] The analysis in this monograph is based on Chomsky and Halle (1968:303ff.), who revised Jakobson and Halle's system.

Karl Hoffmann's reconstruction of Proto-Indo-Iranian phonology (e.g. Hoffmann 1958) is based on rigorous and sound philological principles, and I base my arguments upon his observations, such as that the original outcome of a palatal stem in word-final position is not /ṭ/ but /k/. Mayrhofer (1986, *EWAia.*) and a series of articles by Schindler are also often consulted. Beekes's reconstruction of Proto-Indo-Iranian (e.g. Beekes 1988, 1997) is attractive in its enterprising openness to phonology, but assumptions without sufficient support such as the implication of Sindhi implosives for the Glottalic Theory or the development of laryngeals into a glottal stop, are not adopted as a basis for our discussion. The brilliant contributions of scholars such as Edgerton (1943), Burrow (1965) and Seebold (1972) are not cited as often as most scholars would think they deserve, mostly because their non-laryngealist viewpoint makes their works difficult for me to translate into the laryngealist framework I assume.

This study is not intended by any means as a replacement for the foregoing studies, but as the first, modest installment of my plan to reexamine the whole of Indo-Aryan historical phonology from subsegmental and microscopic viewpoints.

## §3 Importance of linguistic theories

In the history of science, disciplines have often developed by introducing a sophisticated notational system by which their categories and entities were subjected to operation. In the study of speech sounds, descriptive devices such as the phonetic alphabet of the International Phonetic Association, or the distinctive features introduced by Jakobson, Fant and Halle (1952), were proposed for accurate representation, and replacement or transformational rules for formulating their alteration. Since the approach of generative phonology aim to determine basic principles from which phonological alternations may be predictively derived or *generated*, overgeneration vitally compromises the validity of a theory. As the dictum "[i]f the representations are right, rules will follow" (McCarthy 1988:84) concisely illustrates, linguists strive to make their notational system more rigorous and restrictive, to such an extent that a presented input form shows in itself how it will change.

In the early days of generative phonology, segments were represented as individual bundles of distinctive features and their '+' or '−' values. Autosegmental Phonology (Goldsmith 1976) introduced a new plane called an autosegmental tier, on which the values of each feature are represented: a tier extends through a unit such as a foot, a word or an utterance, and is separate for each feature. This approach extended the notion of locality from the segmental level to more specific autosegmental tiers, and introduced a system of representation which restrains the overgenerating power of rule formulation. Feature Geometry, a subfield of phonology addressing the dependency relationship among features, groups features under what is called a node; for example, the features [voiced] and [spread glottis] (i.e. aspiration) are grouped under the Laryngeal node, which is on its own autosegmental tier. The highest node is the Root node, which is equivalent to segments in most cases. Affricates, however, are analyzed as having two Root nodes under one timing slot, and we also need the skeletal tier, a tier with timing

slots C (consonant), V (vowel) or X (C or V), to indicate that they are singletons and not clusters.

The role of a model is crucial in any scientific interpretation of linguistic data.[2] In historical linguistics, a hypothetical rule or a set of rules is tentatively drawn from data available at a certain point; it is then tested and evaluated with newly acquired data, and is modified if necessary. For example, de Saussure's hypothesis of 'coéfficients sonantiques' was later given new life by Kuryłowicz (1927a, 1927b), who explained the unexpected reflex of certain stops as aspirates in Indo-Iranian (1927a:202ff.), the failure of Brugmann's Law to apply in some Indo-Iranian forms (1927a:206), and *ḫ* in the newly found Hittite (1927b:101ff.), by positing a Proto-Indo-European laryngeal *$h_2$ (Szemerényi 1990:129f). An ideal model is simple and yet makes extensive and correct predictions; but linguistic reality is too complex to be captured by a limited number of formulae or principles, and even the most successful model will inevitably involve oversimplification to some extent.

In a phonological study of a language without verifiable speech data, it is unsound to cite results of phonetic research to motivate a hypothesis, unless studies on different aspects of several languages point in the same direction. For example, Balise and Diehl (1994:108) observe that voicing "reduces the intensity differences between sibilants and nonsibilants" and hence it "adversely affects the distinctive acoustic properties of sibilants," but that single observation is not enough to explain, for example, the lack of voiced sibilants in the Sanskrit phonemic inventory. On the other hand, linguistic typology is a useful way to judge the possibility and plausibility of a phenomenon, for it seeks explanations from the same phonological level of different languages, and also because we assume that attested Vedic or reconstructed Proto-Indo-Iranian represents at least some of the real languages as they were once spoken, as per the Uniformitarian Hypothesis (§7).

## §4 Comparative reconstruction

In this work, I assume that Indo-Aryan and Iranian descend from a common ancestor called Proto-Indo-Iranian, which in turn has descended from Proto-Indo-European. It might appear circular to discuss the development of a reconstructed language into the language(s) upon which the reconstruction is based. I suppose, however, that a reconstructed language is not just a mental construct but reflects a past reality, which can be refined by retracing the sound changes forwards in time as I do in the following chapters.

Linguistic reconstruction presupposes the existence of a common protolanguage, which is in principle idealized as homogeneous. For reasons such as dislocation and consequent separation of the speech community, dialectal variation becomes more and

[2] Liberman and Pierrehumbert (1984:165) define the linguistic model as "an explicit system of rules for predicting measurements on the basis of linguistic and paralinguistic properties of assumed descriptions." Maddieson and Precoda (1992:45) also notes: "Through construction of predictive models, phoneticians are making increasingly sophisticated attempts to account for certain aspects of the phonological structure of languages from very general principles ."

more extensive, and finally the dialects follow their own paths of development into distinct languages. When two or more languages show a regularly recurring sound correspondence, the comparative method assumes that a unit of the hypothetical ancester language such as the phoneme has undergone a regular change in certain contexts, and formulates that change as a sound law. The assumptions concerning sound change upon which comparative reconstruction is based may be summarized in the following points (Hock 1991a, Labov 1994:10ff., Krishnamurti 1998b:193f.):

i) A rule operates in all contexts where it applies (known as the Regularity Hypothesis).

ii) If two or more rules are applicable to the same context, there is a clear chronological order (relative chronology) between or among them.

iii) A merger is irreversible (Garde's Principle; Labov 1994:311).

iv) The unit which is subject to historical change is not the word, but the phoneme ("Phonemes change"; Bloomfield 1933:351).

v) Sound change is gradual (Gradualism; cf. Hock 1991a:640, Labov 1994:23f).

If a rule does not apply regularly, the disruption is considered to be caused either by a more specific rule, such as VERNER'S LAW to GRIMM'S LAW in Germanic, or by analogy. When a sound rule applies regularly, it often occurs that the regularity of a paradigm is disrupted; analogical pressure then arises to keep the paradigm regular, and the sound change may be undone or a paradigmatically coherent form may be introduced or restituted. This phenomenon, called 'paradigmatic leveling,' is particularly prominent in Sanskrit historical phonology. For example, the Proto-Indo-European labiovelar stop *$k^w$ develops into a velar stop in Sanskrit when it is followed by a back vowel, and into a palatal stop when followed by a front vowel. The inflectional forms of the root *$\sqrt{sek^w}$ 'follow' in Sanskrit, as in pres.1pl.mid. *sác ā́mahe* ~ Gk. *hepómet$^h$a*, pres.3sg.-mid. *sácate* ≈ Gk. *hépetai*, 3pl. *sácante* ≈ Gk. *hépontai* etc., however, uniformly show palatal *c* before both original *e and *o.[3]

Already in the time of the Neogrammarians, objections were raised against the Regularity Hypothesis by dialectologists (Labov 1994:472ff.). Through their experience in creating dialect maps, dialect geographers developed the notion of isoglosses, or boundaries of a territory "in which any given word or class of words was or was not affected by the spread of [a] change" (Hock 1991a:445). While isoglosses may form an isogloss bundle which helps in defining dialects, it is also quite common that the focal area of one sound change is different from that of another change, and as a consequence, isoglosses cross each other, creating a complex pattern. If a similar entanglement of isoglosses and borrowing[4] also took place in the past, it may happen that many groups consisting of

[3] Cf. also the generalization of voiceless aspirated stops in the paradigm of *pánt$^h$-/pat$^h$-* m. 'path' etc. (§75).

[4] See for example Ringe et al. (1998:407f.) for lexical and grammatical borrowing between pre-Proto-Germanic and pre-Proto-Celtic and between pre-Proto-Celtic and pre-Proto-Italic.

a few words each all have different lines of development, and that regularity of sound change no longer holds true. This is a particularly serious matter in studying languages in areas which form a geographical and cultural continuum, such as the Gangetic plains (§5).

In their study of thousands of lexical entries in twenty-one Chinese dialects, Chen and Wang (1975) make a case for lexical gradualness of sound changes. They provide quantitative evidence in support of the notion of gradual lexical spread of the sound changes by showing how the homonyms of Middle Chinese have split into phonologically distinct pairs in different modern dialects, with processes gradually spreading from a few to more lexical items. On the evidence of atypical sound changes in Dravidian languages, Krishnamurti (1978) observes how an inherited phonological rule spread to areas and lexical items, and shows how a shared innovation can be distinguished from the phenomenon of diffusion. His study concludes that apical displacement, a change traceable to Proto-Central Dravidian, occurs not regularly but with gradient degrees of probability. These studies question the regularity of sound change and support the idea that each word has its own history, and that the word and not the phoneme is the basic unit of sound change (Labov 1994:16). Even though lexical diffusion may sometimes capture the reality of a sound change in progress better than comparative reconstruction, for example in the case of the deocclusion of /$d^h$/ (§57), I will not assume it for this study, because the amount of data required for the evaluation of lexical diffusion is not available for the study of most of the ancient languages discussed in this work.

## §5 Tree model

If a significant amount of affinity, particularly a regular and generalizable correspondence of phonemes and meanings of words using those phonemes, is found between two languages, they are considered to be genetically related: i.e., one is a descendant of the other, or they both diverged from a common proto-language through sound changes. The proto-language from which daughter languages branch is represented by a node, and a line radiating from a node represents a development from a proto-language to a daughter language. Since sound changes usually take place at different times, a better understanding of the relative chronology of sound changes will ultimately lead to a bifurcating tree. If there is an unrepeatable change separating one group from the rest, that split is expressed with a bifurcation.

One of the implications of the notion of a node is that sound change is often blind to what happened in the previous stage. The development of the Indo-Aryan languages after Old Indo-Aryan, for example, rarely reflects pre-Indo-Aryan sounds (such as laryngeals) or phonological rules,[5] but proceeds driven by language-specific motives such as the two-mora restriction of syllable length and cluster simplification in Middle Indo-Aryan, or degemination with compensatory lengthening in New Indo-Aryan.

On the other hand, there are a few forms which challenge the assumption that the

[5]Cf. also Zoller (1988, 1993) on the archaisms of Baṅgāṇī, and Cardona and Jain (2003:25) for the literature on the Baṅgāṇī controversy.

development of the Indo-Aryan languages after Old Indo-Aryan is not related to what happened in the development from Proto-Indo-European to Proto-Indo-Iranian or from Proto-Indo-Iranian to Vedic. For example,

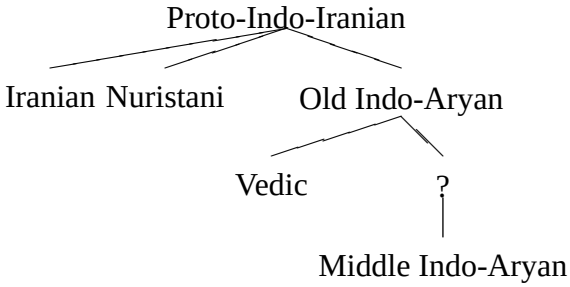
i) *id$^h$a* 'here' in Pāli etc. preserves the original occlusion reconstructed for Proto-Indo-Iranian, which is reflected in Avestan *iδa* but lost in Vedic *ihá* (§57; Wackernagel 1896:250, von Hinüber 2001:179).

ii) The Prakrit middle present participle suffix *-mina-* may be explained as a regular outcome of PIE *-mh$_1$ne/o- (Klingenschmitt 1975:159ff.), and is more archaic than the Vedic thematic middle present participle suffix *-mā̆na-*.

iii) There is the view that Proto-Indo-European *r and *l merged in Iranian and in a dialect of Indo-Aryan represented by the Ṛgveda, but the distinction is preserved in some other Indo-Aryan dialects (§99; Bechtel 1892:380ff., Deshpande 1979:263ff.).

iv) Another example is the preservation of voicing in the cluster /gg$^h$/ as in Pāli *jagg$^h$ati* 'laughs,' which is lost in the corresponding Vedic form, pres.ppl. *jákṣat-* with voiceless /kṣ/ (§45; Hoffmann 1969=1975:306).

Since Middle Indo-Aryan cannot skip a node and "look back" directly to Proto-Indo-Iranian, the language at the node through which Middle Indo-Aryan had developed is not Vedic Sanskrit, but either some form of pre-Vedic Indo-Aryan, or a language which developed from the common Proto-Indo-Iranian parent language but, unlike Vedic, was not recorded.




Vedic was probably a specific dialect of Old Indo-Aryan; it was quite close to, but not identical with the language from which Middle Indo-Aryan developed.

In the traditional tree model, there is no direct way of representing contact and influence after a split.[6] In the Gangetic plains, for example, Hindi forms the future in *-g-*, Braj in *-ih-/-g-*, and Bengali in *-b-/-ib-*, while the languages between these areas show both *-h-* and *-b-*forms, e.g. Awadhi *-ih-* and *-ib-*, and Bhojpuri *-ih-* and *-ab-*. Although these languages have two genders as do many western New Indo-Aryan languages, gender concord is typically restricted to female animates, thus showing an affinity with the

[6]In L. Bloomfield's words: "We may say that the parent community was dialectally differentiated before the break-up, or that after the break-up various sets of the daughter communities remained in communication; both statements amount to saying that areas or parts of areas which already differ in some respects may still make changes in common" (1933:321). Southworth (1964) proposes 'tree-envelope' diagram to represent both branching and common innovation.

loss of gender in eastern languages such as Bengali (Masica 1991:221). They share the genitive postposition in initial *k-* with western Hindi and eastern Rajasthani. Furthermore, Bhojpuri and Maithili have a perfective in *-l-*, similar to the eastern languages. Such a complex distributional pattern cannot be satisfactorily captured by any bifurcating tree model. To take another example, Krishnamurti (1961) demonstrates that Telugu is genetically related to the Gondi-Kui group of Central Dravidian, but has been strongly influenced by neighboring languages of the South Dravidian subfamily, namely Tamil and Kannada. An issue more crucially related to our topic is how to place the Nuristani languages in a sharply bifurcating tree as a subfamily of Indo-Iranian, for they share features partly with Iranian and partly with Indo-Aryan (Degener 2002).

When there is a need to refer to the subgrouping of the Indo-European languages, I will use the partly bifurcating model of Ringe et al. (1998:408), while avoiding depending on it in my argumentation. In their model, first the Anatolian, then the Tocharian, Italo-Celtic and Greco-Armenian subfamilies branched off from Proto-Indo-European, leaving a dialect continuum which consists of the ancestors of Indo-Iranian, Balto-Slavic and Germanic. This model also assumes close contact among the linguistic ancestors of Germanic, Italic and Celtic. Melchert (1998) agrees with the early divergence of Anatolian and Tocharian, but at the same time warns against prejudging the tree diagram of Indo-European languages, pointing out that not a single feature serves as conclusive evidence of a shared innovation.

For Dravidian, I assume four subgroups (Krishnamurti 1969b:325ff., Zvelebil 1990:54ff.). North Dravidian covers Kuṛux and Malto on the one hand, and Brahui on the other. There are no firm grounds for grouping Brahui together with Kuṛux and Malto, but at least they share spirantization of initial *k,[7] occlusion of initial *v to *b*, a past in *-k*, and probable future in *-o̅* (Bray 1934, Krishnamurti 1969b:326, Subrahmanyam 1983:6, Zvelebil 1977). The Central Dravidian languages, Kolami, Naikṛi, Naiki, Gadaba and Parji, share the female derivative of numerals (Krishnamurti 1992) and development of Proto-Dravidian *ẓ into *ɬ or /r/ (Krishnamurti 1958:282). South-Central Dravidian includes Gondi, Konda, Manḍa, Pengo and Kuvi-Kui on the one hand and Telugu, which shows the influence of South Dravidian, on the other. The languages of this group other than Telugu share merger of postconsonantal *ẓ and *ḍ into *ṛ* (Krishnamurti 1998a:73). Finally, Tamil-Malayalam and Irụḷa, Toda and Kota, Koḍagu, Kannada and Badaga, and Tuḷu and Koraga comprise the South Dravidian. The grouping of Tuḷu (Subrahmanyam 1968, Krishnamurti 1985:223), whose plural suffix *ḷ is not shared by other South Dravidian languages, and of Koraga, which has tense suffixes like those in North Dravidian (Bhat 1971:3), remains controversial. The languages of this South Dravidian group share the introduction of female third-person pronouns, palatalization of PDr. *k before front vowels, loss of Proto-Dravidian initial *c- (Burrow 1947), lowering umlaut of high vowels before a syllable containing /a/, and the past suffixes *-i-, *-tt- and *-nt- in the Tamil-Koḍagu subgroup (Krishnamurti 1969b:326).

[7] Even this is argued to be independent developments by McAlpin (2003).

## §6 Linguistic area

Since Trubetzkoy's 1928 address (Trubetzkoy 1930:18), linguists have noted that neighboring but genetically unrelated or remotely related languages often come to share a number of structural properties after a long period of contact. The most famous example of such a groups of languages, called a 'Sprachbund' (Trubetzkoy) or 'linguistic area,' is found in the Balkan peninsula (Sandfeld 1930), where languages belonging to the (South) Slavic, Albanian and Italic subfamilies of Indo-European have come to share features such as a postposed enclitic definite article and the use of coordinate clauses instead of infinitive phrases. In his 1988 article, Hock demonstrated that a dialectological method of demarcating isoglosses better captures the reality of such cases of convergence (Hock 1988:308).

For the languages of the Indian subcontinent as well, similarities regarding retroflex phonemes (Caldwell 1961:147ff., Bloch 1930:732f., Kuiper 1967a:82ff.), gerunds (Bloch 1934:327, Emeneau 1956, Masica 1976:120ff.), echo-word construction (Bloch 1934:328, Emeneau 1938) and quotative particles (Bloch 1934:327, Kuiper 1967:91ff.) have been pointed out. On the other hand, fewer phenomena have been proposed to be areal in the realm of phonological patterns and alternations. Chatterji (1926:171) suggests the possibility that cluster assimilation in Middle Indo-Aryan and Dravidian might be due to convergence. Krishnamurti (1991:170) points out a parallelism between the developments of the Old Indo-Aryan sequence -V̄CCV- into non-Northwest Middle Indo-Aryan -V̄CV̄- and -VCCV- on the one hand, and of PDr. -V̄CCV- into -V̄CV- and of PDr. -V̄NP-, -V̄NPP-, -VNPP- into -V̄P-, -V̄PP-, -VPP- on the other, and suggests that close contact between the two groups caused the parallel reduction of overlong syllables (i.e. those longer than the durational equivalent of two morae) into bimoraic syllables. Since such phenomena occur outside the Indian subcontinent as well, more shared features, particularly ones which are not found elsewhere, need to be collected in order to support the hypothesis of phonological convergence of the two language families.

## §7 Pitfalls of diachronic analysis

Building an argument on the grounds of philologically unsupported reconstruction could compromise its reliability. For example, making conjectures about the phonological behavior of Proto-Indo-European laryngeals on the basis of their estimated phonological or phonetic properties might incur circularity.

Compared with phonetics or generative phonology, historical linguistics seems to require broader discretion in analyzing data. It is not easy, for example, to decide with certainty how likely a particular form has served as a model of analogy, or when exactly dissimilation has taken place, even with years of experience. Lack of strictly objective criteria may cause the methods of historical linguistics, such as appeal to analogy, to overgenerate undesirable predictions.

The idea that tendencies observed in the study of present-day languages can be applied to understanding languages spoken in the past, called the Uniformitarian Principle (Labov 1994:21), helps us to avoid unrealistic explanations in linguistic reconstruc-

tion. For example, Kuryłowicz's above-mentioned explanation of the origin of Indo-Aryan voiceless aspirates from Proto-Indo-European sequences of voiceless stop and *$h_2$ (Kuryłowicz 1927a) finds an equivalent in Korean (C. Kim 1970). Loss of Proto-Indo-European laryngeals in unaccented syllables in Iranian is easier to understand if it is compared to English *h* in an unaccented syllable, such as *Gráham* or *an histórical súmmary*.

The overgenerating power of dissimilation may be better controlled by the Obligatory Contour Principle. This principle, defined by McCarthy (1979:238) as "[i]n a given autosegmental tier, adjacent identical segments are prohibited," limits dissimilation to local contexts only (Clements and Hume 1995:261f). Autosegmental Phonology makes it easier to explain the dissimilation not of identical segments but of segments sharing certain features as the effect of the Obligatory Contour Principle on the tier of the feature in question. Optimality Theory (§8) further offers a way to express priorities among the factors and pressures causing a sound change, and to explain an apparently language-specific phenomenon as an interaction of cross-linguistic constraints with a differing order or ranking of priorities.

In order to refine our discussion of Old Indo-Aryan phonology, which is already a heavily studied subject, and to build a more cogent argument, the use of possibly overgenerating notions such as metathesis or dissimilation should be replaced by generalizable principles and rules, unless the phenomenon in question is sporadic or is caused by an idiosyncratic motivation.

### §8 Constraint-based approaches

In historical studies of a language with an unbroken written tradition, certain phonological changes are attested only in certain periods of time, and the changes are ordered in actual historical time. For example, McManus (1983) demonstrates that a close examination of Latin loanwords in Early Irish makes it possible to order a series of sound changes in a sharply delineated chronological order within a short period from the mid-fifth to the mid-sixth centuries.

In a synchronic study, on the other hand, the ordering of particular rules is stipulated when they stand in feeding or bleeding relationship. If more than one rule potentially obtains in a certain phonological context, and if one must precede another to produce a correct output, we have to assume that the rules apply in a certain sequence, even if there is no factual basis that they are temporally ordered. Since the rule-based theory presupposes levels of rule application which are arranged in a temporal order, and since a rule is considered to apply when the underlying representation itself or the output of a preceding rule satisfies its structural description, the rules must be ordered along a time axis. Yet if there are no empirical grounds for claiming a temporal order, the latter becomes nothing more than a metaphorical means for intuitive understanding.

For example, when a Sanskrit root containing the sequence *-ar* is followed by the cluster /sP/, transposition of /a/ and /r/ takes place as in /√darś 'see' + -tum/ > *draṣṭúm* and the language avoids the cluster ˣ-rṣṭ- (Wackernagel 1896:212). An explanation by

ordered rules entails an ill-formed intermediate form ×darṣṭúm, which is then repaired by metathesis. We see that unnecessary theoretical complexity results from positing an unattested and ill-formed intermediate form and applying temporal metaphor to what is actually a synchronic and immediate process. Another classic example is Yawelmani Yokuts, where both vowel epenthesis and long-vowel shortening before a coda have a common property, i.e. repairing ill-formed syllables; such a property is not captured by positing two separate rules. Although such conspiracies can be captured by means of restrictions on surface forms, a mechanism of blocking and repair with interplaying rules complicates the grammar and is hence to be avoided.

Prince and Smolensky (1993) propose a uniform replacement of rules and restrictions by constraints with gradient degrees of violability. All constraints are considered to be universal and present in all grammars, but they can be active or inactive language-specifically. Universality of constraints makes it possible to reduce the differences among languages to the ranking of the constraints. According to this approach, called Optimality Theory, a component of universal grammar called GEN(erator) generates a set of candidates when an input is given. GEN is inclusive, and each candidate contains the segments of the input. A grammar has its own ordered ranking of constraints, and the candidates are evaluated with respect to this ranking. The candidate which incurs the fewest violations of the highest-ranked constraints "wins" as optimal and is realized as the surface form.

In a few places of this work, where a constraint-based analysis is expected to give insights which are not attained by the traditional ordered-rule approach, I will propose explanations couched in Optimality Theory.

## §9 Synchrony and native grammar

In this study, a diachronic viewpoint is adopted only when we discuss how a peculiar feature of Indo-Aryan phonological alternation has developed, and the alternation itself will be described in purely synchronic terms, using only evidence internal to Indo-Aryan of the period in question, in conformity with the structuralist approaches such as those of Swadesh (1934:128)[8] and Emeneau (1946:87).[9] With respect to palatalization of velars before a front vowel in Sanskrit, Kiparsky (1973a:21ff.) also points out that incorporating historical aspects into the representation to account for synchronically unpredictable alternations is complicating and unjustified.

According to psychological and neurophysiological studies of modern languages, speakers treat one of a number of alternation patterns as the general rule and the others as a set of exceptions to be memorized (Ullmann 1993). Rather than evoking historical

[8] "In determining the phonemic system of a language, only phonetic data are relevant. Historical phonology is not relevant. ... Historical etymology in a matter of phonemics is an acceptable aid only when one is dealing with an inadequately recorded non-contemporary language."

[9] "It should be noted that neither the other descriptive data of the language nor the historical facts are to be allowed to dictate a phonemic solution; they should be permitted only to help in making a choice between solutions arrived at on other grounds."

processes to account for relic forms, it is therefore synchronically more accurate to list them lexically as exceptions. This is essentially what Pāṇini does in describing Sanskrit, and his method of description makes perfect sense as far as synchrony is concerned. Moreover, Pāṇini and the Prātiśākhyas provide first-hand testimony of the synchrony of the late Vedic language. For these reasons, I will refer to the native Indian grammarians to test my own explanations of synchronic alternations.

### §10 Acknowledgments

The present volume is a revised version of my dissertation submitted to the University of Pennsylvania in December 2000. I owe an immense debt of gratitude to my advisor Dr. George Cardona for the hours he devoted to the discussion of this study, for his constant encouragement and for his illuminating suggestions. I would also like to thank Dr. Eugene Buckley, Dr. Mark Liberman, Dr. Rolf Noyer and Dr. Donald Ringe in the Linguistics Department of the University of Pennsylvania for offering generously of their counsel and support at all stages of my work.

Special thanks are due to Dr. Werner Knobl (Kyoto University), who has always been a source of new insight and understanding of Sanskrit since I was a student at Kyoto University. I would like to extend my thanks to Dr. Bhadriraju Krishnamurti (then at the Institute for Advanced Study), Dr. H. Craig Melchert (University of North Carolina), Dr. David Nelson (Van Pelt Library, University of Pennsylvania), and my esteemed friends Dr. Ronald I. Kim (University of Pennsylvania) and Dr. Arlo Griffiths (University of Groningen) for their valuable comments and criticisms. All errors of understanding or of fact are, of course, mine alone.

I wish to express my heartfelt thanks to the Linguistic Data Consortium, University of Pennsylvania, for their research assistantship and extensive training in processing of linguistic data while I was a graduate student. I am deeply indebted to the Research Institute for Languages and Cultures of Asia and Africa, Tokyo University of Foreign Studies, for their research fellowship and for publishing this volume.

Finally, I would like to thank my parents for their support and encouragement for all my life.

## §11 Phonemic inventories

Proto-Indo-European:

| | labial | dental | palatal | velar | labiovelar | |
|---|---|---|---|---|---|---|
| voiceless stop | *p | *t | *ḱ | *k | *k$^{w}$ | |
| voiced stop | *b | *d | *ǵ | *g | *g$^{w}$ | |
| voiced aspirate | *b$^{h}$ | *d$^{h}$ | *ǵ$^{h}$ | *g$^{h}$ | *g$^{wh}$ | |
| fricative | | *s/z | | | | *h$_1$,*h$_2$,*h$_3$ |
| nasal | *m | *n | | | | |
| liquid | | | | | | *l, *r |
| glide | *u̯ | | *i̯ | | | |

Proto-Indo-Iranian:

| | labial | dental | 1ary palatal | 2ary palatal | velar | |
|---|---|---|---|---|---|---|
| voiceless unaspirated | *p | *t | *ć | *č | *k | |
| voiceless aspirate | *p$^{h}$ | *t$^{h}$ | | *č$^{h}$ | *k$^{h}$ | |
| voiced unaspirated | *b | *d | *ǰ | *ǰ | *g | |
| voiced aspirate | *b$^{h}$ | *d$^{h}$ | *ǰ$^{h}$ | *ǰ$^{h}$ | *g$^{h}$ | |
| fricative | | *s,*z | | | | *H |
| nasal | *m | *n | | | | |
| liquid | | | | | | *r |
| glide | *u̯ | | | *i̯ | | |

Old Indo-Aryan (Sanskrit):

| | labial | dental | retroflex | palatal | velar | |
|---|---|---|---|---|---|---|
| voiceless unaspirated | p | t | ṭ | c | k | |
| voiceless aspirate | p$^{h}$ | t$^{h}$ | ṭ$^{h}$ | c$^{h}$ | k$^{h}$ | |
| voiced unaspirated | b | d | ḍ (~ *ḷ*) | j | g | |
| voiced aspirate | b$^{h}$ | d$^{h}$ | ḍ$^{h}$ (~ *ḷ$^{h}$*) | | g$^{h}$ | |
| fricative | | s | ṣ | ś | | h |
| nasal | m | n | ṇ | (*ñ*) | (*ṅ*) | |
| liquid | | | | | | r, l |
| glide | v | | | y | | |

*ḷ* and *ḷ$^{h}$* are dialectal allophones of /ḍ/ and /ḍ$^{h}$/ between vowels. There are a few other sounds of dependent status traditionally called the ayogavāha's. Visarga (*ḥ*) is an alternant of /s/ and /r/. /m/ is replaced by anusvāra (*ṁ*) before fricatives and /r/. /m̐/ denotes nasalization of a preceding vowel and originates from /m/ and /n/.

Proto-Dravidian:

| | labial | dental | alveolar | retroflex | palatal | velar | |
|---|---|---|---|---|---|---|---|
| stop | *p | *t | *ṯ | *ṭ | *c | *k | |
| nasal | *m | *n | | *ṇ | *ñ | | |
| liquid | | | *l | *ḷ | | | *r |
| glide | *v | | | *ẓ | *y | | |

Based on Steever (1998:14). The alveolar stop can also be written 'ɾ,' as is common in romanizing Tamil. See Krishnamurti (1969:318[n18]) for the justification for writing *ẓ.

### §12 Abbreviations

Languages, texts, distinctive features, principles and theories:

| | |
|---|---|
| [ant] | [anterior] |
| Alb. | Albanian |
| Arm. | Armenian |
| Aṣṭ. | Aṣṭādhyāyī |
| [ATR] | [Advanced Tongue Root] |
| Av. | Avestan |
| AV | Atharva-Veda |
| AVPO | Atharva-Veda, Paippalāda recension in Orissa |
| [bk] | [back] |
| Br. | Brāhmaṇa |
| Brah. | Brahui |
| Cl. | Classical |
| [cont] | [continuant] |
| [dist] | [distributed] |
| Ep. | Epic |
| Gk. | Greek |
| Gmc. | Germanic |
| Go. | Gondi |
| [hi] | [high] |
| Hitt. | Hittite |
| Hom. | Homeric Greek |
| IE | Indo-European |
| JB | Jaiminīya-Brāhmaṇa |
| Ka. | Kannada |
| Kāṭh. | Kāṭhaka-Saṃhitā |
| KB | Kauṣītaki-Brāhmaṇa |
| Kur. | Kuṛux |
| Lat. | Latin |
| Lith. | Lithuanian |
| [lo] | [low] |
| Ma. | Malayalam |
| MIA | Middle Indo-Aryan |
| Mlt. | Malto |
| MP | Middle Persian |
| NIA | New Indo-Aryan |
| Nk. | Naiki |
| OAv. | Old Avestan |
| OCP | Obligatory Contour Principle |
| OCS | Old Church Slavonic |
| OHG | Old High German |
| OIA | Old Indo-Aryan |
| OIr. | Old Irish |
| ON | Old Norse |
| OP | Old Persian |
| OT | Optimality Theory |
| OTa. | Old Tamil |
| OTa. | Old Telugu |
| PA | Proto-Anatolian |
| PB | Pañcaviṃśa-Brāhmaṇa |
| PCelt. | Proto-Celtic |
| PDr. | Proto-Dravidian |
| PGmc. | Proto-Germanic |
| PIE | Proto-Indo-European |
| PIIr. | Proto-Indo-Iranian |
| PItal. | Proto-Italic |
| Pj. | Parji |
| Pkt. | Prakrit |
| Pol. | Polish |
| PŚ | Pāṇinīya-Śikṣā |
| PToch. | Proto-Tocharian |
| [rd] | [rounded] |
| ṚPr. | Ṛk-Prātiśākhya |
| Ru. | Russian |
| ṚV | Ṛg-Veda |
| ŚB | Śatapatha-Brāhmaṇa |
| ŚCĀ | Śaunakīyā Caturādhyāyikā |
| [sg] | [spread glottis] |
| Skt. | Sanskrit |
| [son] | [sonorant] |
| Sū. | Sūtra |
| Ta. | Tamil |
| TA | Tocharian A |

| | |
|---|---|
| TB | Tocharian B |
| Te. | Telugu |
| TPr. | Taittirīya-Prātiśākhya |
| TS | Taittirīya-Saṃhitā |
| Tu. | Tulu |
| Umbr. | Umbrian |
| Up. | Upaniṣad |
| Ved. | Vedic |
| [vcd] | [voiced] |
| VS | Vājasaneyi-Saṃhitā |
| VSK | Vājasaneyi-Saṃhitā, Kāṇva recension |
| VSM | Vājasaneyi-Saṃhitā, Mādhyandina Recension |
| YAv. | Younger Avestan |

Abbreviations of classes of segments and other symbols:

| | |
|---|---|
| V | vowel |
| Y | glide |
| C | consonant or glide |
| B | obstruent |
| L | liquid |
| N | nasal |
| W | semivowel (Y + L) |
| R | sonorant (Y + L + N) |
| F | fricative |
| S | sibilant |
| T | stop |
| P | plosive (T + affricate) |
| K | non-continuant (P + N) |
| V̄ | long vowel |
| V̆ | short vowel |
| C̃ | yama |
| * | reconstructed as |
| × | unattested |
| ∗ | violation |
| > | diachronically develops into |
| < | diachronically derives from |
| → | changes into (via morphological change, analogy, etc.) |
| ≫ | ranked higher than |
| $\mu$ | mora |
| $\sigma$ | syllable |
| wd | word |
| ## | utterance boundary |

Inflectional information:

| | | | | | |
|---|---|---|---|---|---|
| 3sg. *etc.* | third singular *etc.* | grdv. | gerundive | pcl. | particle |
| abl. | ablative | ind. | indicative | pf. | perfect |
| abs. | absolutive | indecl. | indeclinable | pl. | plural |
| acc. | accusative | inst. | instrumental | ppl. | participle |
| act. | active | int. | intensive | pr. | present |
| adj. | adjective | ipf. | imperfect | prec. | precative |
| aor. | aorist | iptv. | imperative | pret. | preterite |
| caus. | causative | loc. | locative | prop.n. | proper noun |
| dat. | dative | m. | masculine | rt.aor. | root aorist |
| denom. | denominative | mid. | middle | sg. | singular |
| desid. | desiderative | n. | neuter | subj. | subjunctive |
| dir. | direct | nom. | nominative | them. | thematic |
| du. | dual | num. | numeral | vb.adj. | verbal adjective |
| f. | feminine | obl. | oblique | vb.n. | verbal noun |
| fut. | future | opt. | optative | voc. | vocative |
| gen. | genitive | pass. | passive | | |

# Chapter II. Syllable Nuclei and Rimes

## §13 Syllable and nucleus-forming segments in Proto-Indo-European

Although the syllable is a notion of crucial importance in phonology, it cannot be defined without incurring some circularity, either by the segments which constitute it or by their sonority. According to Henke (1966), the syllable is a unit of articulatory programming, and Chistovich et al. (1965:105) define the syllable as a unit of organizing segment duration. The statements of these phoneticians suggest that the internal structure of a syllable cannot be defined even in acoustic terms, although the phonetic reflection of the syllable may be captured by acoustic measurements and perceptual experiments.[1] If the syllable is a mental construct by which the input string is temporally organized, understanding the synchronic restrictions on the syllable, i.e. figuring out what kind of syllable is well-formed or ill-formed for the speakers of a language in question, is a prerequisite for describing alternation patterns of segmental duration. In this and the next chapters, we will discuss Old Indo-Aryan peculiarities in assigning syllable nuclei, restrictions constraining consonant clusters, and phonotactics of the output string as compared with other Indo-European languages, basing our arguments on metrical and other historical evidence. The generalization will then be cross-checked with native grammarians' judgments on syllabification and syllable-related phenomena.[2]

Since linguistic reconstruction is based on "identities or systematic correspondences of phonemes" (Bloomfield 1933:302), a reconstructed string may not automatically yield itself to syllabic division and analysis of well-formedness. However, evidence does exist for the role of syllable structure within the morphophonology of Proto-Indo-European. For instance, Indo-European roots, which have a monosyllabic template *(F)(T)(R)e(R)(T/S) (Szemerényi 1990:102), fit in the Universal Scale of Sonority (§16), except that fricatives can appear at either end of a root and laryngeals are reconstructed at almost any position of a root.

To cite one example, it has been proposed that an anaptyctic vowel called *schwa secundum* is inserted when reduction of a non-high vowel would result in an undesirable sequence of consonants, particularly obstruents, e.g.

> PIE *$s_ek^w$- < *√$sek^w$ 'accompany,' Lat. *secundus* 'favorable,' Lith. *sėkmẽ* 'success' :: PIE *$sk^w$-, Gk. *spést$^h$ai*, Skt. *ā́skra*- (Gippert 1997:273, Sihler 1967:6).

[1] For example, Boucher (1988) made an acoustic measurement of VC.V : V.CV pairs such as *statute ends* : *statue tends* and found that the timing of consonant closures relative to a vocalic onset reflects syllabification. Cf. also Hoard (1971:136): "Tensing does not occur across word boundaries. In *it sprays* versus *its praise*, the *s* of *its* is lax and short, the *s* of *sprays* is tense and long." See Kubozono (1995) for an acoustic reflection of syllable boundaries in the CV-based segmentation pattern characteristic of the perception of Japanese speakers and the VC-based segmentation of English speakers.

[2] Sections §19, §23, §24 and §29 are based on Kobayashi (2001).

The former words have a *schwa secundum* and the latter do not. If insertion of *schwa secundum* did not happen in each daughter language independently but was a common Proto-Indo-European phenomenon, it would mean that Proto-Indo-European did not allow a sequence of too many obstruents.

### §14 Nucleus-forming segments in Proto-Indo-European

Reconstructed forms of Proto-Indo-European exhibit a morphophonological gradation between the mid vowels *e and *o, called *ablaut.* Ablaut of the low vowel *a has not been firmly reconstructed.

| grade | zero | | full | | lengthened |
|---|---|---|---|---|---|
| *e-series | *∅ | ← | *e | → | *ē |
| | ‖ | | ↕ | | ↕ |
| *o-series | *∅ | ← | *o | → | *ō |
| *a-series (?) | *∅ | ← | *a | → | *ā |

(see Meier-Brügger 2002:146f. for examples)

In the zero grade, mid vowels disappear, and a sequence of consonants are left. When disappearance of a mid vowel in the zero grade would result in a sequence of obstruents, a mid vowel called *schwa secundum* is sometimes epenthesized as we just mentioned in §13, but not when there is a sonorant (*r, *l, *m or *n) in the consonant cluster; instead, the sonorant becomes a syllable nucleus in such cases. It is therefore concluded that all sonorants (*a, *e, *o, *i/i̯, *u/u̯, *r̥/r, *l̥/l, *m̥/m, *n̥/n) can serve as syllable nuclei in Proto-Indo-European.

The Proto-Indo-European high vowels *i and *u alternate with the corresponding glides *i̯ and *u̯ when they adjoin to a nucleus segment. High vowels have the same priority as the liquids *l, *r and nasals *n, *m with respect to the assignment of syllable nuclei. Unlike the mid vowels, high vowels do not participate in gradation; they do not alternate with *∅, and it is not necessary to reconstruct long high vowels for Proto-Indo-European according to the Laryngeal Theory, which explains most reconstructible long high vowels as originating from loss of an adjoining laryngeal and ensuing compensatory lengthening (Mayrhofer 1986:171).[3] Since the alternation pattern of high vowels is closer to that of liquids and nasals than to that of non-high vowels, high vowels are better grouped with sonorants than with *e, *o and *a. For example, apparent minimal pairs such as *√dík- (~*dei̯k-) ‘point to,’ Skt. *ádiṣṭa* aor.mid.3sg., Lat. *dīcere* ‘to say’ (*LIV* 92f.), and *√dék ‘take, acknowledge,’ Skt. *dā́ṣṭi* pres.act.3sg., Hom. *dékto* mid.3sg. (*LIV* 93ff.), actually contrast not in the vowels *e and *i, but in the difference between presence and absence of *i/i̯, as the following reflexes show:

[3] Possible examples of reconstructible *ī and *ū are, for example, long *ī* in YAv. *vīša-* ‘poison,’ Lat. *vīrus*, OIr. *fí*, cf. Skt. *viṣá-* n., and long *ū* in Ved. *mū́ṣ-* m.f. ‘mouse,’ Gk. *mŷs*, Lat. *mūs* (Meiser 1998:57).

| zero grade | full grade | lengthened grade |
|---|---|---|
| Skt. *á-diṣ-ṭa* | OHG *-zīhan*[i)] | Av. *dāiš* |
| Skt. *dāśvā́ṃs-*[ii)] | Hom. *dék-to* | Skt. *dāṣṭi* |

[i)] Gmc. *ī < PIE *ei̯.

[ii)] < PIE *de-dḱ-u̯ós- according to Klingenschmitt (1982:129).

As the regular ablaut of sonorants is often impeded by analogical and paradigmatic pressures, it is necessary first to establish the rule as to which segment of a reconstructed string becomes the syllable nucleus, and as to how it forms a syllable with adjacent non-nucleus segments. Let us start from the question whether the place of a syllable nucleus can be uniquely determined in Proto-Indo-European.

## §15 Reconstructibility of nucleus placement in Proto-Indo-European

When a root, or a root and a suffix, is in the zero grade, a long string without a non-high vowel may occur. In such cases, particularly when there is a sequence of phonemes which can become the nucleus, we have an opportunity to investigate whether the place of a syllable nucleus is determinable in Proto-Indo-European.

1) Cases where nuclear or consonantal status must be fixed in reconstruction.

Some non-root morphemes can or must be reconstructed with nucleus or non-nucleus status specified for the sonorants in them:

Nasal infix:

PIE *-né- ~ *-n- > Skt. *-ná-* ~ *-n-* as in Skt. *yunáj-*/*yuñj-* 'yoke,' Lat. *iungō*

PIE *-né-h$_2$- ~ PIE *-n-h$_2$- > Skt., Av. *-nā-* ~ Skt. *-nī-*, Av. *-n-*, Skt. *gṛbʰṇā́ti* ~ *gṛbʰṇītá* 'seizes.'

PIE *-néu̯- ~ *-nu-: PIE *kʷr̥-neu̯-mi > Ved. *kṛṇómi* pres.act.1sg. 'I do,' YAv. *kərᵊnaomi* ~ *kṛṇutʰá* 2pl.

Tocharian affrication and assibilation:

PIE *ti̯ and *dʰi̯ (> *tʰi̯) > PToch. *tˢ :: PIE *ti and *dʰi (> *tʰi) > pre-PToch. *si > PToch. *ṣə. PIE *poti̯- (obl. of *póti-s) > PToch. *pëtˢ 'husband' > TB *petso*, TA *pats* :: PIE *h$_1$i-dʰí 'go!' > *itʰí > *isí >→ TB *paṣ*, TA *piṣ* (Ringe 1996:79f.).

Infinitive suffix *-dʰi̯ōi̯: PIE *-dʰi̯ōi̯ > Ved. *-dʰyai*, Umbr. *-fi*. In Vedic, this suffix has no variant with Sievers's epenthesis (×-dʰiyai), although there are suspected exceptions like *yajádʰyai* in ṚV 8.39.1ab *agním astoṣiy ṛgmíyam/ agním īḷā́ yajádʰiyai*. According to Rix (1976:327), the consonantal status of the first *i̯ in *-dʰi̯ōi̯ prevents the presuffixal vowels in Umbrian *cehefi* and *herifi* from being syncopated.

Sanskrit passive and class IV suffix: Along with the above-mentioned infinitive suffix *-dʰyai*, the passive suffix *-yá-*, the class IV stem suffix *-ya-*, and the gerund suffix *-tvā*, are generally considered to have no Sievers alternant (a form with anaptyxis such as *martiya-* to *martya-* 'mortal'). Cf. optative *-i̯eh$_1$: *syāt*/*siyāt* act.3sg. of √*as* 'be' etc.

Privative prefix: The Proto-Indo-European privative prefix *n̥- 'un-, non-' always forms one syllable both before consonants and before vowels: > TB *e(n)-* (Ringe 1996:72, 99), Lat. *in-*, Gk. *a-/an-*, Goth. *un-*, Skt. *a-/an-* etc.

2) Cases where the same morpheme shows different nucleus placement. Reassignment of syllable nucleus is found most commonly in inflected forms of verbs, but there are also other suffixes which show variable nucleus placement in their reflexes:

nasal infix: PIE *-n̥h$_2$- > Ved. -*ā*- in *gr̥b$^h$-ā-yá-ti* 'hold,' while PIE *-néh$_2$- ~ *(C)-nh$_2$- (C), originally the same morpheme as *-n̥h$_2$-, always has a non-nuclear /n/ in pairs such as *gr̥b$^h$-n̥̂ā-ti*: *gr̥b$^h$-n̥̄-té*.

Mid. pres. ppl. suffix: *-mh$_1$nó- becomes -*ānā*- in Sanskrit athematic (i.e. *-C_) forms such as *ad ānā*- from the root √*ad* 'eat,' while the same string is reflected in Greek thematic (i.e. *-o_) forms as *-meno-*, e.g. Gk. *p$^h$er-ó-meno-s*, cf. Lat. *alu-mnus* etc. (Klingenschmitt 1975:159ff.).

Initial *CR̥: *pr̥Hé/ó-s > Gk. *prés-bys* 'the elder,'[4] Skt. *puráḥ*; *sma or *sm̥a > Gk. *háma*, Skt. *sma* pcl., *smát-* 'at once,' *sama-* 'some' (Sihler 1967:13).

PIE *m̥ǵ-: *m̥ǵs- 'much, great' > Av. *aš-* :: *mǵ-no- 'id.' > Latin *magnus* (Schindler 1987:345).

Sonorants in verbal roots: PIE √*ǵenh$_1$~*ǵn̥h$_1$ 'give birth': *ǵn̥h$_1$-i̯é/ó- > Skt. *j ā́yate* 'is born' :: *ǵénh$_1$-tor- > *janitar-* 'creator.' PIE √*neḱ~*ń̥k 'to attain': Skt. *naś-* ~ *a(m̥)ś-* ~ *aś-*, Av. *nas-* ~ *ąs-* ~ *as-*.

3) Furthermore, the principle of nucleus placement itself seems to differ across subfamilies in a few cases. Such differences are typically found in sequences of sonorants or of sonorants and laryngeals:

*wR̥ in Hittite: PIE *CuR̥C > PA *CuRC, *h$_{2/3}$u̯l̥-ne-h$_1$- > Hitt. *ḫulle-* 'fight.' PIE *$_{wd}$[uR̥C > Hitt. /uR/, e.g. PIE *u̯r̥gi- > Hitt. *ūrki-* 'trail, track' (Melchert 1994:55f., 66, 1984:12). That this rule took place at an early pre-Proto-Anatolian period is shown by the following relative chronology:

| PIE | *h$_{2/3}$u̯l̥-ne-h$_1$- | PIE | *h$_{2/3}$u̯l̥h$_1$-neh$_2$ 'wool' |
|---|---|---|---|
| | *wR̥ > *uR /C_C | | *wR̥ > *uR /C_C |
| | *-ln- > Hitt.,Luv. -ll-[i)] | | — |
| | *Vh$_1$ > V̄ /_C | | *h$_1$ > ∅ /C_C |
| >PA | *H/hul-lā̆- | >PA | *H/hul-nah-[ii)] |
| > Hitt. | *ḫulle-* | > Hitt. | *ḫul(a)na* |

[i)] Melchert (1994:81f.). [ii)] Melchert (1994:85f.).

*u̯r̥ in Latin: PIE *√u̯r̥g + -ei̯e/o- > Lat. *urgeō* 'impel' instead of ×uor-. But contrast PIE *h$_2$u̯r̥sen- > Skt. *vŕ̥ṣan-* 'male,' Lat. *verrēs* 'boar' (Meiser 1998:63).

[4] This form might be a case of Laryngalschwund like OAv. *frō-* ~ YAv. *parō* 'in front.'

*$ih_2$ in Tocharian: PIE *$\sqrt{d^hih_2g^w}$ 'stab' > *$t^hyag^w$- > *$t^sag^w$- > PToch. *$t^sak^w$-(a-) (Ringe 1996:79).

*RH in Greek: *$n̥h_2$ in *$ḱr̥h_2sn̥$-$h_2$ (nom.pl.) > Hom.Gk. *kár ēna* pl. 'head' vs. Skt. *śīŕṣā* (Nussbaum 1986:158ff.). *di/e-$dh_3$-$mh_1$nó- > Gk. *didómenos* vs. Skt. *dádānа-* 'being given.'

Although the placement of syllable nuclei sometimes varies across subfamilies or even within the same language, the principle of nucleus placement does not seem to differ crucially. Nuclear or consonantal status needs to be prespecified for a few morphemes, but most of the examples of fluctuating nuclei can be explained either by paradigmatic leveling with analogical restitution, by reranking of the sonority of laryngeals in individual subfamilies, or by differences in syllable contact laws across subfamilies.

## §16 The procedure of nucleus placement

If the fixed syllable nucleus reconstructed for a few Proto-Indo-European morphemes cited in §15 1) is due to lexical prespecification of the nucleus for paradigmatic uniformity, the other examples allow us to assume that nucleus placement was originally a dynamic process in Proto-Indo-European.[5]

The Indo-European principle of assigning a syllable nucleus in a sequence of two or more sonorants other than non-high vowels between consonants and/or word-boundaries has engaged the attention of generations of scholars, especially regarding its regularity and cyclic application. If I may set aside Sievers's Law (§20) as a separate adjustment process driven by syllable well-formedness, the Proto-Indo-European principle of nucleus placement may be summarized as follows

> Nucleus Placement Principle (Meillet 1934:134–136, Schindler 1977b:56): In Proto-Indo-European, syllable nuclei are assigned to underlying sonorants other than non-high vowels (i.e. *i̯, *u̯, *r, *l, *n, *m) between non-nucleus segments and/or word boundaries, *iteratively from right to left*.

Examples:

[5]Beekes (1995:125) and Lubotsky (1988:21) even leave out the syllabic symbol (X̥, or traditionally X̯) in their reconstructions probably on this assumption; their position is sensible in that it eliminates predictable and redundant information, but I use the syllabic symbol to emphasize that Proto-Indo-European forms are not just a string of mechanically reconstructed symbols but are subject to phonological restrictions and well-formedness conditions, just like attested forms in ancient and modern languages (cf. Uniformitarian Principle, §7).

| PIE | *u̯és-mn̥ ‘clothes’ | *ḱlu-tó- ‘heard’ | *mr̥-(tó/tí-) ‘death’ | *h$_2$i̯u-Hn̥-(tí-) ‘youth’ | *u̯l̥kʷo- ‘wolf’ |
|---|---|---|---|---|---|
| Hitt. | | | | | *walkuwa*-? |
| TB | | | | | *walkwe*? |
| Alb. | | | | | (*ul’k*) |
| OIr. | | *cloth* | | *ōetiu* | |
| Lat. | | *inclutus* | *mors* | *juventus* | (*lupus*) |
| Arm. | | *lu* | *mard* | | |
| Gk. | *heîma* | *klutós* | *á-mbrotos* | | (*lúkos*) |
| OHG | | *hlot-* | *mord* | *jugund* | *wolf* |
| Goth. | | | | *junda* | *wulfs* |
| OCS | | *sluti* | sŭ-*mrŭtĭ*[i)] | *junŭ* | Ru. *volkŭ* <PSl. *vĭlkŭ |
| Lith. | | | *mìrtis* | *jáunas* | *viĩkas* |
| Skt. | *vásma* | *śrutá-* | *mr̥tyú-* | *yuvatí-* | *vŕ̥ka-* |

[i)]From Proto-Slavic *sŭ-mĭrtĭ, Ru. *smert’* f. ‘death.’

(*EWAia.*, Walde-Pokorny, Rix 1992:144, Meillet 1934:134, Meiser 1998:63, Hoffmann 1976:383, R. Kim 1999b:166f.)

The expression “right to left” in this formulation may lead to overgeneration, for there is a crosslinguistic asymmetry between onset and coda consonants anyway: for example, there is no known language which allows codas but no onsets, while there are languages which have onsets and do not allow codas.[6] If we can code the principle of minimizing the syllable coda in the procedure of nucleus placement itself, the use of such a directional expression will become unnecessary.

First, let us list the Proto-Indo-European phonemes, grouped by feature values and ordered according to sonority and nucleus formation:

| groups | features | segments | nucleus | non-nucl. |
|---|---|---|---|---|
| non-high vowels | [−cons, +low] | *a *e *o | yes | no |
| high vowels | [−cons, +high] | *i *u | yes | yes |
| liquids | [+cons,+son,−nas] | *r *l | yes | yes |
| nasals | [+cons,+son,+nas] | *n *m | yes | yes |
| laryngeals | ? | *h$_1$ *h$_2$ *h$_3$ | (yes) | yes |
| fricative | [+cons, +cont] | *s | no | yes |
| stops | [+cons, −cont] | *k *kʷ *ḱ *t *p etc. | no | yes |

If the Proto-Indo-European laryngeals are voiced, they will naturally be ranked higher than the voiceless fricative *s in sonority. There is no convincing reason, however, for taking any laryngeal except *h$_3$ to be voiced: *h$_3$ is considered voiced on the grounds of the voicing in PIE *pí-ph$_3$-e-ti > Skt. *píbati*, OIr. *ibid* ‘drinks,’ whereas *h$_2$

[6]Cf. the Maximal Onset Principle (Sievers 1885:190, Clements 1990:300).

merely causes aspiration of a preceding stop without changing its voicing status.[7] Except that the ranking of the laryngeals above the fricatives remains an open question, this sonority ranking agrees with the proposed Universal Scale of Sonority (Blevins 1995:211),[8] i.e.

> low vowels ≫ mid vowels ≫ high vowels ≫ liquids ≫ nasals ≫ voiced fricatives ≫ voiceless fricatives ≫ voiced stops ≫ voiceless stops

Proto-Indo-European assigns syllable nucleus status equally to sonorants in the same context, whether they are glides, liquids or nasals. For example,

| | | |
|---|---|---|
| PIE */ḱu̯n-es/ | > *ḱun-es | > Ved. *śúnaḥ* gen.sg. 'dog' |
| PIE */ḱu̯n-b$^h$is/ | > *ḱun̩b$^h$is | > (Ved.) *śvab$^h$iḥ* inst.pl. 'dog' |
| PIE */snu̯b$^h$is/ | > *snub$^h$is | > Ved. *snúb$^h$iḥ* inst.pl. 'back' |
| PIE */h$_2$u̯rsen-/ | > *h$_2$ur̩sen- | > Ved. *vṛ́ṣaṇ-* 'male,' Lat. *uerr ēs* 'boar' |
| PIE */dru̯-neh$_1$/ | > *dru-neh$_1$ | > Ved. *drúṇ ā* inst.sg. 'wood' |

(Wackernagel 1896:74)

The fact that the right one of two adjacent unsyllabified sonorants becomes the nucleus irrespective of its sonority may appear to contradict what would follow from the sonority scale. The universal scale should rather be viewed as representing the finest gradation of sonority;[9] thus, the difference in sonority among nasals, liquids and glides can be understood as being suppressed or neutralized in Proto-Indo-European, because it is superseded by another principle of coda minimization.

In Optimality Theory, this is expressed by the dominance hierarchy of the following three constraints:

a) HNUC (Prince & Smolensky 1993:72): When there is more than one segment which can become the nucleus of a syllable, the nucleus is assigned to the one with the highest sonority. In the case of PIE */ḱu̯n-b$^h$is/ inst.pl. 'dog,' this constraint requires *u̯ to be the nucleus (> ×ḱun-b$^h$is); when, on the other hand, *n becomes the nucleus (> *ḱun̩-b$^h$is), it is counted as a violation of this constraint.

b) ALIGNNUC: ALIGN(Nucleus, R, $\sigma$, R): Align the right edge of a syllable nucleus with the right edge of a syllable, i.e. minimize syllable codas.

c) ONSET: A segment to the left of a syllable nucleus is an onset; in other words, diereses are not allowed. The candidate *ḱu.n̩.b$^h$is. (> Ved. ×śuab$^h$is), in which both the adjoining sonorants become the nuclei of two separate syllables to better satisfy ALIGNNUC, is ruled out by this constraint.

[7] Whether Proto-Indo-European laryngeals directly develop into the vowel /i/ in Indo-Aryan, or are lost with subsequent epenthesis of /i/, will be discussed in §91.

[8] See Clements (1990:284ff.) for a historical review of the proposed sonority scales.

[9] See §63 for the possibility of even finer differences in sonority.

These three universal constraints apply according to the following language-specific ranking of priority:

Ranking: ONSET ≫ ALIGNNUC ≫ HNUC

Take PIE */ḱu̯n-bʰis/ > *ḱu̯n̩-bʰis (> Skt. *śvabʰiḥ*) again as an example. Although the universal sonority scale favors *u̯ as the syllable nucleus, the principle of coda minimization, which outranks the former, requires *n to its right to become the syllable nucleus.

| | */ḱu̯n.bʰis./ | ONSET | ALIGN | HNUC |
|---|---|---|---|---|
| | *ḱun.bʰis. | | ∗! | |
| ☞ | *ḱu̯n̩.bʰis. | | | ∗ |
| | *ḱu.n̩.bʰis | ∗! | | |

## §17 Peculiarities in the development of PIE laryngeals in Indo-Iranian

As mentioned above in §15, Greek, and Tocharian to a smaller degree, treat laryngeals like sonorants, whereas in Sanskrit the laryngeals become /i/ only when there is no other possible nucleus-bearer adjacent to them. In terms of historical development, Proto-Indo-European laryngeals (*$h_1$ *$h_2$ *$h_3$) are considered to remain unvocalized in Proto-Indo-Iranian on the grounds of their different interconsonantal reflexes in Indo-Aryan (Skt. *i*) and Iranian (Av. ∅ ~ *i*), and traces of their consonantal nature in the metrics of the Ṛgveda, e.g. scansion of *jána-* 'people' < PIE *ǵónh$_1$o- with a heavy first syllable, or disyllabic scansion of the gen.pl. ending -*ām* < PIIr. *-aam as -*aam* ("laryngeal hiatus"). With respect to the Proto-Indo-European nasals *n and *m, on the other hand, there is no argument against taking them as having become *a interconsonantally already in Proto-Indo-Iranian, given correspondences such as PIE *ḱm̩tóm 'hundred' > Skt. *śatám* : YAv. *satəm*, PIE *gʷʰn̩-tó- 'killed' > Skt. *hatá-* : YAv. *jata-* (Hoffmann and Forssman 1996:61). The difference between Indo-Iranian and Greek (or Tocharian), therefore, consists in the order of the vocalization of the laryngeals relative to that of the nasals:

| PIE to PToch. | PIE to Greek | PIE to PIIr. |
|---|---|---|
| PIE *H > *ə /C_C[i)] | PIE *n̩, *m̩ > *a* | PIE *n̩, *m̩ > PIIr. *a |
| *ə > PToch. *a | PIE *$h_1$ > *e* | PIE *$h_1$, *$h_2$, *$h_3$ > PIIr. *H |
| PIE *R̩ > PToch. *əR | PIE *$h_2$ > *a* | (unordered) |
| PIE *H > ∅/R̩_C[ii)] | PIE *$h_3$ > *o* | |
| PIE *i$h_2$ > PToch. *ia/ya | (unordered[iii)]) | |
| | | PIIr. to Vedic |
| | | PIIr. *H > Ved. *i* |

[i)] See Ringe (1996:21, 67) for the strict order of these three changes.
[ii)] R̩ here does not include *i/i̯ and *u/u̯.
[iii)] Cf. *-km̄tó-* vb.adj. and *kámatos* m. 'toil' from *kámnō* 'work' (Hoenigswald 1988:207).

## §18 Adjustment of nucleus placement to sonority in the output

When nucleus status is assigned to a string of Proto-Indo-European sonorants in this way, any sonorant may become a nucleus even if there is another sonorant of higher sonority except a non-high vowel, to its left; the resulting output string may therefore violate the Sonority Sequencing Principle, which requires rising sonority from the edge to the nucleus of a syllable.

As noted above (§15), Proto-Indo-European initial and interconsonantal *u̯R̩ develops into /uR/ in Hittite; so does initial *u̯R̩ in some words in Latin. Although it is difficult to identify the exact phonetic value of Hittite /w/, there is no indication that Hittite *w* had constriction stronger than that of a glide. Similarly, Latin consonantal *u* was a glide [w] in early pronunciation, according to Allen (1978:40f.). *u̯r̩ undergoes metathesis before a consonant or a word boundary in Greek, e.g. Proto-Greek *s$^{o}$du̯r̩-i̯e- > Gk. *hidrú o̅* 'establish' (Meier-Brügger 2002:98). That the Hittite output is a result of later adjustment of the place of the nucleus is shown by developments which reflect the original principle of nucleus placement in Proto-Indo-European, e.g. PIE */érh$_2$u̯r/ > *érh$_2$u̯r̩ > *érh$_2$u̯u̯r̩ > Hitt. *arrumar* n. 'washing' (Melchert 1984:25; see Sturtevant 1929 for *u̯ > *m*).

In Indo-Iranian, there is no case of the nucleus being relocated to satisfy the Sonority Sequencing Principle. For the most part, it is due to the development of Proto-Indo-European nucleus-bearing nasals into PIIr. *a and the phonetic realization of nucleus-bearing liquids with a short schwa on both sides (əLə). Paradigmatic leveling, which is particularly frequent in Indo-Aryan, also effectively avoids many underlying sequences of sonorants. For example:

| | | |
|---|---|---|
| √*nab$^h$* '?' as in *náb$^h$as-* n. 'cloud': | *n̩b$^h$-ró- | > Skt. *ab$^h$rá-* 'thunder cloud,' Lat. *imber* |
| but | | |
| √*nam* 'bend' as in *námas-* 'worship': | *nm-ró- | → Skt. *namrá-* 'humble,' YAv. *namra.vač-* 'of humble speech' |

## §19 Syllable-related rules in Proto-Indo-European

In addition to syllable structure and of a procedure of nucleus placement, some subfamilies of Indo-European share rules motivated by the well-formedness of syllables:

i) Sievers's Law and Lindeman's Variation (Seebold 1972):[10]

PIE *i̯̩,*u̯̩ > Ved. *iy, uv* / VXC_V (X = V or C).[11] This rule is not limited to Vedic, but the same adjustment is found in other subfamilies as well:

Germanic: Gothic *harjis* /-ryi-/ 'army' : *haírdeis* /-rdii-/ 'herdsman' instead of ˣ/-rdyi-/ (Krahe 1948:88, Seebold 1972:64ff.). See Kiparsky (1998) for a prosodic account

[10] i) and ii) have already appeared in Kobayashi (2001).

[11] Sievers (1878:129), translated by Collinge (1985:159): "If, in Indic, /I/ or /U/ occurs before a vowel and itself carries no accent (not even the falling contonation of a post-acute syllable or of acute plus contraction), then — no matter what the accent position may be elsewhere in the word — this segment is realized as a consonant after a light syllable and as a vowel after a heavy syllable."

of SIEVERS's LAW in Germanic.

Anatolian: Hittite *ardum ēni* 'we cut with a saw' < */arduwV-/ < */ardwV-/ (Melchert 1984:24ff.).

Tocharian: PToch. *məskél$^{y}$l$^{y}$ë gerundive 'which must be (in a place)' > TB *mäskelle* ~ *mäskelye* : PToch. *ñəkciyë 'divine' > TB *ñäkciye* (Ringe 1991:162f.).

Italic: The split of the verbal present formation in *-i̯e/o- into classes III and IV in Latin, such as III *capi ō, capere* < */kapi̯e/o-/ < PIE *kh$_2$p-i̯e/o- > Goth. *hafjis* 2sg. : IV *senti ō, sent īre* < */senti̯e/o-/ < PIE *sn̥t-i̯e/o-, *audi ō, aud īre* (Meiser 1998:90, 194). This explanation, however, is rejected by Sommer (1948:505f.), who attributes the shortening of *-ī- < *-i̯e- to the Latin rule of IAMBIC SHORTENING ($\bar{V}$ > $\breve{V}$ / $\acute{\breve{V}}$C_, $\breve{V}$_$\acute{V}$).

Cf. Celtic: *i̯ is lost in Middle Welsh *eil* 'other' < PIE *h$_2$eli̯o- > Lat. *alius*, Gk. *állos*, Goth. *alja-* while *i̯ is preserved after *i in Welsh *newydd* 'new' < PIE *nou̯i̯o- > Ved. *náv$_{(i)}$ya-* (Lewis and Pedersen 1937:15f., McCone 1996:109), showing that the nucleus status of *i̯ was still variable in Celtic.

Although anaptyxis itself is a repeatable sound change and there is no conclusive evidence for reconstructing this rule within Proto-Indo-European, these traces suggest that this law started in a very early period, if not Proto-Indo-European itself. The rule implies that syllable rimes of both the shapes VV and VC have the same prosodic effect of making the syllable heavy.

ii) OSTHOFF's LAW: PIE *$\bar{V}$ > $\breve{V}$ / _RC

Italic: PIE *h$_2$u̯eh$_1$n̥to- 'wind' > *u̯ēnto- > Lat. *vĕntu-s*.

Celtic: PIE *h$_2$u̯eh$_1$n̥to- > PCelt. *wīnt- > *wintā > OIr. *fet* 'whistle' (McCone 1996:55).

Germanic: PIE *h$_2$u̯eh$_1$n̥to- > Goth. *winds*.

Cf. PIE *h$_2$u̯eh$_1$n̥to- > Ved. *v ā́ta-*/vaata-/. Hittite *huwant-* might come from a different vowel grade *h$_2$uh$_1$ent- as well as from *h$_2$u̯eh$_1$n̥t- (Melchert 1994:54).

The context of this law can be restated as _R]$_\sigma$, if the word-final preservation of $\bar{V}$R such as in Gk. *pat ḗr* can be explained either by word-final extrametricality (Ringe p.c.) or by analogical restitution. In that case, both SIEVERS's and OSTHOFF's LAWS have the common effect of resolving overlong syllables, respectively by epenthesis and by vowel shortening. It suggests that overlong syllables start to be avoided already in the post-Proto-Indo-European period.

iii) BRUGMANN's LAW: PIE *o > PIIr. *$\bar{a}$ / _]$_\sigma${R/C}V

BRUGMANN's LAW is traditionally understood as a development of PIE *ŏ into Proto-Indo-Iranian *$\bar{a}$ in open syllables. In Kleinhans's formulation of this law (Pedersen

1900:87), it only applies if the consonant following *ŏ is a sonorant. Hajnal, in his study of the root vowel of deverbatives in *-a- in Indo-Iranian (Hajnal 1994), supports Brugmann's original formulation of the law that PIE *o alternating with *e becomes Sanskrit *ā* (PIIr. *ā according to Hajnal) and proposes to remove Kleinhans's provision.[12] Instead of formulating this rule positively as lengthening in a special context, it is simpler to consider that PIE *ŏ regularly becomes long *ā in Proto-Indo-Iranian, which is blocked when the syllable rime is already heavy.

Against this formulation, the argument could be raised that Indo-Iranian does not avoid overlong rimes so often. In particular, OSTHOFF'S LAW, which shortens a long vowel followed by a sonorant in the rime, is traditionally considered to be absent in Indo-Iranian; can we explain, then, why only PIE *ŏ > PIIr. *ā is blocked while PIE *ē and *ō survive as PIIr. *ā before a consonant cluster?

The context of BRUGMANN'S LAW presupposes that the first of a cluster of consonants belongs to the coda of the preceding syllable and so makes it heavy. It should then be possible that overlong syllables tend to be avoided in Proto-Indo-Iranian, but that PIE *ē and *ō are marked enough to override this preference for a syllable rime not exceeding two morae. As shown by the anomalous spreading of root-final aspiration to a suffix-initial stop as in *labdʰá-* 'acquired' < /labʰ- + -tá-/, Proto-Indo-Iranian tends to maximize marked features pertaining to the root (§82).

## §20 Adjustment of nuclei by SIEVERS'S LAW

The Nucleus Placement Principle discussed in §16 applies semi-cyclically: when a suffix is added, the resulting string undergoes a new cycle of Nucleus Placement, sometimes clearing away the syllabification of the input string. Cases of genuinely cyclical application of Nucleus Placement such as *$h_2$nék-se-ti > ṚV *nákṣati* : desid. *$h_2$í-$h_2$nk-se-ti > ṚV *íyakṣati* were leveled out already in Early Vedic, and *ínakṣa-*, the form with fixed nucleus status, begins to show up in the young layers of the Ṛgveda.

No reference to the well-formedness of the output syllables seems to be made when the Nucleus Placement Principle determines the primary syllable structure of the input string. SIEVERS'S LAW, on the other hand, presupposes specification of syllable nucleus in its input, i.e. it operates only after the Nucleus Placement Principle has determined the primary syllable structure, and is conditioned by the place of the nucleus. This law consists of a filter and a repair process. The filter first checks the well-formedness of the syllable: the syllable is ill-formed if a rime maps to two morae and is still followed by a cluster ending in a glide. As to the repair rule for such an ill-formed cluster, there are two possibilities:

i) A glide is inserted: An additional nucleus is assigned to the glide, e.g. *súgmi̯a- > /súgmi̯a-/. Then the dieresis, which is ill-formed in Vedic, is repaired by inserting a glide corresponding to the first nucleus /i/ between the two adjacent nuclei,

[12] Burrow (1971:546f.) even suggests accepting PIE *o > Skt. *ā* in other contexts as well, e.g. *kāṇḍa-* 'single joint of a plant,' *palāṇḍu-* 'onion,' and the variants *āṇḍá-* ~ *aṇḍá-* 'egg.'

/súgmia-/ > /súgmi$^{y}$a-/ > *súgm$_{¡}$ya-*[13] (cf. Calabrese 1999:701ff.).

ii) A nucleus is inserted: Alternatively, anaptyxis of a nucleic counterpart of the glide takes place, and the glide becomes an onset of the following nucleus by the Onset Requirement, e.g. *súgmi̯a- > /súgm$^{i}$ya-/ > *súgm$_{¡}$ya-*.

The intermediate form /súgmia-/ in i) violates the Onset Requirement of a non-initial syllable, even if only temporarily. This principle plays a crucial role in ruling out output candidates with dieresis such as ˣśuab$^{h}$is for */ḱu̯nb$^{h}$is/ in nucleus placement, which immediately precedes Sievers's Law. From the viewpoint of grammar, it is simpler to introduce a new rule of *i/u*-epenthesis than to evoke another step of nucleus placement with a different ranking of constraint violability.[14]

Nucleus Placement is a *structure-building* rule, because it assigns nucleus status to an unsyllabified string without changing it; Sievers's Law, on the other hand, is a *structure-changing* rule, because it inserts additional nuclei, resolving the preceding overlong syllable into a long and a short syllable. It is worth noting that the principle of minimizing the coda lies behind both the Nucleus Placement Principle and Sievers's Law.

In Optimality Theory, Sievers's Law is broken down into the following four universalizable constraints and interaction among them:

a) ★XCY: A cluster of two consonants and a glide, or a long vowel followed by a consonant and a glide, is ill-formed. No overlong syllable followed by a glide is allowed.
b) DepIO: Every segment in the output has a correspondent in the input.
c) MaxIO: Every segment in the input has a correspondent in the output.
d) Onset: A segment to the left of a syllable nucleus is its onset. No dieresis is allowed.

Since an overlong syllable is avoided at the cost of inserting what is not in the input, the constraint ★XCY dominates DepIO. Addition of another nucleus instead of stray erasure as in the candidate ˣsug<m>ya- (<m>: /m/ is not in the output form) means that inserting a segment is not as bad as deleting a stray consonant in the XCY context, i.e. MaxIO ≫ DepIO. Since Sievers's Law is not necessarily abided by when there is no other option than to delete a stray consonant, ★XCY is not as strong as MaxIO:

[13] Subscript $_{¡}$ means that it is not written in the orthography of the transmitted text, but its presence is guaranteed by the metrical evidence.

[14] A possible problem with explanation ii) is whether it is compatible with other cases of vowel insertion. We will suggest in §95 that the development of Proto-Indo-Iranian interconsonantal laryngeals into Sanskrit /i/ might be accounted for by a general anaptyxis; now, if the Sanskrit word *pṛ̯t$^{h}$iv$\tilde{\imath}$* f. 'earth' is a regular outcome of PIE *pl̥̯th$_2$u̯ih$_2$ (Mayrhofer, *EWAia.* s.v.), then a wrong prediction would follow from explanation ii) that essentially the same anaptyxis could develop PIE *pl̥̯th$_2$u̯ih$_2$ into ˣpṛ̯t$^{h}$uv$\tilde{\imath}$. I still prefer explanation ii) to i), for, as we will see in §65, OIA *v* is probably more consonantal than *y* already in pre-Vedic, and the first *h$_2$ of PIE *pl̥̯th$_2$u̯ih$_2$ probably developed just like other interconsonantal laryngeals.

MaxIO ≫ ★XCY ≫ DepIO. Onset is ranked higher than ★XCY, for an XCY cluster is not dissolved by dieresis such as in ˣsúgmia- as far as Vedic orthography is concerned. Although it is not easy to determine the ranking of Onset and MaxIO in the context of Sievers's Law, words such as *títaü-* 'sieve' or *sapta-ṛṣí-* 'seven Ṛṣis' and the absence of a deletion rule to avoid dieresis in the Ṛgvedic period point to dominance of the latter over the former.

Ranking: MaxIO ≫ Onset ≫ ★XCY ≫ DepIO

| /sú-gm-i͡a- | MaxIO | Onset | ★XCY | DepIO |
|---|---|---|---|---|
| súgmia- | | ∗! | | |
| súg<m>ya- | ∗! | | | |
| súgmya- | | | ∗! | |
| ☞ súgm$^{i}$ya- | | | | ∗ |

## §21 Well-formed syllables in Proto-Indo-European and Sanskrit

It may be difficult to find a Proto-Indo-European overlong syllable which is tautomorphemic, non-final, and has no ablaut alternant with a lighter syllable. The shapes of roots and suffixes, however, entail the existence of overlong syllables in Proto-Indo-European; when a root of the form *-e/oRC or *-ēC is followed by a suffix beginning with a consonant or a consonant cluster, the root syllable necessarily becomes overlong, provided that the notion of an overlong syllable is valid in Proto-Indo-European. E.g.:

PIE *u̯oi̯d-th$_2$e 'you know' > Gk. *oîst$^h$a*, Skt. *vétt$^h$a*
PIE *h$_1$eu̯g$^h$-to 'uttered' > OAv. *aogəd ā*, Gk. *eûkto*
PIE *ǵn̥h$_3$-sḱo-h$_2$ 'I come to know'
> Gk. *(gi)gnṓskō*, Lat. *(g)nōscō*
PIE *mēns-e/o-s 'month' > Gk. *mḗnós*, Lat. *mēnsis*, Skt. *mā́s-*

Overlong syllables also arise secondarily from vowel contraction, such as in PIE *e-h$_3$r̥-to rt.aor.3sg.mid. > Hom. *ôrto* 'arose,' Skt. *ārta* 'set in motion.'

As we saw above in §20, Osthoff's Law and Sievers's Law have the common effect of eliminating overlong syllables, respectively by vowel shortening and by epenthesis; i.e. overlong syllables start being avoided in the post-PIE period. Hoenigswald (1988:202, 1989:559) points out that Greek and Vedic developed independent processes which together conspire to avoid overlong syllables:

i) In Epic Greek, PIE *-r̥ appears as *Vr* or *rV* depending on the weight of the preceding syllable.
ii) In the Ṛgveda, full-grade non-thematic forms of *TeRT roots such as *dógd$^h$i* are avoided.
iii) Connective /i/ of non-laryngeal origin is inserted between a perfect stem ending in a heavy syllable and an ending beginning with a consonant (*uvóc-i-t$^h$a* : *vivyák-t$^h$a*).

iv) Hiatus instead of crasis before a consonant cluster as in *sá ít/d C* : *séd V* (Wackernagel 1896:315).
v) SIEVERS'S LAW.

Klein (1980:200) points out that the length variation of the final vowel of *átʰa/ā* 'now, then' is conditioned by the onset of the following syllable. Furthermore, the optional deletion of post-nasal stops as in ṚV 9.5.10b *aṅgdʰi* ~ 10.156.3c *aṅdʰí*, pres.iptv.2sg. of √*añj* 'anoint,' or simplification of /ddʰ/ in *bʰindʰí* (ṚV³) < /bʰi-n-d-dʰí/, pres.iptv.2sg. of √*bʰedʰ/bʰidʰ* 'break' also have the effect of avoiding overlong rimes.[15]

### §22 Quantitative evaluation of Hoenigswald's observation

Although Hoenigswald convincingly demonstrates the tendency to avoid overlong syllables in the cadences of the second book of the Ṛgveda (Hoenigswald 1989), this book contains only about 4.7% of the whole Ṛgveda, and it might not necessarily represent a common tendency of the text. And since the second book is a collection of hymns by the poets of the Gṛtsamada family, this tendency might simply be an idiosyncrasy or a dialectal feature. Scansion of the entire Ṛgveda, however, can only be accomplished by restoring the vowels which are considered to have been contracted by synaeresis, synizesis and crasis before the authority of the text was established, and this metrical restoration requires scrutiny from the viewpoints of prosody, textual criticism and historical linguistics.[16]

In order to view the approximate distribution of overlong syllables in perspective, I scanned two electronic texts of the Ṛgveda. Holland and Van Nooten's version [E01] contains the Saṃhitā text based on Aufrecht's edition, and Cardona's [E02] contains Saṃhitā and Pada texts based on the edition of Vaidika Saṃśodhana Maṇḍala. Both of them treat two pādas as one line, and I first determined pāda boundaries by an algorithm which counts syllables from both ends. Then I counted the numbers of overlong syllables in an entire verse and in a cadence of the stanzas of the Gāyatrī, Anuṣṭubh, Triṣṭubh and Jagatī meters, which account for 91.4% of the Ṛgveda.[17]

| | Holland and Van Nooten | | | Cardona | | |
|---|---|---|---|---|---|---|
| book | total overlong syllables (A) | overlong syllables in cadences (B) | ratio (B/A) | total overlong syllables (A) | overlong syllables in cadences (B) | ratio (B/A) |
| 1 | 2185 | 256 | 11.7% | 2313 | 266 | 11.5% |
| 2 | 588 | 68 | 11.6% | 613 | 74 | 12.1% |
| 3 | 683 | 83 | 12.2% | 714 | 83 | 11.6% |
| 4 | 635 | 97 | 15.3% | 659 | 95 | 14.4% |
| 5 | 695 | 104 | 15% | 719 | 104 | 14.5% |

[15] Simplification of a geminate stop after a sonorant may appear to be a universal phonetic phenomenon, but there are languages which have a phonemic contrast between RT and RTT clusters; e.g. Finnish *vanki* 'prisoner' vs. *vankka* 'firm,' *pirta* 'reed' vs. *pirtti* 'log cabin,' *kontu* 'homestead' vs. *kontti* 'knapsack.'

[16] Most of the discussions in this and the next two sections have already appeared in Kobayashi (2001).

[17] See Kobayashi (2001:95) for technical details.

| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | 921 | 190 | 20.6% | 965 | 199 | 20.6% |
| 7 | 917 | 117 | 12.7% | 982 | 125 | 12.7% |
| 8 | 1501 | 158 | 10.5% | 1564 | 165 | 10.5% |
| 9 | 804 | 113 | 14.1% | 831 | 115 | 13.8% |
| 10 | 2341 | 291 | 12.4% | 2408 | 298 | 12.4% |

(from Kobayashi 2001).

Assuming that uncounted 8.6% of the pādas show the same ratio as the counted pādas, and excluding overlong syllables containing *īr* and *ūr* which originate from a sequence of a short vowel and a laryngeal before a consonant (*ṛH > *īr*/*ūr* / _C), the maximal ratio of overlong syllables in the three non-final cadence syllables is estimated as 14.4%. If we suppose that the Ṛgveda consists only of verses with 12, 11 or 8 syllables, then these three types occupy approximately 28%, 44% and 28% respectively, and the average number of syllables in one verse is 10.44. Excluding the final syllable, the average ratio of the three cadence syllables would then be 3 ÷ (10.44 − 1) = 31.8%. Since only 14.4% or less of all non-final overlong syllables occur in 31.8% of all non-final syllables, avoiding overlong syllables in cadences can be considered to be a general tendency of the Ṛgvedic meter. The ratio of overlong syllables in each book of the Ṛgveda does not differ significantly, although it is a little higher in the sixth book.

## §23 Native grammarians on consonant doubling

Although the Vedic poets seem to avoid consonant clusters which create overlength, phonological rules related to consonant clusters apparently take the opposite direction in the late Vedic period, when the Prātiśākhyas and Pāṇini describe various consonant insertions within a cluster. The following are the most basic rules related to consonant timing, namely gemination rules (Varma 1929:99–125, V. Mishra 1972:202–204, Cardona Unpubl. Ms).

| input | output | TPr. | ṚPr. | VPr. | ŚCĀ | Aṣṭ. |
|---|---|---|---|---|---|---|
| **-VC$_1$C$_2$-** | **-VC$_1$C$_1$C$_2$-** | 14.1 | 6.1 | 4.99 | 3.2.3 | *8.4.47*[i)] |
| **-V{*r,h*}C-** | **-V{*r,h*}CC-** | | | 4.100 | 3.2.8 | *8.4.46* |
| -V{*r,h*}C$_{(\neg S)}$[ii)]- | -V{*r,h*}CC- | | | | 3.2.9 | 8.4.49 *śaro 'ci* |
| -VrC- | -VrCC- | 14.4 | | | | |
| -V{F,W}C- | -V{F,W}CC- | | | 4.101 | | |
| -V{F,L}K- | -V{F,L}KK- | | *6.2* | | | |
| -VFK- | -VFFK- | | *6.2* | | | |
| -VC$_1$C$_2$- | no doubling | | | | | 8.4.52 |
| -VC$_1$C$_2$C$_3$- | no doubling | | | | | *8.4.50* |
| no doubling whatsoever | | | | | | *8.4.51* Śākalya |

[i)] Rules in slanted numbers are optional. [ii)] I.e. a consonant other than a sibilant.

Rules involving articulatory transition (e.g. -VFKV- > -VFTKV- in TPr. 14.9 and ṚPr. 6.2) could be just a microscopic description of differential phases and might have

nothing to do with duration of the consonants in question. There is no doubt, however, that the gemination rules deal with differences in duration.

The question then naturally arises regarding the phonological motivation behind the doubling rules. It is at least clear that the doubling rules are meant for creating geminates in certain environments, and that making the syllable overlong is simply a concomitant phenomenon; for there are rules which cancel doubling if a homorganic occlusive cluster would be attained otherwise, i.e. TPr. 14.23 *savarṇa-savargīya-paraḥ* "A letter followed by one homogeneous with itself, or one of the same mute-series, is not duplicated." (Whitney 1868:307), ŚCĀ 3.2.7 *sast*$^{h}$ *āne ca* (*na*), or VPr. 4.110 *savarṇe*.

Judging from the fact that Sanskrit allows -VC or even tautomorphemic -VrC in word-final position, -VC$_1$C$_1$K- and -VrC$_1$C$_1$V- will be syllabified as -VC$_1$.C$_1$K- and -VrC$_1$.C$_1$V- respectively. If that observation is valid, the motivation for doubling might be to create gemination *across the syllable boundary*. In terms of constraint ranking, what happened between the period of the Vedic poets and that of the native grammarians was a reranking of the constraints on syllable weight and on syllable boundary. By the time of the native grammarians, requiring homorganic occlusives across a syllable boundary has become a highly ranked contraint, and an overlong syllable is no longer as bad as consonants of different aperture across a syllable boundary:

| | | | |
|---|---|---|---|
| Early Vedic | No overlength | ≫ | Same consonantal aperture |
| ↓ | | | |
| Prātiśākhyas | Same consonantal aperture | ≫ | No overlength |

### §24 Syllable weight and cluster rules in Iranian

The observations of native grammarians on syllable boundary discussed in the preceding section are different from the original tendencies of Proto-Indo-European in two respects. In the first place, geminate consonants in Indo-European languages all result from place assimilation of heterorganic consonants, with the possible exception of the geminate in Hitt. *atta-* 'father,' Gk. *átta* etc. (Szemerényi 1990:115). Gemination is strictly avoided in Avestan (Hoffmann and Forssman 1996:108). Secondly, we noted above in §21 and §22 that many Indo-European languages and the meter of the Ṛgveda share a tendency to avoid overlong rimes, which does not seem to take precedence in the gemination rules of native Sanskrit grammar.

Since Brugmann's Law blocks lengthening and lowering of PIE *ŏ before a consonant cluster, it would naturally follow that Proto-Indo-Iranian syllabifies the first consonant of a cluster as a part of the syllable to its left.[18] Comparison of Avestan with corresponding Vedic forms, however, suggests a difference in cluster syllabification between Iranian and Indo-Aryan. Avestan allows more diverse obstruent clusters than Vedic in syllable onset:

[18] See Kuryłowicz (1977:166ff.) for a morphological account for Brugmann's Law.

| | |
|---|---|
| OYAv. *pt ā* ~ OAv. *t ā* nom.sg. 'father' | : Skt. *pit ā* |
| YAv. *xštuua-* m. 'sixth' | : — |
| YAv. *fšt ānа-* 'breast' | ~ Skt. *stána-* |
| OAv. *zd ī* 'be!' | : Skt. *ed$^{h}$í* < *azd$^{h}$í |

On the other hand, the variety of consonants occurring in word-final position is not as broad as in Vedic, given that many final clusters end in a sibilant and *-t̰* probably had no release (Morgenstierne 1942:70f.): *-m*, *-ṇg* (< *-ms), *-t̰*, *-š*, *-s*(*-c q́a*), *-śst* (< *-s-t), *-št*, *-xš*, *-fš* and *-rš*.[19] These final clusters with an /s/ contrast sharply with Sanskrit, where a sibilant cannot become a coda unless it is followed by an onset voiceless stop (§31); in this respect, Avestan is closer to Greek, which allows a final stop only when followed by a sibilant, e.g. Gk. *gála* nom.sg.n. 'milk' < /galakt/ : *t$^{h}$ríks* nom.sg.f. 'hair.' If this distribution of consonants in initial and final position reflects an internal syllable structure by the Laws of Initials and Finals (§26), it would follow that Avestan favors a zero or minimal coda while allowing consonants to be crammed into the onset.

Anaptyxis in internal clusters, another strategy of Avestan to repair coda consonants, is extensive but not very consistent, partly due to the chronologically and geographically mixed background of Old and Younger Avestan, and partly due to the non-transparent assimilation of voicing and frication among consonants. Anaptyctic ə breaks up internal clusters, particularly in Old Avestan (Hoffmann and Forssman 1996:51): YAv. *nəmas$^{ə}$.t ē* : Skt. *námas te*; OAv. *kar$^{a}$p ā* 'ritualist.' ə is inserted after *r* in Old and Younger Avestan, except before *ii* and *uu*, and in *á/ərt (> š̰), *á/ərk and *á/ərp (> *hr*), e.g. OYAv. *ar$^{ə}$θa-* : Skt. *árt$^{h}$a-*; OYAv. *vadarə́$^{ə}$* : Skt. *vád$^{h}$ar*; PIIr. *vr̥ka- > YAv. *vəhrka-*; *árta > OYAv. *aš̰a-* (Hoffmann and Forssman 1996:51, 92).

Among the native grammarians' restrictions on consonant clusters (§27), those of Pāṇini, and of the Ṛk-Prātiśākhya to a smaller extent, resemble the Avestan treatment of coda consonants. If the descriptions of these grammarians reflect actual dialectal features of the schools they belong to, their dialects, which are usually identified as belonging to the upper Indus valley and the Punjab, might represent a transitional state between Indo-Aryan and Iranian.

### §25 Summary

When Brugmann's Law took place between Proto-Indo-European and Proto-Indo-Iranian, an intervocalic cluster such as -VCCV- must have been syllabified as -VC.CV- (§24). By transferring the contrast of vowel quality into one of duration, this law made many light syllables heavy in Proto-Indo-Iranian. On the other hand, the distribution of consonants in Avestan onsets and codas (§24), and the reduplication Pāṇini assumes (§29 in Chapter III), point to a cluster syllabification which minimizes syllable codas (§16). This is probably an innovation of Iranian and Northwest Indo-Aryan, for the poets of the Ṛgveda still avoid a consonant cluster following a long vowel in cadences

[19] For Bartholomae's equation of OAv. *yaogaṯ* with Ved. ˣayok, where the former is claimed to preserve the final cluster of PIIr. *a-i̯au̯k-t better, see Kellens (1974:299f.).

(§22), suggesting that the first syllable of the sequence -V̄CCV- is heavier than that of -V̄CV-, i.e. they are syllabified as -V̄C.CV- and -V̄.CV- respectively.

Contrary to the tendency to avoid overlong rimes, Old Indo-Aryan as known from the Prātiśākhyas shifts the emphasis of the criteria for well-formedness from the length of the rime to the presence of consonants of the same aperture across a syllable boundary (§23). In the Prātiśākhyas, agreement of place and aperture, or at least identical aperture, of consonants across a syllable boundary becomes more important than keeping the rime no more than two morae long; and when the consonants across a syllable boundary have different apertures, a repair process geminates one of them in order to attain the same aperture across the syllable boundary even though it may make the preceding rime overlong. Judging from the word-initial and -final distribution of consonants, Avestan allows a heavy onset and prefers a light coda (§24).

# Chapter III. Syllable Boundary and Position of Sibilants

## §26 Restrictions on word-final consonants

On the basis of crosslinguistic evidence, Vennemann (1972) postulates the Law of Initials, a principle of cluster syllabification which states that "[m]edial syllable-initial clusters should be possible word-initial clusters" (Vennemann 1972:11). As Vennemann admits, this principle is not followed by all languages and is often violated, but it helps in defining the canonical structure of a syllable, especially in languages for which native speakers' judgments are not available. On the other hand, the end of a word is a typical place for constituents such as a segment or a syllable to count as 'extrametrical,' i.e. to be free from certain phonological restrictions.[1] Due to such extrametrical elements, the Law of Finals, which is the reverse of the Law of Initials, is not as strong as the latter,[2] but the phonemic distribution in word-final position must reflect at least some of the restrictions of the language on syllable rimes.

In Sanskrit, only stops or sonorants other than the semivowels /y/, /v/ and /r/, which are grouped under the common feature [−continuant], can occur at the end of a word in open juncture. A rule which applies to almost all word-final clusters is the loss of final clustered consonants except the one which immediately follows the last vowel (Pāṇini, Aṣṭ. 8.2.23), e.g.: /á-myakṣ-t/ aor.3sg. of √*myakṣ* 'to put together' > *ámyak* (ṚV 1.169.3); /á-yāj-s-t/ aor.3sg. of √*yaj* 'to offer' > *ayāṭ*; PIE *dont-s nom.sg. 'tooth' > *dán*, cf. Lat. *dēns* nom.sg.; PIE *nok$^{w}$t-s nom.sg. 'night' > *nák* (ṚV 7.71.1), cf. Goth. *nahts*.

A final cluster of /r/ and a stop, however, is possible even after a long vowel if both segments belong to a verbal root or a root noun (Wackernagel 1896:304f., Renou 1952:82, Pāṇini, Aṣṭ. 8.2.24 and Cardona 1997:348 §542); e.g. ṚV *avart* < */a-vart-t/ ipf.3sg.act. of √*vart*/*vṛt* 'to turn' (ṚV 7.59.4 *ā́vart sumatír*), AV *suhā́rt* nom.sg. of *suhṛd-* 'friend' (AVŚ 2.5.7 *suhā́rt téna*), and VS *ū́rk* nom.sg. of *ūrj-* 'strength' (VSM 17.1 *ūrk*♯♯). This does not apply to other sonorant-stop sequences, e.g. ṚV *acc$^{h}$ān* < /a-c$^{h}$ānd-s-t/ aor.3sg.act. of √*c$^{h}$and* 'to appear.' The exceptional retention of the stop in the final /rT/ cluster (if it was really pronounced as a cluster; cf. svarabhakti in §27) could be explained by regarding the stop in a tautomorphemic /rT/ cluster as extrametrical. Other cases of final extrametricality, however, are conditioned by purely phonological contexts, and stipulating a complex morphophonemic conditions does not yield much insight into extrametricality or the simplification of final clusters. I would rather like to suggest that an acceptable coda consists of one non-continuant by the Law of Finals,

[1] The notion of extrametricality was first proposed by Liberman and Prince (1977). According to the definition of Hayes (1995:57), "An extrametricality rule designates a particular prosodic constituent as invisible for purposes of rule application: the rules analyze the form as if the extrametrical entity were not there."

[2] Vennemann (1972:13) cites the Sanskrit doubling rule in §23 as an example of the Law of Finals, so we need to collect data from other languages to confirm its crosslinguistic applicability.

but when application of that principle would cause two radical consonants to drop or mutate, it is violated, overridden by another principle which disfavors altering the root morpheme beyond recognition.

When the surviving final consonant is a non-continuant (i.e. a plosive or a nasal), it remains unchanged except that voicing, aspiration, and affrication (if any), of a plosive are neutralized. The continuants /s/ and /r/, on the other hand, are neutralized as a non-phonemic pharyngeal release called visarga (*ḥ*, see §104). The distinction between them, however, remains in the Underlying Representation if /a/ or /ā/ precedes, for the original /r/ in *vā́ḥ*, nom.sg. of *vā́r-* n. 'water' or *dvā́ḥ*, nom.sg. of *dvā́r-* f. 'door,' surfaces before vowels as in ṚV 4.5.8 *vā́r iva*, unlike the visarga in final *-aḥ* < /-as/ and *-āḥ* < /-ās/ which is deleted in the same environment.

While the leftmost segment of a final cluster remains in the surface form, the final sonorants /n/ and /r/ are lost in the nominative singular of non-neuter stems formed with the suffixes *-tar-* (including *-tar-* in kinship terms), *-an-*, *-man-* and *-van-*. The stem is supposedly followed by the case-marker *-s in the nominative singular, and then both the stem-final sonorant and the *s disappear, leaving compensatory lengthening of the preceding vowel (Szemerényi's Law). Cf. *pitā́*, nom.sg. of *pitár-* 'father,' Av. *ptā* etc. < *ph$_2$tér-s, *rā́jā* nom.sg. of *rā́jan-* 'king' < *(H)rḗǵen-s (Szemerényi 1990:121) or, alternatively, from *ph$_2$tḗr and *(H)rḗǵōn with the suffix vowels in the lengthened grade (Szemerényi 1990:179ff.). A final /n/ of a root noun is also lost in the nominative singular, as in *vṛtra-hā́*, nom.sg. of *vṛtra-hán-* 'Vṛtra slayer,' Av. *vərᵊθra-jā-ja* 'id.' Since the final /n/ and /r/ of these stems were lost by the time of Proto-Indo-Iranian, or possibly even earlier (Debrunner and Wackernagel 1930:271, 203), their alternation pattern should have already been grammaticalized when they were inherited by Indo-Aryan, so it need not be considered in a synchronic context.

As inferred from word-final position, the distribution of consonants in syllable coda is fairly restrictive: in principle, only one non-continuant is allowed as a coda consonant.

### §27 The native grammarians' rules for the coda

In addition to what the distributional patterns tell us, the Prātiśākhyas prescribe interesting rules which give further insight into the restrictions on the syllable coda. The Śaunakīyā Caturādhyāyikā (1.4.10, 11) teaches that when a consonant cluster begins with an /r/, an extra-short portion of /a/ (probably [ə], cf. ŚCĀ 1.1.36 *saṃvṛto 'kārāḥ*) called *svarabhakti* is inserted after the /r/ (Allen 1953:73ff.); the anaptyxis vowel is longer if the cluster is /rS/. The Ṛk-Prātiśākhya (6.46), the Taittirīya-Prātiśākhya (21.15) and the Vājasaneyi-Prātiśākhya (4.16) have similar rules of anaptyxis, but the rules in the latter two operate in a fairly limited context, i.e. only before a sibilant. Furthermore, /ᵃ/ is inserted between an /r/ and a following sibilant in the Taittirīya-Prātiśākhya (21.15), but not when the /r/ is followed by a geminate. In the first case, the syllable boundary is after /rᵃ/ (TPr. 21.6), whereas the syllable ends in /-rC/ if the C is the first element of a geminate (TPr. 21.5). This provides further support for the idea that a geminate is preferred to a heterorganic cluster or a cluster of consonants with different aperture

across a syllable boundary (see §23).

| | | |
|---|---|---|
| | ŚCĀ | /rSV/ → /r$^{a}$.SV/ (1.4.10) |
| | | /rC$_{(\neg S)}$V/ → /r$^{ă}$.CV/ (1.4.11) |
| more restrictive ↓ | RPr. | /VrC/ → /Vr$^{r}$.C/ (6.46) |
| | VPr. | /{r,l}SV/ → {/r$^{r}$,l$^{l}$/}.SV (4.16) |
| | TPr. | /rS/ → /r$^{a}$.S/ (21.15) :: /rC$_1$C$_1$/ → /rC$_1$.C$_1$/ (21.16) |

Regarding the context of our discussion on the syllable coda, the insertion of *svarabhakti* after /r/ implies that /r/ cannot end a syllable just as it cannot end a word (§26, §104), and that a heterorganic cluster of consonants with different degrees of aperture must be repaired if a syllable boundary would intervene.

On heterorganic clusters other than /rC/ which straddle a syllable boundary, native grammarians teach *abhinidhānana* or checking of release (Allen 1953:71ff., Varma 1929:137ff.). In the Ṛk-Prātiśākhya, it applies even to semivowels like /y/ which have no occlusion to release; /r/, on the other hand, is excluded from the context of *abhinidhānana* because *svarabhakti* is inserted instead. In the following table, a letter in boldface stands for a consonant which should not be released according to the passages listed in the left column.

| | | |
|---|---|---|
| ŚCĀ 1.2.4 | **K**K | *sparśasya sparśe 'b$^{h}$inid$^{h}$ānaḥ* |
| RPr. 6.17 | **{K,W$_{(\neg r)}$}**K | *ab$^{h}$inid$^{h}$ānaṃ kṛtasaṃhitān āṃsparśāntast$^{h}$ān ām apavādya rep$^{h}$am/ ...* |
| RPr. 6.18 | **{K,W}**]$_{wd}$ | *api cāvasāne* |
| ŚCĀ 1.2.5 | **K**]$_{wd}$ | *padānt āvagrahayoś ca* |
| VPr., TPr., Aṣṭ. | — | not mentioned |

These rules suggest that some dialects do not only disfavor different aperture of consonants across a syllable boundary, but also require the aperture of the cluster to be uninterrupted.

### §28 /s/-insertion and the cohesive closure of Indo-Aryan stop clusters

While other Indo-European languages, and probably late Proto-Indo-European as well,[3] insert an *s between two successive heteromorphemic dental stops *-t-t- and *-d-t-, Indo-Aryan eliminated the /s/ in this environment after it branched off from Proto-Indo-Iranian.

| geminating | blocking gemination |
|---|---|
| PIE *u̯id-tó- | PIE *u̯id-tó- > Avestan *vista-* 'found,' |
| > Sanskrit *vittá-* | Gothic *(un-)wiss* '(un)certain,' |
| 'found' | Greek *(á-)istos* '(un)seen,' Latin *vīsus* 'seen'; |
| | PIE *u̯id-tu-s > Old Irish *fius* 'knowledge'; |
| | PIE *h$_1$ed-ti > Hittite *ēzza(z)zi* /ēt$^{s}$.t$^{s}$i/ 'eats.' |

(Mayrhofer 1986:111, Meiser 1998:124)

[3] Meillet (1922:61, "dialectes orientaux"), Mayrhofer (1986:110f.).

This insertion of an *s in Proto-Indo-European, or possibly affrication of the first of a cluster of two dental stops, has an effect of preventing the dental stops from forming a geminate. Proto-Indo-European has almost no reconstructible tautomorphemic geminate.[4] When two dental stops adjoin one another in the combination of morphemes, the Obligatory Contour Principle (§7) requires their timing slots to link multiply to one dental stop, i.e. the two adjoining dental stops are required to form a geminate; the insertion of *s, their continuant counterpart, blocks gemination across a morpheme boundary, which was probably disfavored in Proto-Indo-European phonology.[5]

As we saw in §23 and §24, Avestan strictly disallows gemination, whereas Old Indo-Aryan has geminates in profusion, and the Prātiśākhya texts even prescribe gemination of etymologically single consonants in certain clusters. Some fundamental change in the restrictions on consonant clusters seems to underlie this divergence, and it must be within Indo-Aryan that the change took place, for the tendency toward gemination is stronger in the dialects reflected in the recitation traditions accounted for by the Prātiśākhyas than in Early Vedic, where rimes longer than two morae tend to be avoided in the cadence of a verse (§21).

In Indo-Aryan, plosives across a syllable boundary cannot be interrupted by a continuant consonant like a sibilant, and even the suffix /-s-/ of the aorist as in /á-rud$^{h}$-s-ta/, s-aor.3sg.mid. of √*rod$^{h}$/rud$^{h}$* 'hinder,' is eliminated in the surface form *arudd$^{h}$a* through */á-rud$^{h}$-z-d$^{h}$a/ because it is trapped and strayed between two plosives, while the same *s remains in the Surface Representation between a plosive and a nasal as in *a-bud$^{h}$-s-mahi s-aor.1pl.mid. of √*bod$^{h}$/bud$^{h}$* 'wake' > *ab$^{h}$utsmahi*. In other words, Indo-Aryan has developed a distinctive restriction on juxtaposition of plosives across a syllable boundary: the closure of two plosives across a syllable boundary has to be cohesive there.

> Principle of Cohesive Closure: In Indo-Aryan, the closure of two plosives in the same consonant cluster should not be interrupted by a continuant consonant.

In Early Vedic, by which I refer to the synchronic grammar of the Ṛgvedic poets, there is already no known difference between the metrical behavior of -TR- as in *kṛ́tvan* 'active' < *kṛ-t-van, and that of -TTR- as in *b$^{h}$ittv$\widehat{a}$* 'having split' < *b$^{h}$id-tvā. Words like *árt$^{h}$am*, on the other hand, were probably still syllabified *ár.t$^{h}$am*, for the tendency to avoid overlong syllables in the cadences of the Ṛgveda suggests that alternative forms with a consonant doubled after an *r* like *árt.t$^{h}$am* (§23) are not Ṛgvedic. Then, by the

[4] With the exception of Hitt. *atta-* 'father,' Gk. *átta* etc. Unlike Proto-Indo-European, Proto-Dravidian is reconstructed with geminates (§110).

[5] Essentially the same observation was given already by Kent (1932:26): "The speaker [of primitive Indo-European] was accustomed to utter only short consonants; when because of the functional importance of the two sounds he had to pronounce two dental stops in succession, he did not utter them as one long *t*, but as two short *t*'s ... The breakage of the stoppage and the emission of the breath at this point is easily audible and may well have become stronger in an effort to articulate clearly, the ultimate product being the dental sibilant, voiceless or voiced, according to the stops themselves." For a detailed explanation of the effects of the Obligatory Contour Principle, see McCarthy (1986).

time of the Prātiśākhyas, agreement of not just closure but also of place comes to be preferred, and doubling such as in *akktuḥ* or *artt$^h$am* becomes the general pattern.

The restriction on the closure of plosives across a syllable boundary, and the later addition of the preference for agreement of place, may be formulated as follows:

> Coda Condition (Early Vedic):
> a) A sonorant can be a coda consonant.
> b) An obstruent ([−sonorant]) can be a coda only when the following syllable begins with a segment with the same [$\alpha$continuant] value.
>
> (Prātiśākhyas):
> c) The place feature of the onset plosive should agree with that of the coda plosive of the preceding syllable, if any.

Condition a) obviously omits clusters of the type /ST/ like *st* in *hástaḥ* 'hand.' As we will argue in §31, Indo-Aryan syllabification allows one sibilant before an initial voiceless plosive, and I will propose there that such a sibilant is not a part of the syllable which follows it but an external appendage to it. This notion of an extrasyllabic sibilant explains, for example, why a sibilant can occur word-finally only when the following word begins with a voiceless plosive, particularly a coronal, as in *havíś ca*, *agníṣ ṭv ā*, *divás pári*, or *vásuṣ kavíḥ*. In order to derive *arudd$^h$a* and *utt$^h$ā́ya* correctly from *á-rud$^h$-s-ta and *ut-st$^h$ā́ya, on the other hand, the licensing of sibilants as extrasyllabic must be overridden by the Coda Condition.

Although palatal plosives may behave as [+continuant] on their right edge, their fricative component is not treated as an extrasyllabic appendage, as shown by the lack of clusters beginning with a palatal plosive followed by another plosive. As we will see in §37, the palatal plosives do not behave exactly like fricatives on their right edge.

## §29 Dialectal variation of syllable-boundary rules

In §23, we observed that geminated consonants straddling a syllable boundary are favored in the phonology described by the Prātiśākhya literature, even if the resulting syllable rimes exceed two morae. That argument is too simplistic, however, for doubling is not accepted unanimously by the native grammarians. Furthermore, the Prātiśākhyas offer various views on consonant syllabification, including doubled consonants, in TPr. 21.1–9, ṚPr. 1.23–26, VPr. 1.99–106 and ŚCĀ 1.2.15–18 based on their observations on syllable weight and the accentual property of consonants, and some of them do not seem to agree with what I assumed above (Varma 1929:61–83, Cardona Unpubl. Ms).

The Onset First Principle: All texts (TPr. 21.2, ṚPr. 1.23, VPr. 1.100, ŚCĀ 1.2.15) agree on the point that a consonant adjoining vowels on both sides belongs to the following syllable; in phonological terms, this amounts to the Onset First Principle. Ambisyllabicity as of English intervocalic consonants is not known in Old Indo-Aryan.

Inclusion of a word-final coda: As for the word-final coda, all texts except the Ṛk-Prātiśākhya (TPr. 21.3, VPr. 1.101, 106, ŚCĀ 1.2.17) treat them as belonging to the immediately preceding syllable, but there is no release according to ŚCĀ 1.2.5, as we saw above in §27. On the other hand, RPr. 1.24 mentions only anusvāra (*ṃ*) and visarga (*ḥ*) as a part of the preceding syllable.

Onset-maximizing vs. coda-maximizing dialects: In a cluster of two different consonants, the first one belongs to the preceding syllable according to the same three texts (TPr. 21.4, 6, VPr. 1.102, ŚCĀ 1.2.16), but it is just optional according to ṚPr. 1.25 *saṃyog ādir v ā* A syllable boundary falls between geminate consonants according to the Taittirīya-Prātiśākhya and the Vājasaneyi-Prātiśākhya (TPr. 21.4 before a different consonant, 21.7 before a heterorganic semivowel, 21.9 before a sibilant, VPr. 1.104), but this rule too is optional in the Ṛk-Prātiśākhya, and the Śaunakīyā Caturādhyāyikā limits it to the context after /r/ or /h/ (ṚPr. 1.26, ŚCĀ 1.4.18).

TPr. 21.5 teaches that all but the last consonant of a cluster, provided that it is a non-continuant (21.7), belongs to the preceding syllable, and similarly VPr. 1.105, although the context is formulated as -$C_1C_1C_2$.K-. The cluster syllabification represented in these two texts is characterized by preference for geminates across a syllable boundary and a small onset, while the Ṛk-Prātiśākhya has greater limitations on the syllable coda.

Doubling vs. non-doubling dialects: According to Aṣṭ. 8.4.51 *sarvatra śākalyasya* (46 *dve*, 48 *na*), Śākalya, the supposed author of the Pada-pāṭha of the Ṛgveda, does not allow consonant doubling in any context, representing the strictest line against consonant doubling. The four Prātiśākhyas agree on doubling of one consonant before another as in *pátram* → /pattram/ (§23), and also on doubling after an /r/ as in *árd$^h$am* → /árdd$^h$am/. While the Ṛk-Prātiśākhya and the Śaunakīyā Caturādhyāyikā have doubling rules as extensive as the other two Prātiśākhyas, they have another way to repair /rC/ clusters, namely svarabhakti (§27). Śākalya's rule against doubling might not be his idiosyncrasy alone, but might represent actual dialectal variation, and interestingly, the Ṛk-Prātiśākhya, which belongs to his school, mentions a way to get around one of the contexts of doubling, i.e. through svarabhakti.

To sum up, these rules give a spectrum of restrictions on syllable coda and boundary like the following:

| | | |
|---|---|---|
| Pāṇini | rime | -V, but possibly -VC in _]$_{wd}$ and in doubling |
| | C.C | might not be presupposed at all (Cardona) |
| ṚPr. | rime | -VC optionally allowed, but no release |
| | C.C | need not be homorganic |
| ŚCĀ | rime | -VC is okay, but no release |
| | C.C | must be homorganic |
| TPr./VPr. | rime | -VC is fine |
| | C.C | must be homorganic |

(from Kobayashi 2001)

## §30 Position of sibilants in the Vedic syllable

When a consonant cluster ends in a sibilant, the consonant to its left obeys the same restrictions as when it is followed by a plosive: A stop followed by a sibilant has to have the same voicing status, i.e. has to be voiceless, and cannot have aspiration or affrication, as the latter can occur only at the left edge of a sonorant or of a sequence of sonorants. On the other hand, sibilants in the Vedic syllables differ from other obstruents in the following points:

i) No sibilant may occur in final position: Like aspirated stops and /r/, sibilants cannot appear in absolute final position. Although distributional restrictions across a word boundary need not necessarily constrain medial strings, this might suggest that a syllable in Vedic cannot end in a sibilant (Varma 1929:74f.).
ii) Doubling of non-continuants after a sibilant: Syllables can apparently end in a sibilant. We have seen above, however, that consonants with different degree of closure tend to be avoided across a syllable boundary. The doubling rule -VFK- > -VFK.K- in the Vājasaneyi-Prātiśākhya has the effect of preventing a fricative from ending a syllable; on the other hand, the same treatise prescribes doubling of consonants, including fricatives, after /r/ and /h/ (-{r,h}F- > -{r,h}F.F-), so a fricative may be allowed in a syllable coda when it is geminated.
iii) Violation of the Sonority Sequencing Principle: Sibilants can occur in any position of an onset cluster, including the first position followed by a voiceless plosive. Since fricatives are higher in the universal scale of sonority, such a cluster violates the Sonority Sequencing Principle.

## §31 The extrasyllabic sibilant

In English clusters such as the onset of *s̲tate* and the coda of *sixths̲*, /s/ are less restricted in their distribution than in Vedic. Following Fujimura and Lovins (1978), Halle and Vergnaud (1980) and Kaye, Lowenstamm and Vergnaud (1990), Treiman, Gross and Cwikiel-Glavin (1992:396f.) suggest that /s/ in an onset cluster composed of a sibilant and an obstruent or sonorant, such as in *s̲tate* and *s̲wing*, is an affix, and not part of the

onset of a syllable.[6] They show by perceptual experiments that English speakers treat /s/ in such clusters as belonging to the end of the first syllable, while clusters of an obstruent and a sonorant such as /dr/ syllabify in syllable onset according to the principle of ONSET MAXIMIZATION. The term 'semisyllable' has also been used (Kiparsky 1999:151) for those consonants which cannot be syllabified but are licensed to remain in the Surface Representation on either side of a syllable.

This idea of a syllable appendage or semisyllable can also be used to explain the distributional peculiarities of Sanskrit sibilants. In Sanskrit, a voiceless plosive in the syllable onset licenses a homorganic sibilant to appear on the left side of the syllable. In the following sections, a sibilant in that position is called an *extrasyllabic sibilant*, for it enjoys a special status in that it does not belong to the syllable onset, but projects a mora when preceded by a sonorant. A syllable-initial sibilant followed by a sonorant, on the other hand, is not licensed in this way, for it is distributionally no different from the other obstruents, and is considered to be a part of the onset (see below §32). If visarga (*ḥ*), a word-final alternant of /s/, can be regarded as a non-phonemic pharyngeal release, the distribution of Vedic sibilants may be described as follows:

> In Sanskrit, a sibilant can occur either in the syllable onset, or to its left as an extrasyllabic sibilant when the onset begins with a voiceless plosive. In the syllable onset, it can precede a sonorant and follow a voiceless stop, in conformity with the sonority scale Plosive < Sibilant < Sonorant < Glide < Vowel.
>
> Dialects which allow secondary gemination of sibilants allow a coda sibilant when another homorganic sibilant follows it, due to the restriction of identical aperture and place features across a syllable boundary.

| | example | synchronic representation |
|---|---|---|
| .SV- | *sa* | /sa/ |
| .SRV- | *tisraḥ, śrutá-* | /tis.(s)raḥ/, /śru.tá-/ |
| .TSV- | *kṣa͡m, tsárati* | /kṣa͡m/, /tsá.ra.ti/ |
| .TSRV- | *kṣmáḥ, kr̥tsná-* | /kṣmáḥ/, /kr̥t.tsná-/ |
| <S>$P_{[0voiced]}$- | *skand$^{h}$á-, ścandrá-* | /<s>kan.d$^{h}$á-/, /<ś>can.drá-/ |
| -V<S>.$P_{[0voiced]}$- | *ásti* | /á<s>$_{\mu}$.ti/ |
| -VW<S>.$P_{[0voiced]}$- | *ma͡rṣṭi* | /ma͡r<ṣ>$_{\mu}$.ṭi/ |

What is puzzling about this definition is that an extrasyllabic sibilant projects a mora when there is a sonorant to its left even though it is defined as an appendage of the following syllable. To avoid such an undesirable consequence, we need to distinguish the underlying level, where syllable phonotactics refers to the notion of an extrasyllabic

[6] Treiman, Gross and Cwikiel-Glavin (1992:396f.) "/s/ may be an affix—a segment that is not part of the syllable's onset but that adjoins itself to the word or syllable during the final stages of phonological derivation."

sibilant, from the surface level, where the 'metrical' syllable projects morae without reference to phonotactic templates.[7]

While an extrasyllabic sibilant is eliminated between plosives as in /á-rud$^{h}$-s-ta/ > *árudd$^{h}$a*, the same /s/-morpheme remains in the surface at the cost of the closure of the preceding nasal in /á-man-s-ta/ > *ámaṃsta* s-aor.3sg.mid. of √*man* 'think.' In Optimality Theory, this priority relationship among principles is expressed by ranking them in the following order: Cohesive closure of a PP cluster ≫ Licensing sibilants as extrasyllabic ≫ Cohesive closure of an NP cluster.

## §32 Supporting arguments for sibilant extrasyllabicity

I mentioned in the preceding section (§31) that a syllable-initial sibilant followed by a sonorant is just a normal onset cluster and is not considered to be licensed, unlike the English /sR/ clusters according to the analysis of Treiman, Gross and Cwikiel-Glavin (1992). The difference between clusters of the types /SP/ and /SR/ is shown in the difference in reduplication. The reduplicating consonant of a root beginning with an /S/ cluster differs depending on the consonant which follows the /S/:

| | |
|---|---|
| √*st$^{h}$ ā* 'stand' | act.pf.1sg. *ta-st$^{h}$-au* |
| √*sn ā* 'bathe' | act.pf.3pl. *sa-sn-ur* (Ep.) |
| √*syand* 'gallop' | pf.act.3pl. *si-ṣyad-úr* (AVŚ) |

As the form *ta-st$^{h}$-au* shows, Indo-Aryan forms the reduplicant of a root beginning with an /SP/ cluster with the plosive instead of the sibilant, while other Indo-European languages including Avestan, the closest sibling of Indo-Aryan, have the sibilant as the onset of a reduplicating syllable.

| root | Latin | Greek | Avestan | Vedic |
|---|---|---|---|---|
| √steh$_2$ 'stand' | *sist ō* 'place' | *híst ēmi* (*s > *h*) | YAv. *hištəṇti* (*s > *h*) | *tíṣṭ$^{h}$ati* |
| √sḱend 'appear' | | | | *cacc$^{h}$anda*[i)] |
| √sperd$^{h}$ 'contend' (*LIV*) | | | | *pasprḍ$^{h}$é* |

[i)] *LIV* s.v. "Neubildungen"

Instead of the traditional explanation of the first set of forms by reconstructing the reduplicant as *sti-, which develops into *ti- in Indo-Aryan and *si- elsewhere, we can make use of sibilant extrasyllabicity to account for this Indo-Aryan peculiarity. While other Indo-European languages treat a sibilant before an onset plosive as a part of the root, Indo-Aryan effectively excluded the sibilant of the onset */SP/ cluster from the root syllable when it came to license cluster-initial sibilants in the context SP{R,V}, so that the plosive of the onset cluster, instead of the sibilant, fills the single onset slot of the reduplicant template.

[7] See Marotta (1999:301) for the possibility of levels in describing Latin syllables.

Here I am postulating that only Indo-Aryan needs to license a sibilant before a voiceless onset plosive, while the other Indo-European languages cited above count a sibilant in that position either as part of the onset or as part of the coda of the preceding syllable. Support for this assumption comes from the distribution of sibilants in coda clusters of each language. As mentioned in §24, Avestan allows a word-final cluster if it ends in *š*, e.g. *-xš*, *-fš* and *-rš*. Similarly, Attic Greek allows final *-ks*, *-ps* and *-ls* as in *aíks* 'goat,' *klṓps* 'thief' and *háls* 'salt,' although stops and /l/ themselves cannot end a word. Latin allows final *-ns* and *-rs* as in *fōns* 'fountain' and *ars* 'skill,' stop + *s* as in *dūx*/-ks/ 'leader' and *inops* 'poor,' and even three-consonantal final clusters such as *arx* 'castle' *stirps* 'stem' or *falx* 'sickle' (Meiser 1998:113f.). Old Church Slavonic is closer to Sanskrit, for it allows an initial /SC/ cluster while lacking coda consonants, including sibilants, in word-final position (Shevelov 1965:224).[8]

| | $_{wd}$[ST- | -S]$_{wd}$ | -CS]$_{wd}$ | -CTS]$_{wd}$ |
|---|---|---|---|---|
| Latin | sT- | -s | -x, -ps, -ns, -rs | -lx, -rx, -rps |
| Greek | sT- | -s | -ks, -ps | -ŋks, -rks |
| Slavic | sT- | no | no | no |
| Avestan | FP- | -š,-s(t) | -xš, -fš, -rš | no |
| Sanskrit | SP- | no (-ḥ) | no | no |

Further support for the idea of sibilant extrasyllabicity comes from the sandhi of final /s/ before an initial /SP/ cluster. In this context, final /s/ fuses with the initial sibilant, e.g. /divás skamb$^{h}$ás/ > *divá skamb$^{h}$áḥ* (ṚV 4.13.5d), /agnís stave/ > *agní ṣṭave* (6.12.4b), and /gā́vas sp$^{h}$urā́n/ > *gā́va sp$^{h}$urā́n* (6.67.11c). Compared to other Indo-European languages, Indo-Aryan preserves the skeletal or moraic structure of the original string relatively well, but in this context, one of the two sibilants has to go, because only one sibilant may be licensed before a voiceless plosive onset.

### §33 History of internal sibilant clusters

*s, the only sibilant in Proto-Indo-European, does occur in succession in underlying strings such as *h$_1$es-si 'you are.' Traditionally it has been assumed that geminated sibilants were simplified already in Proto-Indo-European, on the basis of the reflexes Gk. *eî*, Lith. *esì*, Skt. *ási*, OAv. *ahī*, and that forms with double /s/ such as Hom. *essí*, Old Lat. (Plautus) *ess* are the result of restitution (Wackernagel 1896:111, Kuiper 1967b:105, Sommer and Pfister 1977:203f., Mayrhofer 1986:120f., Rix 1992:77f.).

Although Avestan has a variety of fricative clusters, such as YAv. *sixša-*, OAv. *-aoγžā*, OAv. *dafšniia-*, YAv. *aδβan-*, OYAv. *uxδa-*, clusters of two sibilants, or geminate

[8]The distribution of /s/ in Spanish syllables provides an example of a different type. In Spanish, an sC cluster is not allowed in the onset, and a word which etymologically contains an initial sC cluster has a prothetic vowel /e/, as in *espacio* 'space' < Lat. *spatium*, *escribir* 'to write' < Lat. *scrībere*, whereas /s/ can be attached to a coda consonant (and not before an onset consonant as in Sanskrit), according to the syllabification algorithm of Harris and Kaisse (1999): thus the /s/ in *transporte* 'transport' and *abstraído* 'absorbed' are not strayed, for they are syllabified as *trans.por.te* and *abs.tra.í.do*.

sibilants, are simplified as in Proto-Indo-European: YAv. loc.pl. *zazušu* < *-uš-su 'having left,' YAv. *uz ūti* < *uz-zūti- 'hervorsprudelnd' (Hoffmann and Forssman 1996:109).

This simplification of geminate sibilants is a productive rule in Avestan, for it applies to the sibilant clusters resulting from the deocclusion of PIIr. *ć and *ǰ as well, i.e. PIIr. *ćš, *ǰž > Av. *s, z* (Hoffmann and Forssman 1996:103), and it need not necessarily be reconstructed for Proto-Indo-Iranian. But the fact that Vedic preserves *ási* and a few more possible relic forms with degemination such as *apásu* (ṚV 8.4.14b) < /apás-su/, *barhiṣád-* (ṚV) < /barhis-sád-/, and *áṁhasu* (AVŚ 6.35.2c)< /áṁhas-su/ suggests that simplification of geminate sibilants still holds true in Proto-Indo-Iranian as in Proto-Indo-European.

## §34 Occurrences of geminated sibilants

Geminated sibilants occur in the Ṛgveda across morpheme/word boundaries, e.g. nominal *s*-stem + loc.pl. ending *-su* (9.7.2 *havíṣṣu*) and preverb *nis-* + stem/root beginning with /s/ (*niṣ-ṣíd$^h$-* etc.). Except for relics such as *duc$^h$ún ā* (§47), a sequence of /s/ and /ś/ always surfaces as *-ḥś-*, as in *duḥśáṃsa-*, *śúnaḥśépa-*, *duḥśéva* (1.42.2), *cátuḥśṛṅgaḥ* (4.58.2), *áyaḥś īṛṣā* (8.101.3), *duḥś ā́suḥ* (10.33.1), *duḥś ī́me* (10.93.14) etc. The examples of /-ḥ S-/ and /-S S-/ in the Ṛgveda are listed in the following table.

| *-ḥs-/-ḥṣ-* | poet | passage | *-ss-/-ṣṣ-* | poet | passage |
|---|---|---|---|---|---|
| | | | 1.10.5 | Madhucchandas Vaiśvāmitra | *puruniṣṣíd$^h$e* |
| | | | 1.31.14 | Hiraṇyastūpa Āṅgirasa | *ś ā́ssi* |
| | | | 1.64.4 | Nodhas Gautama | *vákṣassu* |
| 1.73.3 | Parāśara Śāktya | *puraḥsádaḥ* | | | |
| | | | 1.104.5 | Kutsa Āṅgirasa | *niṣṣap ī́* |
| 1.127.3 | Parucchepa Daivodāsi | *niḥṣáham āṇo* | | | |
| 1.131.3$^{2\times}$ | Parucchepa Daivodāsi | *niḥsṛ́jaḥ* | | | |
| | | | 1.166.10 | Agastya Maitrāvaruṇi | *vákṣassu* |
| | | | 1.169.2 | Agastya Maitrāvaruṇi | *niṣṣíd$^h$o* |
| | | | 1.181.6 | Agastya Maitrāvaruṇi | *niṣṣ ā́t* |
| 3.28.1 | Viśvāmitra | *pr ātaḥs āvé* | | | |
| | | | 3.37.7 | Viśvāmitra | *śrávassu* |
| | | | 3.51.5 | Viśvāmitra | *niṣṣíd$^h$o* |
| 3.52.4 | Viśvāmitra | *pr ātaḥs āvé* | | | |
| 3.55.21 | Prajāpati Vaiśvāmitra/ Vācya | *puraḥsádaḥ* | 3.55.8 | Prajāpati Vaiśvāmitra/ Vācya | *niṣṣíd$^h$aṃ* |

| | | | | | |
|---|---|---|---|---|---|
| | | | 3.55.22 | Prajāpati Vaiśvāmitra/ Vācya | *niṣṣídʰvarīs* |
| | | | 4.24.1 | Vāmadeva | *niṣṣídʰ āṃ* |
| | | | 4.38.2 | Vāmadeva | *puruniṣ-ṣídʰv ānaṃ* |
| 5.30.15 | Babhru Ātreya | *cátuḥsahasraṃ* | 5.54.11 | Śyāvaśva Ātreya | *vákṣassu* |
| | | | 6.44.11 | Śaṃyu Bārhaspatya | *niṣṣídʰo* |
| 7.55.3 | Vasiṣṭha | *punaḥsara* | 7.34.16 | Vasiṣṭha | *rájassu* |
| | | | 7.56.13 | Vasiṣṭha | *vákṣassu* |
| | | | 7.85.3 | Vasiṣṭha | *sádassu* |
| | | | 8.59.2 | Suparṇa Kāṇva | *niṣṣídʰvarīr* |
| | | | 8.77.5 | Kurusuti Kāṇva | *rájassv* |
| 9.91.5 | Kaśyapa Mārīca | *duḥṣáh āso* | 9.7.2 | Asita/Devala Kāśyapa | *havíṣṣu* |
| 10.47.2 | Saptagu Āṅgirasa | *cátuḥsamudraṃ* | 10.43.8 | Kṛṣṇa Āṅgirasa | *rájassv* |
| | | | 10.48.7 | Indra Vaikuṇṭha | *niṣṣ ấḷ* |
| 10.112.1 | Nabhaḥ-prabhedana Vairūpa | *prātaḥs āvás* | 10.49.10 | Indra Vaikuṇṭha | *ấdʰassu* |

The locative plural of *s*- and *r/n*-stems, the three compounds with /nis-/, i.e. *niṣṣídʰ*-, *niṣṣapín*- and *niṣṣ ấh*-, and *ś ấssi*, pres.2sg.act. of √*ś ās* 'teach, command' have geminated /S/. Finding these forms exceptional, the Ṛk-Prātiśākhya lists them in ṚPr. 14.36 *śunaśśepo niṣṣapīr ś āssi niṣṣ āḷavikram ā brahma viṣṇuḥ sma pṛśniḥ*, along with the form *śunaśśepaḥ* which is not found in the recension of the Ṛgveda available to us. On the other hand, compounds with /dus-/, /punar/, /prātar/ and /catur/, and compounds with /nis-/ other than the aforementioned three, have the first /S/ weakened to visarga /ḥ/.

Geminated sibilants are observed in some Yajurvedic texts as well (Bloomfield and Edgerton 1932:454), i.e. in von Schroeder's edition of the Kāṭhaka-Saṃhitā (von Schroeder 1900:XII), and in the Taittirīya and Vājasaneyi schools according to the Prātiśākhyas.[9] Pāṇini provides in Aṣṭ. 8.3.16 *roḥ supi* that visarga *ḥ* replaces stem-final /s/ before a locative plural ending, but /s/ is optionally retained according to Aṣṭ.

[9] TPr. 9.2 *agʰoṣaparas tasya sastʰ ānam ūṣm āṇam* and VPr. 3.9 *pratyaya-savarṇaṃ mudi ś ākaṭāyanaḥ*.

8.3.36 *vā śari*.[10] Geminated sibilants are also found in the orthography of Kashmirian manuscripts according to Witzel (1979:16). However, unless the relevant school has written standards, like a Prātiśākhya, it is difficult to judge whether a manuscript reflects a genuine archaism or not.

Of the sandhi outputs /-S S-/ and /-ḥ S-/, the former seems to belong to a dialect which is losing ground to the latter type of sandhi or does not treat the loc.pl. ending *-su* as having a word boundary before it, but a small number of medial /SS/ sequences remain in the verbal paradigm such as *śāssvā* (VSM 21.61, 28.23, 28.46).[11] Geminated sibilants do not arise from our principles of Cohesive Closure (§28) and sibilant extrasyllabicity (§31). This is a correct theoretical consequence in Proto-Indo-Iranian, where they are actually degeminated (§33), and probably until sometime in pre-Vedic Indo-Aryan as well; but degeminated forms like *apásu* < /apás-su/ are clearly relics, and our rules should be able to explain synchronic forms. To solve this problem, we should probably extend the former principle so that it optionally allows fricative constriction to straddle a syllable boundary.

## §35 Summary

To describe the canonical shape of Sanskrit syllables, the level of the templatic restrictions must be distinguished from the level at which syllable weight is constrained (§31). If boundary rules such as gemination, which makes the rime heavier and conflicts with syllable weight restrictions, are considered to be postlexical adjustments, Sanskrit syllables may be described with reference to three levels, in addition to the Underlying Representation where input strings are formed:

| | | |
|---|---|---|
| 0 | Underlying Representation | |
| 1 | syllable template | Sonority Sequencing Principle, sibilant extrasyllabicity |
| 2 | mora counting | resyllabification of medial sibilants |
| 3 | coda adjustment | doubling across boundaries |

Restrictions at level 1:

A possible coda may contain one non-continuant (§28). Sibilants may occur either in the onset or before an onset voiceless plosive as extrasyllabic (§28, §31). Since the initial sibilant is extrasyllabic, the Sonority Sequencing Principle is not violated at this level. In dialects which allow cohesive frication, sibilants are licensed by a following onset sibilant as well (§34). Some dialects allow coda /r/ (§29).

The largest possible onset at this level is a sequence of a stop, sibilant, and a sonorant consonant, and an extrasyllabic sibilant may be appended if the onset begins with a voiceless stop followed by a sonorant (§31).

Restrictions at level 2:

[10] More accurately, /ḥ/ optionally remains so that /s/ optionally replaces it.

[11] Cf. Varma (1929:113), who cites the remark of the Varṇaratnadīpikā Śikṣā that *śāssva* and *rāssva* are the only two words with double /s/ in Sanskrit.

Syllable rimes projecting more than two morae are not favored, although they do exist in weight-sensitive contexts (§19, §20, §21, §22, §28).

Restrictions at level 3:

Consonants across a syllable boundary have to have uninterrupted closure (§28), and uninterrupted frication as well in some dialects (§34).

The notion of an extrasyllabic sibilant helps to us understand the distributional asymmetry of Sanskrit sibilants: /SP/ is a possible cluster in word-initial position, while there is no final /PS/ cluster, whereas both are possible in Greek, Latin and Avestan (§32). It also explains the formation of reduplicant syllables without such a sibilant, and the sandhi rule which eliminates word-final /s/ when the following word begins with an /SP/ cluster.

# Chapter IV. Sibilants, Affricates and their Features

## §36 Cooccurrence of frication and voicing

Unlike other subfamilies such as Iranian or Balto-Slavic (§73), Indo-Aryan has a strong restriction against voicing of fricatives,[1] except that the glottal fricative /h/, which results from deocclusion of palatal and other voiced aspirates, is considered to have been voiced to some extent.[2] Proto-Indo-Iranian *s and its RUKI alternant *š disappear in Indo-Aryan when followed by a voiced dental stop *d or *d$^{h}$; the sibilants in this context are presumably voiced in the intermediate stage, and are then eliminated, e.g.

| | | |
|---|---|---|
| PIIr. *s-d$^{h}$í ‘be!’ | > *zd$^{h}$í (> OAv. *zdī*) → *azd$^{h}$í > *aØd$^{h}$í[i)] > Skt. *ed$^{h}$í* | cf. Gk. *íst$^{h}$i* with unexplained initial *i* |
| PIE *misd$^{h}$ó- ‘reward’ | > PIIr. *mižd$^{h}$á- (> Av. *mīždа-*) > *miẓḍ$^{h}$á- > *miØḍ$^{h}$á- > Skt. *mīḍ$^{h}$á-/mīḷ$^{h}$á-* | cf. Gk. *mist$^{h}$ós* |
| PIE *ni-sd-ó- ‘nest’ | > PIIr. *niždá- > *niẓḍá- > *niØḍá- > Skt. *nīḍá-/nīḷá-* ‘abode, resting place, nest’ | cf. Lat. *nīdus*, Arm. *nist*, OHG *nëst*, Lith. *lìzdas*, OCS *gъnězdo* (Stang 1966:94) |
| | PIIr. *mr̥žd-á- ‘merciful’ > *mr̥ẓḍ-á- > *mr̥Øḍá- > Skt. *mr̥ḍá-/mr̥ḷá-* (–∪) | |

[i)]Underlying /az/ becomes *e* or *o* under unclear (possibly dialectal) conditions.

Furthermore, Proto-Indo-Iranian voiced aspirated primary palatal *ǰ$^{h}$ disappears before a dental stop, presumably through an intermediate voiced fricative (§46, §51):

| | | |
|---|---|---|
| *√saǰ$^{h}$ ‘prevail’ | + vb.adj. *-tá- | > *saž$^{h}$-d$^{h}$á- > *sāḍ$^{h}$á-* |
| *√vaǰ$^{h}$ ‘carry’ | + IA inf. -tum | > *váž$^{h}$-d$^{h}$um > *vóḍ$^{h}$um* |
| *√rij$^{h}$ ‘lick’ | + 2sg.iptv. *-d$^{h}$í | > *riž$^{h}$-d$^{h}$í → *réḍ$^{h}$i* |

Whereas compensatory lengthening did not accompany the degemination of *essi to *esi ‘you are,’ which can be reconstructed for Proto-Indo-European (Mayrhofer 1986:120), and laryngeals after a consonant as in PIE *ǵonh$_1$o- > Ved. *jána-* ‘people’ or *róth$_2$o- > Ved. *rátʰa-* ‘chariot’ do not always behave like a cluster and make the preceding syllable heavy in the restored meter of the Ṛgveda (Kuryłowicz 1927a:240, Gippert 1997), the *s and *ǵ$^{h}$ in the above-mentioned three cases either make the preceding vowel long, or the syllable it belongs to metrically heavy, as in the case of *dr̥ḍ$^{h}$á-* vb.adj.

[1]This is still the case with the native phonology of the Modern Indo-Aryan languages other than Assamese and Northwestern languages (Masica 1991:101). For the crosslinguistic preference for voiceless fricatives, see Maddieson (1984:45).

[2]According to the Taittirīya-Prātiśākhya 2.4 *saṃvr̥te kaṇṭʰe nādaḥ kriyate*, 2.6 *madʰye hakārаḥ* and 2.9 *hakāro ha-caturtʰeṣu*, the glottis is between open and closed during the pronunciation of /h/ (Cardona 1986:65). See Allen (1953:34ff.) for the voicedness of Sanskrit /h/.

< PIIr. *√darǰʰ/ dr̥ǰʰ ‘make firm’ + *-tá-, of which the first syllable scans as heavy in e.g. ṚV 10.121.5a *yéna dyáur ugrā́ pr̥tʰiv ī́ ca dr̥ḷʰā́*. Since PIIr. *s and *š disappear when they are followed by a voiced plosive, particularly *d or *dʰ, since voicedness of a coda consonant is dependent on the following onset in Indo-Aryan by Lombardi’s Laryngeal Constraint (§83), and also since Avestan has *z/ž* in the same environment, these sibilants were most likely voiced when they were eliminated. And the fact that an empty timing slot always remains after voiced sibilants disappear and makes the preceding syllable heavy suggests that voiced *s and *š survived in pre-Vedic Indo-Aryan for a considerable time after it diverged from Indo-Iranian, and that its disappearance is more recent than that of the laryngeals (at least *$h_1$ and *$h_3$). Only the *[z] in PIE *si-sd-e-ti ‘sits’ > Ved. *sī́dati*, Av. *hiδa-* seems to have been lost before Proto-Indo-Iranian (Klingenschmitt 1982:129, Hoffmann and Forssman 1996:184). The sound changes mentioned so far are arranged as follows, with horizontal lines indicating definite chronological order:

| | |
|---|---|
| PIE | Degemination of *s |
| | RUKI-rule |
| PIIr. | Voicing assimilation, Bartholomae’s law |
| IA | Loss of laryngeals and subsequent compensatory lengthening |
| | Deaffrication of primary palatals |
| | Loss of *z/ẓ and subsequent compensatory lengthening |

The question naturally arises as to which pair of the three sets of features, i.e. [voiced] for voicing, [±sonorant] and [±continuant] for frication, and place features for oral constriction, came to be incompatible in Pre-Vedic Indo-Aryan.

Although the fundamental difference between /s/ and /ṣ/ might consist in the active articulator rather than in the place of articulation (§103), /s/ doubtless contrasts with /ś/ in its place of articulation, namely the upper teeth vs. somewhere between the alveolar ridge and the hard palate. Thus it is not the place of articulation which conflicts with frication. Voicing and place features can naturally coexist, for Indo-Aryan has voiced plosives with constrasting place, such as /b/, /d/, /j/ and /g/. It must therefore be voicing and oral frication which cannot cooccur.

> SIBILANT VOICING FILTER:[3] In Indo-Aryan, a voiced ([voiced]) oral obstruent ([−sonorant]) must be a non-continuant ([−continuant]).

This filter calls forth a further question about /j/; if Old Indo-Aryan palatals were affricates, /j/ must have had a fricative component after its closure (Grammont 1916:256, Wackernagel 1896:137), and the fricative component is probably voiced since /j/ is voiced. To avoid violation of our filter, we should consider either that the filter rules out *lack* of occlusive constriction and so alows affricates, or that Indo-Aryan /j/ is phonologically a stop whether or not frication follows closure in its phonetic implementation (§37, §38); or alternatively, we can also consider that Indo-Aryan /j/ was a pure stop

[3] For the inappropriateness of filters to capture language-specific restrictions on segment-internal structure, see Myers (1991).

when voiced sibilants were eliminated (§54), and it later became an affricate. The existence of the geminate palatal plosives *jj* as in √*majj* 'plunge' and *cc* in word sandhi suggests that the first /j/ or /c/ of these geminates does not have frication, for pronunciations like [ʤ͡ʤ] or [ʧ͡ʧ] are unlikely in a language which eliminates a fricative between plosives (§28).

## §37 Edge effect of the palatal plosives

When features of a contour segment are aligned in a certain temporal order in their phonetic output, there are cases where rules operate "seeing" only one of those features which is closer to the context of the rule in question (Ewen 1982, Sagey 1986). This is called the *edge effect*, and some of the peculiar combinational restrictions of Old Indo-Aryan palatal plosives can be explained if we assume that they are phonetically affricates and thus are susceptible to edge effects. Since edge effects are observed not only in external sandhi, which reflects more synchronic restrictions, but also in internal sandhi, palatal plosives must have had fricative release well before the Prāti śākhyas.

Internal combination patterns:

| | _V | _$^{h}$V | _Y | _r | _l | _N | _S | _P |
|---|---|---|---|---|---|---|---|---|
| P | yes | yes | yes | yes | *k,p* | yes | [Øvcd] | [Øvcd] |
| $P_{[pal]}$ | yes | no | yes | yes | no | *ñ,m* | no | $C_1C_1$ |
| S | yes | no | yes | yes | *s* | yes | $C_1C_1$ | yes |

| | | r_, l_ | N_ | S_ | P_ |
|---|---|---|---|---|---|
| P | | yes (gemination) | yes (place assim.) | [Øvcd] | yes (voicing assim.) |
| $P_{[pal]}$ | | yes (gemination) | yes (place assim.) | [Øvcd] | yes (voicing assim.) |
| S | | yes (RUKI) | yes (deocclusion) | $C_1C_1$ | yes (voicing assim.) |

The first table shows that a palatal plosive cannot occur before a heterorganic plosive, unlike the plosives of the other series. And as we will discuss in §56, /j/ as well as sibilants cannot have aspiration, which is temporally sequenced after an occlusive constriction. In this way, they show phonotactic restrictions similar to the sibilants on their right edge, whereas their combinational pattern is exactly the same as the other plosives on their left; as the second table shows, they can follow any plosive, except that dental stops which precede them are assimilated in place in external sandhi (e.g. /-d j-/ > *-j j-*).[4] In final sandhi, palatal obstruents and /h/ become stops, /ʈ~ɖ/ or /k~g/.

Although palatal plosives would be expected to behave like fricatives with regard to the segment to their right, their distribution before obstruents actually differs from that of the fricatives. A closer look into the restrictions on the closure of consonant clusters

[4] Assimilation does not take place in a cluster of a retroflex and a palatal plosive, e.g. Ep. *ṣaḍ-ja-* 'the fourth note,' Cl. *ṣaṭ-cakra-* 'six chakras.'

is necessary to go further into this problem.

### §38 Pronunciation of /j/

We assumed in §36 that Indo-Aryan has the Sibilant Voicing Filter, which requires that a voiced oral obstruent be a non-continuant. Accordingly, the pre-Vedic voiced fricative */ź/, which originates from Proto-Indo-Iranian primary palatal *ǰ and had lost occlusion in earlier pre-Vedic Indo-Aryan by the Affricate Filter (to be discussed below in §52), must have regained occlusion and become the palato-alveolar or prepalatal voiced affricate /j/, merging with Proto-Indo-Iranian secondary palatal *ǰ. A merger of a voiced fricative and a homorganic voiced affricate such as /ž/ and /dž/ is not surprising, for not many languages make a phonemic distinction between them.[5]

When /ś/ from PIIr. *ć and /h/ from PIIr. *ǰʰ are followed by an /n/ as in √*śnatʰ* 'pierce' : *śnátʰat* and √*hnav/hnu* 'deny' : *hnuté*, the /n/ is not assimilated in place and remains a dental. If, in the same way, PIIr. *ǰ were a fricative in late pre-Vedic Indo-Aryan, place assimilation would not have taken place and the *n in PIIr. *i̯aǰ-ná- should have remained dental in Indo-Aryan. Along with the fact that no grammarian mentions a special articulation for the /j/ originating from PIIr. *ǰ, the place assimilation of /n/ to *ñ* confirms the presence of occlusion in /j/ < PIIr. *ǰ.

Since secondary palatalization takes place only when a velar stop is followed by a front vowel, in principle the /j/ in the cluster *jñ* comes from a primary palatal.

| | |
|---|---|
| √*yaj* 'to sacrifice' : *yajñá-* m. 'sacrifice' | Av. *yasna-* |
| *jā́nu-~jñú-* n. 'knee' | YAv. *žnu-*, *fra-šnu-* |
| √*rāj* 'to reign' : *rā́jñī* f. 'king's wife' | |
| √*jñā* 'to know' : pf. *jajñé* | YAv. *žnātar-* |
| *rā́jan-* m. 'king' : gen.sg. *rā́jñaḥ* | |
| *samrā́j-* m. 'monarch' : *samrā́jñī* f. | |
| √*janⁱ* 'give birth' : pf. *jajñé* | |
| *majján-* m. 'marrow' : AV *majjñā́* inst. | |

If the /j/ from PIIr. *ǰ is not a fricative but an affricate in Vedic,[6] however, is the cluster spelt *jñ*, with two non-continuant phases separated by intervening frication, pronounceable at all? Or was it actually pronounced differently, just as Latin *-gn-* was pronounced [ŋn]? In Modern Indo-Aryan languages, the cluster *jñ* in *tatsama* words (loanwords from Sanskrit) is pronounced in various ways, but not as /jñ/: i.e. 'gy' in Hindi, Bengali, Oriya and Punjabi, 'dny' in Marathi, and 'jn/dn' (nowadays 'gn,' Cardona and Suthar 2003:666) in Gujarati (Beames 1872–9:303f), possibly through [ɟɟ̃] and [dɲ] from original [ɟɲ] which had no affricated release in between. The Prātiśākhyas do not make any special remark on this cluster, and there is no indication that the pronunciation of /j/ and /ñ/ in *jñ* was different from their occurrences as singletons, except that

[5] Persian and Polish, for example, are among the few languages which distinguish these two sounds. Cf. §103.

[6] See Wackernagel (1896:137f) for the affricate pronunciation of palatal plosives, and §46 for further discussion.

the release, and hence the frication concomitant thereof, were probably suppressed by *abhinidhānana* (§27). As for the silence of the native grammarians on the affrication of Sanskrit palatal plosives, Misra (1967:56) aptly points out that they had different ideas of constriction or aperture from those of modern phonologists, and being *spṛṣṭa* 'contacted' does not preclude fricative release.[7] If, as we suggested in §36, the first palatal plosive in the geminates *cc* and *jj* has no frication, we could say that Vedic /j/ is phonologically a palatal stop, and that even if frication follows upon release, it merely accompanies the release collaterally and is phonologically insignificant.

There are other clusters of a homorganic plosive and a nasal in Vedic (§128, §129):

| | | | | | |
|---|---|---|---|---|---|
| ×pmV | (AV+ *pāpmán-*) | ×bmV | | *b$^{h}$m*V | ṚV+ *jagṛb$^{h}$mā* etc. |
| *tn*V[i)] | ṚV+ *rátna-* etc. | *dn*V | ṚV+ *udná-* | *d$^{h}$n*V | ṚV+ *bud$^{h}$ná-* etc. |
| *ṭṇ*V | TS *āṭṇārāḥ* | ×ḍṇV | | ×ḍ$^{h}$ṇV | |
| *cñ*V | AV+ *yācñá-* | *jñ*V | ṚV+ *yajñá-* etc. | | — |
| ×śñV[ii)] | | | | ×hñ | |

[i)] Cf. t,d → n /_n in external sandhi.
[ii)] Cf. Wackernagel (1896:186).

Even though Vedic lacks ×/ññ/ contrasting with /jñ/, there are distinct pairs /dn/ : /nn/, /tn/ : /dn/, and /cñ/ : /jñ/, and there is no reason to doubt that they were pronounced differently. In the synchronic alternation of external sandhi, cluster-initial plosives in such sequences are assimilated to the corresponding nasals.

## §39 Synchronic status of the alternation of palatals before /t/ and /t$^{h}$/ in the Ṛgveda

A Sanskrit palatal obstruent alternates with either /ṣ/ or /k/ when followed by a suffix beginning with a voiceless dental stop:

| | root | vb.adj. |
|---|---|---|
| PIE *ḱ > PIIr. *ć | √*vaś* 'wish' | *váṣṭi-* |
| | √*naś* 'perish' | *naṣṭá-* |
| | √*prac$^{h}$* 'ask' (< *-ḱ-sḱ-) | *pṛṣṭá-* |
| | √*takṣ* 'timber' (< *-tḱ-) | *taṣṭá-* |
| | √*cakṣ* 'look' (< *-ḱs-) | *caṣṭá-* |
| PIE *ǵ > PIIr. *ǰ | √*yaj* 'worship' | *iṣ-ṭá-* |
| | √*marj/mṛj* 'sweep' | *mṛṣ-ṭá-* |
| | √*sarj/sṛj* 'release' | *sṛṣ-ṭá-* |

[7] "It is evident that these phoneticians have referred only to the contact or closure aspect in their *spṛṣṭa* category and have made no reference whatsoever to the manner in which this contact made by the articulator was released, i.e. whether the closure was released suddenly or with friction." Note that ṚPr. 13.9 *spṛṣṭam ast$^{h}$itam* states that closure of a stop is transient (I owe this reference to George Cardona).

| | | |
|---|---|---|
| PIE *g > PIIr. *ǰ | √*b$^h$aj* ‘share’ | *b$^h$ak-tá-* |
| | √*tej/tij* ‘sharpen’ | *tik-tá-* |
| | √*yoj/yuj* ‘yoke’ | *yuk-tá-* |
| PIE *g$^w$ > PIIr. *ǰ | √*nej/nij* ‘wash’ | *niktá-* |

These two alternation patterns are based on the Proto-Indo-European distinction between velars or labio-velars and fronted velars, which is not preserved as such in Indo-Aryan.

The development of /j/ to *ṣ* before /t/ as in *iṣ-ṭá-* and *mṛṣ-ṭá-* forms a minority group compared to that of /j/ into *k* which, together with the change of /c/ into *k*, makes up the majority. Synchronically, the latter is probably the general pattern, and the former cases must be treated as lexical exceptions to be memorized, as Pāṇini does in his listing in Aṣṭ. 8.2.36 *vraśca-b$^h$rasja-sṛja-mṛja-yaja-r āja-b$^h$r āja-c$^h$aś āṃṣaḥ*.

On the other hand, the output of the change of /ś/ into *ṣ* before /t/ constitutes another group together with the relevant verbal adjective forms of those roots ending in /ṣ/, such as √*peṣ/piṣ* ‘crush’ : *piṣṭá-*, √*reṣ/riṣ* ‘do harm’ : *riṣṭá-*, √*veṣ/viṣ* ‘be active’ : *viṣṭá-* and √*śeṣ/śiṣ* ‘leave’ : *śiṣṭá-*. Since the link between /ś/ and /j/ originating from a primary palatal stop *ǰ is synchronically overshadowed by a more evident voiceless-voiced correspondence between /c/ and /j/, the change of /ś/ into *ṣ* is probably to be posited as an alternation independent of /j/ ~ ṣ. The simplest synchronic grammar therefore seems to be what Pāṇini assumes in Aṣṭ. 8.2.30 *coḥ kuḥ* [1.16 *padasya*, 26 *j$^h$ali*]: a general rule replacing P$_{[palatal]}$ with P$_{[velar]}$ before an obstruent or in word-final position, and a listing of roots originally ending in primary palatal *ǰ as exceptions in Aṣṭ. 8.2.36, cited above:

| | | | |
|---|---|---|---|
| PIIr. *ć | /ś/ | C$_{[palatal][+cont]}$ > $_{[retrofl]}$ /_t | Aṣṭ. 8.2.36 *c$^h$aś āṃśaḥ* |
| PIIr. *sć | /c$^h$/ | lexical exception | Aṣṭ. 8.2.36 *c$^h$aś āṃ śaḥ*, 6.4.19[i]: virtually only √*pracc$^h$/praś* ‘ask’ |
| PIIr. *ǰ | /j/ | lexical exceptions | Aṣṭ. 8.2.36 *(√vraśc$_a$-)√b$^h$rasj$_a$-√sṛj$_a$-√mṛj$_a$-√yaj$_a$-√r āj$_a$-√b$^h$r āj$_a$-* |
| PIIr. *ǰ$^h$ | /h/ | /h/ > ḍ$^h$ / _t | Aṣṭ. 8.2.31 *ho ḍ$^h$aḥ* |
| PIIr. *č | /c/ | C$_{[palatal][−cont]}$ > $_{[velar]}$ / _t | Aṣṭ. 8.2.30 *coḥ kuḥ* |
| PIIr. *ǰ | /j/ | C$_{[palatal][−cont]}$ > $_{[velar]}$ / _t | Aṣṭ. 8.2.30 *coḥ kuḥ*, 8.4.55 *k$^h$ari ca* |
| PIIr. *ǰ$^h$ | /h/ | lexical exceptions | Aṣṭ. 8.2.32 *d āder d$^h$ ātor g$^h$aḥ*: √*dah*, √*deh/dih*, √*doh/duh* |

[i] R. N. Sharma 2003:538.

### §40 Rise of three sibilants and their neutralization

Whereas Proto-Indo-European had only one sibilant *s, Indo-Iranian, together with Balto-Slavic, evolved an anterior allophone *š in the contexts after a high vowel, *r/ṛ, or a velar stop (RUKI rule or PEDERSEN’S LAW, §103). Moreover, the Proto-Indo-Iranian voiceless palatal affricate *ć from PIE *ḱ becomes an alveopalatal or palato-alveolar fricative *ś* [ɕ/ʃ] in Indo-Aryan, in parallel with its development into *s* in Avestan.

The place of articulation of /ś/ in Sanskrit is hard to decide, but it is certainly not as front as dental [s], and it should be more front than palatal [ç] as in German *ich* (Chatterji 1926:242), for Sanskrit palatal obstruents pattern with dentals in the place assimilation of /n/, i.e. /n/ remains dental before velar, retroflex and labial obstruents, whereas it is usually subject to place assimilation when followed by a palatal obstruent, e.g. *mag$^{h}$avañ c$^{h}$akra* (ṚV 1.104.8c), *ic$^{h}$áñ carati* (ṚV 3.54.2b) and *y ā́mañ jánasya* (ṚV 6.38.1d) (§62).[8] As /ś/ is also a sandhi alternant of the dental sibilant /s/ in external sandhi, it is more natural to consider it an alveopalatal or a palato-alveolar fricative than a palatal fricative, which is not a sibilant, although external sandhi does represent relatively new restrictions.[9] These three sibilants of Indo-Aryan, *s*~*ṣ* and *ś*, fully contrast only when they are followed by a sonorant within the same word domain,

| | {RUKI}_ | _V | _Y | _r | _R | _P | _S | _]$_{wd}$ |
|---|---|---|---|---|---|---|---|---|
| /s/ | ṣ | s/ṣ | s/ṣ | s | s/ṣ | s/ṣ/ś(/ḥ) | s/ṣ(/ḥ) | ḥ |
| /ś/ | ś | ś | ś | ś | ś | ṣ/ś/k(/ṭ) | k(/ṭ) | ṭ/k |

i.e., Indo-Aryan sibilants fully contrast *in syllable onset* only. Before an onset plosive, on the other hand, dental /s/ becomes *ś* before a voiceless palatal plosive by place assimilation, but not vice versa; /ś/ becomes *ṣ* when a suffix or an ending beginning with /t/ or /t$^{h}$/ follows, and stem-final /ś/ and /ṣ/ becomes *ṭ/ḍ* at a pā́da boundary. In this way, neutralizing contexts exist for each of the pairs /s/ : /ś/, /ṣ/ : /s/ and /ś/ : /ṣ/, as the following table shows:

| | _-t$^{(h)}$- | _-s- | {i,u,r,K}_ | -_]$_{wd}$ | -_ c$^{(h)}$- |
|---|---|---|---|---|---|
| /s/ | s | t | ṣ | ḥ | ś |
| /ṣ/ | ṣ | k | ṣ | ḥ | ś |
| /ś/ | ṣ | k | ś | ṭ(/k) | ṭ(/k) |

## §41 Occlusion of /s/ and /ṣ/ in the future

Although no sound generalizations can be drawn from the scarce examples of simple future forms of roots ending in sibilants in the Ṛgveda, an epenthetic /i/ is inserted between an aniṭ root and the suffix *-syá-* when the former ends in a sibilant: √*as* 'throw' : ṚV *asiṣyá-*, √*naś* 'perish' : AV *naśiṣyá-*. The sequence /RPSy/ is found only in the form *t ā́rkṣya-* prop.n.

In the literature of the next period, where the tendency to avoid overlong syllable rimes is probably not as strong as in the Ṛgveda, future forms of the template /-VRP-Sya-/ become common, e.g.

[8] In the Ṛgveda, there are 111 cases of *-ñ c$^{(h)}$-* (I$^{32}$, II$^{8}$, III$^{5}$, IV$^{5}$, V$^{5}$, VI$^{6}$, VII$^{6}$, VIII$^{12}$ IX$^{11}$, X$^{21}$) compared to 34 cases of *-ṃ́ś c$^{(h)}$-* (I$^{4}$, II$^{2}$, III$^{3}$, IV$^{3}$, V$^{1}$, VI$^{4}$, VII$^{0}$, VIII$^{2}$, IX$^{1}$, X$^{14}$) according to Holland and Van Nooten's electronic text [E01].

[9] Cf. Hall (1997a:208) "In Sanskrit dentals became alveolopalatal before alveolopalatals (e.g. *ut + carati → uccarati* 'rises'; Cho, 1990:66 [=1999:59]). Importantly, Sanskrit *ś* surfaces in the same environment, e.g. *tatas + ca → tataśca* 'and then.' If *ś* and *c* have the same place of articulation then they are both alveolopalatal."

√*kart/kṛt* ‘cut’ : AV *kartsy ā́mi* (AVŚ 10.1.21b),
√*vart/vṛt* ‘turn’ : AVŚ, TS *-vartsya-*,
√*band*$^{h}$ ‘bind’ : AVPO, ŚB, TB *b*$^{h}$*antsya-*,
√*varj/vṛj* ‘turn away’ : TS, ŚB *-varkṣya-*.

Forms without /i/ outnumber those with /i/ in the Brā́hmaṇa period (Whitney 1885:228f.). It is mainly this period when the root-final /s/ undergoes secondary occlusion into *k* or *t* (§43):

√*vas/uṣ* ‘dawn’ : *vatsya-*,
√*vas/uṣ* ‘dwell’ : *vatsya-*,
√*veṣ/viṣ* ‘be active’ : *vekṣya-*,
√*śeṣ/śiṣ* ‘leave’ : *śekṣya-*, but also
√*varṣ/vṛṣ* ‘rain’ : *varṣiṣya-*.

In Epic and later Sanskrit, forms with /i/ become commoner again (*band*$^{h}$*iṣya-*, *kartiṣya-* etc.). The following rules of Pā́ṇini show fluctuation regarding the insertion of a non-original /i/ in contexts including before the future suffix *-syá-*:

| | | |
|---|---|---|
| Aṣṭ. 7.2.44 | roots with *ū́* as an *it* marker | /i/ is optional |
| Aṣṭ. 7.2.57 | √*kart/kṛt* ‘cut,’ √*cart/cṛt* ‘attach,’ √*c*$^{h}$*ard/c*$^{h}$*ṛd* ‘vomit,’ √*tard/tṛd* ‘pierce,’ √*nart/nṛt* ‘dance’ | /i/ is optional |
| Aṣṭ. 7.2.58 | √*gam* ‘go’ | /i/ in the active |
| Aṣṭ. 7.2.59 | √*vart/vṛt* ‘turn,’ √*vard*$^{h}$*/vṛd*$^{h}$ ‘grow,’ √*śard/śṛd* ‘challenge,’ √*syand* ‘gallop’ | no /i/ in the active |
| Aṣṭ. 7.2.60 | √*kalp/klṛp* ‘arrange in order’ | no /i/ in the active |

### §42 Regularity of the occlusion of /s/

As to the occlusion of /s/ into *t* in √*vas* ‘dwell’ : *vatsyati* fut.act.3sg., *av ā́ts ī́ḥ* s-aor.act.2sg. etc. and √*g*$^{h}$*as* ‘eat’ : AV *jíg*$^{h}$*atsati* desid.act.3sg., Bartholomae (1896:711)[10] already points out forms such as AV *av ā́ts ī́ḥ*, *áv āt* s-aor.act.3sg. of √*vas* ‘shine’ and AV *ag*$^{h}$*at*, rt.aor.act.3sg. of √*g*$^{h}$*as* as the starting point. The *-t* < *-s-t in these forms may have been reinterpreted as a root element interchangeable with /s/, and was then introduced into the future stems where the suffix-initial /s/ would otherwise obscure the identity of the root. Narten (1964: 239)[11] views this process as a minor sound change

[10] “Ich möchte es daher doch immer noch für wahrscheinlicher halten, dass die unthematischen 3. Sing. Praet. Act. auf *-t* statt *-s* für arisches *-st* als Ausgangspunkt für die Bildung jener Formen — es sind ihrer im Ganzen noch kein Dutzend — gedient haben ...”

[11] “Es entspricht dieser Wandel dem Bestreben, die sich aus dem Zusammentreffen von wurzelauslautendem *s* und Tempuszeichen *s* zunächst ergebende Doppelkonsonanz als solche zu bewahren und damit auch die Silbengrenze an ihrer alten Stelle zu erhalten ... Hier war die Analogie zur Erhaltung von *ss* gegen das Lautgesetz der Vereinfachung zu *s* wirksam. Dagegen weist bei Antritt von Tempuszeichen *s* jeweils das Gesamtparadigma des entsprechenden Futurs, *s*-Aorists oder Desiderativs das gleiche lautliche Erscheinungsbild auf, es konnte also keine innerparadigmatische Analogie wirken. So entstand anstelle des ersten der beiden dentalen Spiranten der entsprechende Verschlußlaut: *s* + *s* > *ts*.”

driven by dissimilation rather than as an analogy.

Let us summarize here the cases where *s* alternates with *t*:

| | | |
|---|---|---|
| verb | s-aorist | √*dā* 'give' : 2sg. *adās*, 3sg. *ádāt* |
| | | √*pā* 'drink' : 2sg. *ápās*, 3sg. *ápāt* etc. |
| verb | root aorist | √*gʰas* 'eat' : 3sg. *agʰat* |
| | | √*vas* 'shine' : 3sg. *avāt* |
| noun | stem ending in *s* | *mā́s-* 'moon, month' : RV *mād-bʰís* |
| noun | vocative | *-mant-/-vant-* : RV *-mas/-vas* |

If the dissimilatory occlusion of /s/ into *t* were phonological, it would also be expected to occur in the locative plural (*-su*) forms of the nominal stems in *-s* such as *apás* adj. 'active,' *áṃhas* n. 'hardship' etc. According to Lanman (1877:497, 567), however, no such forms are attested in Vedic:

> *ū́dʰar-/-an-* 'udder' : *ū́dʰas-su*; *rájas-* 'space' : *rájas-su*; *śrávas-* 'fame' : *śrávas-su*; *sádas-* 'seat' : *sádas-su*; *havíṣ-* 'offering' : *havíṣ-ṣu*.
> *apás-* 'water' : *apásu*; *púmas-* 'man' : *puṃsú*; *mā́s-* 'moon, month' : TS *māsú*, PB *māssu*.

A significant difference between those locative forms and those verbal forms with occlusion is that the nominal stems ending in *s* are mostly two syllables long and there is little room for confusion. Furthermore, the loc.pl. ending *-su* is often treated as if there were a word boundary before it. Also worth noting is that s-aorist roots have a vowel in the lengthened grade in the active, and future forms have roots in the full grade followed by the suffix-initial cluster *-sy-*, whereas in the locative plural forms with double /s/ the stem-final vowel is always short except in the monosyllabic stem *mā́s-*. It is possible, therefore, that syllable weight played a role when the occlusion of root-final /s/ arose as a phonological process, like the distribution of *ss* after short, and *s* after long vowels, in Latin (Meiser 1998:125).

> Tentative explanation: The morpheme-final /s/ is crowded out of the syllable when the vowel is in the lengthened grade. Since the next syllable cannot begin with /ss-/ with non-rising sonority, the first of the two /s/'s becomes occluded (cf. also §44).

| | | |
|---|---|---|
| √*vas* : | *a-vāt-sīt* | /a.vā.tsī<t>/ |
| | | ★/a.vā.ssī<t>/ |
| | | ★/a.vās.sī<t>/ |
| *haviṣ-* : | *haviṣ-ṣu* | /ha.viṣ.ṣu/ |
| but √*gʰas* : | *jí-gʰat-sa-* | |

### §43 Medial occlusion of /ś/ and /ṣ/ in fricative clusters

The deocclusion of PIE *ḱ > PIIr. *ć to Skt. *ś* is blocked when an /s/ or a pada boundary follows it. Before voiceless plosives, the Ṛgveda shows examples of *śp* across the boundary of compound nouns beginning with *viś-* such as *viś-pati-* 'Clanherr' (Geldner) and *viśpál ā-* prop.n. (cf. Epic *viṭ-pati-*, Cl. Skt. *dik-pati-*), but the sequence ˣśk does not occur in the Ṛgveda (§125).[12]

Although /ś/ merges with /ṣ/ before /t/, the original velar occlusion of PIE *ḱ > PIIr. *ć is restored, or in view of the irreversibility of sound changes, PIIr. *ć independently develops into /k/ by place dissimilation (Allen 1974:111, §45), when it occurs before *s or its RUKI alternant *š, resulting in the cluster *kṣ* instead of ˣśs, for example,

| | |
|---|---|
| /á/ + /√diś/ 'point' + /-si/ | : *adikṣi*, s-aor.1sg.mid. (ṚV 5.43.9), |
| /á/ + /√viś/ 'enter' + /-s-/ + /-mahi/ | : *ávikṣmahi* (ṚV 10.127.4), |
| /viś(]$_{wd}$)/ 'settlement' + /-sú/ | : loc.pl. ṚV *vikṣú* (later *viṭsu*). |

An interesting fact is that the other two sibilants /s/ and /ṣ/, which come from Proto-Indo-European sibilant *s, also acquire occlusion and become *t* and *k* respectively before another /s/. It is found already in

| | |
|---|---|
| *rírikṣati* (ṚV) | desid. of √*reṣ/riṣ* 'harm,' |
| *dvikṣat*, *dvikṣata* (AV) | s-aor. of √*dveṣ/dviṣ* 'hate,' |
| *av ā́ts ī́h* (AV) | s-aor.2sg.act. of √*vas* 'dwell,' |

and becomes almost a productive pattern of the sigmatic aorist, the desiderative, and particularly the future in late Vedic (§41, Wackernagel 1896:178, Debrunner 1957:96, Kuiper 1967b:107f); cf.

| | |
|---|---|
| √*vas* 'dwell' | : Br. *vatsyati* fut.3sg.act., |
| √*peṣ/piṣ* 'crush' | : ŚB *apikṣan* sa-aor.3pl.act., |
| √*śeṣ/śiṣ* 'leave' | : Br. *śekṣyáti* fut.3sg.act. |

The incidence of TS from S + S may be summarized in the following table:

| | desiderative | sa-aorist | s-aorist | future |
|---|---|---|---|---|
| ṚV | *rírikṣa-* | | | |
| AV | | *dvikṣa-* | *av ā́ts ī́t* | |
| Saṃh. | *śuśukṣa-*, *śiślikṣa-* | *aślikṣa-* | | |
| Br. | | | | *śekṣya-*, *vekṣya-* |
| | | *apikṣa-* | | |
| Sū. | | *akṛkṣa-* | | |

(Avery 1875, Whitney 1885, Narten 1964)

[12]The first *k* in ŚB *a-dík-ka-* 'one who has no space' is already *k* when *-ka-* is suffixed, for *a-dík-* itself is a bahuvrīhi compound (Cardona p.c.).

Whereas the restoration of the closure of PIIr. ć has established status as a phonological rule in Vedic, the occlusion of root-final /ṣ/ is limited to, and probably conditioned by, a relatively small morphological context, namely before verbal suffixes and endings beginning with /s/.

The merger of /ś/ with /ṣ/ before /t, $t^h$/ (§39), which typically occurs in root-final position, e.g. √*naś* 'perish' : *naṣṭá-* vb.adj., might have been the starting point of the confusion of *ṣ* and *ś*, as the following proportional analogy shows:

| | | | |
|---|---|---|---|
| √*veś*/*viś* 'enter' : | *viṣ-ṭá-* vb.adj. | : *á-vikṣ-* (RV) s-aor. | |
| √*veṣ*/*viṣ* 'be active' : | *viṣ-ṭá-* vb.adj. | : x | ; x = *a-vikṣ-* |

## §44 Affricate status of $c^h$, kṣ and ts

As a result of the simplification of obstruent clusters and the restriction against sibilant clusters, Sanskrit abounds in clusters of a stop and a sibilant, such as /kṣ/, /(c)$c^h$/ and /ts/; the first two occur in word-initial position as well, while initial /ts/ is found only in the forms of the root √*tsar* 'sneak,' *tsárati* pres.3sg.act. If the doubling of a cluster-initial plosive across a syllable boundary (e.g. /-k.ṣ-/ → /-k.kṣ-/), as provided by TPr. 14.1 etc. (§23) and TPr. 21.9 etc. (§29), already started by the time of Vedic, a large number of syllables have clusters of the type /TS/ in the onset. These clusters reflect a sonority scale which ranks fricatives above stops:

Sonority scales and clustering rules:

| | |
|---|---|
| Gk.[i)] | plosive ≪ fricative ≪ nasal ≪ liquid<br>Minimal sonority distance requirement: 2<br>Augmentation of /s/: onset, coda |
| IA | stop ≪ fricative(,aspiration) ≪ nasal ≪ liquid, glide<br>No cluster of three consonants including a nasal and a semivowel.<br>Augmentation of /s/: onset only (§31 extrasyllabic sibilant) |
| Ir. | plosive, fricative ≪ nasal, liquid<br>Augmentation of /s/: onset, coda |

[i)] Steriade (1982) cited in Kenstowicz (1994:267ff.).

Instead of ascribing initial /TS/ clusters to the sonority scale, one might also suppose that these clusters acquired the phonemic status of affricates, or of unit phonemes, in Old Indo-Aryan (Kurołowicz 1962:111).[13]

In §42, we noted the possibility that a sequence *s-s which is crowded out of a preceding heavy syllable becomes /ts/, in conformity with the Sonority Sequencing Principle. If that is the case, /t/ (rather than /$t^s$/) can be viewed as the alternant of the sibilant /s/, for the motivation of the change is to create a rising sonority sequence and thus a possible onset cluster. Another possible case of alternation between a sibilant and an

[13]Cf. Allen (1974:100f.), who is skeptical about reconstructing phonemes *$k^s$ etc. for the 'thorn' cluster. Regarding the Greek cluster /ks/, Allen (1987:59) also points out that it occurs both in an initial and final position of a word and it is comparable with single consonants in terms of its phonotactic peculiarity.

affricate is the insertion of a transitional stop at word boundary. Among these cases of stop insertion, those which occur between a nasal and a sibilant, such as

/-ṅ S-/ → -*ṅ k* S-
/-ṇ S-/ → -*ṇ ṭ* S-
/-n s-/ → -*n t s*-
/-n ś-/ → /-n t ś-/ (> -*ñ c*$^h$-)

(ṚPr. 4.16–17, VPr. 4.15–16, TPr. 5.32[–33], ŚCĀ 2.1.9 and Aṣṭ. 8.3.28–31; Cardona, unpublished MSS),

have the same place as the preceding nasal, and are probably nothing more than transitions between voiced and voiceless segments. However, in cases of stop insertion between a plosive and a sibilant (Allen 1962:109ff., Lubotsky 2001:46f.) such as

/-ṭ s-/ → -*ṭ t s*-

(ṚPr. 4.17, TPr. 5.33, ŚCĀ 2.1.8 and Aṣṭ. 8.3.29–31) and

/-T ś-/ → -T *c*$^h$- in Aṣṭ. 8.4.63 *śaś c*$^h$*o ’ṭi*,

as in ṚV 3.33.1 *víp āṭ c*$^h$*utudrī* for *śutudrī* or ṚV 10.91.7 *pṛt*$^h$*ak c*$^h$*árd*$^h$ *āṃsi* for *śárd*$^h$ *āṃsi*, *ts*- and *c*$^h$- behave as if they are non-continuant counterparts of /s/ and /ś/. The alternation in this case might not entail mere insertion of stops, but affrication of /s/ and /ś/ to /ts/ and /cś/ (*cc*$^h$ in the surface form) respectively. This affrication is different from the occlusion of sibilants discussed in §43, for most cases of occlusion there take place in a limited morphological context, with gradual analogical spreading.

| occlusion (morphological) | | | affrication (phonological) | | |
|---|---|---|---|---|---|
| /s/ | /ṣ/ | /ś/ | /s/ | /ṣ/ | /ś/ |
| t | k | k | ts | – | cc$^h$ |

There is no regular phonological alternation between /ṣ/ and /kṣ/, but /ṣ/ and velar stops might have had some affinity, for /kṣ/ is a ubiquitous cluster in Sanskrit, and /ṣ/ and /k$^h$/ are often confused in some manuscripts and in later Indo-Aryan languages (Wackernagel 1896:136, Bloomfield and Edgerton 1932:153, Allen 1953:56).

### §45 Origins of Vedic *kṣ*

Sanskrit *kṣ* has its origin in various Proto-Indo-European consonant clusters, and is the product of the most extensive neutralization in the consonantal phonology of Old-Indo-Aryan. The origins of *kṣ* are reconstructed on the following bases:

a) Some of the other Indo-European languages treat the clusters underlying Vedic *kṣ* as distinct:

| PIE | Av. | Gk. | Hitt. | Toch. | examples |
|---|---|---|---|---|---|
| *k$^{w}$s | *xš* | *ps* | /k$^{w}$s/ | | Hitt. *tekkušša-* ‘give a sign’ |
| *ks | *xš* | *ks* | /ks/ | *ks* | TB *okso* ‘ox’ ~ Skt. *ukṣáṇ-* ‘young bull’; Hitt. *takkis-* ‘mingle’ |
| *ḱs | *š* | *ks* | | | Gk. *deksiós* adj. ‘right’ ~ Skt. *dákṣiṇa-*, Av. *dašina-* |
| *g$^{wh}$s | | *ps* | | | Gk. *éneipsa*, aor. of *neíp$^{h}$o͞* ‘snow’ |
| *ǵ$^{h}$s | *ž* | *ks* | | | Gk. *héksō* fut. of *ék$^{h}$o͞* ‘hold,’ Skt. √*sah* ‘subdue’; YAv. *už-uuažaṯ* aor.subj. ~ Skt. √*vah* ‘carry’ |
| *tḱ? | *š* | *kt* | /tk/ | kts? | Hitt. *ḫart(tag)ga-* ‘bear,’ Gk. *árktos*, Skt. *ṛ́kṣa-*; TB *takts ā͞ntsa* ‘expert’ ~? Skt. *tákṣaṇ-* ‘carpenter’ |
| *d$^{h}$g$^{h}$ | | | /tk/ | | Hitt. *ḫatk-* ‘shut’ |
| *d$^{h}$ǵ$^{h}$ | *z* | *k$^{h}$t$^{h}$* | /tk/ | *tk* | Gk. *k$^{h}$t$^{h}$ôn* ‘earth,’ TA *tkaṃ*, Av. *zam-*, Hitt. *tēkan* |
| *d$^{h}$g$^{wh}$ | *γž* ? | *p$^{h}$t$^{h}$* | | *kts* ? | TB *ktsaitse* ‘old’ ~? Gk. *p$^{h}$t$^{h}$ín o͞* ‘wane,’ Skt. *kṣay*: *kṣiṇā́ti* ‘destroy’ |

(Hoffmann and Forssman 1996:103ff., Melchert 1994:61f., 64, Kimball 1999:197, Beekes 1995:134, Ringe 1996:4)

b) Equation of Proto-Indo-European labiovelar, velar and palatal plosives:

| PIE | Ved. | Av. | Gk. | PGmc. | Lith. | OCS | Lat. | Irish | Hitt. |
|---|---|---|---|---|---|---|---|---|---|
| *g$^{wh}$ | g$^{h}$/h | g/*γ*/j | p$^{h}$/t$^{h}$/k$^{h}$ | *g̶$^{w}$ | g | g/ž/dz | f-/gu/v | g/g̶ | kw-/gw |
| *g$^{h}$ | g$^{h}$/h | g/*γ*/j | k$^{h}$ | *g̶ | g | g/ž/dz | h-/g | g/g̶ | k-/g |
| *ǵ$^{h}$ | h | z/ž | k$^{h}$ | *g̶ | ž | z | g | g/g̶ | k-/g |
| *g$^{w}$ | g/j | g/*γ*/j | b/d/g | *k$^{w}$ | g | g/ž/dz | v-/gu | b | kw-/gw |
| *g | g/j | g/*γ*/j | g | *k | g | g/ž/dz | g | g/g̶ | k-/g |
| *ǵ | j | z/ž | g | *k | ž | z | g | g/g̶ | k-/g |
| *k$^{w}$ | k/c | k/x/c | p/t/k | *x$^{w}$ | k | k/č/c | qu | c/ch | kw-/gw |
| *k | k/c | k/x/c | k | *x | k | k/č/c | c | c/ch | k |
| *ḱ | ś | s/š | k | *x | š | s | c | c/ch | k |

(Szemerenyi 1990:64ff., Beekes 1995:110, Meier-Brügger 2002:129ff.)

c) Proto-Indo-European root constraint: When the voicing and aspiration of a root-final stop cannot be reconstructed, the general absence of Proto-Indo-European roots of the templates /BeD/, /B$^{h}$eT/ and /TeB$^{h}$/ helps us to infer the original value.

The following are Vedic etyma with /kṣ/ (from Mayrhofer, *EWAia.* and *LIV*):

| word | source | cognates |
|---|---|---|
| *ákṣa-* ‘axle’ | PIE *ǵs? | Gk. *hámaksa* etc. < PIE *√h$_{2}$eǵ ‘drive,’ Skt. √*aj*, YAv. *azaiti*, Gk. *ág o͞* etc. |

| | | |
|---|---|---|
| *ákṣi-* ‘eye’ | PIIr. *ḱs? | Av. *aš-* |
| | PIE *k$^{w}$s? | Gk. *op$^{h}$t$^{h}$almós*, Lat. *oculus* |
| *√īkṣ* ‘see’ | ↑ | ~ *ákṣi-* |
| *an-ṛkṣará-* ‘spineless’? | ? | |
| *antárikṣa-* ‘middle sky’ | ? | |
| *ī̂k-ṣe, áikṣet ām* | PIIr. *ḱs | *√iś* ‘rule,’ OAv. *is ē* |
| *ukṣáṇ-* ‘young ox’ | PIE *ks | Av. *uxšan-*, OHG *ohso* |
| *ṛ́kṣa-* ‘bear’ | PIE *tḱ | YAv. *arša-*, Gk. *árktos*, Hitt. *ḫart(tag)ga-* etc. |
| *kákṣa-* ‘armpit’ | PIE *ćs | YAv. *kaša-*, Lat. *coxa* |
| *kukṣí-* ‘cheek’ | PIIr. *ḱs | Sogdian *qwšy-*, ~*kóśa-* ‘container’ |
| *√krakṣ* ‘make noise’ | ? | |
| *ákrukṣat* aor.3sg.act. | PIIr. *ćs | *√kroś/kruś* ‘shout,’ OAv. *xraosəṇtąm* |
| *kṣatrá-* | PIE *tk? | ~ *√kṣay/kṣi* ‘dominate’ : *kṣáya-*, Av. *xšaθra-*, Gk. *ktômai* |
| *√kṣad* ‘serve food’ | PIIr. *ćs? | YAv. *šanman-* |
| *√kṣaṇ* ‘wound’ | PIE *tk? | Gr. *kteín ō* |
| *kṣáp-* ‘night’ | PIE *k$^{(w)}$s | YAv. *xšap-*, Gk. *psép$^{h}$as* etc. |
| *kṣám-* ‘earth’ | PIE *d$^{h}$ǵ$^{h}$ | Gk. *k$^{h}$t$^{h}$ôn*, TA *tkaṃ*, Hitt. *t ēkan* |
| *√kṣam$^{i}$* ‘endure’ | PIIr. *kš? | OAv. *xšąnmən ē* |
| *√kṣar* ‘flow’ | PIE *d$^{h}$g$^{whi)}$ | YAv. *√γžar*, Gk. *p$^{h}$t$^{h}$eír ō* |
| *kṣíp-* ‘finger’ | ? | |
| *√kṣep/kṣip* ‘throw’ | PIIr. *kš? | YAv. *xšuua ꞵ̄a-* |
| *√kṣay/kṣi* : *kṣáya-* ‘rule’ | PIE *tk | OAv. *xšaiieh ī*, Gk. *ktômai*? |
| *-kṣá-* | ↑? | |
| *√kṣay/kṣi*: *kṣéti* ‘dwell’ | PIE *tḱ | OAv. *ša ēit ī*, Mycenian <ki-ti-je-si> 3pl., Gk. *ktíz ō* |
| *kṣétra-* ‘land’ | ↑ | OAv. *š ōiθra-* |
| *√kṣay/kṣi*: *kṣiṇ ā̂ti* ‘destroy’ | PIE *d$^{h}$g$^{wh}$ | Gk. *p$^{h}$t$^{h}$ín ō* |
| *kṣ īrá-* ‘milk’ | PIIr. *kš | MP *š īr* |
| *kṣú-* ‘cattle’ | PIIr. *pć | ~*paśú-*, YAv. *fšumaṇt-* |
| *√kṣod/kṣud* ‘scatter’ | ↓ | |
| *kṣudrá-* ‘small’ | PIIr. *kš | YAv. *xšudra-* |
| *kṣud$^{h}$* ‘be hungry’ | ↓ | |
| *kṣúd$^{h}$-* ‘hunger’ | PIIr. *kš | YAv. acc.sg. *šuδəm* |
| *√kṣob$^{h}$/kṣub$^{h}$* ‘quake’ | PIIr. *kš | YAv. *xšufsąn* |
| *kṣúmpa-* ‘?’ | ? | |
| *kṣurá-* ‘razor’ | PIE *ks | Gk. *ksurón* |
| *kṣoṇá-* ‘?’ | ? | |
| *kṣoṇ ī̂* | PIIr. *pć | YAv. *fšaoni-* |
| *√kṣṇav/kṣṇu* ‘sharpen’ | PIIr. *kš | YAv. *hu-xšnuta-*, ~ Lat. *nov ācula* ‘razor’ |
| *kṣvíṅk ā-* ‘?’ | ? | |
| *√cakṣ* ‘see’ | PIE *ḱs | ~ *√k āś*, YAv. *čašte* |
| *cákṣus, cákṣas* | ↑ | |
| *cakṣáṇi-* | ↑ | |
| *√jakṣ* ‘laugh’ | PIIr. *g$^{h}$-s | ~ *√has* ‘laugh’ |
| *jugukṣa-* desid. | PIIr. *ǵ$^{h}$-s | *√goh/guh* ‘hide’: *g ūḍ$^{h}$á-*, YAv. *√guz-* |

| | | |
|---|---|---|
| √*takṣ* ‘hew’; *tákṣaṇ-* ‘carpenter’ | PIE *tḱ | YAv. *tāšti*; Gk. *tékt̄on* ‘craftsman’ ~ TB *takts̄antsa* ‘expert’? |
| *tr̥kṣí-*, *tā́rkṣya-* | ? | |
| *títikṣa-* desid.? | PIE *g$^{w}$-s | √*tyaj* ‘abandon,’ OAv. *iθiieǰah-* |
| √*tvakṣ* ‘be active’ | PIIr. *kš | OAv. *θβaxšah-* |
| √*dakṣ* ‘be able’ | PIIr. *kš | Av. √*daxš* |
| *dákṣiṇa-* a. ‘right’ | PIE *ḱs | YAv. *dašina-*, Gk. *deksiós* etc. |
| *ádr̥kṣata* s-aor.3pl.mid. | PIE *ḱ-s | √*darś/dr̥ś* ‘look,’ Gk. *dérkomai*, etc. |
| *d$^{h}$/dákṣa-*, *d$^{h}$/dákṣi* | PIE *g$^{wh}$-s | √*dah* ‘burn,’ Lith. *degù*, OCS *žegǫ*, Lat. *fove̅o* ‘warm’ etc. |
| *d$^{h}$/dukṣa-* sa-aor. | PIIr. *g$^{h}$-s | √*doh/duh* ‘give milk,’ Gk. *teúk$^{h}$ō* ‘make ready,’ ON *duga* ‘avail’ etc. |
| *nákṣa-* s-aor.subj., *íyakṣa-* desid. | PIE *ḱ-s | √*naś* ‘reach,’ OAv. *nąsa̰t*, OIr. *-icc*, *-ánaic* etc. |
| *nákṣatra-* ‘constellation’ | ? | |
| √*nekṣ/nikṣ* ‘pierce’ | PIIr. *ǰ$^{(h)}$s? | YAv. *na̅eza-*? |
| *pakṣá-* ‘wing’ | PIIr. *kš | Ossetic *faxs* |
| (√)*prakṣ/pr̥kṣ* ‘strengthen’ | PIE *k-s | ~ √*parc/pr̥c* ‘fill,’ Middle Irish *ercaid* ‘fills’ |
| *b$^{h}$akṣ-*, *b$^{h}$ikṣ-* | PIE *g-s | √*b$^{h}$aj* ‘share,’ OAv. *baxšt̄a*, Gk. *p$^{h}$ageîn* ‘devour’ |
| *mákṣ-* f.(?) ‘fly’ | PIIr. *kš | YAv. *maxš̄ī* |
| *makṣ́ū* ‘quickly’ | PIE *ḱs | OAv. *mošu-č̄a*, Lat. *mox* |
| *mukṣ-* | PIE *k-s | s-aor. of √*moc/muc* ‘release,’ Lith. *munkù* ‘loosen,’ Lat. *ē-mung̅o* ‘rip off’ |
| *mr̥kṣ-* | PIE *ǵ-s | s-aor. of √*marj/mr̥j* ‘wipe,’ YAv. *marəzaiti*, Gk. *amélg̅o* ‘milk’ etc. |
| √*myakṣ/mikṣ* ‘mix’ | PIE *ḱs? | ~ ˣmiś as in *miśrá-* ‘mixed’?, OCS *měsiti* ‘knead’ |
| *yakṣ-* | PIE *ǵ-s | s-aor. of √*yaj*, Av. √*yaz*, Gk. *házomai* |
| √*yakṣ* ‘appear’ | PIIr. *kš? | Yaghnobi *yaxš-* ‘be visible’ |
| *yákṣma-* ‘consumption’ | ? | |
| *yukṣ-* | PIE *g-s | s-aor. of √*yoj/yuj* ‘join,’ OAv. *yaogat̰*, Lat. *iungere* |
| √*vakṣ/ukṣ* ‘grow’ | PIE *gs | ~*ójas-*, OAv. *uxšiieit̄ī*, Goth. *wahsjan* |
| *vikṣ-* | PIE *ḱ-s | s-aor. of √*veś/viś* ‘settle down in,’ OAv. *vīs̄n̥t̄e* |
| *vivekṣi* pres.2sg. | PIE *k-s | √*vec/vic* ‘sift,’ YAv. *hąm.vā́šiia*, Goth. *weihs* |
| *vr̥kṣ-* | PIE *g-s | s-aor. of √*varj/vr̥j* ‘turn over,’ Lat. *uergere*, etc. |
| *vr̥kṣá-* ‘tree’ | PIE *ḱs? | YAv. *varəša-* |
| √*rakṣ* ‘protect’ | PIE *ks | Gk. *alékst̄a*, Ir. *xš* in Arm. *erašxi-k‘* |
| *rírikṣa-* | PIIr. *š-s | desid. of √*reṣ/riṣ* ‘be hurt,’ YAv. *irišiieiti* |
| *rukṣá-* (ṚV 6.3.7) | PIE *k-s | ~ √*roc/ruc* ‘shine,’ Goth. *liuhaþ*, Gk. *leukós*, etc. |
| *lakṣá-* | ? | |

| | | |
|---|---|---|
| *lákṣman-, lakṣmī* | ? | |
| √*śikṣ* ‘help’ | PIIr. *k-š | ~ √*śak* ‘be able,’ OAv. *saš̌aθā* |
| *āśuśukṣáṇi-* | PIE *k-s | √*śoc/śuc* ‘shine,’ OAv. *saočaiiaṯ* |
| √*sakṣ* | PIE *k$^{w}$-s | √*sac* ‘accompany,’ Gk. *hépetai̯*, etc. |
| *sakṣ-, sākṣ-, sīkṣ-* | PIE *ǵ$^{h}$-s | √*sah* ‘prevail,’ YAv. *hazah-*, Gk. *ék$^{h}$ō* |
| *sṛkṣ-, srakṣ-* | PIE *ǵ-s | √*sarj/sṛj* ‘release,’ YAv. *hərəzəṇti* |

[i] *LIV* *g$^{w}$ǵ$^{h}$er.
(For *kṣ* from /š-s/, see §43.)

Aside from languages such as Old Irish or Slavic which simplify most obstruent clusters, such an extensive neutralization of place and laryngeal contrasts is unique, particularly in a language which otherwise preserves Proto-Indo-European consonant system relatively well. The cluster *ks* also occurs often in Tocharian B; at first sight, it looks similar to Sanskrit *kṣ*, but it is actually a product of a quite different development. In the first place, all dorsal stops collapse into a single phoneme /k/ in Proto-Tocharian whether or not they are followed by a sibilant, so voicing neutralization is not peculiar to dorsal-sibilant clusters. The merger is not as extensive as in Indo-Aryan either, for the ‘thorn’ cluster in Proto-Indo-European does not become /ks/, e.g. Skt. *kṣám-* vs. TA *tkaṃ* for PIE *d$^{h}$éǵ$^{h}$ōm- ~ *d$^{h}$ǵ$^{h}$em- f. ‘earth.’ Furthermore, the output *ks* in Tocharian B often results from syncopation of *ə which was inserted in Proto-Tocharian. Forms such as TB *preksa* pret.3sg. ‘asked’ and TB *neksa* pret.3sg. ‘perished,’ have their origins in Proto-Indo-European aorist stems *preḱ-s- and *neḱ-s- (Ringe 1996:112, 109), but Tocharian A cognates *prakäs* and *ñakäs* indicate that they have actually developed respectively through PToch. *pr$^{y}$ekósə and *n$^{y}$ekósə. *ə is inserted in other clusters as well, e.g. PIE *s(u̯)eḱstós ‘sixth’ > PToch. *ṣəkəstḗ > TB *ṣkaste*, TA *ṣkäṣt* (Ringe 1996:71, R. Kim 1999:146f.). Words with inherited clusters of a dorsal and a sibilant are therefore relatively small in number, e.g. TB *okso* ‘ox’ from PToch. *wək$^{w}$s+p < *uksṓ(n) ← PIE *uksḗn- ‘bull’ (R. Kim 1999b:164), or *läks* nom/obl.sg. ‘fish’ presumably from PIE *loḱs- ‘salmon’ (Ringe 1996:92, R. Kim 1999a:112ff.).

Contrary to Sanskrit, Avestan preserves the distinction in voicing, and partly in place as well, so the neutralization must have taken place after the divergence of Indo-Aryan from Proto-Indo-Iranian. The merger to /kṣ/ in Sanskrit is different not only from Iranian, but also from later languages of Indo-Aryan itself. Middle Indo-Aryan voiced reflexes ((*g*)*g$^{h}$* or (*j*)*j$^{h}$*: geminated in medial position) corresponding to Sanskrit *kṣ*, e.g. Skt. *kṣárati* ‘flows’: Pāli *(pa-)gg$^{h}$arati*, Pkt. *j$^{h}$araï* or Skt. *kṣāmá-*‘scorched’ : Pāli, AMg. *j$^{h}$āma-*, are claimed to have preserved original voiced clusters from Proto-Indo-Iranian, as in Av. √*γžar* in *-γžārayeiti* caus.3sg. (Pischel 1900:§326, Geiger 1994:§56, Emeneau 1966:134, von Hinüber 1986:115, 2001,184f., Masica 1991:173). If that was the case, it follows that the extensive merger to Skt. /kṣ/ does not apply to the Old Indo-Aryan dialects through which those Middle Indo-Aryan languages developed, for a merger is generally considered to be irreversible (§4); but rather, the cluster /kṣ/ belongs just to a dialect of Old Indo-Aryan which had a restriction against sibilant voicing.

Another case of an apparently reverted merger is Sanskrit *kṣ* from PIIr. *ćš < PIE *ḱs as in Skt. *kákṣa-* m. 'armpit' : YAv. *kaša-* (Hoffmann and Forssman 1996:103), whose /k/ looks as if PIIr. *ć reverted to the original Proto-Indo-European dorsal stop; but since the dorsal pronunciation is irrevocably lost in Proto-Indo-Iranian, the development into Skt. *kṣ* has to be explained by place dissimilation (§43). Pischel (1900:§318, 319) again argues that the distinction between PIIr. *ćš and *kš is partly preserved in Middle Indo-Aryan reflexes *cc*$^{h}$ and *kk*$^{h}$ (cf. von Hinüber 2001:183).

If the extensive neutralization of phonemic contrasts in Sanskrit /kṣ/ is a dialectal phenomenon within Indo-Aryan, it could be neatly represented as dominance of the following constraints over MaxIO, which requires every contrast in the input to appear in the output, in this particular dialect.

★FricVoi: A fricative is not voiced. Undominated in Vedic, but ranked low in Avestan, and probably in an Old Indo-Aryan dialect other than Sanskrit through which Middle Indo-Aryan developed.

Laryngeal Constraint: Lombardi's Laryngeal Constraint (§83) states that voicing and aspiration of an obstruent not immediately followed by a sonorant is licensed only parasitically, and that consonants in a cluster should share the features [voiced] and [spread glottis], if any.

★SS: Sibilants cannot stand side by side. Undominated in Avestan.

OCP (i.e. Obligatory Contour Principle)**:** Assuming that /s/ in Sanskrit is redundantly specified for [spread glottis] (§72), two adjacent segments cannot independently bear aspiration.

Vedic: ★FricVoi, OCP ≫ Laryngeal Constraint ≫ Max-IO

| | /g$^{h}$s/ | ★FricV | OCP | LC | Max |
|---|---|---|---|---|---|
| | g$^{h}$ṣ | | *! | * | |
| | gṣ | | | *! | * |
| | g$^{h}$ẓ | *! | * | * | * |
| | gẓ | *! | | | ** |
| | gẓ$^{h}$ | *! | | | * |
| ☞ | kṣ | | | | ** |
| | k$^{h}$ṣ | | *! | | * |

| | /ǵs/ | ★FricV | OCP | LC | Max |
|---|---|---|---|---|---|
| | jṣ | | *! | * | |
| | jẓ | *! | * | | * |
| | gṣ | | | *! | * |
| | gẓ | *! | | | ** |
| | cś | | *! | | * |
| ☞ | kṣ | | | | ** |

In Avestan, on the other hand, ★FricVoi is not active, and the OCP is irrelevant because there is no aspiration. Since Avestan does not allow a sibilant cluster in any context, we should posit ★SS, an undominated constraint which prohibits a sibilant cluster. The ranking is hence ★SS ≫ Laryngeal Constraint ≫ Max-IO.

| | /g$^{h}$s/ | ⋆SS | LC | Max |
|---|---|---|---|---|
| | γš | | ∗! | |
| ☞ | γž | | | ∗ |
| | χš | | | ∗∗! |

| | /ǵs/ | ⋆SS | LC | Max |
|---|---|---|---|---|
| | zš | | ∗! | |
| | zž | ∗! | | ∗ |
| | sš | ∗! | | ∗ |
| ☞ | ž | | | ∗ |

### §46 Development of Indo-Iranian palatal voiced aspirates

Although voiceless unaspirated, voiceless aspirated and voiced unaspirated plosives almost never lose their occlusive constriction in Old Indo-Aryan, some voiced aspirates become /h/ already in Vedic. Aside from this asymmetry of deocclusion, it is also surprising that deocclusion results in a total loss of the place feature. Since the deocclusion of /d$^{h}$/, /b$^{h}$/ and /g$^{h}$/ is apparently not conditioned by a particular phonological context and seems to involve analogy to some extent (§57), we should begin our discussion of the phonological details of this development with the uniform deocclusion of the Proto-Indo-Iranian voiced aspirated palatals *ǰ$^{h}$ and *ǯ$^{h}$ into Sanskrit /h/.

As the Proto-Indo-Iranian voiceless unaspirated primary palatal plosive *ć becomes the fricative *ś* in Vedic, as *j* in √*yaj* which comes from an Indo-Iranian primary palatal plosive *ǰ becomes *ṣ* in the verbal adjective form *iṣ-ṭá-*, and as the primary palatals become the fricatives *s* and *z* in Avestan, primary palatal plosives seem to have lost their occlusive constriction in a fairly early period, although they are still affricates in Proto-Indo-Iranian. The phonetic values of the Proto-Indo-European primary palatals are reconstructed as alveopalatal or palato-alveolar affricates according to the Nuristani evidence, such as Kati *jõ* 'knee' : Sanskrit *j* $\bar{a}$*nu-* < PIIr. *ǰanu- < PIE *ǵonu-, Kati *duċ* 'ten' (*ċ*: [ts]) : Sanskrit *dáśa* < PIIr. *daća- < PIE *dekṃt-, Waigali *ċ* $\bar{u}$*nɒ-* 'empty' : Sanskrit *ś* $\bar{u}$*na-* 'emptyness,' *ś* $\bar{u}$*nyá-* 'empty' < PIIr. *ćuHna-, or K$\bar{a}$mviri *zim* 'snow' (*z*: [d$^{z}$]) < PIIr. *ǰ$^{h}$imá- < PIE *ǵ$^{h}$imó- (Morgenstierne 1973:335ff; Buddruss 1977:28f; Strand E11). It is possible that the Proto-Indo-Iranian primary palatals were still palatal stops, but from the viewpoint of the gradualness of sound change, the development of affricates into fricatives is easier to explain than that of stops into fricatives (Hall 1997a:213). Kuryłowicz (1977:195f.) also reconstructs a palatal (palato-alveolar or alveopalatal in our terminology) affricate in view of the reflex of PIIr. *ć as *ṭ* and *ṣ* in Sanskrit.[14]

The idea that all primary palatals once lost occlusive constriction, however, leads to a puzzling consequence that the four voiced palatal plosives in Proto-Indo-Iranian went through four different processes to wind up as *j* and *h*:

[14]Kuryłowicz (1977:196): "Au point de vue historique ce double reflet d'i.e. $\hat{k}$ plaide l'existence d'une ancienne affriquée, simplifiée soit en *ṣ* soit en occlusive cérébrale *ṭ*, suivant l'entourage. $\bar{A}$ cause du lieu d'articulation de *ś*, qui est la continuation normale de $\hat{k}$ devant voyelle ou sonore, on posera comme point de départ du développement l'affriquée palatale *'*ç* (*ts'*) laquelle semble du reste confirmée par certains dialectes du nord-ouest."

| PIIr. source | process | outcome |
|---|---|---|
| *ǰ (primary) | first became fricative (?), then restored occlusion | *j* |
| *ǰ̌ (secondary) | remained occlusive | *j* |
| *ǰ$^h$ (primary) | early (?) deocclusion | *h* |
| *ǰ̌$^h$ (secondary) | later (?) deocclusion | *h* |

The above-mentioned SIBILANT VOICING FILTER, which prohibits voicing of fricatives, does not explain why not only *ǰ$^h$ but also *ǰ̌$^h$, which should have maintained its occlusive constriction at that point,[15] both lose occlusion and become *h*.

Instead of assuming that the primary palatal plosives once underwent deocclusion, one may also suppose that this skewed polarization of the voiced palatal stops between *j* and *h* took place all at once after the first and the second palatal series merged. In that case, we have to assume that only PIIr. *ć became /ś/ while the other first palatal stops maintained their occlusion, and that the fricative reflection of PIIr. *ǰ and *ǰ$^h$ as in √*yaj* : *iṣṭá-* or √*reh/rih* : *réḍ$^h$i* < */-ẓd$^h$-/ is a special development and does not imply that the first palatal *ǰ became fricative */ź/ in all contexts. These two assumptions are, I think, more complicated than explaining the development of the four voiced palatal stops into *j* and *h* individually. See §56 for further discussion on the deocclusion of *ǰ$^h$ and *ǰ̌$^h$.

## §47 The problem of PIE *sḱ > PIE *sć > Sanskrit *cc$^h$*

Among the morphemes with /cc$^h$/ which are traceable back to Proto-Indo-European, the one most widely attested in other Indo-European languages is the verbal suffix *-s{k/ḱ}{é/ó}-.[16] Its reflexes, or at least its traces, are proposed for almost all subgroups:

| | Examples | Grammat. categories |
|---|---|---|
| Hittite | *atsk̲antsi* ‘they devour’ etc. | verbal suffix *-sk-* |
| TB | *p ā̲sk̲au* ‘I keep,’ class IX presents, etc. | transitive suffix *-sk-* |
| Latin | *pos̲c̲ere* ‘to ask’ < *pr̥̄(ḱ)-sḱé- | |
| | *alb ē̲sc̲ere* ‘to whiten’ etc. | inchoative suffix *-V̄-sc-* |
| OIr. | *arc̲u, arc̲o* ‘I ask’ < *pr̥̄(ḱ)-sḱó-h$_2$ | |
| Arm. | *e-harc̲‘* aor.3sg. ‘asked’ < *é-pr̥̄(ḱ)-sḱe-t | |
| Gk. | Hom. *bás̲k̲e* ‘go,’ *érk̲$^h$omai* ‘I go’ < *h$_1$r̥̄-sḱó- | |
| OHG | *was̲c̲an* ‘to wash’ | |
| OCS | *is̲k̲ati, iš̲t̲etĭ* ‘seeks’ < *h$_2$is-sḱé/ó- | |
| Alb. | *nieh/ nief* ‘to count, consider’ < *nem-ska- < *-sḱe/o-? | |

(Szemerényi 1990:293ff., R. Kim 2002:69, Orel 2000:100)

[15] Although there is no clue to the phonetic value of the pre-Vedic secondary palatal plosives, the initial *j* in the relic imperative form *jahí* for the root PIIr. *√ǰ̌$^h$en ‘smite’ < PIE *√g$^{wh}$en shows that *ǰ̌$^h$ still had occlusion (provided that GRASSMANN’S LAW was active in Indo-Aryan), for it is unlikely that /j/ synchronically functions as an unaspirated counterpart of /h/ (Cardona, p.c.).

[16] A shorter version of the discussion from §47 to §54 was presented at the 12th World Sanskrit Conference and is to appear in the proceedings volume edited by Bertil Tikkanen.

The reconstruction of the second consonant not as velar *k but as palatal *ḱ is based on Avestan *-s-* as in *jasaiti* 'goes,' to which Vedic *-cc$^h$-* as in *gácc$^h$ati* 'goes' corresponds: Avestan *s* is the regular outcome of Proto-Indo-European palatal *ḱ before vowels (Brugmann 1897:559 §615, Hoffmann and Forssman 1996:102, 188), e.g. YAv. *satəm* 'hundred' < PIIr. *ćatám < PIE *(d)ḱm̥tó-m, and in Avestan, the last of a cluster of sibilants survives, in this case *s* < PIIr. *ć of *sć in this case. Against projecting *-sḱ- with palatal *ḱ back to Proto-Indo-European, Lubotsky (2001) argues that reconstructing *sk accounts for most reflexes as well or better, and that Sanskrit *cc$^h$* and Avestan *s* may be explained as the result of leveling from palatalizing contexts (before PIE *e, for example); he further points out that inherited *cc$^h$* is limited to postvocalic position. One of the advantages of this explanation is that the suffixal doublet *-śc ā́ ~ -cc$^h$ ā́* as in *tiraśc ā́* 'backward' ~ *acc$^h$ ā́* 'toward' or roots such as √*vraśc/vr̥śc* 'hew,' which are hard to explain under the traditional view (cf. Gotō 1987:73 for √*vraśc*), are neatly accounted for as remappings of PIIr. *sć and *sč respectively to postvocalic and postconsonantal contexts. However, as Proto-Indo-European intervocalic *sk is leveled to palatal *sć in Proto-Indo-Iranian under his hypothesis (Lubotsky 2001:37), it does not affect our discussion of the development of Proto-Indo-Iranian *sć after Indo-Aryan branches off.

Of the Early Vedic words containing /c$^h$/, those deriving from the *-sḱé/ó- suffix are:

| | |
|---|---|
| √*eṣ/iṣ* : *icc$^h$á-* 'seek' | < *h$_2$is-sḱé/ó- |
| √*vas/us* : *ucc$^h$á-* 'shine' | < *h$_2$us-sḱé/ó- |
| √*ar/r̥* : *r̥cc$^h$á-* 'come across' | < *h$_1$r̥-sḱé/ó- |
| √*praś/pracc$^h$/pr̥cc$^h$* : *pr̥cc$^h$á-* 'ask' | < *pr̥(ḱ)-sḱé/ó- |
| √*m ū́rc$^h$* : AV+ *m ū́rc$^h$a-* 'thicken' | < *mr̥H-sḱé/ó- |
| √*gam* : *gácc$^h$a-* 'go' | < *gm̥-sḱé/ó- |
| √*yam* : *yácc$^h$a-* 'hold' | < *i̯m̥-sḱé/ó- |
| √*yav/yu* : *yúcc$^h$a-* 'keep away' | < *i̯u-sḱé/ó- |
| √*hvar* : Kāṭh.+ *h ū́rc$^h$a-* 'fall away' | ←< *ǵ$^h$ur-sḱé/ó- (Gotō 1987:352f.) |

(The last four verbs have secondary initial accent.)

A few verbal roots have initial *c$^h$*:

√*c$^h$ad* 'cover': *c$^h$ ādáya-*, *c$^h$adíṣ-*
√*c$^h$and* 'appear': *c$^h$adáya-*, YAv. *saδaiieiti*
√*c$^h$ed/c$^h$id* 'cut': *c$^h$idrá-* adj., Av. √*sid*, Gk. *sk$^h$íz ō*, Lat. *scind ō* < *sḱ$^{(h)}$id
√*c$^h$ard/c$^h$r̥d* 'pour over': *c$^h$r̥ṇátti*
√*c$^h$ ā́*: AV *c$^h$yáti* 'hide, skin'

There are several other cases of *c$^h$*, some of which do not have transparent etymologies:

| | |
|---|---|
| *ácc$^h$ ā́* 'toward' | etymology unclear: < PIIr. *a-sćā́? (Lubotsky 2001:42) |
| AV+ *r̥cc$^h$ár ā́-* 'fetlock' (?) | ṚV *an-r̥kṣará-* 'spineless' (?) |
| *ducc$^h$ún ā́* f. 'calamity' | < *duṣ-* 'ill-' + *śúna-* n. 'felicity' |

| | |
|---|---|
| AV+ *púcc$^{h}$a-* ‘tail’ | etymology unclear |
| TS+ *párucc$^{h}$epa-* prop.n. | < *parut* + *śepa-* (Hoffmann 1974=1975:332) |
| *c$^{h}$úbuka-* n. ‘chin’ | |
| *c$^{h}$avī́-* f. ‘skin, hide’ | |
| *c$^{h}$āyā́-* f. ‘shadow’ | YAv. *saiiā-*, Gk. *skiā́*, Alb. *hē*, TB *skiyo* |
| *c$^{h}$āga-* m. ‘goat’ | |
| *tuc$^{h}$yá-* ‘empty, vain’ | |

(examples from *EWAia.* and Lubotsky 2001)

The compound *ducc$^{h}$únā-* from /dus-śuná-/ or PIIr. *duš-ćuná-, compared with the more general type of Ṛgvedic compound like *duḥśáṃsa-* < /dus-śáṃsa-/, shows that the change of PIIr. *sć into Sanskrit *cc$^{h}$* ceased to be productive at some point in pre-Vedic Indo-Aryan. It is known that the compound *āsat-* ‘nothingness’ dates back to a period when the verb PIE *h$_1$es > PIIr. *Has > Sanskrit √*as* ‘be’ still had an initial laryngeal, because the compensatory lengthening of *a-* ‘un-’ < PIE *n̥- would not have happened once the root-initial laryngeal had disappeared. In a similar way, the irregular sandhi found in a few compounds in the Ṛgveda with *dus-* ‘ill-,’ i.e. *dūḍábh$^{h}$a-* instead of ×dur-dábhˣa-, *dūḍā́ś-* instead of ×dur-dā́śˣ-, *dūḍh$^{h}$ī* instead of ×dur-dh$^{h}$ī, *dūṇáśa-* instead of ×dur-náśa-, or *dūṇā́śa-* instead of ×dur-nā́śa-, indicates that they are old enough to be established as lexical units (Whitney 1889:67f., §199d), if not as old as Proto-Indo-Iranian, and thus are exempt from application of external sandhi rules (§67).

From a phonological and historical viewpoint, the development of PIIr. *sć < PIE *s{k/ḱ} into Vedic /(c)c$^{h}$/ involves the following three problems:

i) Why is /c$^{h}$/, being a single phoneme, treated as a cluster when preceded by a short vowel? What does its Underlying Representation look like?
ii) The original Proto-Indo-Iranian sequence *sć contains no aspiration. Where does the aspiration of /cc$^{h}$/ come from?
iii) Why is only the *s in the cluster *sć lost, while *s before other voiceless plosives is ‘protected’ as an Extrasyllabic Sibilant (§31)?

i) can easily be attributed to the skeletal structure of the original string *sć, as in the case of /ḍ$^{h}$/ < PIIr. *žd$^{h}$, which is also treated as a cluster metrically, e.g. ṚV 8.61.11b *nā́rāyāso ná jáḍhavaḥ* (ṚV *ḷ$^{h}$*=/ḍ$^{h}$/) but emergence of aspiration (ii) and a Prakrit-like loss of a cluster-initial sibilant (iii) cannot be explained simply by adding up gradual sound changes.

In the following sections, I will discuss previous explanations for the development of PIIr. *sć into Sanskrit /cc$^{h}$/, and then seek to account for this apparently irregular phenomenon as the result of common and regular phonological changes.

### §48 Explanation 1: Place assimilation *sć > *ść + occlusion

Wackernagel (1896:156) states that the *s in PIE *sḱ had undergone place assimilation to *ś* already by Proto-Indo-Iranian, i.e. PIE *sḱ > PIIr. *śś > Av. *s*, Ved. *cc$^{h}$*. He points

out the parallelism between this change of *śś to *cc*h* and the occlusion of /ss/ to *ts* as in √*vas* 'dwell' : fut. *vat-sya-ti* (Br.+) (179).

It is more likely, however, that PIE *ḱ had occlusion in Proto-Indo-Iranian, given the Nuristani evidence such as Waigali *ċ ūnɒ-* 'empty' (*ċ*: [ts]) < PIIr. *ćuHna- and Kati *duċ* 'ten' : PIE *dekm̥t- (§46); hence the Proto-Indo-Iranian reflex of PIE *sḱ with place assimilation would better be written as *ść, rather than *śś (Hoffmann and Forssman 1996:103). The whole development according to this hypothesis would be tabulated in the following chronological order:

| | **PIE** | *sḱ | *ḱs | *ḱ-t | *tḱ | *sk(w)i/e |
|---|---|---|---|---|---|---|
| 1 | Metathesis of *tḱ[i)] | – | – | – | *ḱθ | – |
| 2 | Pedersen's ('ruki') Law | – | *ḱš | – | *ḱš | –[ii)] |
| 3 | 1ary Palatalization | *sć | *ćš | *ć-t | *ćš | – |
| 4 | *s > *ś / _ć | *ść | – | – | – | – |
| 5 | 2ary Palatalization | – | – | – | – | *sč |
| | **PIIr.** | *ść | *ćš | *ć-t | *ćš | *sč |
| 6 | *ć > *š / _t[iii)] | – | – | *š-t | – | – |
| | **Iranian** | *ść | *ćš | *š-t | *ćš | *sč |
| 7 | Deocclusion of *ć | *śś | *śš | *š-t | *śš | *sč |
| 8 | $S_1S_2 > S_2$ | *ś | *š | – | *š | – |
| | **Avestan** | *s* | *š* | *št* | *š* | ×sc |
| | **Indo-Aryan** | *ść | *ćš | *š)-t[iv)] | *ćš | *s)č |
| 9 | Dissimilation of *ćš | – | *kš | – | *kš | – |
| 10 | Deocclusion of *ć | *śś | – | – | – | – |
| 11 | Occlusion of *ś | *cś | – | – | – | – |
| | **Vedic** | *cc*h* | *kṣ* | *ṣ)ṭ* | *kṣ* | *ś)c* |

* Here I use the symbol *ś for a palatal or palatalized sibilant, and *š for a [−anterior] equivalent of the dental sibilant *s (see §103).

i) Metathesis of the 'thorn' cluster. See Schindler (1977a:31).

ii) There is no *sk(w) in this environment except *ciśc ā́* (ṚV 6.75.5).

iii) Brugmann (1897:559), Hoffmann and Forssman (1996:102, §68db).

iv) *š in *š-t is licensed as an Extrasyllabic Sibilant (§31).

Essentially the same explanation is given by Burrow (1965:92f.), Hock (1987:151) and Jamison (1991:83).

One problem with this view is pointed out by Bartholomae (1896:710) and Leumann (1941:12f.), regarding the occlusion of a sibilant before */ś/ < PIIr. *ć (11): according to them, this hypothesis overestimates the regularity and antiquity of the occlusion of *s~*š

in a cluster of two sibilants. As we noted in §43, the occlusion of the first of two contiguous sibilants as in √*vas* 'dwell' : *av ātsṯh*(AV+) s-aor.2sg.act., *vatsyati* fut.3sg.act. (Brāhmaṇa+) is probably not a phonological phenomenon, but rather an analogical alternation which gradually emerges in Vedic in certain morphological contexts like the aorist and the future tense, whereas the occlusion of a sibilant before *ś* < PIIr. *ć is assumed to have been a regular development.

### §49 Explanation 2: Metathesis of *sḱ

One possible way to explain the discontinuous change of PIE *sḱ into OIA /(c)c$^{h}$/, though not found in the previous literature, is to suppose that *s and *ḱ were transposed after Indo-Iranian diverged from Proto-Indo-European, just like the Proto-Indo-European 'thorn' cluster *tḱ according to Schinder (1977a). That metathesis cannot have been as early as the metathesis of the 'thorn' cluster, however, because PIE *sḱ would then merge with PIE *ḱs, which becomes *kṣ* in Sanskrit. This undesirable merger is avoided if the metathesis of *sḱ is ordered after the 'RUKI' rule.

| | **PIE** | *sḱ | *ḱs | *ḱ-t | *tḱ | *sk$^{(w)}$i/e |
|---|---|---|---|---|---|---|
| 1 | METATHESIS of *tḱ | – | – | – | *ḱθ | – |
| 2 | PEDERSEN'S ('RUKI') LAW | – | *ḱš | – | *ḱš | – |
| 3 | METATHESIS of *sḱ | *ḱs | – | – | – | |
| 4 | 1ARY PALATALIZATION | *ćs | *ćš | *ćt | *ćš | – |
| 5 | 2ARY PALATALIZATION | – | – | – | – | *sč |
| | **PIIr.** | *ćs | *ćš | *ć-t | *ćš | *sč |
| 6 | *ć > š / _t[ii)] | – | – | *š-t | – | – |
| | **Iranian** | *ćs | *ćš | *š-t | *ćš | *sč |
| 7 | DEOCCLUSION of *ć | *śs | *śš | *š-t | *śš | *sč |
| 8 | $S_1S_2 > S_2$ | *s | *š | – | *š | – |
| | **Avestan** | *s* | *š* | *št* | *š* | ˣsc |
| | **Indo-Aryan** | *ćs | *ćš | *š)-t | *ćš | *s)č |
| 9 | DISSIMILATION of *ćš | | *kš | | *kš | |
| 10 | BLOCKING OF *ć > ś | *ćs | – | – | – | – |
| 11 | *ć > ś | – | – | – | – | – |
| | **Vedic** | *cc$^{h}$* | *kṣ* | *ṣ)ṭ* | *kṣ* | *ś)c* |

This hypothesis is not readily acceptable in two respects. In the first place, PEDERSEN'S LAW, or the 'RUKI' rule, remains active until Old Indo-Aryan, although it is probably no longer a purely phonological rule, and it is difficult to imagine that the metathesized sequence *ḱs in (3) remained distinct from *ḱš. It is also unlikely that the near-merger pre-forms, PIIr. *ćs from PIE *sḱ and PIIr. *ćš from PIE *ḱš, would have become OIA *cc$^{h}$* and *kṣ* respectively.

### §50 Explanation 3: Transfer of *s to aspiration

Zubatý (1892) and Wackernagel (1896:157)[17] suggest that the development of PIE *sḱ into Sanskrit /cc$^{h}$/ is essentially the same as the change of the Old Indo-Aryan clusters /sp/, /st/, /ṣṭ/, /sc/, /sk/ into /pp$^{h}$/, /tt$^{h}$/, /ṭṭ$^{h}$/, /cc$^{h}$/, /kk$^{h}$/ in many Middle Indo-Aryan languages, e.g.

> Skt. *púṣpa-* 'flower' : Māhārāṣṭrī etc. *pupp$^{h}$a*; Skt. *ásti* 'is' : Pāli *att$^{h}$i*; Skt. *dṛṣṭí-* 'look' : Māhārāṣṭrī etc. *diṭṭ$^{h}$i*; Skt. *paśc ā́(t)* 'afterwards' : Gāndhārī Dhammapada *pac$^{h}$a*; Skt. *śúṣka-* 'dry' : Ardha-Māgadhī *sukk$^{h}$a-* (Pischel 1900:§301ff, von Hinüber 1986:113, 2002:181, Bailey 1946:774).

In featural terms, the transfer of /s/ into aspiration in Middle Indo-Aryan can be represented as follows:[18]

| | | | |
|---|---|---|---|
| 1. | s | P | Old Indo-Aryan. P = {*k*, *c*, *ṭ*, *t*, *p*} |
| 2. | ḥ | P | Coda /s/ becomes ill-formed, and becomes a fricative release, losing its segmental status. |
| 3 | ⌴ | P$^{h}$ | All codas are eliminated unless they are multiply linked to an onset. |
| | ǂ<br>[s.g.] | | Floating aspiration ([spread glottis]) relinks to the onset P. |
| 4. | P ← | P$^{h}$ | The empty C slot is filled by a voiceless counterpart of P$^{h}$, which is the only possible coda before a plosive. |
| | \| | \| | |
| | C | C | |

The problem with appealing to transfer of aspiration to explain the origin of /(c)c$^{h}$/ is the hundreds of years of chronological gap between the change from PIIr. *sć to Sanskrit *cc$^{h}$*, which was completed already in the pre-Vedic period, and the change from Old Indo-Aryan clusters of the same shape /SP/ to Middle Indo-Aryan /PP$^{h}$/ clusters. In other words, this hypothesis fails to prevent Proto-Indo-Iranian SP clusters other than *sć from becoming PP$^{h}$. In fact, Vedic does attest a few precursors of the transfer of /s/ to aspiration like the doublet root √*k$^{h}$yā* ~ √*kśā* 'see,' ṚV *ak$^{h}$k$^{h}$alī-kṛ́tya* from *akṣarī- (Thieme 1954:109), or the historically unexplainable aspiration of initial /sP-/ clusters

[17] "Dass *cch* auch *sk̂* vertritt, beruht entweder auf phonetischer Analogie, indem man statt des seltnen unaspirierten stimmlosen Doppelpalatals (etwas wie *śś*) den nächstverwandten Laut, das häufigere (?) *cch*, sprach, oder es liegt in ur-ai. *śśh* aus ig. *sk̂* ein ähnlicher Fall vor wie in mi. doppelter Tenuis aspirata aus Sibilant + Tenuis und in mi. aspiriertem Nasal aus ai. *s* + Nasal z.B. pā. *amh ākaṃ*: ai. *asm ā́kam*„unser"."

[18] This is not the only explanation given by the proponents of this theory. See for example Bubenik (2003:217), who proposes metathesis of /sC/ into /Cs/. As we remarked in §7, we try to do without metathesis unless the phenomenon in question is otherwise inexplicable.

as in Ved. *sp$^h$íj-* f. 'loin, buttock' : OHG *spec* 'fat' (§70), and it is not inconceivable that an /SP/ cluster became /PP$^h$/ already in pre-Vedic. Yet /SP/ clusters are perfectly well-formed in Old Indo-Aryan (cf. §31), and examples of the transfer of /s/ to aspiration are found only sporadically (Wackernagel 1896:122f.) — quite unlike the sweeping elimination of coda sibilants in most of the non-Northwestern Middle Indo-Aryan languages.

The explanations by Leumann (1941:7ff.)[19] and Lubotsky (2001:48) are also based on the transfer of a sibilant to aspiration. Instead of a rather ad hoc use of the term Prākritism, they explain the transfer more sensibly by pointing out the aspirational nature of a sibilant in Old Indo-Aryan. The abrupt but thoroughgoing loss of the cluster-initial *s of *sć still remains unexplained, but their explanation narrows down the problem of the origin of Sanskrit /(c)c$^h$/ to the chronological gap between PIIr. *sć > OIA /(c)c$^h$/ and OIA /SP/ > MIA /PP$^h$/.

## §51 Explanation 4: Regular simplification of obstruent clusters

Instead of drawing a parallel between the loss of cluster-initial *s in *sć and a similar phenomenon in Middle Indo-Aryan, I think it is better to explain the development of PIIr. *sć into Sanskrit *cc$^h$* within the context of the simplification of obstruent clusters, essentially as L. Bloomfield (1911:44) proposed,[20] and to view the abrupt but exceptionless loss of the cluster-initial *s and the gap between PIIr. *sć > OIA *cc$^h$* and OIA /sP/ > MIA /PP$^h$/ as the result of regular phonological processes.

To sum up briefly, PIIr. *sć violates the criteria for phonological well-formedness in pre-Vedic Indo-Aryan with respect to coutour segments, for PIIr. *ć is considered to have been an affricate with stop and fricative phases, so that PIIr. *sć has three obstruent phases in two consonant slots. Just as a cluster of three or more obstruents loses the first one by the most general rule of simplification, PIIr. *sć [stɕ] becomes [tɕ], which spreads to the two consonant slots. Since the feature [spread glottis] (= aspiration) is redundantly specified for a sibilant in late pre-Vedic phonology, as in the Sanskrit sandhi rule *-t ś- > cc$^h$* (§54), [tɕ] is phonemicized as an aspirate /(c)c$^h$/ and fills in the empty slot of an aspirated voiceless palatal plosive in the consonant inventory of Old Indo-Aryan.

## §52 The 'Affricate Filter'

The phonemic inventory of Proto-Indo-Iranian is reconstructed with two series of palatal plosives, primary and secondary. Primary palatal plosives *ć, *ǰ and *ǰ$^h$ come from Proto-Indo-European palatalized velars *ǩ, *ǵ and *ǵ$^h$, and secondary palatals *č, *ǰ and *ǰ$^h$ come from other velars in palatalizing contexts, i.e. before front vowels, e.g.

[19] Leumann (1941:17) "nach *s* und Verschlußlaut wäre idg. palatales *k̂* nicht zur Spirans *ś* geworden, sondern es blieb auf der Stufe einer palatalen Affrikata *ć* stehen, die dann unter (nicht näher motivierter) Aspiration sich zu *ch* entwickelte," (19) "Um zu *cch* aus *sś* aus idg. *sk̂* und zu *ch* aus *ś* nach Verschlußlaut zurückzukehren, so bleibt wohl, nach der Unmöglichkeit einer Zwischenstufe urar. *sć*, nichts anderes übrig, als an die Prākritentwicklung eines *cch* aus *ps ts* und *psy tsy* und aus *kṣ* zu erinnern."

[20] Bloomfield (1911:44) "IE. *sk̂'(h)* (=*sk'(h)*) became *śk'h* > *šk'χ'* > *š't'š'* which was then simplified to *t'š'* — written *(c)ch* and pronounced as a prolonged *t'* plus decided spirant glide."

*śúc̲i-* adj. ‘bright’ : *śóḵa-* m. ‘light.’

The phonetic values of the primary and secondary palatal plosives in Proto-Indo-Iranian are estimated as follows. For Proto-Indo-Iranian primary palatal plosive *ć, both Sanskrit and Avestan have sibilants, but it is reconstructed as an affricate in Proto-Indo-Iranian, primarily based on its reflex as a dental affricate /t$^{s}$/ (*ċ*) in the Nuristani languages (§46). Primary palatal voiced plosives *ǰ and *ǰ$^{h}$ are similarly reconstructed as affricates. From the reflexes of PIIr. *ć in prevocalic contexts, i.e. dental fricative *s* in Iranian, dental affricate /t$^{s}$/ in Nuristani, and palato-alveolar or alveopalatal (see §40 and Hall 1997a:208) fricative *ś* in Indo-Aryan, the place of articulation of the primary palatals can be reconstructed either as dental or as palatal (Degener 2002:109f); the Proto-Indo-Iranian development of *ć into anterior *š in a cluster such as PIIr. *nać-tá- ‘perished’ > *naš-tá- > Skt. *naṣṭá-*, YAv. *našta-* (Brugmann 1897:559 §615, Hoffmann and Forssman 1996:102), however, is better explained by assuming that primary palatal plosives were not yet depalatalized in Proto-Indo-Iranian as in Iranian or Nuristani. In actual pronunciation, they were probably prepalatal or palato-alveolar, for pure palatal affricates are not common cross-linguistically.

In the case of the secondary palatal plosives, the palatalization of the original Proto-Indo-European velars or labiovelars is more recent than that of the primary palatals. If they were affricated already in Proto-Indo-Iranian, they would merge with, or at least be confused with, the primary palatals; hence they are assumed to have been palatalized velars or palatal stops.

| | primary palatals (prepalatal/palato-alveolar affricates) | | | secondary palatals (palatal/palatalized velar stops) | | |
|---|---|---|---|---|---|---|
| PIIr. | *ć [tɕ] | *ǰ [dʑ] | *ǰ$^{h}$ [dʑ$^{h}$] | *č [k$^{j}$/c] | *ǧ [g$^{j}$/ɟ] | *ǧ$^{h}$ [g$^{hj}$/ɟ$^{h}$] |
| Sanskrit | /ś/ [ɕ/ʃ][i)] | /j/ [ɟ/dʑ] | /h/ [ɦ] | /c/ [c/tɕ] | /j/ [ɟ/dʑ] | /h/ [ɦ] |
| Avestan | /s/ [s] | /z/ [z] | /z/ [z] | /c/ [tɕ] | /j/ [dʑ] | /j/ [dʑ] |

[i)] Hall (1997a:208) argues that /ś/ was alveopalatal [ɕ].

As we observed in §46 (and §56), the first occlusive component of the Proto-Indo-Iranian primary palatals *ć, *ǰ and *ǰ$^{h}$ is lost in pre-Vedic Indo-Aryan as well as in Iranian. Although Sanskrit *j* is a plosive, forms such as *iṣ-ṭá-*, vb.adj. of √*yaj/ij* ‘worship,’ must have gone through an intermediate form *iʑ-tá- (cf. *tik-tá-* vb.adj. of √*tej/tij* ‘sharpen’ with *j* from secondary *ǰ). The same intermediate stage is assumed for the voiced aspirate *ǰ$^{h}$, for *r ī̱ḍʱá-*, a verbal adjective of √*reh/rih* ‘lick,’ is considered to have developed from PIIr. *riǰ$^{h}$-tá- > *riʑ$^{h}$-dʱá- > *riʑ-dʱá- by Bartholomae’s Law (§82), deletion of *ʑ and compensatory lengthening, closely parallel to the development of an actual sibilant in PIE *misd$^{h}$-u̯ós- > PIIr. *miž-dʱvás- (*ž = [ʒ/ʑ]) > Sanskrit *m ī̱ḍʱvás-* ‘bountiful.’

All the three primary palatal plosives are thus considered to have been sibilants at one time in pre-Vedic Indo-Aryan, and their development from affricates into sibilants

may be generalized as a change of contour segments[21] into simple segments. Since primary palatals are the only contour segments in Proto-Indo-Iranian, this amounts to saying that Indo-Aryan, shortly after it branched off from Proto-Indo-Iranian, introduced a restriction against contour segments. As a contour segment is a segment with two root nodes under one timing slot, this restriction may be formulated in the following way:

> AFFRICATE FILTER (active in early pre-Vedic Indo-Aryan): A timing slot may have only one root node (i.e. only one phase such as occlusion or frication).

An affricate, which has stop and fricative phases under one timing slot, is ruled out by this filter. Proto-Indo-Iranian secondary palatals were probably not yet affricated at this point, so they passed through this filter. As a filter, AFFRICATE FILTER merely checks the well-formedness of a segment; the actual repair process is taken care of by a separate rule of delinking, which is tentatively formulated as follows:

> DELINKING OF MULTIPLE ROOT NODES: When there is more than one root node under one timing slot, the leftmost one is delinked.

It would be more cogent, however, if we could view this delinking phenomenon within the larger context of cluster simplification, rather than setting up an ad hoc rule just to explain the deocclusion of primary palatals.

## §53 Simplification of obstruent clusters

Simplification of consonant clusters is a fairly complicated issue, and I do not intend to present an exhaustive account of that problem here. Instead, let us limit our discussion to the simplification of clustered obstruents (i.e. plosives and fricatives), and begin with easily generalizable phenomena.

It is widely accepted as a peculiarity of Indo-Aryan that an /s/ trapped between two plosives is deleted (Pāṇini, Aṣṭ. 8.2.26 *j$^{h}$alo j$^{h}$ali*, Wackernagel 1896:269, Reichelt 1909:36, Mayrhofer 1986:110f.).

*P$_{[den]}$sP$_{[den]}$: PIIr. *sad-s-tá- > ṚV *sattá-* vb.adj. of √*sad* 'sit,' Av. *sasta-*. In Proto-Indo-European, an *s is inserted in a heteromorphemic cluster of dental stops, probably in order to prevent the heteromorphemic dental stops from being multiply linked as required by the Obligatory Contour Principle (§28).

*P$_{[2pal]}$sP$_{[den]}$: PIIr. *b$^{h}$aǰ-s-ta > Sanskrit *áb$^{h}$akta* s-aor.3sg.mid. of √*b$^{h}$aj* 'share.' *s is not lost in Old Avestan *baxšt ā* (Hoffmann and Forssman 1996:231).

*P$_{[vel]}$sP$_{[den]}$: PIIr. *(a-)g$^{h}$s-ta ipf.mid.3sg. > *gd$^{h}$a*, PIIr. *n̥-g$^{h}$s-ta- > Sanskrit *a-gd$^{h}$a-* vb.adj. of √*g$^{h}$as* 'eat' (Leumann 1952:33).

[21] A contour segment is a segment with one timing slot and two root nodes, which roughly correspond to articulatory gestures or acoustic phases in phonetic terms.

*$P_{[1pal]}sP_{[den]}$: PIIr. *čaćs-tai̯ becomes Sanskrit *cáṣṭe*, pres.3sg.act. of √*cakṣ* 'see.' If the medial sibilant of the cluster *ćst was deleted already in Proto-Indo-Iranian, it would further become *št in Proto-Indo-Iranian (PIIr. *ćt > PIIr. *št), and *čaštai̯ would then develop into Sanskrit *cáṣṭe* and YAv. *cašte* (a). This is the view of Wackernagel (1986:230), Reichelt (1909:51 §83.3), Macdonell (1910:47), Allen (1974:111) and Wiedenmann (1992:244). However, deletion of a medial sibilant does not occur in other Avestan forms such as *sasta-* < PIIr. *sad-s-tá-. If a primary palatal plosive triggered the 'RUKI' rule and changed a following *s into anterior *š, PIIr. *čaćs-tai̯ should have become *čaćš-tai̯ already in Proto-Indo-Iranian, as observed by Bartholomae (1896:723) and Renou (1952:62); if so, the simplest hypothesis might be that the cluster-initial *ć is lost already in Proto-Indo-Iranian (> *čaštá-) (b).

Alternatively, it is also possible that the cluster was still intact in Proto-Indo-Iranian, except that the *s had become anterior *š by the 'RUKI' rule. In Iranian, where the general simplification rule discussed below applies, the cluster-initial *ć is lost, as YAv. *cašte* shows. In Indo-Aryan, on the other hand, a new rule deletes the medial /s/, leaving *čać-tai̯ which would also result in *cáṣṭe* (c).

| (a) | (b) | (c) |
|---|---|---|
| PIIr. *čaćš-tai̯ > | PIIr. *čaćš-tai̯ > | PIIr. *čaćš-tai̯ > |
| PIIr. *čać-tai̯ > | PIIr. *čaš-tai̯ > | *cać-tai̯ > *caš-tai̯ > |
| PIIr. *čaš-tai̯ > | Skt. *cáṣṭe* YAv. *cašte* | Skt. *cáṣṭe* YAv. *cašte* |
| Skt. *cáṣṭe* YAv. *cašte* | | |

As far as heteromorphemic dental contexts like PIIr. *sad-s-tá- are concerned, this phenomenon has no exception, and probably holds for *s between other plosives as well, although we are not sure about the simplification process when the first plosive is a primary palatal, which is not a stop but an affricate.

STRAY ERASURE OF /s/ in pre-Vedic Indo-Aryan: PIIr. *s → ∅ / T_T (T: stop), or possibly P_P (P: plosive).

There is a case, however, where this rule does not seem to work. ṚV *viśvá-psnya-* 'alle Milch(labung) habend (*KEWA*)' is taken to come from PIIr. *-pstnya-, a derivative of PIIr. *pstana- 'breast,' with deletion of *t instead of *s (Forssman 1968:35ff.). Younger Avestan also has *ərᵊdva-fšnī-* 'with protruding breasts,' and the simplification might have taken place already in Proto-Indo-Iranian.[22] In Iranian, there are at least two more cases of loss of a cluster-internal dental (Reichelt 1909:36). PIE *nept-sú, loc.pl. of *népt-/népōt- 'grandson,' for which no Indo-Aryan form is attested, becomes *nafšu(cā)* in Old Avestan. Although not involving a cluster of three obstruents, YAv.

[22] If the similar loss of /t/ as in Greek *nýks*, Latin *nox* nom.sg. 'night' < *nokʷt-s and Latin *postne > *posne > *pōne* 'behind' (Leumann 1926–28:209) belongs to the same phenomenon, simplification of a dental stop in a coronal context might date even further back.

*ā-sna-* adj. 'successful' is derived by Bartholomae (*AirWb*, s.v.) from PIIr. *ā-zd$^{h}$-na, with the same root as Sanskrit √*s ād$^{h}$/sid$^{h}$* 'to succeed' (cf. Kuiper 1939:28). In these three cases, *t stands next to *s, and next to *n in two of them: thus a cluster-internal *t might be deleted when it stands next to another coronal.

In order to draw further generalizations, let us examine forms with simplified obstruent clusters other than the type /PsP/. Some are already simplified in Proto-Indo-European or Proto-Indo-Iranian.

PIE *pŕ̥k-sḱé-ti 'asks,' Sanskrit *pr̥cc$^{h}$áti*: Since no Indo-European language preserves the cluster-initial *ḱ, it is considered to have been deleted already in Proto-Indo-European (§47).

PIE *h$_1$es-si 'you are,' Sanskit *ási*: As we noted in §33, the geminate *-ss- was simplified to *-s- already in Proto-Indo-European. This degemination might have been motivated by other phonological restrictions of Proto-Indo-European.

PIE -Tć-: According to Klingenshmitt (1982:129), Sanskrit *d āśvā́ṁs-* comes from PIE *de-dḱ-u̯ós- with early loss of *d and compensatory lengthening. *pañc āśat* 'fifty' is explained from PIE *penk$^{w}$e-dḱm̥t in the same way.

*P$_{[pal]}$P$_{[den]}$ > PIIr. *št: PIIr. *naćtá- > YAv. *našta-*, Sanskrit *naṣṭá-*. The first occlusive constriction of the cluster PIIr. *ćt ([tɕt]) was lost before the split of Iranian and Indo-Aryan (§48); this sound change must be reconstructed for Proto-Indo-Iranian in order to explain the difference between it and the Indo-Aryan rule *PsP > PP. This is not a case of cluster simplification in the traditional sense, but I cite it here because the occlusive component of *ć is lost outside the usual context of the deocclusion of the primary palatals before vowels.

PIIr. *kturiHa-: > Sanskrit *tur ī́ya-* 'fourth,' by loss of the initial *k.

PIIr. *pstána- > *stána-* 'breast,' by loss of the initial *p.

PIIr. *vr̥ćk + -tvī́ > *vr̥ktv ī́* (ṚV 10.87.2), gerund of √*vraśc/vr̥śc* 'hew.' But also *vr̥ṣṭv ā́* (AVŚ 8.3.2) and *vraṣṭum* etc. according to Aṣṭ. 8.2.36.

PIIr. *nápt-b$^{h}$yas > *nád-b$^{h}$yaḥ* (ṚV 10.60.6a), dat.pl. of *nápt(r)-/náp ā́t-* 'grandson': Which of the cluster consonants *p and *t is lost remains an open question, for the loss of the cluster-initial *p would create *nád-b$^{h}$yaḥ*, but *náp-b$^{h}$yas could also end up as *nád-b$^{h}$yaḥ* by place dissimilation as in *ad-b$^{h}$yáḥ* ← *ap-b$^{h}$yás, dat.pl. of *áp-* 'water.'

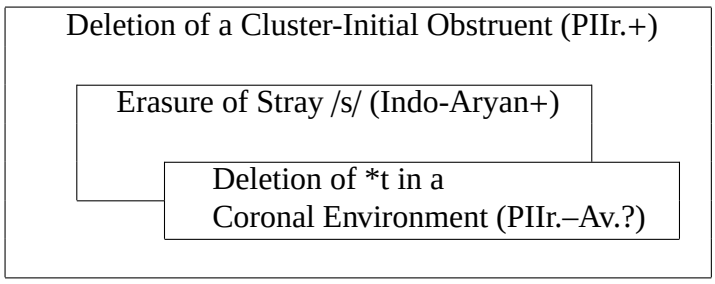
PIIr. *ći-ćk-š-: Although Sanskrit *śíkṣati* 'help,' desid. of √*śak* 'be able,' can come both from *śi-ś[k]-ṣá- and *śi-[ś]k-ṣá-, Av. *sixš-* shows that *ć is lost in the cluster *ćkš, for *ćš would develop into *š* in Avestan. Cf. Aṣṭ. 8.2.29 *skoḥ saṃyog ā́dyor ante ca* [1.16 *padasya*, 23 *lopaḥ*, 26 *j$^{h}$ali*].

PIIr. *di-db$^{h}$-sa-ti: > *dípsati* desid. of √*dab$^{h}$* 'deceive.' There are other cases of this formation, such as √*pad* 'step' : *pitsati*, but as Leumann (1952:47) points out, not all of them result from a purely phonological process of simplification.

A medial cluster of three obstruents and an initial cluster of two plosives are regularly simplified, but there are also cases of two medial obstruents undergoing simplification. Except for Indo-European *-ss-, which can be explained independently, such sequences contain a primary palatal *ć, so that there might be some restriction regarding affricates.

An obvious common feature of these examples is that there is no demonstrable case of deletion of a cluster-final obstruent; on the contrary, it is possible in almost all cases to argue that the cluster-initial obstruent is deleted. A general rule of obstruent cluster simplification from Proto-Indo-Iranian to Indo-Aryan and Iranian seems to be to drop the initial one.[23] Furthermore, Wackernagel (1896:127, 1905:213) gives *ád$^h$a kṣarant ī́r* (ṚV 7.34.2) and the compound *divá-kṣ āḥ* 'Himmelsherr' (Geldner) as examples of exceptional Sandhi /-s kṣ-/ > -∅ *kṣ-*, but they might actually reflect an older rule of obstruent cluster simplification such as that discussed here.[24] Pāṇini notes in Aṣṭ. 8.3.35 *śarpare visarjan īyaḥ* that a final /s/ (→ '/Ru/' → /ḥ/) mandatorily remains *ḥ* instead of becoming *ṣ* before a plosive when it is followed by a sibilant, unlike before a plosive followed by a vowel, as in ṚV 5.28.2b *havíṣ kṛṇvántaṃ* or ṚV 7.54.1a *v ā́stoṣ pate* (Aṣṭ. 8.3.39 *iṇaḥ ṣaḥ*). The Taittirīya-Prātiśākhya also provides retention of *ḥ* before /kṣ/ in TPr. 9.3 *na kṣa-paraḥ* (2. *sast$^h$ānam ūṣmāṇam*). These rules might also be due to a restriction against conjunctions of three obstruents. Shevelov (1965:188ff) on Slavic, Leumann (1926–28:203ff) and Sommer and Pfister (1977:190) on Latin, and Orel (2000:101) on Albanian make similar observations; but in Old Irish, PIE *sp- develops into *s-* (McCone 1996:44), and Old Prussian has *sepmas* 'seventh,' where *t in *-ptm- seems to be lost by simplification (Meillet 1922:17, cf. OCS *sedmŭ*). Thus loss of the first of clustered obstruents cannot be posited as a common Indo-European rule.

Against the general rule deleting the first of a cluster of obstruents, Indo-Aryan independently developed a special rule, Erasure of Stray *s, which stands in a disjunctive relationship with the former; as an 'Elsewhere Case' in Kiparsky's terminology, it has priority over the older and more general rule. Deletion of the middle one in a medial cluster of three obstruents seems to be limited to PIIr. *t followed or preceded by *s.




### §54 Regular development from *sć into *cc$^h$*

In §52, we proposed that primary palatal plosives are ruled out by the Affricate Filter and lose their occlusion by delinking of the first phase or root node, without consid-

[23] C. Wilson (2001:167) formulates the same principle as *inventory-restricted first consonant deletion* for languages in general.

[24] Oldenberg (1912:34) considers the emendation from *ád$^h$a* to ×ad$^h$á(s) to be unnecessary.

ering primary palatals in consonant clusters. And in the preceding section (§53), we tried to draw generalizations about simplification of clusters composed mainly of three obstruents, without considering sub-phonemic phases of affricates.

As we just saw above in §53, however, cluster simpification occurs not only in a cluster of three obstruents, but also in a cluster of two obstruents when one of them is a primary palatal plosive. Primary palatal plosives were affricates already in Proto-Indo-Iranian (§52), and as they had stop and fricative phases, a two-obstruent cluster with a primary palatal might have been ill-formed, just like clusters of three or more obstruents. Proto-Indo-Iranian *sć also has three obstruent phases in two consonant slots, so it too is ill-formed in that sense.

Now, if a cluster of three obstruents, including a cluster of two obstruents of which one is a primary palatal, is ill-formed in early pre-Vedic Indo-Aryan, and so is a singleton primary palatal because of the AFFRICATE FILTER, the question arises as to which is repaired first. Delinking of the first of two phases and deletion of the first of three obstruents are phonologically motivated by a universal tendency called the ONSET FIRST PRINCIPLE, i.e. an onset consonant is incorporated into a syllable with higher priority than a coda consonant, and hence is more resistant to phonological processes such as deletion. Since these two processes are based on the same principle, it is possible, though not necessary, that they were actually two manifestations of one and the same phenomenon. If primary palatals first undergo wholesale repair by delinking of their first phase, PIIr. *sć would lose the occlusive part and become *sś, a quite implausible sequence even as an intermediate form. If, on the other hand, deocclusion and cluster simplification is the same repair process, as I propose, *ć and *sć are simultaneously simplified to *[ɕ] and *[t ɕ].[25] As the skeletal structure of the two consonant slots still remains, the remaining [t] and [ɕ] spread to those two consonant slots.

We will discuss in §71 and §72 that a sibilant is redundantly aspirated in late Old Indo-Aryan, i.e. the feature [spread glottis] is explicitly specified for a sibilant in phonological representation although it does not change the actual pronunciation. In pre-Vedic Indo-Aryan as well, BARTHOLOMAE'S LAW stops to work on a *T$^h$s cluster and 'Aspiration Throwback' starts to be triggered by an *s, and it is safe to assume that *s was treated as aspirated in late pre-Vedic Indo-Aryan.

> Redundancy rule: An oral fricative is [spread glottis] in Indo-Aryan.
> [−sonorant, +continuant] → [spread glottis].

Of course, this does not mean that *ś was also treated as aspirated in pre-Vedic, but the Sanskrit sandhi /-t ś-/ > *cc$^h$* suggests that this was the case by the time of the Ṛgveda.

[25] Alternatively, we could argue that PIIr. *ć underwent deocclusion before a vowel but that *ć in the cluster *sć remained an affricate, for the stop in an *sC cluster sometimes follows a different path of development from a singleton, as in e.g. the non-application of GRIMM'S LAW to a voiceless stop after voiceless fricatives in Gothic *aht̲au* 'eight' or OHG *nift̲ila* 'niece' (Prokosch 1939:60). In that case, Indo-Aryan would differ from Avestan, where both a singleton *ć and a *ć in the *sć cluster seem to become sibilant *s* (§48). I thank George Cardona for pointing out this possibility to me.

Thus it would be natural for [tɕ] to be phonemicized as an aspirate /cc$^{h}$/, filling in the gap of a voiceless aspirated palatal in the phonemic inventory of Sanskrit.

If, as we assume, */t ɕ/ preserved the two timing slots of the original sequence PIIr. *sć, its actual pronunciation was probably not [tɕ] but rather [ttɕ], just as plosives are doubled in other plosive-continuant clusters such as *patra-* 'leaf,' which is pronounced *pattra-* with unoriginal gemination of the /t/ (§23).

After this period, the 'one phase for one slot' restriction ceases to be active, and affrication of the secondary palatals takes place. PIIr. *č and *ǰ thus become the affricates *c* and *j*; as a combination of aspiration and frication is still prohibited, *ǰ$^{h}$ becomes *h* instead of ×j$^{h}$. Furthermore, a new restriction against voiced fricatives emerges, and *z and *ź are eliminated. While the former is lost with compensatory lengthening and retroflexion if it is in a RUKI context, the latter undergoes occlusion and merges with the affricate *j*.

> One timing slot can have two root nodes, i.e. affricates are allowed.
>
> SIBILANT VOICING FILTER (§36): A voiced ([voiced]) oral obstruent ([−sonorant]) must be a non-continuant ([−continuant]) (i.e. no voiced fricative). Arranged after the AFFRICATE FILTER.

The development of the Proto-Indo-Iranian primary palatal plosives and the cluster *sć are summarized as follows:

| PIIr. | | early Pre-Vedic | late Pre-Vedic | Vedic |
|---|---|---|---|---|
| Obstr. Cluster Simplif. | | Affricate Filter ↓ / Stray /s/ Erasure → | Sibilant Voicing Filter / Aspiration of Sibilants → | |
| *sć | *[stɕ] | *[tɕ] | *[tɕ$_{[s.g.]}$] | /(c)c$^{h}$/ |
| *ć | *[tɕ] | *[ɕ] | *[ɕ$_{[s.g.]}$] | /ś/ |
| *ǰ | *[dʑ] | *[ʑ] | *[dʑ] | /j/ |
| *ǰ$^{h}$ | *[dʑ$^{h}$] | *[ʑ$^{h}$] | *[ɦ] | /h/ |

([s.g.] stands for [spread glottis].)

One question not answered here concerns dialectal variation of Sanskrit /cc$^{h}$/. In the preface to his edition of the Kaṭha Saṃhitā, von Schroeder (1900:XIf.) remarks that the ligature which looks like *śc$^{h}$* in Kashmirian manuscripts is simply to be read *cc$^{h}$*. Witzel (1979:16), on the other hand, considers that it is actually *śc$^{h}$* and might reflect an archaic pronunciation of Kaṭha school, at least in Kashmir. If that was the case, we need to reconsider whether the AFFRICATE FILTER operated on the whole of pre-Vedic Indo-Aryan, or only on some of its dialectal varieties.

Sanskrit manuscripts written in the Malayalam script have *cś* in place of *cc$^{h}$* (Yasuke Ikari, p.c.). In this case, it is probably not a reflection of dialectal variation, but of native

grammarians' understanding of aspirate plosives as composite sounds (cf. Deshpande 1976:174f.).[26]

**§55 Summary**

Primary palatal plosives in Proto-Indo-Iranian, which originate from Proto-Indo-European palatal stops, were affricates in Proto-Indo-Iranian (§52). Between Proto-Indo-Iranian and Old Indo-Aryan, there was a period when all primary palatals were spirantized (§46, §56). During that period, we propose that a new restriction called the Affricate Filter, which prohibits more than one root node (or articulatory gesture) for one consonant slot, was active. Affricates, which were ruled out by this filter, changed into sibilants by losing their stop component.

Simplification by delinking the first root node also seems to be the most general procedure for dissolving a cluster of more than two obstruents in Indo-Aryan (§53). The same procedure is considered to have caused the apparently irregular development from Proto-Indo-Iranian *sć into Sanskrit /(c)c$^{h}$/ (§54).

Once affricates were eliminated in early pre-Vedic Indo-Aryan, however, a new restriction against voiced sibilants emerges, which we call the Sibilant Voicing Filter (§36); *ź$^{h}$ becomes /h/ and *ẓ is either deleted or rhotacized, while *ź regains occlusion and merges with /j/ from Proto-Indo-Iranian secondary palatal *ǰ (§38).

Due to the Indo-Iranian secondary palatalization, development of *sć into /(c)c$^{h}$/, reaffrication of primary palatal *ź, and occlusion of sibilant clusters which has created the affricate-like clusters /kṣ/ and /ts/ (§41, §42), Indo-Aryan is rich in affricate sounds (§44).

[26] E.g. ṚPr. 13.16 *soṣmat āṃca soṣmaṇ ām ūṣmaṇ āhuḥsast$^{h}$ ānena* with Uvaṭa's commentary *c$^{h}$ak ārasya śa ity anena*, and ŚCA 2.1.13 *tak ārasya śak āra-lak ārayoḥpara-sast$^{h}$ ānaḥ*.

# Chapter V. Aperture/Stricture

## §56 Deocclusion of Proto-Indo-Iranian *ǰʰ and *ǰ̌ʰ

Proto-Indo-Iranian *ǰʰ and *ǰ̌ʰ lose oral constriction completely, and only the aspiration component is left in its outcome /h/, a voiced or semi-voiced pharyngeal fricative which is roughly equivalent to IPA [ɦ]. Since all oral constriction and oral place features are lost, this change can be called 'debuccalization.'

Based on the assumption that Bartholomae's Law operates on *-Cʰs- sequences, creating intermediate forms with *zʰ or *źʰ, e.g. PIIr. *dibʰ-sa- > *dib-zʰa-, and that PIIr. *misdʰá- 'reward' and *rijʰ-tá- vb.adj. 'licked' > *rij-dʰá- develop in the same way into *mi̯ɻ̥ʰá-* and *-ri̯ɻ̥ʰá-* respectively, we may safely posit aspirated and unaspirated voiced fricatives for pre-Vedic Indo-Aryan (§36, §73). In §54, we argued that PIIr. *ǰʰ loses occlusion and becomes *źʰ in pre-Vedic, due to a restriction against multiple root nodes which we call Affricate Filter; we then proposed that a restriction called Sibilant Voicing Filter rules out *źʰ as well as *ź. We will propose in §72 and §75 that Indo-Aryan sibilants have the feature [spread glottis] redundantly and behave as if they are aspirated. If this hypothesis is valid, aspiration adds another axis to the coordinate of the features [±voiced], [±sonorant] and [±continuant] which we discussed above in §36 with regard to the voicing of fricatives. According to these assumptions, voiced fricatives and the voiced aspirated palatal plosives should have gone through the following stages of development:

| PIIr. | *[z] | *ǰ [d͡ʑ] | *ǰ̌ [ɟ] | *ǰʰ [d͡ʑʰ] | *ǰ̌ʰ [ɟʰ] |
|---|---|---|---|---|---|
| Affricate Filter | — | ★ | — | ★ | — |
| Repair: Delinking | — | *[ʑ] | — | *[ʑʰ] | — |
| Affrication of *[ɟ]? | — | — | [d͡ʑ] | — | *[d͡ʑʰ] |
| Sibil. Voic. Filter | ★ | ★ | — | ★ | — |
| Repair processes | *[s(/∅/r)] | *[d͡ʑ] | — | *[d͡ʑʰ] | — |
| Debuccalization | — | — | — | [ɦ] | [ɦ] |
| Redund. Asp. of /S/ | *[s$_{(s.g.)}$] | — | — | — | — |
| Sanskrit | s [s$_{(s.g.)}$] | j [d͡ʑ] | j [d͡ʑ] | h [ɦ] | h [ɦ] |

('★' in this table denotes violation of a filter. 's.g.' stands for 'spread glottis,' i.e. aspirated.)

In the third line from the bottom of this table, the primary and secondary palatal voiced aspirates, which are both considered to have become *[d͡ʑʰ] by this stage, undergo debuccalization and become [ɦ]. Since we are not sure what exactly triggered this sound change, it needs to be posited as an independent rule.

> Debuccalization of Voiced Aspirated Affricates: In pre-Vedic Indo-Aryan, a voiced aspirated affricate loses all oral features. Applies after affrication of secondary palatal plosives is complete, if ever.

With regard to this debuccalization, we do not understand why the fricative oral constriction had to be totally lost while other voiced aspirates remain as such, and exactly which two features are incompatible with each other. Stipulating yet another filter which rules out cooccurrence of frication and aspiration is just a restatement of the fact and does not yield much insight.

In the above table, the AFFRICATION OF *[ʝ], if it ever took place, must be placed after the AFFRICATE FILTER and repair rule, but it need not necessarily precede the SIBILANT VOICING FILTER and its repair processes. A crisp line cannot be drawn between the DEBUCCALIZATION OF *[ʤʰ] and REDUNDANT ASPIRATION OF /S/, due to lack of evidence for relative chronological order.

Whatever the case, a repair process delinks not the aspiration but the oral components of *ǰʰ or */jʰ/. Among the constituents of these sounds, aspiration surfaces with the highest priority,[1] as [ɦ] remains when all the oral features and the feature [cont] of a voiced aspirate are lost. If we follow the model of Clements (1985) and group these features under the Supralaryngeal node, in contrast to the Laryngeal node to which [spread glottis] belongs, the preservation of [spread glottis] in Indo-Aryan debuccalization may be generalized as the following principle:

> LARYNGEAL FIRST PRINCIPLE: In Indo-Aryan, laryngeal features appear in the Surface Representation with a higher priority than oral features.
> MAX-IO(Lar) ≫ MAX-IO(Oral)

### §57 Deocclusion of /dʰ/ and /bʰ/: Examples

The sporadic change of /dʰ/ to Sanskrit *h* includes both Proto-Indo-European/Proto-Indo-Iranian *dʰ > *h* and synchronic fluctuation between /dʰ/ and /h/ in Sanskrit; it is complete in some morphemes, but is apparently still in progress in others. The following are the examples of the deocclusion of *dʰ and *bʰ with solid etymologies (von Bradke 1886:657ff., Wackernagel 1896:250ff., Bloomfield and Edgerton 1932:65ff.):

*h* from *dʰ, /dʰ/:

a) endings. The 1st pl. and du. middle endings: Primary *-mahe* 1pl., *-vahe* 1du., secondary *-mahi* 1pl., *-vahi* 1du., subj. *-mahai* 1pl., *-vahai* 1du.
The 2sg. iptv. ending of athematic stems *-dʰí/-hí*: *-hí* is usually chosen after a vocoid. See §59 for individual examples.

b) suffixes. Locatival adverbial suffix *-dʰa/-ha*: *ihá* 'here,' *sahá* 'together,' *kúha* 'where,' *viśváha/-ā* 'everywhere,' *samaha* 'irgend, so oder so' (*PW*) :: *ádʰa* 'there, then,' *kadʰa-* as in *kadʰa-priye* voc.sg. (ṚV 1.30.20), *kadʰa-priyaḥ* voc.pl. (ṚV 1.38.1, 8.7.31), *sadʰa-* as in *sadʰa-mād-* etc.
Suffix *-hi*: *uttarāhi* 'northerly' (ŚB 2.1.2.9, 3.2.3.15, Aṣṭ. 5.3.38), *dakṣiṇāhi* 'weit rechts, weit im Süden (*PW*)' (Aṣṭ. 5.3.37).

[1] See §82 for the markedness of [spread glottis].

c) nouns. 'house': *gṛhá-* 'house' < PIE *gʰṛdʰó- (*EWAia.*); *gehyà-* (ṚV 3.30.7b); *géhya-* adj. 'present in the house' (AVP 6.14.8, 7.11.3, YV); *gehá-* 'house,' *geh ā́ya* VSM 30.9=VSK 34.2.1 (Kuiper 1938:301ff.).
'red': *rohít-*, *róhita-*, *róhiṇī*, *-lohitá-* in *nīlalohitá-* (ṚV 10.85.28) :: *rudʰi-* as in *rudʰi-kr ā́-* (ṚV 2.14.5), *rudʰirá-* (AVŚ 5.29.10).

d) verbs. √*dʰ ā* 'put': *hitá-* vb.adj. as in *hitá-mitra-* (ṚV 1.73.3, 3.55.21), *hit ā́vat-* (ṚV 1.180.7), *-hiti-* as in *asmé-hiti-* (ṚV 10.108.1), *devá-hiti-* (ṚV 7.103.9), *puró-hiti-* (ṚV 7.60.12, 7.83.4) :: *-dʰiti-* as in *nemá-dʰiti-* (ṚV[4]), *mitrá-dʰiti-* (ṚV 1.120.9), *vaná-dʰiti-* (ṚV 1.121.7), *vásu-dʰiti-* (ṚV[6]), *dʰit ā́van-* (ṚV 3.27.2, 3.40.3).
√*ah* 'say': *ā́ha* 3sg., *āhús* 3pl. (ṚV+).
√*sparh*/*spṛh* 'strive': *spṛháyati* pres.3sg.act. :: √*spardʰ*/*spṛdʰ* 'rival': *spardʰaté* pres.3sg.mid.
√*roh*/*ruh* 'grow': *róhati* pres.3sg.act. :: √*rodʰ*/*rudʰ* 'grow': *ródʰati* pres.3sg.act. (ṚV 8.43.6), *rodʰat* pres.inj.3sg.act. (ṚV 1.67.9). Possibly contamination (Gotō 1987:277ff.).

*h* from *bʰ, /bʰ/:

e) nouns. Ved. *kakuhá-* < *kakúbʰ-* :: *kakubʰá-* 'eminent' (Kāṭh.)
Ved. *dabʰrá-* adj. 'little, scanty' :: *dahrá-* adj. 'little, tender' (Kāṭh.+), *dahara-* 'little, thin' (Up.+).

f) verbs. √*grabʰi*~*grahi* 'seize,' *gṛhṇ ātu* pres.iptv.3sg. (ṚV 4.57.7); *hasta-gṛ́hya-* (ṚV 10.85.26, 10.109.2).[2]

In most cases, the deocclusion seems to be an idiosyncratic property of the morpheme in question: For example, while the (post-)Proto-Indo-European ending *-medʰoi̯ is always *-mahe* in Sanskrit and PIE *-dʰí becomes Skt. *-hí* in most postvocalic contexts, the dative infinitive ending *-ádʰyai* never occurs with *h*, nor does the adverbial suffix *-dʰ ā* '–fold,' and the Proto-Indo-Iranian locatival suffix *-dʰa is *-dʰa* in some words and *-ha* in others. Due to such irregularity and lexical idiosyncrasy, deocclusion has traditionally been understood as a Prākṛtism (Ascoli 1868:258) or attributed to dialectal variation (von Bradke 1886:693, Meillet 1912/13:123).

Although deocclusion of voiced aspirates becomes commoner in most Middle Indo-Aryan languages,[3] /dʰ/ reflecting PIIr. *dʰ is sometimes preserved or restored in forms whose Sanskrit correspondents have /h/. Meillet (1912/3) points out that the Northwestern languages (Vedic, Shāhbāzgaṛhī and Mānsehrā Aśokan) have more forms with /h/ than others.

[2]Cf. Bloomfield and Edgerton (1932:65): "The popular texts, AV. and most of the Gṛhya Sūtras, seem to like *grah* a little better, but they are not consistent .... Perhaps the same preference may be discernible in TS. and KS. ṚV. and other archaizing texts—seemingly including VS., MS., ŚB. and ApMB [=Āpastambha-Mantra-Pāṭha].—and the ṚV. sūtras prefer *grabh* on the whole. But really the one stable factor is inconsistency."

[3]Pischel (1900:§188), Geiger (1994:§37), Bloch (1965:68[65]).

PIIr. *id$^{h}$a > Vedic *ihá* :: Pāli *id$^{h}$a* ‘here’ beside less frequent *iha*, Aśokan (Girnār and Dhauli, vs. Shāhbāzgaṛhī *iha*: Hultzsch 1925:lvii), Śaurasenī, Māgadhī and Āvantī *id$^{h}$a* (Pischel 1900:§266, von Hinüber 1986:24, 2001:179)

Skt. *gehá-* ‘house’ :: Pāli *geha-*, and *ged$^{h}$a-* Aṅguttara-Nikāya 1.154.1=3.128.23 (perhaps to be read *rod$^{h}$a-*: *EWAia.* s.v., Kuiper 1938:-301), Aśokan (Mānsehrā) *gehat$^{h}$ani*, Śaurasenī *geha* (Pischel 1900:§366a)

In the following sections, we will examine whether any phonological explanation is possible for the deocclusion of *d$^{h}$~/d$^{h}$/ and *b$^{h}$~/b$^{h}$/.

### §58 Influence of tonal contexts?

Wackernagel (1896:251) points out that the deocclusion of /d$^{h}$/ and /b$^{h}$/ takes place in the contexts $_{wd}$[_V as in *hitá-* and V_V, with the exception of *gṛhṇātu* (ṚV 4.57.7) and *hasta-gṛ́hya-* (ṚV 10.85.26, 10.109.2), which according to him may be explained as analogical to other forms of √*grab$^{hi}$* ‘seize’ followed by a vowel. If *h* from an initial /d$^{h}$/ or /b$^{h}$/, the only example of which is *hitá-* from ×d$^{h}$itá-,[4] originally occurred only after a word or a compound member ending in a vowel, the environment for deocclusion is reduced to intervocalic position (*ibid.*).

Skt. /h/ originating from PIIr. *ǰ$^{h}$ and *ǰ̌$^{h}$ occurs after a word boundary, vowels, liquids or anusvāra, and before vowels, glides, liquids or nasals (Wackernagel 1896:244). The context where PIIr. *b$^{h}$ and *d$^{h}$ become Skt. /h/ is quite similar to this, i.e., after vowels or word boundary (e.g. *hitá-*) and before vowels, glides, liquids and nasals. The only unique condition for the deocclusion of *d$^{h}$ and *b$^{h}$ is that they are almost always preceded by a vowel.[5]

a) V̲_V?

Wackernagel (1896:252) further tries to narrow down the environment to the position after an unaccented vowel, i.e. /d$^{h}$/, /b$^{h}$/ > [+continuant] / V̲ _.[6] Since there are more unaccented vowels than accented, this generalization inevitably involves overgeneration. To support this idea, Wackernagel brings up the following arguments:

i) Lack of udātta accent on the vowel before /h/ in forms such as *ihá*, *kakuhá-*, *gṛhá-*, *bárjaha-*, *balihṛ́t-*, *rauhiṇá-*, *sahá*.

ii) The *h* of the root √*grah$^{i}$/grab$^{hi}$* ‘seize’ appears only after an unaccented /ṛ/ in all but the tenth book of the Ṛgveda, which represents a relatively younger layer of the text.

[4] A similar case from a different period is Skt. √*b$^{h}$av$^{i}$/b$^{h}$ū* ‘become’: *b$^{h}$ávati* :: Pāli *hoti*.

[5] √*d$^{h}$ā* ‘put’: *hitá-* still has to be ascribed to some environment peculiar to this lexical item.

[6] “Ihre eigentliche Stelle hat die Umwandlung wahrscheinlich hinter unbetontem (oder, wenn der Anlaut betroffen ist, vor unbetontem) Vokal”.

iii) The second singular athematic imperative ending is *-dʰí* when affixed to a full-grade of a root, e.g. √*as* 'be': *edʰí* < *az-dʰí, √*bʰavⁱ/bʰū* 'become' and √*bodʰ/budʰ* 'wake': *bodʰí*, √*yodʰ/yudʰ* 'fight': *yódʰi*, √*yav/yu* 'keep away': *yuyodʰí*, √*śā* 'sharpen': *śiśādʰí* (§59). The preservation of /dʰ/ in these forms might be due to an original accent on the full-grade root vowel.

iv) The Ṛgveda has *ródʰati*, present of √*rodʰ/rudʰ*, beside *róhati*; *ródʰa-* and *āródʰana-* have no counterpart with /h/ in the Ṛgveda.

b) V_V́?

Among the examples cited above, the vowels which follow an /h/ resulting from the deocclusion of /bʰ/ in *kakuhá-* and *dahrá-* (to which Wackernagel adds *balihṛ́t-*) have a high tone. There are also examples of /dʰ/ followed by a vowel with a high tone which loses its occlusion. For example, the words formed with the locative suffix show fluctuation of /h/ ~ /dʰ/; they may be grouped as *ihá, kúha, sahá* :: *ádʰa, kadʰa-, sadʰa-*.[7] If the initial high tone of *kúha* in the first group is the result of analogy after *kvà* (*/kúa/*),[8] a more common word for 'where,' these forms could be taken to suggest the possibility of a pretonal context for deocclusion. This generalization, however, faces too many counterexamples: thus forms derived from the root √*grabʰi/grahⁱ* 'seize' such as *-gṛ́hya-* or *gráha-*, and the stems *náh-ya-* and *róh-a-/ródʰ-a-* from √*nah* and √*rodʰ/roh*, do not agree with this pattern; and forms suffixed with *-dʰā* have a high tone on the suffixal vowel except for *dvi-dʰā* and *tri-dʰā*, which are oxytonic according to Aṣṭ.5.3.42ff. but paroxytonic in the ṚV (Wackernagel, *AiGr.* III § 215). Finally, forms such as ṚV *mitrá-dʰiti-, vásu-dʰiti-* :: *devá-hiti-, puró-hiti-* do not fit any phonological generalization.

### §59 The athematic imperative 2sg. ending *-dʰí/-hí*

The second person singular imperative ending of athematic verbs in Sanskrit is either *-dʰí* or *-hí*, which are usually added to zero-grade stems. The rule for choosing between *-dʰí* and *-hí* in Classical Sanskrit is summarized by Kielhorn (1896=1970:§261) as follows:

> "The term[ination] *dhi* of the 2 Sing. Par[asmaipada=active voice] is changed to *hi* after special[= present] [athematic] bases ending in vowels (except in *juhudhi* from *hu*) and semivowels. It is dropped after the special bases of roots of the 5th and 8th classes, when the final *u* of these bases is preceded by only one consonant. Roots of the 9th class that end in consonants substitute in the 2 Sing. Par. *āna* (or *āṇa*) for *nīhi* (or *ṇīhi*)".

Although this ending must have been *-dʰí in Proto-Indo-Iranian, given Avestan *-diⁱ/-δi, -hí* has been generalized in Sanskrit. In Vedic, however, archaic *-dʰí* occurs in cases other than those listed above. Leaving aside anomalous forms with full-grade

[7] As for the accent of *viśváha*, which contradicts to this pattern, Wackernagel (1896:252) suggests influence of the synonym *viśvâhā*

[8] *kúha* ṚV[15] including derivative forms :: *kvà* ṚV[34].

root vowels such as *bodʰí*, *yódʰi* etc., the following are the examples which draw our attention regarding the choice of *-dʰí* and *-hí* (examples from Whitney 1889, Macdonell 1910:§505, Bloch 1929 and Turner 1937):

a) present imperative: √*hav/hu* 'sacrifice': *juhudʰí* (MS 1.8.1, 1.4.13, 3.6.6, Kāṭh. 6.1, Kap.K. 3.12); √*avⁱ/ū* 'assist': *avadʰi*[9] :: √*ay/i* 'go': *ihí* (*edʰi*[10]); √*bravⁱ/brū*: *brūhí* (, √*stav/stu* : *stuhí*) etc.

b) aorist imperative (Whitney 1889:§839): √*kar/kṛ*, *kṛṇóti* : *kṛdʰí*; √*var/vṛ*, *vṛṇóti* : *vṛdʰi* (ṚV[8]); √*śrav/śru*, *śṛṇóti* : *śrudʰí*; √*spar/spṛ*, *spṛṇoti* : *spṛdʰi* (ṚV 5.3.9, 8.66.14); √*gam*, *gácchati* : *gahi* but also *gadʰi* (ṚV 8.98.4); cf. √*yam*, *yácchati* : *yandʰí* (ṚV[9]).

c) intensive imperative (Whitney 1889:§1011): √*karⁱ/kṛ* 'praise' : *carkṛdʰi* :: √*dar/dṛ* 'split': *dādṛhí/dardṛhi* or √*jar/gṛ* 'wake': *jāgṛhi*.

i) always *h*: *śiśīhí* (ṚV) :: *śiśādʰí*, *śaśādʰí*; *kṛṇuhí*, *-ī* :: *kṛdʰí* or *śṛṇudʰī*, *spṛṇuhi* (ṚV 10.87.7) :: *spṛdʰí*; *ihí* :: *kṛdʰí*, *śrudʰí* etc.

ii) fluctuating cases: *śṛṇudʰī* (ṚV 4.9.7, 8.3.18, 8.13.7) ~ *śṛṇuhī*, *-i* (ṚV[7]); *gadʰi* (ṚV 8.98.4) ~ *gahi* (ṚV).

iii) always *dʰ*: *kṛdʰí*, *-ī*, *vṛdʰi* (√*var/vṛ* 'cover, ward off,' *vṛṇoti* pres.); *śrudʰí*, *-ī*, *spṛdʰi* (ṚV 8.66.14, 5.3.9), Aṣṭ. 6.4.102 *śru-śṛṇu-pṝ-kṛ-vṛbʰya-ś cʰandasi*; *juhudʰi* (MS, Kāṭh., Kap.K.); √*bʰavⁱ/bʰū* 'become': *bodʰí* (ṚV[36+1]) (Grassmann, Gotō 1987:218n on 7.75.2); √*bodʰ/budʰ* 'wake': *bodʰí* (ṚV[10−1]) (Grassmann, Gotō *loc.cit.*); √*yodʰ/yudʰ* 'fight': *yódʰi* (ṚV 5.3.9), *yuyodʰí* (ṚV[7]), Aṣṭ. 6.4.103 *aṅitaś ca*; √*as* 'be': *edʰi*; √*śās* 'order': *śādʰi* (ṚV 2.28.9), Aṣṭ. 6.4.35 *śā hau*, *śaśādʰi* (ṚV 7.1.20, 25), *śiśādʰi* (ṚV[4]).

### §60 Minimal Word effect?

It should be noted that /dʰ/ is unexpectedly preserved in a few forms of two morae or two syllables long: *kṛdʰí*, *vṛdʰi*, *śrudʰí* and *spṛdʰi*. Turner (1927=1975:292)[11] considers the ending *-dʰí* to be protected from sound changes characteristic of endings, such as deocclusion, in disyllabic forms.

Of other forms retaining /dʰ/ which are more than two morae or two syllables long, Whitney (1889:245, §652) explains *juhudʰí* as avoiding recurrence of /h/ in two successive syllables. The *-dʰí* in *carkṛdʰi* and *śṛṇudʰī* might have survived the change because of an analogical influence of the frequently used aorist imperatives *kṛdʰí* and *śrudʰí* corresponding to them.[12]

[9] An anomalous form by ritual motivation according to Gotō (1987:106n).

[10] Sāmamantra-Brāhmaṇa, Gobhila-Gṛhyasūtra. *udakenaidʰi*, Bloomfield and Edgerton (1932).

[11] "[I]n dissyllables the consonant of the termination, sharing presumably in the main stress of the word, is not so liable to special treatment. It is therefore not without significance that the imperatives of root aorist stems, being dissyllabic words, show more forms with *-dʰi* than the present stems".

[12] Bloch (1929:176) "*çṛṇudhí* qui coexiste avec *çṛṇuhí* est refait sur *çrudhí* comme A. V. *carkṛdhi* sur *kṛdhí*."

Another possible example of an archaism preserved in bimoraic words is Grassmann's Law, regressive dissimilation of aspiration in adjacent syllables. This rule does not apply to the stems to which *-dʰí/-hí* is attached, e.g. *juhudʰí* and not ×jujudʰí, *dʰehí* 'put!' and not ×dehí, except in the following 2sg. imperative form in *-dʰí/-hí*:

> √*han* 'smite' : root aor. iptv. *jahí* (and not ×hahí/×hadʰí) from *gʷʰn̥-dʰi through *gʷn̥-dʰi. Aṣṭ. 6.4.36 *hanter jaḥ* (6.4.1 *aṅgasya*, 6.4.35 *hau*). YAv. *jaⁱδi*, OP *jadiy*.

It might be possible that a minimal word length of two morae somehow caused this form to resist the newer tendency not to apply Grassmann's Law across morpheme boundaries. Since the trimoraic form *bodʰí* (: √*bʰavⁱ/bʰū* 'become') shows the same archaism, the unexpected application of the law would be related to the length of two syllables rather than two morae. The suffix fits in the two-syllable window of Grassmann's Law, and the root-suffix boundary which usually blocks the application of Grassmann's Law fails to do so.

## §61 Rule formulation

The deocclusion of *dʰ in the forms cited in §59 does not seem to tilt towards any particular lineage of poets, and *dʰ develops differently in very similar environments such as *stuhí* : *śrudʰí* or *mitrá-dʰiti-* : *devá-hiti-*. It seems to be difficult to get around the fact that no single phonological formulation or dialectal generalization can satisfactorily explain all cases of deocclusion.

a) *dʰ after front vowels other than *e* < *az

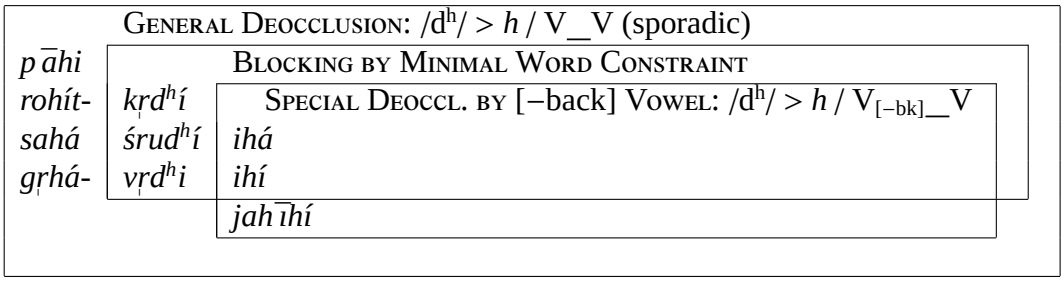
It is worth noting, however, that *dʰ is not retained after /i/ in the examples of *-dʰí/-hí* imperatives listed above — not even in bimoraic imperative forms, where /dʰ/ is preserved after stem-final /u/, /r̥/ and /a/:

> √*ay/i* 'go': root aor.iptv. *ihí* :: *kr̥dʰí, śrudʰí* etc.
> √*śās* 'order': *śiśīhí* :: *śādʰí, śiśādʰí*
> √*hā* 'foresake': *jahīhí, jahihi* or *jahāhí* (Whitney 1889:§665. pres. *jahāti*)
> :: √*hav*: *juhudʰi* (avoidance of recurrence of *h* according to Whitney 1889:245)

It may be simply a coincidence that there is no ×*idʰí* attested beside *ihí*, unlike the case of √*gam*: *gahí~gadʰi*, where *gadʰi* appears only once in the Ṛgveda while there are a good many occurrences of *gahí*. However, if the *-dʰí* of *juhudʰí* is to avoid a sequence of *h* in adjacent syllables, as Whitney claims, why then do we not have a form ×*jahidʰí* instead of *jahihi*? The total absence of ×*idʰá* in Vedic should also be recalled. Although the examples are very limited, it might have been a phonological rule that a front vowel, namely /i/ or the diphthongs /e/ or /ai/, causes deocclusion of a following /dʰ/.

> Deocclusion of /dʰ/ after a front vowel: /dʰ/ > *h* / [−back] _V

*d*$^{h}$*ehí* and *dehí* might be included as further examples, and also *gehá-*, if the /h/'s in them come from *d$^{h}$. On the other hand, *ed*$^{h}$*í* looks like a counterexample; but this case will not contradict our rule if *az > *e* is ordered after the deocclusion of *d$^{h}$ after a front vowel (Lubotsky 1995a:136).[13] The relationship of this minor rule to more general rules may be schematized as follows:




Since this rule claims that the deocclusion of *d$^{h}$ after a front vowel regularly takes place even in short words where postvocalic *d$^{h}$ is not infrequently retained, its structural description cannot help but fail to cover all contexts of the deocclusion of *d$^{h}$ into /h/. I do not have an explanation, however, for *dvi-d*$^{h}$ *ā* 'twofold,' *tri-d*$^{h}$ *ā* 'threefold,' √*d*$^{h}$*arṣ*/*d*$^{h}$*ṛṣ* 'dare': *ad ī d*$^{h}$*ṛṣat* etc., √*d*$^{h}$*ay*$^{i}$/*d*$^{h}$ *ī* 'muse': *d ī d*$^{h}$*ayaḥ*, √*vyad*$^{h}$/*vid*$^{h}$ 'pierce': *vídʰyati*, *vi-* + √*d*$^{h}$ *ā* 'lay down': *vid*$^{h}$*i-* f. 'order, rule' etc. I do not know of any comparable phenomena to motivate deocclusion after a front vowel in Indo-Aryan or in other Indo-European languages. If the alleged deocclusion is a left-to-right palatalization, it is unknown even in Celtic which shows extensive palatalization; only in Slavic is the third palatalization considered to be conditioned by a preceding front vowel (Bräuer 1961:193), and in Modern High German *ch* is pronounced [x] or [ç] depending on the value of the feature [*α*back] of the preceding vowel, e.g. *Sache* [ˈzaxə] vs. *sicher* [ˈzɪçər]. In Middle Indo-Aryan, *k*$^{h}$ and *c*$^{h}$ are used indiscriminately after an *i* as in *b*$^{h}$*ik*$^{h}$*uni* ~ *b*$^{h}$*ic*$^{h}$*uni* in Bharhut and Sanchi inscriptions (Chatterji 1926:245). Among non-Aryan South Asian languages, some of the South Dravidian languages (Emeneau 1967:383, Subrahmanyam 1971:96) and Telugu (Subrahmanyam 1983:200) have palatalization of dental non-continuants by preceding high front vocoids /i/ and /y/. In Old Tamil (Shanmugam 1971:39) and Modern Tamil (Schiffman 1999:16) as well, a preceding /i/ and /y/ palatalizes /tt/ and /nt/ (see §123).

An interesting question is whether the pre-Vedic deocclusion of *d$^{h}$ in the endings *-med$^{h}$oi̯ etc. should also be accounted for by this rule. Allen (1962:101–108) convincingly argues that the merger of *o and *e in Proto-Indo-Iranian was complete and irreversible. If, however, *e in *-med$^{h}$oi̯ was still a front vowel in a non-ablauting position such as this, at some post-Proto-Indo-Iranian stage when *d$^{h}$ began to be deoccluded after a front vowel, this would constitute an example of *d$^{h}$ developing into *h* after a front vowel. As for this specific case, Turner (1927) offers an alternative account involving

[13] /dʰ/ in *ed*$^{h}$*í* might be explainable as an analogy to *bod*$^{h}$*í*, but it is unlikely that *bod*$^{h}$*í* and *ed*$^{h}$*í* acquire the full-grade root vowel and *d*$^{h}$ respectively from each other, and there is no reason why *bod*$^{h}$*í* must have had /dʰ/ instead of /h/. Dissimilation from *ā-ayi* : *ehí* (RV) is not convincing either.

stem-ending asymmetry. The fact that there is no trace of *$d^h$ in the Old Indo-Aryan first plural endings, and that the *$d^h$ in the 2sg. athematic imperative ending surfaces regularly as *h* with certain explainable exceptions, suggest a tendency for terminations to undergo peculiar developments, according to his idea.[14] It is true that there is some asymmetry between roots/stems and endings in their susceptibility to sound changes. Analogical restitution driven by paradigmatic uniformity typically applies to roots or stems, and the fact that endings consist of a smaller set of phonemes than do roots might be the result of such asymmetry.

If avoiding two /h/'s in adjacent syllables, which Whitney (1889:245) proposed to account for *juhud$^h$i*, can be generalized as a universal constraint, it should be ranked lower than the deocclusion of /$d^h$/ by a front vowel because of forms such as *jah$\bar{\imath}$hi*, and higher than deocclusion in general because of *juhud$^h$i*.

b) other possibilities

Since /i/ is high as well as front, we should also consider whether deocclusion takes place after a high vowel, i.e. both /i/ and /u/. Forms such as *br$\bar{u}$hí*, *śṛṇuh$\acute{\imath}$*/*śṛṇuhi* and *kúha* support extending the triggering context to /u/, but *rud$^h$irá-*, *śrud$^h$í*, *śṛṇud$^h\acute{\imath}$* and *juhud$^h$i* question the regularity of deocclusion after /u/. Of these counterexamples, *juhud$^h$i* and *śrud$^h\acute{\imath}$ (hávam)*/*śṛṇud$^h\acute{\imath}$ (hávam)*[15] could be explained as avoiding a sequence of successive /h/'s by preserving /$d^h$/, which would otherwise undergo deocclusion. If a preceding high vowel causes deocclusion, the rule should be formulated as follows:

/$d^h$/ > *h* / [+high] _V

In this case, we have to give up including the mid front vowel /e/ as causing deocclusion of a following /$d^h$/. This idea is hard to support, in any case, because Sanskrit does not make a phonological distinction between high and mid vowels and always treats a mid vowel as a diphthong of low and high vowels. Edge effects show that there is no category of mid vowels: note that Skt. /e/ < PIE *o$\underset{\frown}{\text{i}}$ does not cause palatalization at the left edge as in √*ceṭ*/*cit* 'recognize': pf.3sg. *cikéta* < *$k^w$i-$k^w$o$\underset{\frown}{\text{i}}$t-a, while /e/ and /o/ trigger the RUKI-rule at their right edge as in √*poṣ*/*puṣ* 'prosper': pf.3sg. *pupóṣa*.

Finally, Bloch (1929) points out that the vowel preceding a *$d^h$ or *$b^h$ which underwent deocclusion is long in pairs such as *br$\bar{u}$hi* :: *śrud$^h$í*, Pāli *paṇḍitehi*, *sabbehi* :: *isib$^h$i*, *ñ$\bar{a}$tib$^h$i*.

## §62 Asymmetrical alternation of /m/ and /n/

In the sonority scale we assumed for Old Indo-Aryan in §44, /m/ and /n/, or /y/ and /v/, occupy the same level as nasals or glides. Their alternation patterns, however, show

[14] Cf. also Lubotsky (1995a:136) "From a phonetical view-point, this rule is probably due to weakening of intervocalic *-dh-* at the end of the word."

[15] The contexts of *śṛṇud$^h\acute{\imath}$ ~ śṛṇuh$\acute{\imath}$*, *-i* are as follows: ṚV 4.9.7c, 8.3.18d, 8.52.8d *śṛṇud$^h\bar{\imath}$ hávam*, 8.13.7b *śṛṇud$^h\acute{\imath}$ jaritúr hávam*, 8.84.3b *śṛṇud$^h\acute{\imath}$ gíraḥ* :: 1.82.1a *ṣú śṛṇuh$\acute{\imath}$ gír[aḥ*, 1.104.9d *śṛṇuhi h$\bar{u}$yám $\bar{a}$naḥ*, 1.139.7a *ó ṣ$\acute{u}$ ṇo agne śṛṇuhi tvám ī*ḷ*itó*, 4.22.10a *sú śṛṇuhi tvám indr[a*, 7.28.1d *ś]ṛṇuhi viśvaminva*, 9.82.4b *śṛṇuhí brávīmi te*, 10.75.5d *śṛṇuhy $\acute{a}$ suṣómay$\bar{a}$* *śṛṇud$^h\acute{\imath}$* is used with *hávam* and *gíraḥ* just as *śrud$^h\acute{\imath}$*, *-í* is.

subtle differences, which arouse doubts as to whether one of them is more resistant to alteration or loss of features than the other; if I may use a more impressionistic word, one looks *more consonantal* than the other. In the sections which follow, I will discuss the factors which seem to be causing such asymmetries.

Indo-Aryan /m/ and /n/ pattern differently in the following respects:

a) Intervocalic deocclusion in Middle and New Indo-Aryan: While Old Indo-Aryan /n/ between vowels remains non-continuant throughout its development into Middle and New Indo-Aryan languages, an intervocalic /m/ in Old Indo-Aryan sometimes becomes *ṽ* in Middle Indo-Aryan (Pischel 1900:§251, 261), e.g. OIA *kamala-* 'water-lily' > Apabhraṃśa *kaṽalu*, which is also written *kamvalu* (von Hinüber 1986:107, 2001:171f.), and similarly OIA *gr̄āma-* 'village' > Hindi *gā̃v* etc. /m/ is thus more liable to deocclusion than /n/ in an intervocalic context.

b) Deocclusion before a sibilant: In the sandhi of final /m/ and /n/ before a sibilant in the Ṛgveda, the closure of /n/ shows greater persistence than that of /m/. /m/ → *ṃ* / _ ]$_{wd}$ [−sonorant, +continuant] :: /n/ → *n*(*t*) / _ ]$_{wd}$ [−sonorant, +continuant], e.g. *túbʰyaṁ sutáḥ* (ṚV 2.36.5c) :: *vajrin svám* (ṚV 6.41.1c) or *magʰavañ cʰr̥ṇu* (ṚV 8.45.6a). This problem will be discussed in §64.

c) Place assimilation: Place assimilation does not occur to a final /n/ if it is followed by a word beginning with a non-coronal stop, e.g. *mahā́n kavíḥ* (ṚV 1.95.4d) and *asmín bʰayástʰe* (ṚV 2.30.6d); /n/ before a palatal obstruent is subject to place assimilation, e.g. *magʰavañ cʰakra* (ṚV 1.104.8c), *icʰáñ carati* (ṚV 3.54.2b) and *yā́mañ jánasya* (ṚV 6.38.1d), suggesting that palatals belong to the coronal class in Sanskrit (§40). Final /m/, on the other hand, is assimilated in place before any plosive, while it loses occlusion before all sibilants, as just observed in b) (Grammont 1916:254f., Allen 1962:83).

d) Doubling before a word beginning with a vowel: /n/ → *nn* / V̆_]$_{wd}$V and /ṅ/ → *ṅṅ* / V̆_]$_{wd}$V, while /m/ remains ungeminated in the same environment. As Whitney (1889) points out,[16] word-final -V̆*n* and -V̆*ṅ* often derive from underlying *-nt and *-ṅk, while word-final -*m* is etymologically just *-m. In phonological terms, the deletion of a final stop as in *sant > *san* leaves an empty C slot, which is filled by gemination when a vowel follows it. This doubling does not take place after a long vowel, presumably because the syllable is already heavy and overlength tends to be avoided (§21). The doubling of -V̆*n* which has no etymological *t after it, e.g. in *ádʰvann ā́*, needs to be explained as analogical spreading.

The relative weakness of final -*m* reminds us of the fact that Latin prosody often treats final -*m* as non-segmental unless it is followed by a consonant (Sommer

[16] "This [doubling] is also to be regarded as a historical survival, the second nasal being an assimilation of an original consonant following the first. It is always written in the manuscripts, although the Vedic meter seems to show that the duplication was somehow omitted. The RV has the compound *vr̥ṣaṇaśva*" (§210a).

and Pfister 1977:219ff.), while final *-n* is not elided before a vowel-initial word (Leumann 1926–28:226).

e) *NH before the suffix *-tá-*:

| PIE *n̥H > *ā*/_ [−sonorant] | PIE *m̥H > *ām*/_ [−sonorant] |
|---|---|
| PIE *ǵn̥h$_1$-tó- > *j ātá-* ‘born’ | PIE *krm̥H-tó- > *śrām-tá- > *śr āntá-* ‘tired’ |

To my knowledge, there is no philological evidence which supports the assertion that both *n̥H and *m̥H first became PIIr. *ā and then *m was analogically reintroduced after the *ā from *m̥H, as Hoffmann and Forssman (1996:70) assume. The possibility that this difference results from a regular sound change should be considered seriously.

f) Nucleus-forming *N before a sonorant or a pause:

Of the two nucleus-forming nasals in Proto-Indo-European, *m̥ becomes *am* not infrequently when followed by a non-nucleus sonorant or in word-final position:

| PIE *n̥{R, ]$_{wd}$} | PIE *m̥{R, ]$_{wd}$} |
|---|---|
| PIE *h$_1$néh$_3$mn̥ ‘name’ > *n ā́ma* | PIE *septm̥ ‘seven’ > *saptá* |
| | PIE *-oi̯(h$_1$)m̥ > *-eyam* them.opt.1sg. |
| PIE *tn̥-néu̯-ti > *tanóti* | *gm̥-i̯éh$_1$-s- > *gamy ā́ḥ* prec.3sg. of √*gam* ‘go’ (ṚV 1.163.13c), PIE *nm̥-ró- > *nam-rá-* ‘humble, obedient’ |

Word-medial *m̥ becomes *am* before a sonorant fairly regularly, but final *-am* < *m̥, such as in *p ā́dam* acc.sg. ‘foot’ < PIE *pód-m̥, *b$^h$iyásam* acc.sg. ‘fear’ < *b$^h$iH-és-m̥, or √*vah* ‘carry’ : *áv ākṣam* s-aor.1sg. < *é-u̯eg$^h$-s-m̥, can also be explained by leveling after the model of *-am* in the inflexion of other stems. There are not enough examples of medial *n̥, but at least it does not appear as ˣan in *tanóti*.

The combinational variation of /m/ also differs from that of /n/:

g) *mr* and ˣnr:

Proto-Indo-European tautomorphemic *mr without ablaut: Skt. *ni-mrúc-* ‘sunset’ (ṚV+), *-mróca-$^{ti}$* (AV), *mlóca-$^{ti}$* (ŚB), Gk. *hypó-bryk$^h$a* adv. ‘under water’ (Hom.), PIE *√{b/m}ruk$^h$ (?). If *m > b / _L as in *mr̥tó- > Gk. *brotós* is a regular development in Greek (Rix 1992:68), *mr- rather than *br- should be reconstructed. On the other hand, there is no example of the sequence ˣnr, while *nr̥* is common.

Tautomorphemic *mr with ablaut: Skt. *mr-iyá-te* pres.3sg. ‘dies’ < *mr̥-i̯é-toi̯, *ma-mr-uḥ* pf.3pl.act. (ṚV+).

Heteromorphemic /mr/: Skt. *nam-rá-* adj. ‘humble, obedient,’ YAv. *namra.vač.* PIE *tum + -ró- > Skt. *túm(-)ra-* adj. ‘powerful’ ~ *tuvi-*, Lat. *tumidus* ‘puffed up’ ~ *tume ō, tum ēre* ‘be puffed up.’

/mr/ across a word boundary: Skt. *sam-r ā́j-* ‘universal ruler,’ *sam-r ā́jñī* f. *samr ā́j-* and its derivatives are the only compounds in which the /m/ of *sam* remains un-

changed. As we will discuss in §67, native grammarians note this group as exceptions.

h) *ml* and ˣnl:

Proto-Indo-European tautomorphemic *ml- without ablaut: Skt. *bráv̄ımi* (ṚV+) pres.1sg.act. 'speak' < PIE *√mleu̯H 'speak,' YAv. *mraoiti* pres.3sg.act., TB *palwaṃ* 3sg., *pälw ā́mane* ppl.[17]

Proto-Indo-European tautomorphemic *ml-, possibly with ablaut: Skt. *ml ā́tá-* 'tanned,' YAv. *(a)mr ā́ta-*, Lat. *blandus*, PIE *√mlah$_2$.

Skt. *√mrad* 'soften' (*ví mrad ā́*, *ū́rṇa-mrad ā́* ṚV), PIE *√mled. Skt. *tuvi-mrakṣ ā́saḥ* (ṚV), *mrakṣa-kŕ̥tvan-* (ṚV), ~ Gk. *blápt ṓ* (?),

i) *mn* and ˣnm:

Tautomorphemic, no ablaut: PIE *√mneh$_2$ 'remember'; PIE *mneh$_2$-o- > Hom.Gk. *mnáomai*, with vowel coloring by laryngeal and *H> *ϕ* /V_V :: PIE *mn̥h$_2$-tó- > *mn̄tá- by laryngeal neutralization and compensatory lengthening > ˣmā́tá- → Ved. *mn ā́ta-* by restitution of *n (KB *ā́-mn ā́ta-* etc.). Ved. *carma-mná-* 'tanner'[18] (< ˣcarma-m{l/r}á- by dissimilation). Ved. *-mná-* (?~ *mánas-*); *dyu-mná-* n. 'heavenliness,' *ni-mná-* adj. 'going down,' *nr̥-mn̥á-* 'manfulness,' *ma-mn-ā́te* pf.3du.mid. of *√man* 'think,' *su-mn-á-* 'goodwill.'

Tautomorphemic, with ablaut: Proto-Indo-Iranian suffix *-man- ~ *-m(a)n-, OAv. *a$^{i}$riiamn ā́* inst.sg., prop.n., OAv. *a$^{i}$riiam$^{a}$nas-c ā́* abl.sg.. Ved. *-man-* ~ *-mn-*; *aryamán-* prop.n. ~ *aryamn̥-*, *jarimán-* 'senility' ~ *jarimn̥é*, *dʰ ā́man-* 'seat' ~ *dʰ ā́mn-*, *n ā́man-* 'name' ~ *n ā́mn ā́* inst.sg., *mahimán-* 'largeness' ~ *mahimn ā́*, *mahin ā́*, *y ā́man-* 'drive' ~ *-y ā́mn ā́*, *lóman-* 'body hair' ~ *lómnaḥ*, *s ā́man-* 'song' ~ *s ā́mne*. *-mn-* in most of these examples may not originally be a cluster.[19]

Heteromorphemic: Root-final /m/ + nasal infix, e.g. *á-ram-n̥ ā́t* ipf.3sg. of *√ram* 'come to rest,' *ścamnan* (ṚV 1.104.2). Intensive of *√nam* 'bend': *nám-na-te* pres.mid.3sg. (ṚV 1.140.6).

On the other hand, the sequence *nm* is limited to heteromorphemic contexts.

Heteromorphemic: *ján-man-* n. 'birth,' *mán-man-* n. 'thought,' *hán-man-* 'blow,' *aśman-máya-* 'made of stone,' *mr̥n-máya-* 'earthen' < /mr̥d-máya-/. Roots in /n/ + ending; *√man* : /man-u-mahe/ > *manmahe*, *√kar/kr̥* : /kr̥-n̥u-másі/ > *kr̥n̥másі*, *√van* : *vavanm ā́* (ṚV 7.37.5)

j) gemination: It may be just a coincidence that word-internal *-mm-* is rare while *-nn-*

[17] This is an almost regular development. PIE *√mleu̯H ~ *mluH > *ml$^{y}$eu̯H- ~ *mluH- by palatalization, > *ml$^{y}$əu̯H- ~ *mluH- by *e > *ə, > *ml$^{y}$əu̯a- ~ *mlua- by *H > *a and *uH > *u(u̯)a (Ringe 1996:32ff), → *mləu̯a- by loss of ablaut (Ringe 1996:135ff), > *bləu̯a- by *ml > *bl > *pləu̯a- by devoicing, and > PToch. *pəluu̯a- by metathesis of liquids (K. T. Schmidt 1982:365).

[18] As for the failure of retroflexion of /n/ in *-mná-*, cf. Wackernagel (1896:187) "Doch unterbleibt die Cerebralisierung: ... Mehrmals, wenn dem *n* ein Verschlusslaut, *m* oder *h* unmittelbar vorausgeht oder *m* oder *v* unmittelbar folgt."

[19] Lanman (1877:524) "This rule [=syncopation of *ă* of *-van, -man*] holds good neither for the written text of the Rik, nor for the text as the meter shows it to have been pronounced..."; Arnold (1905:88).

< *-dn- is quite common. /d/ becomes *n* before a nasal while the context of /b/ > *m* is virtually unknown. Nighaṇṭu 2.14 gives two roots with tautomorphemic *mm*, *hammati* and *drummati* (meaning unclear).

### §63 What is behind the asymmetry of /m/ and /n/?

Such asymmetries in the distribution of /m/ and /n/ are in large part caused by intrinsic properties of these sounds. Marotta (1999:302) discusses similar phonotactic restrictions on /n/ in Latin and calls them a *coronal syndrome*, the mutual effects of tongue-tip articulations when they occur in sequence.

If we may indulge ourselves in conjecturing about articulatory processes, the vocalization of Proto-Indo-European syllabic nasals *n̥ and *m̥ in the daughter languages as in

> PIE *déḱm̥(t) 'ten' > Lat. *decem* > /decẽ/ > inscription *dece*; > Lith. *dẽšimt*; > Gk. *déka*; > Skt. *dáśa*

would be most easily understood by positing vowel epenthesis such as *N̥ > */$^{V}$N/ > VN,[20] which further becomes > */Ṽ/ > V in Greek and Indo-Iranian (§95 j).[21] If that is the case, and if there is no lip rounding involved in such a V, /n/ would be more easily superimposed on a vowel than /m/ as a suprasegmental property like nasalization, for both /n/ and unrounded vowels have mandibular constriction in common.

The Sonority Scale discussed in §16 treats /m/ and /n/ as equally sonorous, and gives no indication of the differences between /m/ and /n/. If a consistent asymmetry is observed between them crosslinguistically, however, it would not be circular if we assign a slightly higher sonority to /n/. In Indo-European languages, word-initial /mn-/ is much commoner than /nm-/: Russian and Greek, for example, have words beginning with /mn/, such as Ru. *mnógo* 'much,' Gk. *mimnḗskō* 'remember,' but no words beginning with /nm/. The only Indo-European language I know of with initial /nm/ is Tocharian A, where both /mn-/ and /nm-/ are possible onsets, as in *mnu* 'idea' and *nmuk* 'ninety' (Krause and Thomas 1960–1964).[22]

Some of the cases of combinational asymmetry can be explained by the Obligatory Contour Principle (OCP). We see that a sequence of labial sonorants *mv is dissimilated in *jaganvā́m̥s-* pf.ppl. of √*gam* 'go' < *g$^{w}$e-g$^{w}$m̥-uóms-. This sequence is subject to dissimilation, whereas a sequence of homorganic non-continuants such as /mp/ is exempt from it, probably because the difference in the [±continuant] values of /m/ and /v/

[20]Tachelhit Berber is reported to have nucleic consonants including obstruents, e.g. *aknkar* 'bone,' *asmḍl* 'tomb,' *immkn* 'perhaps' (Horiuchi 2000), and it is not unimaginable that a nasal which was not accompanied by an epenthetic vowel became a syllable nucleus while maintaining occlusive constriction in the prehistory of Indo-Aryan as well.

[21]The feature values of the epenthesized V (vowel) are determined by the redundancy rules of each language. See §93.

[22]Outside Indo-European, the Niger-Congo languages Swahili and Mang'anja, for example, have words with /mn-/ but not ones with /nm-/, e.g. Swahili *mnamo* 'about' (Rechenbach 1967) or Niger-Congo *mnofu* 'flesh' (Scott and Heatherwick 1929)

prevents them from being multiply linked as in /mp/; see §100 for the role of the [continuant] tier in the spreading of retroflexion. The lack of the sequences ˣnr and ˣnl may be explained either by a similar OCP effect or by the above-mentioned coronal syndrome.

On the other hand, there is also a language-specific aspect in the asymmetries between /m/ and /n/. In Catalan, for example, a coronal nasal /n/ shows place assimilation in final position while other final nasals remain unchanged, e.g. /son pocs/ → *som pocs* 'they are few' :: /som dos/ → *som dos* 'we are two' (Kiparsky 1985:95), whereas /m/ is more easily assimilated to the initial sound of the following word in place and aperture than /n/ in Sanskrit as we saw in §62 c). In such cases, it is difficult to say one is a more marked nasal phoneme than the other on purely phonological grounds, for the distribution of place features is based on language-specific facts and not on universal markedness features such as the bivalent values of vowel features like [±rounded], [±back] or [±low]. So we may simply assume that /m/ is a less marked nasal than /n/ in Sanskrit, at least in final position. It might not be a coincidence that /m/ occurs more often than /n/ as a final nasal in Sanskrit.

### §64 Deocclusion of nasals

Tautomorphemic *ms may be reconstructed for Proto-Indo-European.

PIE *mems- ~ *memsó- ~ *mēmsó- 'flesh, meat': Ved. *mā́ṁsá-*, *mā́ṁs-*, n.acc.sg. *mā́s*, YAv. *måŋhəm*; OCS *męso*; Old Prussian *mensā*, *menso*; TB *mīsa*, Goth. *mimz*; Arm. *mis*.

| PIE *mēmsó- | PIE *mems-e-$h_2$ [i] | PIE *mēmsó- ~ *memsó- |
|---|---|---|
| Indo-Iranian | Tocharian | Germanic |
| Vowel Merger, | *e$h_2$ > *ā | ( Osthoff's Law |
| *m>[0place] /_C | *m > *n /_ [apical] [ii] | > *memsó-) |
| > PIIr. *māɴ.sá- | Palatalization | Verner's Law |
| Deocclusion | *e > ə | > *memzó- |
| > Ved. *mā́ṁsá-* | *-ā/*-a > *-a | Accent Shift |
| | > PToch. *m$^{y}$ənsa | *e > i / _N]$_{\sigma}$ |
| | > TB *mīsa* | Apocope [iii] |
| | | > PGmc. *mimz- |
| | | > Goth. *mimz* |

[i] Collective (Ringe 1996:70f.). [ii] Ringe (1996:70f.). [iii] Jasanoff (1994:264).

PIE *mēms-ro- in Italic

| | | | |
|---|---|---|---|
| > | PItalic | *mems-ro- | *ē > e by Osthoff's Law |
| > | pre-Lat. | *memb-ro- | s > b [i] / _r, "wohl ursprünglich β" (Meiser 1998:119) |
| > | Latin | *membrum* | 'Glied' |

PIE *ómso- ~ *ṓmso- 'shoulder': TB *ānts*e, TA *es*; Goth. *amsans* acc.pl.; Gk. *ômos*; Arm. *ows*; Ved. *áṁsa-*.

| PIE *ó̄mso- | PIE *(H)ómso- | | | |
|---|---|---|---|---|
| Tocharian | Germanic | Greek | Armenian | Indo-Iranian |
| *ō̄ > *a | a/o-Merger | *s>h [i] | *o>u/_N | V-Neutralization |
| o-Unrounding | > PGmc. *amsa- | > *omho- | *N>*ϕ*/_F[iii] | *m > [0pl] /_C |
| *m > *n /_[apical] | > Goth. *ams-ans* | 1CL[ii] | Apocope | PIIr. *aNsa- |
| >PToch. *ansë | | > *ômos* | > *ows* (o) | Indo-Aryan |
| B *ā̄ntse*, A *es* | | | | Deocclusion |
| | | | | > *áṁsa-* |

[i] Other than next to a stop or word-finally

[ii] First Compensatory Lengthening: *VhR, *VRh > V̄R

[iii] Winter (1992:121).

Vedic *kṣáḥ*, nom.sg. of *kṣám-* f. 'earth,' is explained as an analogical formation from acc.sg. *kṣā́m*. *mā́s* m. 'month' is not derived directly from PIE *mḗms-, but through PIIr. *meH-ṇs- according to Schindler (1980:84). The following Vedic form *dán*, together with *praśā́n* 'painless' (ŚB 3.1.3.10, Pāṇini, Aṣṭ. 8.3.7) < *-ćamH-s, might reflect a regular development of the cluster *ms in final position (Wackernagel 1896:195f., Narten 1980:161).

PIE gen.sg. *dém-s 'house'

| Greek | Indo-Iranian | |
|---|---|---|
| *dém-s pót(is) | Vowel Neutralization | |
| -ms > -ns /_]$_{wd}$ | *ms > *Ns /_]$_{wd}$ | |
| {N,T$_{[dental]}$} > ∅ /_sC[i] | PIIr. *daNs | |
| > *despót-ēs* 'master' | Avestan | Indo-Aryan |
| | *-ans > OAv. -ə̄ṇg [ii] | C$_1$...C$_n$]$_{wd}$ > C$_1$ |
| | >OAv. *də̄ṇg* | > Ved. *dán* |

[i] Rix (1992:78). [ii] Hoffmann and Forssman (1996:88).

Klingenschmitt (1982:212) notes that Proto-Indo-European *m before a sibilant is lost in Armenian and undergoes occlusion in Slavic. Younger Avestan *må̊ŋhəm* 'meat' shows the sequence ŋ*h* for PIE *ms. These reflexes, however, may be individually explained and do not undermine the reconstruction of *ms in Proto-Indo-European. In Indo-Aryan, where the *m in PIE *ms loses its occlusion word-medially (Grammont 1916:255), the feature [−continuant] of /m/ is licensed only when a non-continuant sonorant, i.e. a nasal, follows; thus in the cluster /mn/ as in *dyumnám*, /m/ and /n/ are both [+sonorant] and [−continuant] but remain distinct. When /m/ is followed by an obstruent consonant as in *śumb$^h$ate* or *puṃsáḥ*, on the other hand, the [$\alpha$continuant] value of the /m/ is decided by that of the following consonant. In other words, all features of /m/ except [nasal] are delinked unless it is followed by a non-continuant sonorant, and the following consonant assigns its [continuant] value, plus its place feature if it is [−continuant], to that nasal sound.

### §65 Asymmetries between /v/ and /y/

Sanskrit /v/ and /y/, which come from the Proto-Indo-European glides *u̯ and *i̯, also show a distributional asymmetry: sequences of /v/ followed by /y/, /r/ and /l/ (and /n/, although actually /van/ in most cases) are attested, whereas /y/ is not followed by any of these sonorants (Elizarenkova 1974:22). Sequences of *-yr̥-* or *-y r̥-* in the Ṛgveda are metrically disyllabic /ir̥/ in all cases except ṚV 10.110.11c *asyá hótuḥ pradíśy r̥tásya vā́cí* (Triṣṭubh), and possibly 10.105.8ab *áva no vr̥jiná śiśīhy r̥ ćā́ vanema ā́ r̥cáḥ*, if the ending *-hy* belongs to the b verse;[23] *vr̥*, on the other hand, is usually monosyllabic.[24]

It is probably unnecessary to invoke sonority to explain this asymmetry, for the articulation of /v/ involves the teeth and /v/ has stronger constriction than /y/, at least in the dialects described in TPr. 2.43, VPr. 1.81 and PŚ 18 (Allen 1953:57). The consonantal[25] status of /v/ may not date back to Proto-Indo-Iranian, if the Avestan and Sanskrit reflexes of PIIr. *u̯i̯ respectively as *oi̯* in YAv. *gaoya-* 'consisting of cows' and *vy* in Skt. *gavyá-*, *gávya-* (Meillet 1922:71f.) mean that *u̯ was still a glide in Proto-Indo-Iranian. But it might have been spirantized already in pre-Vedic. Sanskrit *pr̥t$^h$iv́ī* f. 'earth' is considered to be the regular outcome of PIE *pl̥th$_2$u̯ih$_2$ (Mayrhofer, *EWAia.* s.v.), with the first *h$_2$ having developed into /i/, as is often the case with a laryngeal in an interconsonantal context. But if *u̯ in pre-Vedic Indo-Aryan was still a glide and did not have consonantal constriction, the first *h$_2$ in this word may not have developed into /i/, for in *mat$^h$yám ānaḥ* (ṚV 5.11.6c), pass.ppl. of √*mat$^h$* 'churn' < PIE *meth$_2$,[26] or in *(ava-)dyáti* (TS etc.), pres.3sg. of √*dā́* 'divide,' from *-dh$_2$i̯é-ti, *h$_2$ in the similar interconsonantal context of *Th$_2$-i̯ has been lost without an epenthetic vowel. The *u̯ in *pl̥th$_2$u̯ih$_2$ might therefore have been a labiodental approximant [ʋ], or already a fricative like [v] or [β] in pre-Vedic.

The sequence /r̥v/ occurs in ten stems in the Ṛgveda, namely *dadr̥vā́ṃs-*, *cakr̥vā́ṃs-*, *jāgr̥vā́ṃs-*, *mamr̥vā́ṃs-*, *sasr̥vā́ṃs-*, *jā́gr̥vi-*, *dā́d$^h$r̥vi-*, *ab$^h$rāṭ r̥vyá-*, *nr̥vát-* and *pitr̥vát-*, whereas /r̥y/ occurs only in *bib$^h$r̥yād*, an optative form of √*b$^h$ar*/*b$^h$r̥* (Lubotsky 1997:148f.). Furthermore, there is a pre-Vedic development of *$_{\text{wd}}$[Cry- into C*riy-* and not into ×Cry-, as in verbal stems in *-yá-* like PIIr. *kr-i̯á-tai̯ > *kriyáte*, *d$^h$r-i̯á-tai̯ > *d$^h$riyáte*, *b$^h$r-i̯á-tai̯ > *b$^h$riyate* and *mr-i̯á-tai̯ > *mriyáte* (Seebold 1972:288). On the other hand, the sequence *r̥u̯ does not undergo a similar epenthesis of *u*, except in *d$^h$ruvá-* adj. 'firm,' *d$^h$ruvás-* n. and *d$^h$rúvi-* adj., which might derive from the root √*d$^h$ar*/*d$^h$r̥* 'hold' and suffixes beginning with a /v/.

Another asymmetry of Sanskrit /y/ and /v/ is that geminated /y/ occurs in a few words like Br.+ *śayyā́* f. 'bed,' while there is no ×vv. Unlike geminated /r/, which is avoided

[23] Oldenberg (1888:159) puts a pāda boundary after *-hy*.

[24] Harris and Kaisse (1999) point out a similar but opposite phonotactic asymmetry of /w/ and /y/ in Spanish, where /yw/ exists but /wy/ does not.

[25] Glides, together with vowels, are [−consonantal] in Chomsky and Halle's feature theory (Chomsky and Halle 1968).

[26] It has to be admitted, however, that this form is under paradigmatic pressure from other roots, e.g. √*dah* 'burn,' *dáh-ana-* vb.n., *dahyá-* pass. stem :: √*mat$^h$*, *mat$^h$ana-*, *mat$^h$yá-*.

even though there are roots ending in and suffixes/endings beginning with /r/, the lack of ×vv might merely be due to an accidental absence of suffixes which begin with a /v/ and take roots in the full grade.

### §66 Absence of geminated rhotics in Indo-Aryan and the pronunciation of /r̥/

/l/ and /r/ are both liquids, but they differ in their values for the feature [continuant]; the latter belongs with glides and fricatives as [+continuant], but the former can be grouped either as [+continuant] or [−continuant]. In Sanskrit, lateral /l/ patterns with [−continuant] sounds such as nasals and plosives in that it can be geminated across and inside word boundaries, e.g. ṚV 10.163.5 *vanaṃkáraṇ ā́l lómabʰyaḥ*, 10.163.6 *áṅg ād-aṅg ā́l lómno-lomnaḥ*, Ved. *-vállabʰa-* 'darling' (Khila, Gotō 1987:196), Ep. *malla-* 'wrestler' etc. In the spreading of retroflexion from /r/ or /ṣ/ to /n/ as well, /l/ might belong with the coronal plosives, for it is not included among the phonemes which are transparent with regard to spreading, namely vowels, glides, /r/, /h/, and velar and labial non-continuants according to Pāṇini, Aṣṭ. 8.4.2 *aṭ-ku-pv-* (§100). As we saw in §23, a coda /r/ in medial syllables tends to be displaced from coda position by geminating the following plosive, while such doubling does not take place when the coda consonant is /l/. These asymmetries may be explained by assuming that Sanskrit /l/ is a non-continuant.

Geminated /r/, on the other hand, is not found in Old Indo-Aryan, whether in non-derived contexts, internal or external sandhi (Bloch 1951:44). Word-final /r/ which comes from original *r or from *s in a RUKI context is lost with compensatory lengthening when followed by a word beginning with /r/, e.g. /pátis/ + /rayīṇā́m/ > /pátir rayīṇā́m/ > *pátī rayīṇā́m*, /paptur/ + /ragʰuyā́/ > *paptū ragʰuyā́* (Allen 1962:70). Such a strong restriction against geminated rhotics as in Sanskrit is not found in other Indo-European languages. In Latin, for example, the preposition *com* is assimilated before both /l/ and /r/, e.g. *col-ligō* 'gather,' *cor-rigō* 'correct.' In Greek, /-rr-/ is less frequent than /-ll-/, but it does exist, for example in *érrō* 'get lost.' Proto-Indo-European *rs becomes *r̄* in Armenian, e.g. *t'arāmim* 'I wither' < *tr̥s- (Schmitt 1981:72).[27]

In the articulation of /l/, the release of the closure is held back as in the other [−continuant] phonemes, but /r/ was probably an alveolar flap according to the Prātiśākhyas (Varma 1929:6f., Allen 1953:54). If Sanskrit /r/ was a flap, contact of tongue with the root of the teeth is inevitably released, and repetition of a flap or trill is ruled out according to the requirement of cohesive closure of clustered consonants (§28). This intrinsic duration of /r/ and the principle of COHESIVE CLOSURE (§28) presumably are responsible for the categorical absence of geminated /r/ in Indo-Aryan. A sequence of consonantal and nucleic /r/'s is possible, however, e.g. *nír-r̥ti-* 'perdition.' Some 'vocalic element' (Allen 1953:61f.), which seems to be implied by ṚPr. 13.34 *madʰye saḥ* 'it (an

[27] Outside Indo-European, Korean has *-ll-* but no *-rC-*. The templatic morphology of Arabic, on the other hand, seems to presuppose that /r/ can be geminated: The second or intensive form of Arabic geminates the second consonant, which may be an *r*, e.g. *ḍaraba* 'to beat' : *ḍarraba* 'to beat violently' (Caspari and Wright 1896:31, §40f. I thank Haruko Sakaedani for this reference).

/r/-sound) is in the middle (of *ṛ*),' might make /-rṛ-/ a possible sequence.

**§67** ***samrā́j-, praüga-* and old sandhi**

We saw in §50 that the boundaries of a few compounds with the first member *duṣ-* 'ill-, bad, difficult' obey sandhi rules which apply only at a morpheme boundary, instead of the expected word sandhi, as is partly provided by ṚPr. 5.55 *dūḍʰya-dūṇāśa-dūḍʰabʰa-*.

| surface | underlying | expected | comparable form |
|---|---|---|---|
| *ducchúnā* | < /dus + śúnā/ | ⊁duḥśúnā | *gácchʰa-* < *gʷṃ-ské/o- |
| *dūdā́ś-* | < /dus + dā́ś-/ | ⊁durdā́ś- | *nīḍá-* < *ni-sd-ó- |
| *dūdábʰa-* | < /dus + dábʰa-/ | ⊁durdábʰa- | |
| *dūdʰī* | < /dus + dʰī́/ | ⊁durdʰī | *mīḍʰá-* < *misdʰó- |
| *dūṇáśa-* | < /dus + náśa-/ | ⊁durṇáśa- | |
| *dūṇā́śa-* | < /dus + nā́śa-/ | ⊁durṇā́śa- | |

Since sandhi between morphemes reflects older alternations than does word sandhi, these compounds were probably univerbated early enough to undergo the same sandhi rules as those applying across morpheme boundaries (§47).

A similar example is the sequence /mr/. As Ṛgvedic compound verbs such as *saṃrihānáś-*, *saṃrarāṇá-*, *saṃrábʰya* show, /m/ loses its occlusive constriction and becomes anusvāra when the next word begins with /r/. This deocclusion does not apply to word-internal /mr/, e.g. *vamrá-*, *vamraká-*, *tamrá-*, *camríṣ-*; in these two groups, the same sequence /mr/ is treated differently depending on its morphological context. The failure of deocclusion of /m/ in the latter group is a case of blocking in a non-derived environment (Kiparsky 1973a:60f.).

Only the /m/ of *sam* in the compound *sam-rā́j-* 'universal ruler' and its derivatives remains non-continuant, and native grammarians make special reference to them: Pāṇini, Aṣṭ. 8.2.25 *mo rāji samaḥ kvau*, TPr. 13.4 *na saṁs-sāṁ iti rāparaḥ* ↦ *sam-rāj-*, *sāṁ-rājya-*, ŚCĀ 2.1.36 *na samo rājatau* ↦ *sam-rā́j-*, *sam-rā́jñī* This compound might have been univerbated at an early enough period to evade deocclusion; Iranian does not have an equivalent of this word, but note that the sequence *mr* is possible there, e.g. OAv. *mraomī* 'I speak' (~ Ved. *brávīti*). *sam-rā́j-* was compounded when /m/ was still specified for [−continuant]; the deocclusion of /m/ before approximants (i.e. glides and liquids) must have been introduced into Indo-Aryan after this compound was established. Deocclusion of /m/ before /r/, being a post-lexical rule, did not affect word-internal sequences, while *-ms- is persistently avoided in any context both in Proto-Indo-Iranian and in Indo-Aryan (§64).

The word *práüga-* (ṚV 10.130.3) 'the part in front of the yoke' (Sparreboom 1985), a compound of *prá* 'forward' and *yugá-* 'yoke,' has undergone an anomalous loss of initial *y*, not found in other words with the same sequence across morpheme or compound boundaries, e.g. *deva-yú-*, *prá-yuta-*, *ratʰa-yúj-*, *sa-yúj-* (ṚV). The only phenomenon

comparable to this is the sandhi rule attributed to Śā̄kalya (Aṣṭ. 8.3.19 *lopaḥ śā̄kalyasya*), which changes /-e V-/ into *-a V-* probably through */-a$^{y}$ V-/ (Allen 1962:38). For Vedic variants with or without an intervocalic *y*, such as ṚV 6.15.5a *pā̄vakáyā̄*: TS 4.6.1.2 *pā̄vakáā́*, see Bloomfield and Edgerton (1932:173f.).

**§68 Summary**

Along with Greek, Old Indo-Aryan is one of the Indo-European languages which best preserve inherited occlusive constriction. Nevertheless, there are still a significant number of cases of deocclusion, both regular and sporadic (§56, §57).

The deocclusion of voiced aspirates to /h/ shows that laryngeal features in Old Indo-Aryan appear in the surface representation with a higher priority than oral features (§56). This markedness of the feature [spread glottis] is confirmed by the debuccalization of voiced aspirates to a placeless glottal fricative *h*, as well as the generalization of aspirated stem forms in paradigmatic leveling as in the paradigm of PIIr. *pn̥tH-~*pantaH- 'path' : Skt. *pat$^{h}$-~pánt$^{h}$ ā̄-*(cf. Av. *paθ-* ~ YAv. *paṇtā̊*).

Debuccalization of Proto-Indo-Iranian primary and secondary palatal voiced aspirates is fully regular, and occurred in late pre-Vedic after reaffrication of */ʑ$^{h}$/ < *j́$^{h}$ (§56). The regular deocclusion of *m before *s is an Indo-Iranian innovation (§64). Voiced aspirates other than palatal ones, i.e. /d$^{h}$/, /b$^{h}$/ and /g$^{h}$/, are debuccalized only sporadically (§57), and the exact context triggering debuccalization is difficult to demarcate, even within a unitary morphological category such as the 2sg. athematic imperative in *-d$^{h}$í/-hí* (§58, §59, §60, §61). Unlike Iranian which retains place features while giving up phonemic contrasts of aspiration, no oral feature remains upon Sanskrit debuccalization of voiced aspirates, by the Laryngeal First Principle (§56) which is unique to Indo-Aryan.

In Indo-Aryan, continuants are usually more limited than non-continuants in distribution (cf. the elimination of final /s/, §30), but the oral feature of /m/ surfaces in a very limited context, namely only before vowels and tautomorphemic sonorants (§62, §63). Since *mr is originally a possible sequence, the deocclusion of /m/ before sonorants is an Indo-Aryan innovation (§64). /l/ patterns as a non-continuant in Sanskrit (§66).

# Chapter VI. Laryngeal and Vowel Features

## §69 Laryngeal features in Indo-Aryan

The features [voiced] and [spread glottis] are subsumed under the Laryngeal node (Clements 1985:233ff.), so they are referred to as laryngeal features. Lombardi (1991) has demonstrated that the laryngeal features are not bivalent, i.e. do not occur with two feature values like '[+voiced]' and '[−voiced],' but are privative, on the basis of the assimilation and neutralization patterns of these features in many languages; we assume her view in our analysis. Along with the retroflex consonants, the four-way contrast of laryngeal features by the two-by-two matrix of [voiced] and [spread glottis] is the most conspicuous characteristic of Indo-Aryan phonology. While aspirated stops shift toward fricatives in some other Indo-European languages, such systematic deaspiration did not take place in Old Indo-Aryan:

| | |
|---|---|
| Latin | $*b^h(*d^h) > p^h > f$, $*G^h > k^h > h$ (initially) |
| Hellenistic Gk. | $*b^h > *p^h > f$, $*d^h > *t^h > \theta$, $*G^h > *k^h > x$ (Allen 1987:23ff) |
| Germanic | $*b^h > *\text{ƀ}$, $*d^h > *\text{đ}$, $*G^h > *\text{ɠ}$ (Jasanoff 1994) |
| Avestan | $*\acute{g}^h > z$, $*p^h > f$, $*t^h > \theta$, $*k^h > x$ |
| Vedic | PIIr. $*\acute{j}^h/\acute{\jmath}^h > h$; $*b^h/d^h > h$ (sporadic) |

When voiced aspirates undergo deocclusion in Indo-Aryan, they lose all place features and become /h/ (§46), which native grammarians identify as bare voiced aspiration.[1] Fricative /h/ occurs only before a sonorant, and the sibilants /ś/, /ṣ/, /s/ occur either before a sonorant or before a voiceless plosive followed by a sonorant (§31). It is another characteristic of Old Indo-Aryan that laryngeal features are licensed only when they are followed by a sonorant (Lombardi's Laryngeal Constraint, §83). A voicing pattern with word-final devoicing[2] and mostly regressive voicing assimilation in obstruent clusters is also found in Dutch (Lombardi 1995:51ff., Kenstowicz, Abu-Mansour and Törkenczy 2002:122).

## §70 Voiceless aspirates: Aspiration of initial *sT clusters

Since Kuryłowicz (1935:46ff.) showed that many voiceless aspirates in Indo-Aryan originate from a combination of the corresponding voiceless stops and PIE $*h_2$, a three-way system of voiceless unaspirated, voiced aspirated and voiced unaspirated stops has been widely accepted for Proto-Indo-European. The other occurrences of voiceless aspirates which can be reconstructed for "core" Proto-Indo-European (i.e. Greek, Germanic, Balto-Slavic and Indo-Aryan) appear after a word-initial *s:[3]

[1] For example, TPr. 2.6 *mad$^h$ye hak ā́raḥ* and 2.9 *hak ā́ro ha-caturt$^h$eṣu*. See §36.

[2] Final devoicing is only optional according to Pāṇini, Aṣṭ. 8.4.56 *v ā́vas ā́ne* Final stops are all voiced according to Aṣṭ. 8.2.39 *j$^h$al ā́m jaśo 'nte*.

[3] As for the view that the Greek pf. 2sg. ending *-st$^h$a* as in *oîst$^h$a* reflects aspiration by $*h_2$, Cowgill (1965:173) proposes an alternative explanation based on the spreading of aspiration from root-final /p$^h$/ and /k$^h$/ to /-st-/.

| Gk. /sT$^h$/ | : | Skt. /sP$^h$/ |
|---|---|---|
| Gk. *sk$^h$íz$\bar{o}$* | : | Skt. *c$^h$i-ná-t-ti* ‘cut’ |
| Gk. *sp$^h$áll$\bar{o}$* | : | Skt. *sk$^h$al-a-te* ‘go astray’ (Br.) (Klingenschmitt 1982:144, 168) |
| Hom. *sp$^h$arageûnto* | : | Skt. *sp$^h$ūrj-a-* ‘thunder’ (Klingenschmitt 1982:169) |

| /sT/ | : | Skt. /sT$^h$/[i)] |
|---|---|---|
| Hitt. *išp$\bar{a}$ri* | : | Skt. *sp$^h$urá-* ‘kick’ |
| Lat. *sp$\bar{e}$s* ‘hope’ | : | Skt. √*sp$^h$$\bar{a}$* ‘become fat’ |
| OHG *spec* ‘fat’ | : | Skt. *sp$^h$íj-* ‘loin’ |

| /sT$^h$/ | : | Skt. /sT/ |
|---|---|---|
| Gk. *sp$^h$andáz$\bar{o}$* | ? | Skt. *spand* ‘quiver’ |

[i)]Klingenschmitt (1982:169) “Für das Griechische ist kein Fall einer Entsprechung gr. *sp-* : ai. *sp$^h$-* nachweisbar.”

Since the phonological nature of the aspiration of Skt. /c$^h$/ is not clear, solid examples of reconstructible voiceless aspirates mostly involve forms with PIE *p$^h$ preceded by an initial *s (Hiersche 1964:175). If the alternation of $_{wd}$[T$_{[voiced]}$- and $_{wd}$[sT$_{[0voiced]}$- in Germanic double forms such as MHG *briezen* ~ *spriezen* ‘sprout’ derives from PIE *sT$^h_{[voiced]}$, as Sieb’s Law postulates (Collinge 1985:156f., Szemerényi 1990:109, Southern 1999:49ff.), the evidence for the existence of voiceless aspirates in Proto-Indo-European would become even scarcer.

There is hardly any Proto-Indo-European form with initial *sT$^h_{[0voiced]}$ which forms a minimal pair with its unaspirated counterpart. This gap raises the suspicion that voiceless aspirates are allophonic variants of their unaspirated counterparts after a word-initial *s, or reflect a transition from /sP/ to /P$^h$/ according to the theory of Hiersche (1964:145, 175):

> *sP$^h_{[0voiced]}$ as an allophone of *sP: *C$_{[0voiced,-continuant]}$ ~ *C$^h$ / $_{wd}$[*s_
> C = *p in Proto-Indo-European; spreads to other voiceless plosives in Indo-Aryan.

In accordance with the Neogrammarian method of reconstruction which requires unexplained variation to be posited for the previous stage, Klingenschmitt (1982:168f.) reconstructs initial *sT$^h_{[voiced/0voiced]}$ in Proto-Indo-European. There is no notable difference between the phonological context of the forms beginning with /sT$^h$-/ and that of the forms beginning with /sT-/ which would allow us to define the allophonic alternation between them and to remove voiceless aspirates completely from the phonemic inventory of Proto-Indo-European. The following seem to be the only contexts in which initial *sT$_{[0voiced]}$- remains constantly unaspirated:

‘*s* mobile’: The forms which have a voiceless plosive preceded by an *s alternating with Ø might be exempt from aspiration: PIE *√k$^w$er, Skt. √*kar/kṛ* ~ √*skar/skṛ* ‘do’; PIE *(s)pe$\acute{k}$, Skt. √*paś* ~ √*spaś* ‘see’; Skt. √*sparś/spṛś* ‘touch’ ~ *pṛśan$\bar{\imath}$*(?).

*sP's which are preceded by another consonant: PIE *$h_2$ster- 'star,' Skt. *tā́raḥ* ~ *stŕbhiḥ*; PIE *psten- 'breast,' Skt. *stána-*, YAv. *fštāna-*, Arm. *stin*.

Grassmann's Law: *sP in an initial syllable which is followed by an aspirated stop is deaspirated or remains unaspirated: *√skemb$^h$H, Skt. √*skamb$^h$* 'prop up.'

Although the context triggering or blocking aspiration after initial *s cannot be sharply defined, the contrast of *sT$_{[0voiced]}$ and *sT$^h_{[0voiced]}$ can be considered on the whole an allophonic variation, for *sT clusters and initial stops exhibit peculiar irregularities regarding aspiration which will be discussed in the following two sections.

## §71 PIE *s and cooccurrence restriction of the laryngeal features

Proto-Indo-European has a restriction against the cooccurrence of a voiceless unaspirated stop in the onset and an aspirated stop in the coda of a root morpheme (*√T$_{[0voiced]}$...T$^h_{[voiced]}$). This restriction does not apply, however, when the onset consonant is preceded by an *s as in PIE *√steig$^h$ 'mount' or *√sperd$^h$ 'run' (Normier 1977/78:209, Szemerényi 1990:103). In other words, an initial *s exempts the following stop from the restrictions on the laryngeal features of stops in a root morpheme.

It is also known that PIE *s, unlike stops, freely occurs with any obstruent in Proto-Indo-European roots:

| C | *√s...C | *√C...s |
|---|---|---|
| voiceless unaspirated | *√seup 'sleep,' Skt. *svapiti* | *√kes, Hitt. *kešzi* 'combs' |
| voiced unaspirated | *√sed 'sit,' Skt. *sīdati* | *√des 'find,' Alb. *n-dieh* |
| voiced aspirate | *√sreb$^h$ 'drag,' Gk. *r$^h$op$^h$éō* | *√ǵ$^h$eis, Skt. *hināsti* 'harm' |
| sibilant | *√ses 'rest,' Hitt. *šešzi*, Skt. *sásti* | |

(examples from *LIV*)

In order to bring this free distribution into line with the restrictions on the other obstruents, I propose that PIE *s is unspecified for the laryngeal features [voiced] and [spread glottis] (§54); in other words, these laryngeal features could freely occur with *s in Proto-Indo-European and are hence non-distinctive.

This assumption is supported by the attested alternation of clusters beginning with *s: there is no phonemic contrast between *s and *z in the reconstructed lexicon of Proto-Indo-European. The Germanic variation of Sieb's type *sT ~ *T$^h_{[voiced]}$ is understandable if *s here is both [voiced] and [spread glottis], which spread to the following stop as *s itself disappears. Furthermore, Mayrhofer (1986:119) points out that Indo-Iranian *s in clusters of the type *sT$_{[voiced]}$, such as *s-d$^h$í 'be!' > Av. *zdī* → *az-d$^h$í > Skt. *ed$^h$í*, follows the general rule of right-to-left assimilation of voicing, e.g. PIE *ped- 'foot,' YAv. *frabdəm* m.acc.sg. 'forefoot,' Skt. *upa-bd-á-* m. 'stamping' (Mayrhofer 1986:99, 110. See also §77). Finally, the fact that Indo-Iranian *s after a voiced aspirate undergoes Bartholomae's Law in Avestan (Mayrhofer 1986:119) shows that the feature [spread glottis] can link to *s still in Proto-Indo-Iranian. From a cross-linguistic point of view, the feature [spread glottis] is at least compatible with /s/, as demonstrated by the

existence of languages which distinguish aspirated from unaspirated /s/, e.g. Burmese (Ladefoged 1973) and Korean (Kagaya 1974).[4]

### §72 Indo-Aryan innovations in the laryngeal configuration of *s

Iranian reflexes of clusters of the type *$P^{h}_{[voiced]}$s, such as OAv. *diβža-* : Ved. *dípsa-* (ṚV+) < /díb$^{h}$-sa-/ desid. of √*dab$^{h}$* 'deceive' along with *d$^{h}$ípsa-* (VS), *d$^{h}$ī̆psa-* (JB) (Schindler 1976:624, Cardona 1991, Scharfe 1996), show that Bartholomae's Law or left-to-right assimilation of voicing and aspiration applies to these clusters in Proto-Indo-Iranian. As roundabout as it may sound, PIE *$T^{h}_{[voiced]}$s first became *$P^{h}_{[voiced]}z^{h}$ in Proto-Indo-Iranian, and the sibilant is then devoiced in Indo-Aryan, regressively devoicing and deaspirating the preceding voiced aspirate. To put it differently, voicing and aspiration in the *$T^{h}_{[voiced]}$ of PIE *$T^{h}_{[voiced]}$s redundantly spread to the following *s in Proto-Indo-Iranian, where a sibilant is still unspecified for laryngeal features.

At first sight, this devoicing and deaspiration seem to contradict the tendency in Indo-Aryan, and in Proto-Indo-Iranian to some extent, to maximize [spread glottis] within a root (see Bartholomae's Law in §82). If, as I propose, Indo-Aryan /s/ was initially unspecified for the feature [spread glottis] in the early pre-Vedic period, but was then redundantly prespecified for [spread glottis], a form such as *dípsa-* can be understood in the following way. The [spread glottis] of the root part of /dib$^{h}$-sa-/ is not lost in *dipsa-*, but is present, linked to /s/, for in early pre-Vedic, to which I think this form belongs, *s is still unspecified for [spread glottis]. Since the laryngeal features of a cluster-initial consonant are licensed only parasitically by a cluster-final consonant (Lombardi's Laryngeal Constraint, §77), and since [spread glottis] is aligned at the right edge of an obstruent cluster in Indo-Aryan (§76, §82), the root-final *p*, although it is underlyingly /b$^{h}$/, is neither voiced nor aspirated in the surface form *dipsa-*.

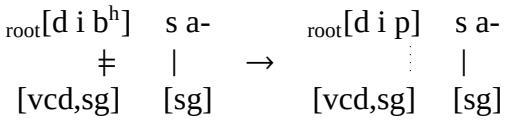
PIE/PIIr. *s~*z → early pre-Vedic *s → late pre-Vedic *s
|
Lar
|
[sg]

In the following period, when /s/ becomes prespecified for [spread glottis], the same input form /dib$^{h}$-sa-/ follows a different path of derivation. Now the laryngeal node of the root-final voiced aspirate /b$^{h}$/ can neither spread to /s/, which is already specified for the laryngeal node, nor stay linked in the surface form because of the above-mentioned Laryngeal Constraint, and because of the Obligatory Contour Principle which prohibits two identical entities, features in this case, next to each other; so it is delinked and becomes a floating autosegment. Then it relinks to the root-initial /d/, the only other

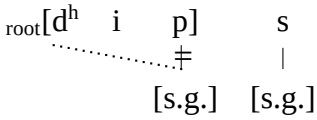
[4] From a phonetic point of view, Kingston (1990:411), for example, describes the relationship between fricatives and glottal frication as follows: "voiceless fricatives demand a very wide glottal aperture to elevate air flow through the glottis sufficiently to produce turbulence downstream through the oral constriction."

linkable segment in the same morpheme, and aspirates it, resulting in the output form *d$^{h}$ipsa-*.

Delinking




Relinking




There is another advantage in assuming fricatives to be redundantly aspirated. I explained above that the Sibilant Voicing Filter (§36) blocks voicing of fricatives; thus there should also be a possibility for */z/ to become a homorganic voiced stop /d/ instead of its voiceless counterpart /s/, just as *[ʑ] < PIIr. *ǰ is considered to have become a plosive *[ɟ/ʤ] (§52). If, however, the aforementioned priority of maximizing [spread glottis] over maximizing [*α*continuant] is applied here, changing */z/ to /s/ does not cause a loss of [spread glottis] and is hence better than changing it to /d/. In the case of stop aspiration in the sequence /sT$^{h}$/, which we explained by spreading of [spread glottis] of /s/ (§70), a single occurrence of the feature [spread glottis] is linked multiply to /s/ and /T$^{h}$/ and so does not violate the Obligatory Contour Principle.

### §73 *z in Proto-Indo-European

Avestan has voiced fricatives, as in forms such as OAv. *-aoγž$\bar{a}$* ‘speak!,’ Av. *m$\bar{\imath}$žda-* ‘reward, wage,’ OAv. *diβža-* ‘try to deceive,’ OAv. *mazd$\bar{a}$* voc.sg. (YAv. *mazda*), and OAv. *zər$^{ə}$d$\bar{a}$(-č$\bar{a}$)* inst.sg. of *zər$^{ə}$d-* n. ‘heart’ from PIIr. *ǰ$^{h}$ṛd-. In other subfamilies, PIE */z/, which is an allophone of PIE *s in voicing contexts, develops as follows:

| | | |
|---|---|---|
| Hittite | *š* | Melchert (1994:63) |
| Tocharian | *s* | |
| Latin | *s*; *r* /V_V | Sommer & Pfister (1977:146ff.) |
| Celtic | assimilated; đ | Lewis & Pedersen (1937:21ff.) |
| Greek | ∅ /V_V; *s*; zd>*ζ* | Rix (1992:77ff.) |
| Armenian | ∅ /V_V, _N; *s* /N_ | Schmitt (1981:65f.) |
| Germanic | ∅ /_]$_{wd}$; *r*; *z*,*s* | Krahe (1948:85f.) |
| Slavic | *z* | Entwistle & Morison (1949:101) |
| Baltic | *z* | Stang (1966:94) |
| Iranian | *z*, *ž* | |

Based on these reflexes in Indo-European languages other than Latin and Indo-Aryan (and Tocharian, which has no voiced obstruents anyway), PIE *s is reconstructed without any prespecified laryngeal features. This may appear to conflict with the three-way contrast of Proto-Indo-European stops for the features [voiced] and [spread glottis], but an actual example is found in Thai, which has a three-way laryngeal contrast of labial

and dental stops but lacks a phonemic voiced sibilant.[5]

### §74 Aspiration of initial *$T_{[0voiced]}$ + *$h_2$ in Indo-Aryan

In Vedic, the feature [spread glottis], which an initial /s/ redundantly has, occasionally spreads to a following voiceless stop, although the exact condition for that aspiration cannot be determined. In Greek, where there is only one series of aspirates and adding [spread glottis] to an unaspirated stop may create homonymy, cases of possibly allophonic variation of /p/ : /$p^h$/ and /k/ : /$k^h$/ are even fewer.

While a medial stop followed by PIE *$h_2$ develops into a voiceless aspirate in Indo-Aryan, the initial sequence *p$h_2$ in PIE *p-$h_2$tér- 'father' does not become ×$p^h$i- in Sanskrit (Kuiper 1942:24). Skt. *kúmb$^h$a-* 'jar' : YAv. *xumba-* < *$k^h$úmb$^h$a- might also reflect the same phenomenon, although this word can be traced back only to Proto-Indo-Iranian *$k^h$úmb$^h$a- (see §81). Similar cases of non-aspiration in initial position are *(nṛ́-)p$\bar{\imath}$ti-* from $\sqrt{p\bar{a}}$ 'protect,' if this root originally had *$h_2$ and not *$h_3$, and *dáyate* 'distribute' < PIE *$dh_2$-éye-toi̯.

The non-aspiration of the initial /p/ of *pitár-* 'father' suggests the possibility that the Proto-Indo-European sequence *T + *$h_2$ develops differently in initial and non-initial position; only an *$h_2$ in non-initial position seems to cause aspiration of a preceding stop, whereas *$h_2$ after an onset stop in an initial syllable behaves just like the other laryngeals, i.e. it disappears before a vocoid without any trace and leaves *i* before a consonant. Medial *TH was originally syllabified as *-T.H- in pre-Vedic according to the metrical study of the Ṛgveda by Gippert (1997), whereas initial *TH- is naturally tautosyllabic. The sequence *sT, on the contrary, sometimes becomes *sT$^h$-* initially and usually remains unaspirated in non-initial position:

| | initially | | medially | |
|---|---|---|---|---|
| *sT | *[sT- | > *sT$^h$-* (sporadic) | *-s.T- | > *-sT-* |
| *TH | *[T$h_2$- | > *T-* | *-T.$h_2$- | > *-T$^h$-* |

Although there are not a sufficient number of examples to draw a firm conclusion, it is possible that PIE *$h_2$ causes aspiration of a preceding stop only when it is a syllable onset, while the spreading of the redundant laryngeal features of *s to a following stop takes place only when they are in the same syllable. If Skt. *k$^h$idáti* 'tear' is cognate with Lat. *caedere* 'cut' and the initial *k$^h$-* comes from PIE *k + *$h_2$ (Polomé 1972:237, 240, cf. *LIV* 307, s.v. *ke$h_2$d), it would serve as a counterexample.

Laryngeals in the onset of an initial syllable are subject to special developments in other Indo-European languages as well. Hoenigswald (1952:184) suggests that initial *$h_2$ is deleted in variants with *s mobile, e.g. Lat. *anus* 'old woman' : *senex* 'old man.' Hittite laryngeals are also lost after initial consonants as in *$dh_3$-énti > Hitt. *danzi* 'they take' (Oettinger 1979:501).

[5] Cf. Kingston's Binding Principle (Kingston 1990), according to which glottal articulations bind more tightly to oral ones in stops than in continuants.

## §75 Phonemicization of voiceless aspirates in Indo-Aryan

While there is some fluctuation of /sP/ ~ /sP$^{h}$/ in Vedic pairs such as ṚV *vi-ṣp$^{h}$ulíṅga-* : Br. *vi-ṣpuliṅgaká-* (Hiersche 1964:45ff., §70), phonemicization of voiceless aspirates (Hoenigswald 1965a) as distinct from their unaspirated counterparts has introduced a few minimal pairs:

| | | |
|---|---|---|
| Ved. *pṛṣṭá-* 'asked' | : | Ved. *pṛṣṭ$^{h}$á-* 'back' |
| Ved. *riktá-* 'left' | : | Ved. *rikt$^{h}$á-* 'inheritance' |
| Ep. *paṇa-* 'wager' | : | Taitt.Br. *p$^{h}$aṇá-* 'scum' |
| Ved. *starī́* 'barren cow' | : | TS *st$^{h}$ála-* 'dry land,' Br. *st$^{h}$alī-* |
| *-ta* 2ary.2pl.suffix | : | *-t$^{h}$a* 1ary.2pl.suffix |

As a corollary of phonemicization, unaspirated and aspirated voiceless stops in the same paradigm have been leveled out. Interestingly, it is always the aspirated stop which is generalized:[6]

| reconstruction | Vedic | Avestan |
|---|---|---|
| PIIr. *pantāH-s nom.sg. | *pánt$^{h}$āḥ* | YAv. *paṇtå* |
| PIIr. *pantaH-m acc.sg. | *pánt$^{h}$ām* | YAv. *paṇtąm* |
| PIIr. *pn̥t$^{h}$H-as gen.sg. | *pat$^{h}$áḥ* | YAv. *paθō* |
| PIIr. *sti-štHa-ti 3sg. | *tiṣṭ$^{h}$ati* | YAv. *hištaiti* |
| PIIr. *a-staH(a)t rt.aor.3sg. | *ást$^{h}$āt* | YAv. *xšt āt* |
| PIIr. *staH-na- | *st$^{h}$āna-* | *st āna-* |
| PIIr. *a-mat-naH-t ipf.3sg. | *ámat$^{h}$nāt*(?) | |

(Hoffmann and Forssman 1996:125)

Although */s/ in some pre-Vedic forms, e.g. *dib-z$^{h}$a- > Ved. *dipsa-* (§72), may have had laryngeal features, Vedic lost the voiced fricatives *z and *z$^{h}$ by devoicing and deaspiration, leaving the single voiceless fricative /s/. The laryngeal features of sibilants are no longer contrastive in Old Indo-Aryan phonemic inventory. Subsequently, Old Indo-Aryan clusters of the form /SP/ develop into /PP$^{h}$/ in Middle Indo-Aryan languages except Māgadhī, through an intermediate form */SP$^{h}$/ (Pischel 1900:§301–311).[7]

TPr. 14.12 *prat$^{h}$ama ūṣmaparo dvitīyam* teaches that a stop changes into its voiceless aspirated counterpart when followed by a sibilant. Other schools have similar rules, some with slightly different contexts, i.e. ŚCĀ 2.1.6 *dvitīyāḥśaṣasaṣu* (1 *saṃhitāyām*, 2 *padāntānām anuttamānām*, Deshpande 1997:268f.), ṚPr. 6.54 *ūṣmodayam prat$^{h}$amaṃ sparśam eke dvitīyam āhur apadāntab$^{h}$ājam*, VPr. 4.120 *asast$^{h}$āne mudi dvitīyaṃ śaunakasya*, and Vārttika 3 *cayo dvitīyāḥśari pauṣkarasādeḥ* on Aṣṭ. 8.4.48. The Yājñavalkya-Śikṣā and the Nārada-Śikṣā also teach that voiceless stops are aspirated when a fricative follows (Varma 1929:73). These passages show that sibilant /s/ actually had redundant [spread glottis] by that period.

[6] Cf. the generalization of forms with /c/ in secondary palatalization, e.g. *sácate* pres.3sg.mid. (§4).

[7] Kiparsky's principle of Structure Preservation (Kiparsky 1985:93), explains why the change swept through all applicable contexts without reference to morphological contexts: only postlexical rules make reference to redundant features.

### §76 Difference between Indo-Aryan and English /sT/ clusters

Regarding the spreading of the laryngeal features of *s to a following stop, English has a well-known contrast of aspiration between /$T^h$V/ and /sTV/, as in *top* [$t^h$ɑp] and *stop* [stɑp] (Lisker 1963, Kenstowicz 1994:58f., etc.). Special behavior of an /sT/ onset is known from elsewhere in Germanic as well: for example, Polomé (1972:241) and Iverson & Salmons (1995:386ff.) point out that a stop in an *sT cluster in Germanic is exempt from the application of Grimm's Law.

If the *s in PIIr. *sP$_{[0voiced]}$- causes aspiration of the following /P/ (plosive) in Sanskrit, or if the /S/ in an Old Indo-Aryan onset cluster /SP/ causes aspiration of /P/ in Middle Indo-Aryan, the question naturally arises as to why the same aspiration does not take place in initial /sT-/ clusters in English. The English and Sanskrit phonemic systems exhibit the following differences with respect to the laryngeal features of /s/ and plosives:

| | Sanskrit | English |
|---|---|---|
| [voiced] of /P/ | phonemic | phonemic |
| [voiced] of /s/ | incompatible | phonemic |
| [spread glottis] of /P/ | phonemic | allophonic |
| [spread glottis] of /s/ | allophonic → redundant | redundant? |
| /P$_{[0vcd]}$/ : /P$^h_{[0vcd]}$/ | phonemic | allophonic |
| /sT/ : /sT$^h$/ | yes, but the latter is unoriginal | only /sT/ |
| /T$_{[0vcd]}$r/ : /T$^h_{[0vcd]}$r/ | yes, but the latter is rare (e.g. *mat$^h$rá-* 'shaker') | only /T$^h_{[0vcd]}$r/ |

These differences do not offer a direct clue to our problem. For example, the status of the feature [spread glottis] of /s/ could be considered the parameter causing the difference between Indo-Aryan and English; i.e. in a language where /s/ has [spread glottis], /sT/ in the Underlying Representation is expected to become /sT$^h$/ on the surface, whereas /sT/ remains unaspirated in a language whose /s/ has no [spread glottis]. In the following table, I assume that Old Indo-Aryan /s/ always has [spread glottis] (§75):

| | OIA | English | Burmese |
|---|---|---|---|
| [sg] of /s/ | always [sg] | always [∅sg]? | phonemic |

This assumption, if it is valid, may explain why /s/ in the English sequence /sT$_{[0voiced]}$/ does not spread aspiration to the following voiceless stop, but the fact that English lacks /sT$^h$/, even though a voiceless stop in a foot-initial onset is always aspirated, remains unexplained.

Bartholomae's Law states that aspiration of the first plosive of a Sanskrit obstruent cluster appears at the right edge of the cluster. In English, aspiration of /p, t, k/ occurs at the beginning of a foot-initial syllable (Iverson and Salmons 1995:375). The principle that underlies the difference seems to be that (the right edge of) the feature [spread glottis] is aligned with the left edge of a syllable rime in Sanskrit, while in English it is aligned with the left edge of a syllable and not of a rime. This supposition explains

not only the difference between Indo-Aryan /SP/ > /SP$^{h}$/ and English /sT/, but also the behavior of the sequence /P$_{[0voiced]}$r/, which is always aspirated in English but rarely so in Sanskrit.

Following C. Kim (1970:114),[8] Iverson and Salmons (1995:371, 373) consider that aspiration is present in English /sT-/ onsets, but it ends before the release of the stop.[9] Contrary to that, the intervention of a plosive between /S/ and the rime in an Old Indo-Aryan onset cluster /SP-/ prevents the aspiration from being implemented on /S/, and the feature [spread glottis] links to the following plosive only occasionally (§70).

## §77 Assimilation of laryngeal features

Many Indo-European languages preserve the inherited contrast of the laryngeal features [voiced] and [spread glottis] (or possibly [constricted glottis] according to the Glottalic Theory), or at least bear traces of this contrast:

| language | [voiced] | [spread glottis] | reference |
|---|---|---|---|
| Anatolian | V_V | lost | Melchert (1994:20) |
| Tocharian | lost | lost | Ringe (1996:152ff.) |
| Celtic | preserved | lost | Lewis & Pedersen (1937:27ff.) |
| Italic | preserved | modified | Sommer & Pfister (1977:134f.) |
| Greek | preserved | preserved | Rix (1992:82ff.) |
| Armenian | modified | modified | R. Schmitt (1981:56ff.) |
| Germanic | modified | modified | Jasanoff (1994:255) |
| Balto-Slavic | preserved | lost | Shevelov (1965:26ff., 32ff.) |
| Iranian | preserved | scarce | Hoffmann & Forssman (1996:93ff.) |
| Indo-Aryan | preserved | preserved | |

Although the laryngeal features are subject to different language-specific alterations when the stop to which they link ends a syllable, there are two common tendencies which are found in several different branches of Indo-European. One of the two tendencies is to assimilate the voicing of a coda obstruent to that of the onset obstruent of the following syllable,[10] and similarly for aspiration as well, at least in Greek:

[8] "... the glottal movement for /p/ of /sp/ will start during /s/, i.e., the glottis will begin to widen. This means that, if the glottis is instructed to open to the same degree and for the same period for /p/ of /sp/ as it would for initial /p/, the glottis will begin to close by the time the closure for /p/ is made, and consequently, by the time /p/ is released, the glottis will already have become so narrow that the voicing for the following vowel will immediately start, and thus we have an unaspirated /p/ after /s/."

[9] "Though the glottis progressively narrows until achieving voicing in the following vowel, as it does in the release portion of singleton stops, in /sp/ the period of 'aspiration' is consumed in the oral closure phase of the stop member of the cluster" (371). "In *spit* the single [spread glottis] gesture in the syllable onset is shared between the /s/ and the /p/, as it is between the /s/ and the /l/ in *slip*; in the former case 'aspiration' is absorbed by the voiceless stop's oral closure, in the latter case it is manifested as voicelessness in an otherwise spontaneously voiced sonorant" (373).

[10] Gusmani (1971) §20: "adeguamento del modo di articolazione"; Mayrhofer (1986:110): "[+okklusiv,−aspiriert] → [$\alpha$stimmhaft] / _[+okklusiv, $\alpha$stimmhaft]."

| | voiced | voiceless | aspirated |
|---|---|---|---|
| Gk. | *é-blab̲-en* ‘disable’ pass. aor.3pl. (Ep.) | *bláp-t ō* pres.1sg. | *e-bláp$^{h}$-t$^{h}$ ēn* pass.aor. 1sg.[i)] |
| Gk. | — | *gégrap-tai* pf.3sg.mid. | *gráp$^{h}$- ō* pres.1sg.act. |
| Lat. | *ag-ere* ‘do’ inf. | *ā̲c-tus* vb.adj. | — |
| Skt. | *ad̲- ānā-* ‘eating’ pres.ppl. | *át-ti* pres.3sg. | *ad$^{(h)}$-d$^{h}$í* iptv. |
| Hitt. | *eku-/aku-* (/g$^{w}$/) ‘drink’ | *akkuške-* (/k/) (Melchert 1994:17) | |

[i)] Gk. *lélonk$^{h}$t$^{h}$a* ‘thou hast obtained’ < *-g$^{h}$-t- is a counterexample to this pattern (Cowgill 1965:172).

Voicing pattern (K and G here stand respectively for voiceless and voiced obstruents):

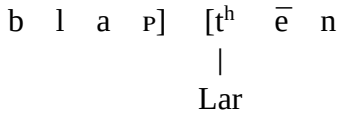
| | -K-G- | -G-K- | -K-G$^{h}$- | -G$^{h}$-K- | -G-G$^{h}$- | -G$^{h}$-G- |
|---|---|---|---|---|---|---|
| Gk. | — | -K-K- | -K$^{h?}$-K$^{h}$- | -K-K- | -K$^{h}$-K$^{h}$- | — |
| Av. | — | -K-K- | -G-G- | -G-G- | -G-G- | — |
| Skt. | — | -K-K- | -G$^{(h)}$-G$^{h}$- | -G$^{(h)}$-G$^{h}$- | -G$^{(h)}$-G$^{h}$- | — |

How the laryngeal features are assimilated is not clear in Tocharian, Celtic, Armenian and Germanic.

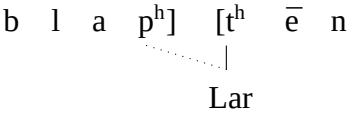
Since these features spread together, the Laryngeal node (Clements 1985:233ff.), to which they belong, is considered to be the unit of this spreading phenomenon.[11] Instead of explaining assimilation by stipulating a delinking of a Laryngeal node from the syllable-final stop and its subsequent relinking to the Laryngeal node of the following stop (Mester and Itô 1989:281), Lombardi (1995:56) shows that a positive constraint and a universal repair mechanism of delinking can account for syllable-final neutralization; then the final stop is parasitically licensed to link to the laryngeal node of the following segment, resulting in laryngeal assimilation:

> Laryngeal Constraint (Lombardi 1995:42):
> “A Laryngeal node is only licensed in a consonant if it immediately precedes a [+son(orant)] segment in the same syllable.”

a. A syllable-final stop has no Laryngeal node




b. Then an association is created with an adjacent licensed Laryngeal node which, by the Laryngeal Constraint, must be the onset consonant of the following syllable (“Parasitic Licensing,” Lombardi 1995:52).




[11] The intricacy related to Bartholomae’s Law will be discussed later in §82.

## §78 Voicing neutralization in absolute final position

The other of the two common tendencies found in different branches of Indo-European is voicing neutralization in absolute final position.

What would be expected from the privativeness of the laryngeal features (§69) is that the stops in neutralized position will be voiceless and unaspirated due to absence of the features [voiced] and [spread glottis]. The voicing status of consonants in absolute word final cannot be reconstructed, however. In Anatolian, all word-final stops are voiced (Melchert 1994:85). In Early Latin, a word-final dental stop uniformly becomes *-d* (Sommer and Pfister 1977:202). Greek does not offer any evidence, for stops cannot occur at the end of a word unless an /s/ follows (§32). Nor does Celtic, except that Celtiberian has forms in *-e-z* which possibly reflect the 3sg. ending *-t/d (Villar 1995: 17–19).

According to Pāṇini, a Sanskrit stop in absolute final position can be either voiced or voiceless:

> Aṣṭ. 8.2.39 *jʰal āṃjaśo 'nte* [1.16 *padasya*] "Substitute voiced unaspirated stops replace non-nasal consonants at the end [of a pada]" (Katre 1987)

> Aṣṭ. 8.4.56 *v āvas āne* [53 *jʰal ām*, 54 *car*] "[Substitute unvoiced unaspirated stops and sibilants 54] optionally [replace non-nasal stops and spirants 53] occurring in pausa [in continuous utterance 2.108]" (Katre 1987)

Since both rules are in the domain of the metarule Aṣṭ. 8.2.1 *p ūrvatr āsiddʰam*, the latter rule is invisible to the former, i.e. "the element that results from this [latter] operation is regularly not subject to an operation stated in an earlier rule" (Cardona 1997:67).[12] These rules state only that a word-final stop always loses the feature [spread glottis], while the loss of [voiced] is optional. However, the sandhi rules for the alternation between final /r/ and /ḥ/, i.e.

$$/r/ \rightarrow ḥ \;/\; \_\,]_{wd}$$
$$/ḥ/ \rightarrow r \;/\; V_{[+hi]}\_\,]_{wd}\; X_{[voiced]}$$

show that [voiced] is neutralized in final position (§104). If the optional voicing of a word-final stop can be viewed as an adjustment on a postlexical level, the following generalization is possible with regard to laryngeal features across a word boundary: In the word sandhi rules of Sanskrit, the laryngeal features of a word-final segment are despecified, and are then filled in either by a redundancy rule or by spreading from the following word-initial segment, for which laryngeal features are lexically specified (Allen 1962:97f., Kessler 1994). In other words, laryngeal features are non-distinctive in rules operating across a word boundary.

[12] Although the latter is in the domain of Aṣṭ. 8.2.108 ... *saṃhit āy ām* 'in close junction' (Cardona 1997:19), the word *avas āne*, which is also used in Aṣṭ. 8.3.15 *kʰar-avas ānayor visarjan īyaḥ* to provide visarga *ḥ* for final /r/ and /s/, ensures that final voicing takes place in absolute final position. Aṣṭ. 8.2.39 and Aṣṭ. 8.4.56 may sound similar, but the expression "end of a pada" in the first rule refers not only to fully inflected words but also to their substrings (Cardona 1997:42f.).

### §79 Diaspirate representation of Sanskrit roots

A Sanskrit root cannot have more than one voiced aspirate in its surface forms; for example, the root part of the forms *bud$^{(h)}$-d$^{h}$á-*[13] vb.adj. 'awaken,' *á-b$^{h}$ut-si* aor. and *búd$^{h}$-ya-te* pres. invariably has one token of the feature [spread glottis].

Diaspirate forms ($T^{h}_{[voiced]}...T^{h}_{[voiced]}$) have been posited as the Underlying Representation of those Sanskrit roots with two voiced stops of which one is always aspirated,[14] as most of these roots are reconstructed with double aspirates in Proto-Indo-European. This reconstruction is based on the following facts: a) there are Indo-European roots of the shape $*T_{[voiced]}...T^{h}_{[voiced]}$ where the first voiced stop does not alternate with a voiced aspirate:

| | |
|---|---|
| PIE *√gleub$^{h}$ 'carve' | Gk. *glúp$^{h}$ o͞*pres. :: Gk. *glúpsai*, Lat. *gl ū̆ps ī̆* |
| PIE *√delǵ$^{h}$ 'make firm' | Skt. *dṛ́ṃhati* :: Lat. *in-dulg ēre?* |

and b) there are minimal pairs which contrast in the aspiration of the initial voiced stop:

> PIE *√geld$^{h}$ 'be greedy,' Skt. *á-gṛd$^{h}$-at* a-aor.3sg. : PIE *√g$^{h}$eld$^{h}$ 'compensate,' Goth. *-gildan* 'revenge';
> PIE *√gerd$^{h}$ 'cry,' Arm. *kardam* : PIE *√g$^{h}$erd$^{h}$ 'surround,' Skt. *gṛhá-* m. 'house,' ON *-gyrða*;
> PIE *√dreg$^{h}$ 'hold,' YAv. *dražaite* pres.3sg.mid., Gk. *drássomai* : PIE *√d$^{h}$reg$^{h}$ 'trail,' Gk. *trék$^{h}$ o͞*, Hom. *ét$^{h}$reksa* aor.1sg.act.
> (Examples from *LIV*)

In spite of this original situation, a representation with a single [spread glottis] explains the Sanskrit facts better than the diaspirate representation with deletion of one of the two [spread glottis] by Grassmann's Law, as Sag (1974, 1976) has argued. Hoenigswald (1965c:59f.) and Sag (1974:600) show that the monoaspirate representation of etymologically diaspirate roots is descriptively justified,[15] pointing out that Sanskrit has no homonyms originating from Proto-Indo-European types $*T_{[voiced]}...T^{h}_{[voiced]}$ and $*T^{h}_{[voiced]}...T^{h}_{[voiced]}$, and that the roots of the first type, *√darb$^{h}$/dṛb$^{h}$* 'bunch,' *√garh* 'complain' and *√ja(m)b$^{h}$* 'smash' never fall within the context of 'Aspiration Throwback.' The explanation by 'Aspiration Throwback'[16] can be restated as an autosegmental

[13] Here I assume that the aspiration of the root-final /d/ is suppressed in the surface form. See §80.

[14] For the argument for this position, see Kiparsky (1973b:130ff.): "The principle that among alternative underlying forms, other things being equal, the closest to the phonetic form is preferred, would indeed choose /badh/ rather than /bhadh/ as the underlying form of isolated [badh] at the time before the aspirates had been devoiced, when both underlying representations would have given the right output."

[15] Hoenigswald (1965c:60): "it is ... descriptively true that ALL those Sanskrit roots which begin with a plain voiced stop and end with a voiced aspirate allow or require aspiration of the initial in those cases in which the root final is mandatorily deaspirated".

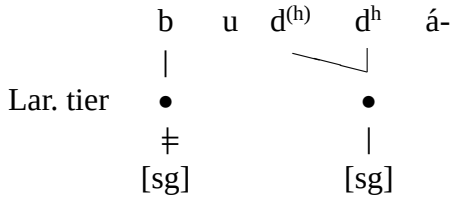
[16] Wackernagel (1896:127): "Weil nun so die Wurzeln mit ursprünglich zwei Aspiraten in der Regel die erste, in besondern Fällen die zweite Aspiration einbüssten, während sich die ursprüngliche doppelte Aspiration nirgends hielt, erschienen die Formen mit verlorner zweiter Aspiration als eine Modifikation der Formen mit verlorner erster Aspiration also z.B. *d$^{h}$ruk-* als eine Modifikation von *druh-*. Es schien, als ob Wurzeln, die am Ende ihre Aspiration verlieren, sie auf den Anlaut zurückwerfen."

relinking of the single token of [spread glottis], which has somehow been delinked from the root and is floating.

### §80 Locality of Grassmann's Law

Schindler (1976) investigates the interaction of rules related to laryngeal features such as Bartholomae's Law, Grassmann's Law, Voicing Assimilation and Final Laryngeal Neutralization, and illustrates the derivational order among them. At one point, Schindler redefines Grassmann's Law so that it covers both coda deaspiration and deaspiration across a syllable nucleus, of which only the latter is referred to by the traditional formulation of this rule. Grassmann's Law thus redefined operates iteratively until there is no remaining applicable context. For example, the input /b$^{h}$ud$^{h}$d$^{h}$á-/ becomes /b$^{h}$udd$^{h}$á-/ by the first application, and another application creates the output *budd$^{h}$á-*. This reformulation of Grassmann's Law as an iterative process of deaspirating an adjacent plosive, or a plosive adjacent but one rime, incurs an undesirable complication, for it often has to be applied twice within a single suffixation cycle. In addition, the formulation is not strict enough about locality, and this flexibility may lead to overgeneration. For example, Schindler's formulation does not preclude the possibility of a similar dissimilation for [voiced], as in /dá-dā-ti/ > ×tádāti or /budbudáyāśu-/ > ×putbudáyāśu- or ×putpudáyāśu-.

Since Parasitic Licensing (§77) together with the Principle of Cohesive Closure (§28) can take care of the deaspiration of the first segment of the cluster /T$^{h}$T$^{h}$/, Schindler's extension of Grassmann's Law to coda deaspiration is unnecessary. As we saw in §77, the Laryngeal Constraint allows only a plosive followed by a sonorant to have a Laryngeal node, so /b/ and /d$^{h}$/ in *budd$^{h}$á-* can be viewed as adjacent on the Laryngeal tier:




Assuming a diaspirate representation of the root,[17] the first /d$^{h}$/ in the intermediate form /b$^{h}$ud$^{h}$.d$^{h}$á-/ is the coda of the first syllable, so its laryngeal features are only possible by the Parasitic Licensing of the laryngeal node of the second /d$^{h}$/.[18] The /b$^{h}$/, which underlies the initial *b* of the surface form *budd$^{h}$á-*, is adjacent to the second /d$^{h}$/ on the laryngeal tier. The two successive occurrences of [spread glottis] in /b$^{h}$/ and in the second /d$^{h}$/ violate the Obligatory Contour Principle, which prohibits adjacent identical features; a language-specific rule then deletes the first [spread glottis], resulting in the output form *budd$^{h}$á-*. In *b$^{h}$ut-* or *b$^{h}$otsya-*,[19] on the other hand, the *t* has no laryngeal

[17] This part of Grassmann's Law is unnecessary if the root is represented with a single aspiration.

[18] See Borowsky and Mester (1983:58) for a similar view to take the root-final *d* as actually aspirated.

[19] For the laryngeal node of the *t* in the latter form, see §85.

node, hence the Obligatory Contour Principle is not violated. In this way, GRASSMANN's LAW can be stated as a strictly local rule.

### §81 Antiquity of GRASSMANN's LAW: *kúmb$^h$a-*

Following the line of Grassmann (1863), Schindler (1976) considers GRASSMANN's LAW to be an Indo-Aryan innovation, because it applies to voiceless aspirates which are usually not older than Proto-Indo-Iranian and, more importantly, because the Younger Avestan form *xumba-* suggests that GRASSMANN's LAW was not active in Proto-Indo-Iranian.[20] After Kiparsky (1973b:126ff.) pointed out that the alternation between voiceless unaspirated and aspirated stops in the Greek equivalent of GRASSMANN's LAW need not necessarily mean that the law is of (post-)Proto-Indo-European origin, this single form has been considered to crucially separate GRASSMANN's LAW in Indo-Aryan from core Proto-Indo-European.

As I mentioned above in §74, Skt. *kúmb$^h$a-* instead of ×k$^h$úmb$^h$a-, which is expected from YAv. *xumba-*, might be the regular outcome of an initial voiceless stop followed by *h$_2$, just as *ph$_2$- in dat.sg. *ph$_2$tŕ̥i̯ becomes *pitré* in Sanskrit. Old Avestan has *fᵊδr̥ōi* (beside nom.sg. *pt̄a*), where the laryngeal loss might have taken place before the aspiration of *p.[21] This is nothing more than a conjecture, however, unless PIIr. *k$^h$umb$^h$a- is reconstructed for Proto-Indo-European.

### §82 BARTHOLOMAE's LAW and root-suffix asymmetry

In the following sections, we will discuss how Indo-Aryan phonology treats laryngeal features, first focusing on the direction of laryngeal assimilation in BARTHOLOMAE's LAW, then on non-local spreading of laryngeal features, which are best treated in autosegmen-

[20] Polomé (1972:242): "... or Skt. *kumb$^h$áḥ*, "jar, pitcher": Av. *xumbā*, Pers. *xum(b)*, "jar," where we apparently deal with an Indo-Iranian prototype **k$^h$umb$^h$-*, with initial *k-* due to dissimilation of aspiration in Indic and early loss of the aspiration of /b$^h$/ after nasal in Iranian?"

[21] Insler (1971:573): "I suspect, however, that in the original Iranian paradigm of this word *ə was lost when the resultant inflected form contained two or more syllables, but was maintained if the form were to become monosyllabic after its loss. Thus the proper Av. paradigm should be nom. *pitā*, acc. *ptarəm*, dat. *piθreę/ē*, nom.pl. *ptarō*(...) dat.pl. *ptərᵊbyō*(...) etc." Gernot Schmidt (1973:83): "Gerade in diesen besonderen Fällen wird im Gegenteil nicht aspiriert: iran. **duxθr-*; **fθr-* < **pθr-* (nicht < **phθr-*). Aspiriert wird vielmehr in den normalen Fällen, wo iran. ∅ einem aind. *i* entspricht: awest. *dugᵊdar-* = aind. *duhitár-*; aber nicht da, wo auch das Iran. regulaer ə > *i* bewahrt, nämlich in ersten Silben: awest. *pitar-* wie aind. *pitár-* ohne Aspiration. Das u.a. zwingt uns aber dazu, Kuipers Unterscheidung zweier verschiedener Vertretungen von interkonsonantischem idg. *H* im Indoiran. in modifizierter Form beizubehalten: Idg. *H* in potentiellen ersten und wohl z.T. letzten Silben war idg. *$_e$H* geworden, das im Indoiran. überall *i* ergibt, idg. *H* in potentiellen Mittelsilben (und wohl z.T. auch Endsilben) aber *H$_e$*, das im indoiran. aspiriert, im Iran. danach schwindet, im Indischen jedoch ebenfalls zu *i* wird." Cf. also Beekes (1981b:285f.), and Mayrhofer (1981:436): "so sieht es aus, als würde Gernot Schmidts Gesetz, wonach in (-)CHC(-) der Laryngal im Indoiranischen vokalisiert wurde, in (-)CHCC(-) aber schwand, in der Modifizierung durch Martin Peters aufgehen, wonach letzterer Prozeß nur in CHCC- (>CCC-) eintrat."

tal representation (§3) as pointed out by Borowsky and Mester (1983:52).[22]

Bartholomae's Law is a sound rule which spreads the features [voiced] and [spread glottis] from left to right in obstruent clusters. The actual examples of this rule are limited to sequences of a voiced aspirate and /t/ or /t$^{h}$/, as Pāṇini formulates it in Aṣṭ 8.2.40 *j$^{h}$aṣas tat$^{h}$or d$^{h}$o 'd$^{h}$aḥ*. The correspondence of Old and Younger Avestan *vərᵊzda-* with Vedic *vṛdd$^{h}$á-* 'grown' shows that it may be traced back at least to Proto-Indo-Iranian (Hoffmann and Forssman 1996:95f.), although the voiceless stop /t/ of the verbal adjective suffix *-ta-* is often restored in Avestan. See Cowgill (1965:172) for possible cases of Bartholomae's Law in Greek, and Prokosch (1939:84) and Krahe (1948:101) for Germanic.

Whereas the plosive system of Indo-Aryan makes a four-way distinction of laryngeal features, the voiceless aspirates were originally irrelevant to this Indo-Iranian rule, for they generally come from combinations of voiceless unaspirated stops and PIE *h$_2$ (Kuryłowicz 1935:46ff.), which become voiceless aspirates accompanied by /i/ in Indo-Aryan when followed by another non-nucleus segment, e.g. √mat$^{h}$ 'rip' (< PIE *√meth$_2$) + -tá- > *mat$^{h}$itá-*, and not ×matt$^{h}$á-.

On the other hand, two innovations are introduced in Indo-Aryan: the aspiration of the first obstruent (plosive) is blocked from surfacing due to the Indo-Aryan principle of Cohesive Closure (§28), which prohibits the occlusive constriction of a plosive cluster from being split; and /s/ after a voiced aspirate is excluded from the structural description of the rule (Schindler 1976:630). So for example,

| | |
|---|---|
| √śod$^{h}$/śud$^{h}$ 'purify' (+ s) + -tá- | > *śudd$^{h}$á-* vb.ppl. |
| √lab$^{h}$ 'grab' + -tv$\acute{\bar{a}}$ | > *labd$^{h}$v$\acute{\bar{a}}$* grdv. |
| á- + √rab$^{h}$ 'grab' + -s- + -ta | > *a-rab$^{h}$-ta > árabd$^{h}$a* aor.3sg.mid. |
| á- + √bod$^{h}$/bud$^{h}$ 'wake' + -s- + -t$^{h}$ās | > *a-bud$^{h}$-t$^{h}$ās > ábudd$^{h}$ āḥ* aor.2sg.mid. |

Already Kuryłowicz pointed out that this phenomenon does not conform to the tendency shared by several Indo-European subfamilies for voicing of a coda obstruent, and in Greek aspiration as well, to be assimilated to that of the onset obstruent of the following syllable (§77).

Lombardi (1991:140) explains the spreading of both [voiced] and [spread glottis] instead of just [spread glottis] (which would result in ×śutt$^{h}$á- instead of *śudd$^{h}$á-*) by spreading of the entire Laryngeal node, to which these two features belong. The puzzling fact about this rule, however, that the spreading takes place in the direction opposite to that of the other assimilation of laryngeal features (see §77), still remains unexplained. This irregular assimilation can only be understood by taking morphology into account, as we will discuss below.

[22] Despite the criticism of Janda and Joseph (2002), I still think that an autosegmental approach itself is valid.

### §83 Limit of purely phonological principles

Both the features [voiced] and [spread glottis] belong to the Laryngeal node in feature geometry. Since they spread together in Bartholomae's Law, the Laryngeal node can be taken as the unit of this phenomenon.

If examples of right-to-left spreading like /ad + -ti/ > *átti* (see §77) represent the unmarked assimilation pattern of the laryngeal features in Proto-Indo-European just as in Indo-Aryan, it follows that Proto-Indo-European has the Laryngeal Constraint (§77) which, in Lombardi's definition (Lombardi 1995:42), states that "[a] Laryngeal node is only licensed in a consonant if it immediately precedes a sonorant segment in the same syllable." Lombardi (1995) demonstrates that generic phonological constraints on laryngeal features only produce right-to-left voicing assimilation regardless of the order in which they may be ranked. Thus a cluster-initial obstruent is first neutralized with respect to laryngeal features, and then it is parasitically licensed to link to the Laryngeal node of the following onset segment, resulting in assimilation of voicing and aspiration. Since the spreading of laryngeal features in Bartholomae's Law takes place from a coda to an onset stop, namely in a direction opposite to that of the examples in §77, it does not agree with what follows from the Laryngeal Constraint.

When the default spreading from right to left is overridden by a morphological requirement to maximize the feature [spread glottis] of the root in the output, the Laryngeal node of the coda (i.e. root-final) consonant, which fails to surface due to the Laryngeal Constraint, relinks to the next linkable segment available, i.e. the suffix-initial stop to its right. To illustrate this point, let us first restrict ourselves to phonological constraints only, and evaluate candidate forms involving Bartholomae's Law in the framework of Optimality Theory:

Identio(lar)**:** The laryngeal configuration of an input has an identical correspondent in the output. When one feature is changed, it is regarded as one violation. Since voiceless aspirates were not yet phonemicized in this period, input /b$^{h}$/ to output /p/, for example, is counted as one violation.

License(lar)**:** A coda consonant does not have a Laryngeal node unless parasitically licensed. Obversion of the Laryngeal Constraint.

Since a coda consonant cannot have its own laryngeal node in Sanskrit, License(lar) is ranked higher than Identio(lar). The following are the ranking of the constraints and an evaluation tableau, where the last candidate ×lap-tá- is wrongly evaluated as optimal:

License(lar) ≫ Identio$_{\text{Lar}}$

| | /lab$^{h}$ + tá-/ | License(lar) | Identio(lar) |
|---|---|---|---|
| | ×lab$^{h}$-tá- | ∗! | |
| | ×lab$^{h}$-dá- | ∗! | ∗ |
| | ×lab-dá- | | ∗∗! |
| | lab-d$^{h}$á- | | ∗∗! |
| ☞ | ×lap-tá- | | ∗ |

With respect to the constraint IdentIO(lar), the candidate with /-dá-/ adds the feature [voiced] and the one with /-d$^{h}$á-/ adds [spread glottis],[23] so they are both counted as having one violation. We could add a candidate ×lap-t$^{h}$á-, although voiceless aspirates did not exist when Bartholomae's Law was first introduced. It contains two violations of IdentIO(lar), just as ×lab-dá- does.

This result shows that phonological principles are not sufficient to derive /labd$^{h}$á-/ in favor of /labdá-/. It is still possible to obtain the effect of Bartholomae's Law by stipulating a phonological rule which applies to the particular sequence of a voiced aspirate and a voiceless stop, but it is simpler and less arbitrary to attribute Bartholomae's Law to the general principle of root-suffix asymmetry, which requires the feature [spread glottis] of the root to be maximized in the output. In other words, the transfer of the root-final aspiration involves a morphological preference which favors the features of the root segments to appear in the output at the cost of the input-output faithfulness of affixes.[24]

## §84 Conspiratorial nature of Bartholomae's Law

In Optimality Theory, derivation is made by a once-and-for-all evaluation by universal constraints with different degrees of violability. It provides a more elegant explanation than an ordered-rule approach, particularly when one and the same underlying principle triggers apparently irrelevant or conflicting phenomena to effectively create a certain result, like maximization of root features in our case. For that reason, let us make use of Optimality Theory here as well, so that we can better capture the conspiratorial nature of the processes involved. The two constraints introduced in §83 — IdentIO(lar), which requires the laryngeal configuration of an input to have an identical correspondent in the output; and License(lar), which states that a segment in coda position does not have a Laryngeal node — are purely phonological.

Within the framework of Beckman's Positional Faithfulness (Beckman 1998), the asymmetry between root and suffix morphemes is represented by the constraint

MaxRoot([spread glottis])**:** Maximize the distinctive features, in this case the feature [spread glottis], of the root morpheme, in the output.

This constraint overlaps with IdentIO(lar), which disfavors changes in the laryngeal features of any morpheme. In order to introduce this constraint, the definition of IdentIO(lar) must be modified so that it covers only affixes.

IdentAffix(lar)**:** The laryngeal configuration of the input of an affix has an identical correspondent in the output.

[23] I assume here that [voiced] accompanies [spread glottis] in early pre-Vedic, when voiceless aspirates did not yet have firm phonemic status.

[24] Cf. Sag's formulation with specification of the feature "+ROOT" (Sag 1974:592).

Since the feature [spread glottis] of the root surfaces even though it is moved to the adjacent suffix-initial onset stop in forms like /lab$^{h}$-tá-/ > *labd$^{h}$á-*, IdentAffix(lar) is dominated by MaxRoot[spread glottis]. License(lar) is undominated according to our assumption that Indo-Aryan has the Laryngeal Constraint (§83).

License(lar) ≫ MaxRoot[spread glottis] ≫ IdentAffix(lar)

This ranking should generate the maximization of the feature [spread glottis] of a root morpheme, as the following tableau illustrates:

| | /lab$^{h}$ + tá-/ | License(lar) | MaxRoot[sg] | IdentAffix(lar) |
|---|---|---|---|---|
| | ×lab$^{h}$-tá- | ∗! | | |
| | ×labdá- | | ∗! | |
| ☞ | lab-d$^{h}$á- | | | ∗ |
| | ×laptá- | | ∗! | |

The first candidate in the tableau has aspiration in coda position, which fatally violates License(lar). The second and the last candidates fatally violate MaxRoot[spread glottis], for they do not have [spread glottis] in the output. Bartholomae's Law may have remained active until Old Indo-Aryan, however, so what about a candidate with a voiceless aspirate such as ×lap-t$^{h}$á-? It is actually as harmonious as *lab-d$^{h}$á-*, as the following tableau makes clear.

| | /lab$^{h}$ + tá-/ | License(lar) | MaxRoot[sg] | IdentAffix(lar) |
|---|---|---|---|---|
| ☞ | ×lap-t$^{h}$á- | | | ∗ |

This result means that our constraints may work in a stop system with a three-way laryngeal contrast like Pre-Vedic Indo-Aryan, but they are not sufficient for actual candidate evaluation in Old Indo-Aryan, which has a four-way laryngeal contrast.[25]

Based on the fact that spreading takes place on the entire Laryngeal node, we could extend MaxRoot[spread glottis] to MaxRoot(lar), which requires both [voiced] and [spread glottis] of the root to be maximized in the output. This extension, however, leads to a false prediction of voicing assimilation, for maximizing [voiced] in the input /ad-ti/ 'eats' would result in the wrong output ×addi. It would therefore be preferable to introduce a separate constraint, MaxRoot[voiced]:

MaxRoot[voiced]: Maximize the feature [voiced] of an input root morpheme in the output.

[25] In the analysis of S. Kim (2000), this problem of voiceless aspirates is avoided by treating voiced aspirates as having the feature [murmur], unlike voiceless aspirates which have the feature [spread glottis]. We consider voiced aspirates to have [spread glottis], for the Indo-European second laryngeal *h$_2$ affects both voiceless and voiced stops, e.g. *róth$_2$o- > *rát$^{h}$a-* 'chariot' and *meǵh$_2$ > *máhi* neut.adj. 'big, greatly.' See also Borowsky and Mester (1983:62), who adduce deaspiration in reduplication to support use of the same feature for voiced and voiceless aspirates. Cf. also Janda and Joseph (2002:70f.).

This constraint is dominated by all the other constraints, and usually does not contribute to candidate evaluation, but it plays a key role when other constraints are not relevant or cannot determine the optimal candidate, by McCarthy and Prince's principle of Emergence of the Unmarked.[26] The following is the modified constraint ranking and an evaluation tableau:

LICENSE(lar) ≫ MAXROOT[spread glottis] ≫ IDENTAFFIX(lar) ≫ MAXROOT[voiced]

| /lab$^{h}$ + tá-/ | LICENSE(lar) | MAXRT[sg] | IDENTAFF(lar) | MAXRT[vcd] |
|---|---|---|---|---|
| ×lab$^{h}$-tá- | ∗! | | | |
| ×lab$^{h}$-dá- | ∗! | | ∗ | |
| ×lab-dá- | | ∗! | ∗ | |
| ☞ lab-d$^{h}$á- | | | ∗ | |
| ×lap-t$^{h}$á- | | | ∗ | ∗! |
| ×lap-tá- | | ∗! | | ∗ |

| /ad + ti/ | LICENSE(lar) | MAXRT[sg] | IDENTAFF(lar) | MAXRT[vcd] |
|---|---|---|---|---|
| ☞ at-ti | | — | | ∗ |
| ×ad-ti | ∗! | — | | |
| ×ad-di | | — | ∗! | |

Furthermore, we need to add another constraint LINEARITY (McCarthy and Prince 1995), which prohibits the order of phonemic or sub-phonemic segments from being disrupted, so that forms like ×b$^{h}$ut-ta- should be precluded.[27]

LICENSE(lar) ≫ MAXROOT[spread glottis] ≫ LINEARITY ≫ IDENTAFFIX(lar) ≫ MAXROOT[voiced]

| /bud$^{h}$ + tá-/ | LICENSE(lar) | MAXRT[sg] | LINEARITY | IDENTAFF(lar) | MAXRT[vcd] |
|---|---|---|---|---|---|
| ×b$^{h}$ut-tá- | | | ∗! | ∗ | ∗ |
| ☞ bud-d$^{h}$á- | | | | ∗ | |

The idea of a low-ranked constraint MAXROOT[voiced] could just be an ad hoc measure if it does not play any role elsewhere in Sanskrit phonology. There is another case, however, where maximization of the feature [voiced] of a root morpheme might possibly have caused a morphological innovation: see §88 below.

[26] McCarthy and Prince (1994:334) explain this principle as follows: "Even in languages where **C** is crucially dominated and therefore violated, the effects of **C** can still be observed under conditions where the dominating constraint is not relevant. Thus, in the language as a whole, **C** may be roundly violated, but in a particular domain it is obeyed exactly."

[27] The transfer of aspiration in *budd$^{h}$á-* is not considered to violate LINEARITY, for the aspiration is linked to root-final /d/ by parasitic licensing.

### §85 'Aspiration Throwback': Another case of root feature maximization

With regard to the maximization of root features by the constraint MAXROOT(lar) (§84), the autosegmental spreading of the feature [spread glottis] before a suffix beginning with a voiced aspirate, traditionally called 'Aspiration Throwback,' provides some interesting examples. Here I cite the forms which Schindler (1976:634f.) suggests are due to an analogical reintroduction of initial aspiration and Lombardi (1991:144f.) treats as exceptional:

i) When the nominal endings *-bʰyām*, *-bʰis*, *-bʰyas*, which are called *pada* (≈word) endings (i.e. endings before which external sandhi applies), are added to the root noun *búdʰ-* 'awakening,' aspiration throwback takes place, creating the forms *bʰud-bʰyām*, *bʰud-bʰis* and *bʰud-bʰyas*, which apparently violate GRASSMANN'S LAW.

ii) The verbal endings of the second plural middle, *-dʰve* and *-dʰvam*, do not deaspirate the initial stop. For example, the Āśvalāyana-Śrauta-Sūtra gives *dʰuṅ(g)-dʰvam* 'milk!' instead of ×duṅ(g)-dʰvam, which would be expected from the root √*dogʰ*/*dugʰ* 'give milk.'

We proposed above in §72 that Indo-Aryan introduced an innovation of specifying the feature [spread glottis] for /s/. According to this assumption, we can include those suffixes beginning with /s/ in the context of 'Aspiration Throwback.'

iii) Before the /s/ of the sigmatic aorist and imperatives in *-si*: ṚV 4.52.4 (poet: Vāmadeva), 7.81.3 (Vasiṣṭha) *abʰutsmahi*, 8.9.16 (Śaśakarṇa Kāṇva) *ábʰutsi*; ṚV 1.76.3 (Gotama Rāhūgaṇa) *dʰákṣi*, 4.4.4 (Vāmadeva), 6.18.10 (Bharadvāja) *dʰakṣi*, 6.3.4 (Bharadvāja) *dʰákṣat*, 10.16.7 (Damana Yāmāyana) *vidʰakṣyán*, 10.91.7 (Aruṇa Vaitahavya) *dʰákṣataḥ*. Cf. ṚV 1.141.8, 2.1.10 *dakṣi*.

iv) Later desideratives: √*bādʰ* 'suppress': ṚV 1.164.8 (Dīrghatamas Aucathya), 10.124.8 (Soma), 10.124.9 (Soma) *bībʰatsú-*; √*grabʰ* 'grasp': *jigʰṛkṣati*; √*dah* 'burn': *didʰakṣati*; √*bodʰ*/*budʰ* 'wake': *bubʰutsati*. Cf. √*goh*/*guh* 'conceal' : ṚV 8.31.7 (Manu Vaivasvata) *jugukṣataḥ*; √*doh*/*duh* 'give milk' : ṚV 7.18.4 (Vasiṣṭha), 10.61.10 (Nābhānediṣṭha Mānava), 10.74.4 (Gaurivīti Śāktya) *dúdukṣan*.

Schindler (1976:632) considers those forms in the Ṛgveda without 'Aspiration Throwback' to be 'memorized [i.e. lexically specified] relics,' and Cardona (1991) argues that the distribution of forms with and without 'Aspiration Throwback' is demarcated by the families to which the Ṛgvedic poets belong. Scharfe (1996:361), on the other hand, locates the books of the Ṛgveda geographically by the rivers mentioned in them, and observes that forms with 'Aspiration Throwback' are common in the western books (4, 5, 6, 8 and 9), while forms without it are limited to the eastern books (1, 2, 3, 7 and 10). In the forms cited above in iii) and iv), Vāmadeva's (book 4) and Bharadvāja's

(book 6) use of Throwback forms, and Manu Vaivasvata's use of a non-Throwback form, are in line with Cardona's observation, but forms ascribed to the same author, e.g. ṚV 7.81.3 (Vasiṣṭha) *ab$^{h}$utsmahi* : ṚV 7.18.4 (Vasiṣṭha) *dúdukṣan*, cannot be so explained.

Although in violation of Grassmann's Law, the 'Aspiration Throwback' which occurs in these forms does not affect the operation of Bartholomae's Law. Attributing phenomenon i) to the word boundary before the *pada*-endings (Lombardi 1991:144) could be circular, for the native grammarians might have introduced a word boundary to explain irregular declensional forms, including those cited.

Note that these endings all begin with a segment with [spread glottis]. The feature [spread glottis] is inherent in the initial stop of these affixes, unlike the suffix *-tá-* as in *bud-d$^{h}$á-* < /bud$^{h}$-tá-/ to which Bartholomae's Law spreads aspiration and voicing. Unlike the root-final [spread glottis] of the root √*bod$^{h}$/bud$^{h}$* 'wake' in *bud-d$^{h}$á-* which, transferred to the following suffix-initial /t/, remains in the Surface Representation multiply linked to the root-final stop and the suffix-initial /t/ (see 1 in the diagram below), the [spread glottis] of the root in the Underlying Representation /bud$^{h}$-d$^{h}$vam/ is delinked by the Obligatory Contour Principle (OCP) or by the principle of Cohesive Closure. The delinked feature [spread glottis] becomes a floating autosegment, which then anchors to the only other linkable root segment /b/, resulting in the form *b$^{h}$ud-d$^{h}$vam*. The forms with 'Aspiration Throwback' satisfy input-output faithfulness of the features of the root morpheme just as do Bartholomae's forms discussed above (1 in the following diagram), but the order of the features is disrupted. The process of 'Aspiration Throwback' is described in 2 and 3 below:

| 1. /bud$^{h}$-tá-/ | 2. /a-bud$^{h}$-s-d$^{h}$vam/ | 3. /a-bud$^{h}$-si/ |
|---|---|---|
| vb.adj. | ao. | ao. |
| [bud$^{(h)}$]$_{rt}$-d$^{h}$á- | a-[b$^{h}$ud]$_{rt}$-d$^{h}$vam | a-[b$^{h}$ud]$_{rt}$-si |
| ╲╱ | ˙×.ǂ \| | ˙×.ǂ \| |
| [sg] | [sg] [sg] | [sg] [sg] |
| → *budd$^{h}$á-* | → *áb$^{h}$udd$^{h}$vam* | → *áb$^{h}$utsi* |

One problem with this explanation is that OCP blocking does not take place when the suffix-initial consonant is the voiceless aspirate /t$^{h}$/, but Bartholomae's Law applies instead: cf. *a-bud-d$^{h}$ ā́ḥ*s-aor.2sg.mid. < /a-bud$^{h}$-t$^{h}$ās/ vs. *a-b$^{h}$ud-s-d$^{h}$vam* 2pl. < /a-bud$^{h}$-s-d$^{h}$vam/. It is strange that the OCP is evoked only when the Laryngeal node of the suffix-initial stop has both [spread glottis] and [voiced], while OCP blocking does not occur when the suffix-initial stop has just [spread glottis].

In order to avoid this problem, we need to locate 'Aspiration Throwback' carefully within the chronology of sound changes between Proto-Indo-Iranian and Old Indo-Aryan. In Proto-Indo-Iranian, voiceless aspirates are still clusters of a voiceless stop and a laryngeal, or possibly unit phonemes. A trace of the cluster status of voiceless aspirates remains in the treatment of voiceless aspirates as clusters in the meter of the Ṛgveda (Gippert 1997). 'Aspiration Throwback' must have preceded the phonemiciza-

tion of voiceless aspirates. It must also be ordered after the specification of the feature [spread glottis] for /s/ (§72), for otherwise it would not occur before suffixes beginning with /s/. Yet the Ṛgveda also contains many forms with such suffixes but without 'Aspiration Throwback.' How is this variation to be understood?

### §86 'Aspiration Throwback' and featural domains

As with root morphemes subject to Bartholomae's Law, phonological processes regarding 'Aspiration Throwback' conspire to ensure that the surface form of the root always has one token of [spread glottis]. When the aspiration of the root is blocked from linking to the root-final obstruent by the Obligatory Contour Principle, it autosegmentally links to the next available segment within the root domain, changing the order of the features. Although an autosegmental representation accounts for this conspiratorial relationship, it does not always provide a rigorous formulation that precludes overgeneration. By the same set of constraints as we assumed in §84 to derive the forms of Bartholomae's Law such as *budd$^{h}$á-*, the form *b$\bar{\imath}$-b$^{h}$at-sú-* (§85, iv) is correctly evaluated as optimal. Every time a segment or a feature is transposed across another segment, it is counted as one violation of Linearity. The constraint MaxRoot[spread glottis] is considered to be satisfied if aspiration of the root is present anywhere in the surface form; it can trigger transposition of aspiration, but it does not limit the transposition within the root morpheme.

| /b$\bar{\imath}$-[bad$^{h}$]$_{rt}$-sú-/ | License(lar) | MaxRt[sg] | Linearity | IdentAff(lar) |
|---|---|---|---|---|
| b$\bar{\imath}$-bad$^{h}$-sú- | ∗! | | | |
| b$\bar{\imath}$-bat-sú- | | ∗! | | |
| ☞ b$\bar{\imath}$-b$^{h}$at-sú- | | | ∗ | |
| b$^{h}\bar{\imath}$-bat-sú- | | | ∗∗! | |

While the same set of constraints as with Bartholomae's Law can thus derive forms of 'Aspiration Throwback,' an alternative explanation is also possible by taking the root morpheme as a featural domain (Cassimjee and Kisseberth 1999) within which phonological processes conspire to maintain one token of [spread glottis] in the surface form.[28] If we suppose that a new constraint Incorporate[spread glottis], which requires [spread glottis] to be inside its domain, emerged in some dialects of the pre-Vedic period after /s/ was specified for [spread glottis] and before voiceless aspirates were phonemicized, then forms with 'Aspiration Throwback' are evaluated as optimal by the following ranking.

License(lar) ≫ MaxRoot[spread glottis] ≫ Incorporate[spread glottis] ≫
IdentAffix(lar) ≫ MaxRoot[voiced]

[28] Such a featural domain is unnecessary if a diaspirate representation is assumed for the relevant Sanskrit roots. See §79.

| /bī-[badʰ]$_{rt}$-sú-/ | License(lar) | MaxRt[sg] | Incorporate[sg] | IdentAff(lar) |
|---|---|---|---|---|
| bī-badʰ-sú- | ∗! | | | |
| bī-bat-sú- | | ∗! | ∗ | |
| ☞ bī-bʰat-sú- | | | | |
| bʰī-bat-sú- | | | ∗! | |

Obvious counterexamples to this explanation by a featural domain such as *ja-hí* iptv. of √*han* 'smite,' and *vidátʰa-* 'assembly' provided that it comes from *vi-* + √*dʰā* 'distribute' (Wackernagel 1896:128), are relics, and Grassmann's Law no longer applies across morpheme boundaries in its productive version. In an early period, Grassmann's Law may have operated under purely phonological conditions, such as in a window of two initial syllables; when the rule was later grammaticalized and became sensitive to the morphological context, the triggering context of the rule probably narrowed down to the cycle of primary affixation.

An advantage of this analysis over the first one is that the notion of featural domains is independently motivated elsewhere in Sanskrit. As we will discuss in §108, the *nati* rule of retroflexion spreading from /r/ to /n/ curiously fails in the paradigm of the root √*naś* 'be lost' when the verbal stem already has a retroflex consonant (Pāṇini, Aṣṭ. 8.4.14, Wackernagel 1896:187), e.g. *pra [ṇaśya]te* 'perishes' vs. *pra [nāṅkṣya]ti* 'will perish.' In this case, the difference could be due to the syntactic relationship between the preverb and the verb, but two other pairs show a featural correspondence more clearly. They probably do not reflect dialectal variation, for both forms are attested in the seventh book of the Ṛgveda, the family book of the Vasiṣṭhas.

The latter form in the pair *pináṣṭi* pres.ind.3sg, and *piṇák* pres.inj.2,3sg., to √*peṣ/piṣ* 'crush,' shows a transfer of retroflexion from the root-final consonant to the nasal infix.

In the pair *abʰí-naṭ* (ṚV[1]) and *prá-ṇak* (ṚV[4]) as well, the final *ś* of the root √*naś/aś* 'reach' does not become *ṭ* in the second form because the /n/ is already retroflexed by the /r/ of the preverb *prá-*.

In these forms, the stem part of each inflectional form always has one occurrence of retroflexion, in a similar manner to 'Aspiration Throwback.'

## §87 Allomorphy in *dʰatté*

Phelps (1975:448) lists the present middle paradigms of the roots √*dʰā* 'put' < PIE *dʰeh$_1$ and √*doh/duh* 'give milk' < PIE *dʰe̯ugʰ. Although the former is a class III (reduplicating) present, the early loss of root-final *h$_1$ has made its present middle inflection almost indistinguishable from that of the class II (root) presents, to which the latter root belongs, and this apparent similarity makes the differences between them look all the more contradictory. The inconsistency in question concerns the outcome of the addition of the third singular ending *-te*:

| root | class | underlying | surface |
|---|---|---|---|
| √*doh/duh* ‘give milk | II | /dug$^{h}$ + -té/ | *dugd$^{h}$é* |
| √*d$^{h}$ a*‘put’ | III | /$^{RED}$da-d$^{h}$($h_1$) + té/ | *d$^{h}$atté* |

In the second example, regular application of Bartholomae’s Law would give ×dadd$^{h}$é instead of *d$^{h}$atté*. Pāṇini explicitly rules out the application of this law to the final *d$^{h}$* of the stem *da-d$^{h}$-* in Aṣṭ. 8.2.40 *j$^{h}$aṣas tat$^{h}$or d$^{h}$o ’d$^{h}$aḥ*. As Schindler comments on this form, “before obstruents /dad$^{h}$-/ behaves as though it were /d$^{h}$ad-/. These forms are thus exceptions in any grammar of Sanskrit and must be handled by a special morphological rule” (Schindler 1976:628). Thus the best synchronic explanation for this alternation is that *d$^{h}$ad* is an allomorph of *dad$^{h}$* before obstruents, particularly dental, as in pres.2du.act. *d$^{h}$att$^{h}$ás*, pres.2pl.act. *d$^{h}$attá*, pres.2sg.mid. *d$^{h}$atsé*, pres.3sg.mid. *d$^{h}$atté*, iptv.act. *d$^{h}$attám, d$^{h}$att a͡m, d$^{h}$attá(na)*, iptv.mid. *d$^{h}$atsvá* etc.

On the other hand, the root √*doh/duh* ‘give milk’ is replaced by *d$^{h}$ug* only before /s/ or a word-boundary, both of which are taken care of by Aspiration Throwback, and before endings beginning with /d$^{h}$/, which is discussed above in §85.

**§88** [voiced] **as an autosegment**

I mentioned in §79 that Aspiration Throwback in Sanskrit reflects an autosegmental reinterpretation of the behavior of the single [spread glottis] of a root which originally had two tokens of [spread glottis] in Proto-Indo-European and lost the first of them by the pre-Vedic process of Grassmann’s Law.

If we accept that the feature [spread glottis] behaves as an autosegment, then an obvious question would be why [voiced], another laryngeal feature, does not spread in the same way when a root-final voiced stop is devoiced.[29] For example, the Vedic root √*tej/tij* ‘sharpen’ becomes Ved. *tiktá-* and not ×diktá-, when the verbal adjective suffix *-tá-* is added and the root-final /j/ is devoiced.

a. Underlying Representation:

```
/t   i      j      -t   á-/
            |
          [vcd]
```

b. The OCP filter does not apply to the adjacent voicing in /i/ and /j/ because the vowels are underspecified for the feature [voiced], which is redundant.

c. The Laryngeal Constraint delinks [voiced] from the root-final /j/:

```
t   i      c      -t   á-

          [vcd]
```

d. Feature Filling gives the vowels the redundant feature [voiced]:

[29] Lombardi (1991:147): “assuming feature geometry, all features are autosegmentalized.”

t i c -t á-
| |
[vcd] [vcd] [vcd]

e. The No Crossing Constraint blocks autosegmental spreading of the stray feature [voiced], which is then lost.

f. Surface Representation:

t i k t á-
| |
[vcd] [vcd]

There is a case, however, where autosegmental spreading of the feature [voiced] might have contributed to a morphological innovation. When a root ends in /d/, the verbal adjective suffix *-tá-* starts to be replaced by its allophone *-ná-* in Vedic:

| | | |
|---|---|---|
| √*sad* 'sit' | ṚV *sattá-* | : AV *sannά-* |
| √*ved/vid* 'find' | ṚV *vittá-* | : AV *vinnά-* |
| √*nod/nud* 'push' | ṚV *á-nutta-* | : SV *nunna-* |

The status of this suffix in Proto-Indo-Iranian is not clear, for the Avestan and Vedic forms do not always correspond with each other:

Avestan *pəršna-* : Ved. *pūrṇá-* 'full' (Hoffmann and Forssman 1996:245)
*prātá-* 'filled'
*pūrtá-* 'gift' for √*par*$^{i}$/*pṛ*$^{2}$ 'give'
YAv. *starəta-* : Ved. *stīrṇá-*

As far as Indo-Aryan is concerned, *-ná-* occurs primarily after roots ending in {i/y, u/v, ṛ/r} plus an Indo-European laryngeal, and within Vedic, older texts have more forms in *-tá-*. The affixation of *-ná-* after roots ending in /d/ can therefore be viewed as an innovation of Indo-Aryan. As the presence of root-final laryngeals became ambiguous in the phonology of Vedic, the original context conditioning the alternation of *-tá-* and *-ná-* may well have been obscured. At this point, the *-ná-* forms began to spread at the expense of the *-tá-* forms, possibly because the feature [voiced] of a root-final /d/ is preserved in the *-ná-* forms, where the /d/ becomes a voiced dental nasal /n/ by assimilation instead of becoming a voiceless dental stop /t/ before the suffix *-tá-*.[30] In this way, it is possible to motivate the constraint MAXROOT[voiced] to account for the late Vedic shift of e.g. *sattá-* to *sannά-*.

## §89 Sonorance of Indo-European laryngeals

As far as I know, there is no evidence against taking Proto-Indo-European laryngeals as [+consonantal], i.e. phonemes other than vowels and glides. The arguments for their consonantal nature may be summarized as follows:

[30] Pāṇini, Aṣṭ. 8.2.42 *ra-dābhyām* ...

Their position in Indo-European roots: Indo-European roots are reconstructed as monosyllabic. Although laryngeals may appear in any position of a root-final cluster, their distribution in root-initial clusters is almost regular: most onset laryngeals fit the patterns *He-, *HRe- and *BHe- (R: sonorant, H: laryngeal, B: obstruent). According to *LIV*, the following three are the only roots for which onset *HB- may be reconstructed with considerable certainty:

| | |
|---|---|
| *$h_1$ger 'wake up' | Attic Gk. *egr$\bar{e}$gora*, YAv. *jaγ$\bar{a}$ra*, Skt. *j$\bar{a}$g$\acute{a}$ra* |
| *$h_3$sle$\hat{i}$d$^h$ 'err' | Goth. *slindan*, Hom.Gk. *ólist$^h$e*, Skt. *srid$^h$at* |
| *$h_2$se$\hat{u}$s 'become dry' | Gk. *haú$\bar{o}$*, Skt. *śúṣyati* (Lubotsky 1985) |

The general pattern of onset clustering suggests that laryngeals are ranked between sonorants and obstruents on the Proto-Indo-European sonority scale.

Their frequent loss: *$h_2$ and a word-initial *$h_3$ appear as fricative *h̯* before a syllable nucleus in Anatolian, unless preceded by a stop in the case of *$h_2$. In the other branches, pre-nucleus laryngeals are lost with or without changing the features of the nucleus vowel. The lack of vowel or glide reflexes before a nucleus supports the idea that laryngeals are always lower in sonority than vocoids.

Their consonantal reflexes: Proto-Indo-European laryngeals appear as consonants in a few subfamilies. Their development in Anatolian, a subfamily which is often considered to have branched off first from the rest of the Indo-European languages (§5), is clearly consonantal, for *$h_2$ and word-initial *$h_3$ often become a fricative such as Hitt. *ḫ*. There are a few cases where laryngeals are possibly realized as velar stops in Germanic, e.g. Goth. *unkis* < PIE *n̥$h_3$u̯é (Jasanoff 1994:257). Aspiration of (mostly voiceless) plosives by a following *$h_2$ in Indo-Iranian can also be taken to support a fricative pronunciation of PIE *$h_2$.

Their metrical behavior: The consonantal treatment of the Indo-European laryngeals in the meter of the daughter languages was first demonstrated by Kuryłowicz (1927a), who explained the blocking of Brugmann's Law in perfect active 1sg. forms such as *cakara* by the cluster effect of the root-final *r and the laryngeal at the beginning of the desinence, i.e. < *k$^w$e-k$^w$ór]$_\sigma$-He (Kuryłowicz 1927a:206f.), or causative stems such as *janáya-$^{ti}$* < *ǵon]$_\sigma$H-éye-ti. Gippert (1997:64) shows that the meter of the Ṛgveda treats even interconsonantal laryngeals as making a cluster with the preceding stop or /h/, so that e.g. the first syllable of the Sanskrit words *pṛt$^h$iv$\bar{\imath}$* f. 'earth' < PIE *pl̥th$_2$u̯-ih$_2$ or *duhitár-* f. 'daughter' < PIE *d$^h$ugh$_2$tér- are metrically heavy.

Osthoff (1876) and Brugmann (1876) first discovered that sonorant consonants in Indo-European, namely the liquids (*r, *l) and nasals (*n, *m), become either syllable nuclei or consonants depending on their context, just as the glides *i̯ and *u̯ alternate with nucleus-forming *i and *u. Some scholars think that Indo-European laryngeals also belong to this class, for they are reflected as vowels in many branches, particularly between non-nucleus consonants. For example, Kuiper (1947:199) treats laryngeals as

sonorants like *r, *l, *m, *n, *i̯, *u̯ because "like these ['sonants'], they can serve as a consonant, as the second part of falling diphthongs (*eh$_1$, *eh$_2$, *eh$_3$, which later became *ē, ā, ō* before consonants), and as vowels, e.g. *ph$_2$tér-, Skr. *pitár-*, Greek *patér-*, English *father*". While Kuryłowicz (1927a:233) and Kuiper (1947) concede that the vocalizability of the laryngeals is more limited than that of the sonorants, Keiler (1970:81) asserts that a syllable nucleus was originally assigned equally to the laryngeals and the (other) sonorants, placing more emphasis on the Greek development of PIE *-ih$_2$ into *-ia* as in *pótnia* 'mistress, queen' than on the forms with compensatory lengthening like Skt. *pátnī* 'wife.'

To the natural question of how the laryngeals can be [+sonorant] although at least one of them (*h$_2$) seems to have fricative nature (Job 1994:422), Keiler (1970:84) answers that they are implemented as 'pharyngealized vocoids' when they form a syllable nucleus. If the laryngeals were really vocoids as Keiler says, then we can get around the problem that laryngeal consonants cannot be considered to be more sonorous than the other obstruents ([−sonorant]) on the Universal Scale of Sonority (§16). Although Keiler draws upon parallel phenomena from Afro-Asiatic languages to enforce his argument for the sonorance of Indo-European laryngeals, his reasoning itself seems to be bound by the presupposition that laryngeals develop into vowels. Rather than ascribing the behavior of unattested postulates to their equally unprovable physical realization, I would like to begin by examining how Indo-European laryngeals were represented in the phonology of each period and branch.

### §90 When did the three laryngeals merge?

Before determining the phonological representation of laryngeals in Indo-Iranian, we must first decide at which point the three laryngeals of Proto-Indo-European merged. Precise dating of the merger of *h$_2$ with the other laryngeals can clarify the problem as to whether the aspiration of a plosive caused by a following *h$_2$ in Indo-Iranian means

a) that *h$_2$ survived as a phoneme distinct from the other two laryngeals, or

b) that aspiration took place before Proto-Indo-Iranian and then all three laryngeals merged into PIIr. *H.

Lindeman (1997:188) reconstructs a merger as early as after the branching-off of Anatolian, on the grounds that interconsonantal laryngeals develop into a unique vowel, *i* in Indo-Aryan and *a* everywhere else. The triple vocalic reflection in Greek, and the Indo-Aryan aspiration of voiceless plosives before *h$_2$, are respectively explained as Greek innovation and an early change. The development of interconsonantal laryngeals into a single vowel in many branches, however, does not necessarily imply their early merger, for the same fact can be used to defend the position that the consonantal character of the laryngeals was preserved until their merger at a late period, while the coloring of vowels by adjacent laryngeals took place early enough to reflect their difference. Since individual facts which admit of different interpretations can be misleading,

let us first summarize the development of the laryngeals in each branch in simple tabular form.[31]

| language | difference | coloring | vocalic | consonantal | reference |
|---|---|---|---|---|---|
| Anatolian | 1:2:3 | yes | yes | yes | Melchert (1994) |
| Tocharian | 1:2(:3) | yes | yes | no | Ringe (1996) |
| Celtic | 1:2:3 | yes | yes | no | McCone (1996) |
| Italic | 1:2:3 | yes | yes | no | Meiser (1998) |
| Armenian | 1:2:3 | yes | yes | yes | Winter (1965) |
| Greek | 1:2:3 | yes | yes | no | Rix (1992) |
| Germanic | 1:23 | yes | yes | yes | Beekes (1995) |
| Baltic | 1:2:3 | yes/pitch | yes | no | R. Kim (p.c.) |
| Slavic | 1:2:3 | yes/pitch | yes | no | R. Kim (p.c.) |
| Iranian | 13:2 | no | yes | (no) | |
| Indo-Aryan | 13:2 | no | yes | (no) | |
| Albanian | 1:2:3 | – | – | yes | Hamp (1965) |

The three laryngeals show different developments even among the so-called 'core' Indo-European languages, namely Greek, Germanic, Balto-Slavic and Indo-Aryan. The apparent merger of $*h_2$ and $*h_3$ in Germanic and Slavic can actually be due to the merger of *a and *o. It is therefore possible that $*h_2$ remained distinct up to Proto-Indo-Iranian.

One way of explaining the paradoxical situation of laryngeals in Proto-Indo-Iranian, where laryngeals have supposedly merged but $*h_2$ in addition causes aspiration, is to suppose that the aspiration by $*h_2$ in the context *T_V took place before Proto-Indo-Iranian, and that the double reflection of $*h_2$ as aspiration + /i/ as in Skt. *mat$^h$itá-* instead of ×matitá- < *meth$_2$-tó- (Hoenigswald 1965a:94) is due to reintroduction of aspiration by paradigmatic leveling. For example, Beekes (1981b:283f.) explains Skt. *duhitár-* as follows: "In the cases that had *-gHt-V-* the laryngeal must have caused aspiration already in PIIr., because both languages had aspiration and because Bartholomae's Law operated in PIIr." Conversely speaking, cases like the following would prove that $*h_2$ survived into Proto-Indo-Iranian as a distinct phoneme:

a. double reflection of $*h_2$ in an isolated item: Namely, a form which is free from the pressures of paradigmatic leveling and in which $*h_2$ is doubly reflected as aspiration and /i/. For example, if the etymological relationship between Skt. *śit$^h$irá-* 'loose' and √*śrat$^{hi}$* 'become loose' was obscured by the irregular development of the samprasāraṇa vowel *r̥ into /i/, it would be highly possible that the double reflection in *śit$^h$irá-* occurred independently of the influence of inflected forms of √*śrat$^{hi}$*.

[31] The ordering of the languages in the following table is based on the tree model of Ringe et al. (1998). In this model, the treatment of laryngeals is not taken into account, so assuming this order in discussing the date of merger does not incur circularity. It should be noted that this is not the only proposed tree, and that the tree model is not the only one for describing the development of a language family (§5).

b. analogical spreading of $T^h$ from *$Th_2T$: If the analogical spreading of voiceless aspirates starts from a form with an interconsonantal zero-grade *$h_2$, it means that the *$h_2$ in that context is distinct from the other laryngeals. For example, it is at least possible that the aspiration of $t^h$ in Ved. $\sqrt{st^h\bar{a}}$ < PIE *steh$_2$ had its origin in forms with a zero-grade root followed by a consonant such as aor.3sg.mid. *ást$^h$ita*.

c. lack of aspiration in Iranian counterparts: Cases where *$h_2$ is lost in Iranian without aspiration due to the general tendency of Iranian to lose laryngeals without any trace, whereas Indo-Aryan has both aspiration and /i/. For example, YAv. *pərəθβīm* can come from pre-Proto-Iranian *pr̥tvīm, although *pr̥t$^h$vīm is equally possible.

Gippert (1994, 1997) believes that *$h_2$ was still distinct from the other laryngeals in Proto-Indo-Iranian,[32] adducing the behavior of an interconsonantal laryngeal as a consonant cluster as well as in the well-known context of *C_V such as *jána-* < *ǵónh$_1$o- (Oldenberg 1888:478f., Kuryłowicz 1927a:240). The cluster effect of *ǵh$_2$ in PIE *d$^h$uǵh$_2$tér- > Ved. *duhitár-*, reflected in the metrical scansion of the first two syllables as −∪, is particularly important, because it suggests that *$h_2$ in this word developed differently in Iranian (OAv. *dug°dar-*, YAv. *duγδar-*), where interconsonantal *$h_2$ only causes aspiration of *ǵ, and because it challenges explanations which treat the aspiration as analogical and secondary.[33]

We noted earlier in this section that there is little evidence for reconstructing the merger of laryngeals earlier than Proto-Indo-Iranian. At the same time, there is no conclusive evidence for the distinct phonological status of *$h_2$ in Proto-Indo-Iranian either, with possible exception of OAv. *dug°dar-*, YAv. *duγδar-* : Ved. *duhitár-* 'daughter.' I assume here that aspiration by *$h_2$, and subsequent merger of the three laryngeals as well, took place before Proto-Indo-Iranian.[34] The phonological status of the laryngeals in Proto-Indo-Iranian would then be represented either as a) or as b), depending on whether or not the aspiration part of *$h_2$ has already been disjoined:

a) *$h_{1,3}$: C *$h_2$: C PIIr. *d$^h$ u ǰ C t á r-
| |
[sg] [sg]

[32]Gippert (1994:464): "Wichtig ist dabei auch die Feststellung, daß der zweite Laryngal in postkonsonantischer Stellung **nicht**, wie das angenommene $h_3$ in der Vorform von aind. *pibati*, bereits voreinzelsprachlich absorbiert worden sein kann."

[33]Cf. Hoffmann and Forssman (1996:82): "Durch Kontamination der Nebenformen *$d^hug^hter$- und *$d^hugiter$- entstand *$d^hug^hiter$- > *$d^huǰ^hiter$- > ved. *duhitár-*."

[34]Tichy (1985:239f.): "Eine solche Erklärung ist unter der Annahme möglich, daß *$h_2$/*$\underset{\cdot}{h}_2$ in einer Vorstufe des Urindoiranischen einen vorausgehenden Verschlußlaut durch Assimilation aspirierte, ohne bei diesem Vorgang bereits vollständig zu schwinden. Vielmehr wäre der eigentliche Reflex von *$\underset{\cdot}{h}_2$ später mit den Kontinuanten von *$\underset{\cdot}{h}_1$ und *$\underset{\cdot}{h}_3$ in urindoiran. *$^i$ zusammengefallen:" Gippert (1994:463): "Der zweite Laryngal selbst muß über das letzte Stadium der Grundsprache hinaus bis in eine Vorstufe des Indoiranischen in einer phonetisch wahrnehmbaren Form erhalten geblieben sein."

b) $*h_{1,2,3}$: C PIIr. $*d^h$ u $ǰ^h$ C t á r-

[sg]

The C's for $*h_{1,3}$ in a) and $*h_{1,2,3}$ in b) have no feature linked, except for being consonantal; they are bare timing slots (Clements and Keyser 1983). By the time of Early Vedic, the union of a voiceless plosive and an $*h_2$ has been phonemicized as a voiceless aspirate. If $*h_2$ still had [spread glottis] and was distinct from $*h_{1,3}$, they underwent merger, and the ensuing single laryngeal *H surfaces as /i/ when it is strayed:

c) *H: X Early Vedic: */duj$^h$Xtár-/ > *duhitár-*

By the notation 'X' I mean a featureless timing slot which can become a syllable nucleus between C's or between a C and a word boundary. If Indo-Iranian already had a vocalic reflex of laryngeals as Beekes (1981b:284) assumes, a clear line cannot be drawn between the representations ab) and c).

### §91 The 'vocalization' theory of Indo-Iranian laryngeals

The phenomenon that laryngeals strayed between non-nucleus segments become /i/ in Indo-Aryan has been explained in the following ways:

a) Direct vocalization in Proto-Indo-European: Interconsonantal laryngeals first become *ə or a syllabic laryngeal $*h_{1/2/3}$, which then develops into /i/ in Indo-Iranian and /a/ elsewhere (Rasmussen 1994:444).

b.) Direct vocalization in individual branches: Interconsonantal laryngeals remain consonantal until Proto-Indo-Iranian, where some of them become *i without causing aspiration (Beekes 1981b:284ff., Mayrhofer 1981:435).[35]

c) Anaptyxis in Proto-Indo-European: Anaptyctic *ə or $*_e$ is inserted when a laryngeal and the consonants on either side form a cluster of three or more consonants (Kuryłowicz 1927a:233, Lehmann 1952:89ff., Hoenigswald 1965a:97f, possibly Meier-Brügger 2002:114).

d) Anaptyxis in individual branches: Anaptyctic *ə or $*_e$ is inserted in Proto-Indo-Iranian before or after an interconsonantal laryngeal, which is subsequently lost (Polomé 1972:235, G. Schmidt 1973, Gippert 1997).

e) Loss of consonantal *H and subsequent vowel insertion: In addition to these four hypotheses on the Indo-Iranian development of the Proto-Indo-European laryngeals, Melchert (1994:47, 65, 69, 74) explains the Anatolian development of interconsonantal laryngeals as loss and subsequent epenthesis, based on the assumption

[35]Mayrhofer (1981:435): "Das Phänomen der häufigen ∅-Vertretung weist neben vielem anderen auf die konsonantische Natur der *H*-Phoneme hin, die nur in bestimmten Positionen (...) als „ə" erscheinen; das Indo-Iranische hatte noch kein /i/ aus „H", das mit ererbtem /i/ gleich behandelt worden wäre.

that laryngeals remained obstruent and not sonorant from Proto-Indo-European to Proto-Anatolian.[36]

Since laryngeals in Proto-Indo-Iranian behave metrically as consonants between two consonants as well as between a consonant and a vowel, a) and b) are excluded. d) does not conflict with any of the evidence. e), epenthesis of *ə subsequent to the loss of laryngeals in Anatolian, seems to be a language-specific development in Anatolian, for an interconsonantal laryngeal in Indo-Aryan metrically behaves as a consonant even after the insertion of *i* has taken place, and the chronological order of the loss of laryngeals and epenthesis might be opposite from Anatolian.

### §92 The necessity of positing *ə

I understand that *ə has been posited as an intermediate form of vocalized laryngeals for the following reasons:

i) They develop differently across subfamilies, e.g. Tocharian *a, Greek /e/a/o/, Sanskrit /i/.

ii) Reconstruction of the phonetic value of a segment with diverse reflexes makes use of inductive approximation, requiring an intermediate vowel which can acquire any surface features or even disappear.

iii) /ə/ is a vowel without distinct features (Jakobson 1939=1962:278 “la voyelle indéterminée ou *neutre*”), and it can be used as a “wildcard” vowel.

If, as Gippert’s metrical analysis demonstrates, an interconsonantal laryngeal as well as a laryngeal between a consonant and a vowel remained consonantal all the way until Proto-Indo-Iranian, i) becomes baseless, for Indo-Aryan /i/ < *H is the result of epenthesis in that case, and there is no reason for reconstructing a vowel from Indo-Aryan *i* and vocalic reflexes in other branches. Here let us try to trace the development of stray laryngeals in Indo-Iranian without making use of *ə, in order not to obscure the real problem why the vowel for a stray laryngeal is /i/ in Vedic while many other Indo-European branches have non-high vowels. In particular, we would like to locate the exact difference in the systems of vowel features from which the different outcomes of stray laryngeals may be predictively derived.

Although representation of segments as feature bundles may seem to allow any combination of features and feature values, some features do not cooccur due to articulatory restrictions. For example, low vowels are rarely tense or rounded, and front vowels are more often unrounded than rounded. In addition to such cooccurrence restrictions, there are cases which suggest language-specific markedness of certain features. In Yoruba (Archangeli and Pulleyblank 1989), for example, only [−ATR (Advanced Tongue Root)] spreads to mid vowels, suggesting that ‘+’ is the default value of the

[36] Melchert (1994:74): “A preform **(s)th$_3$mn̥t* would have begun with three (or four) consonants. Deletion of the laryngeal in such a cluster and **then** anaptyxis in the remaining cluster cannot be excluded.”

feature [ATR], whereas [+ATR] is suspected to be marked in Akan. Radical Underspecification (Archangeli and Pulleyblank 1989) even assumes that features have universally marked values. If there is a crosslinguistic asymmetry between the values of a feature, the marked value is considered to presuppose the existence of the other value, while the unmarked value "corresponds to the normal, neutral state of the relevant articulator" (Steriade 1995:119).

### §93 Vowel features in Proto-Indo-European

The vowel system of Proto-Indo-European has length gradation of the vowels *e, *o and possibly *a, and an alternation between *e and *o, both of which serve grammatical functions. The high vowels *i̯/i and *u̯/u, on the other hand, do not alternate with each other or in length, and there is no solid evidence which allows us to reconstruct their long counterparts for Proto-Indo-European (§14). A syllable nucleus is preassigned to non-high vowels, and high vowels have the same priority as the other sonorants (liquids and nasals) in nucleus assignment (§16). Proto-Indo-European high vowels group together with liquids and nasals rather than with non-high vowels, in that the first two constitute lexical elements while the last serve derivational and inflectional functions.[37] The segregation of high from non-high vowels is also shown by the fact that Proto-Indo-European has neither a rule which changes the value of the feature [high], nor a pair in which [high] is contrastive (§14).

Similarly, alternation between low and mid vowels is not common in Proto-Indo-European. There are data which suggest the existence of a phonemic contrast for the feature [low], although many of reconstructed low vowels are argued to derive from laryngeals (cf. Lubotsky 1989):

i) Examples of PIE *a: *ǵʰans- 'goose,' Lat. *ānser*, OHG *gans*, Gk. *kʰēn*, Skt. *haṁsá-* (Lubotsky 1989:60); *√Hyaǵ- 'worship,' Gk. *házomai*, OAv. *yazaitē*, Ved. *yájate* (Lubotsky 1989:54); *Hnas- 'nose,' Lat. *nāris*, Ved. *nás-*, *ŕjūnas-* etc. (Mayrhofer 1986:170, Lubotsky 1989:60).

ii) Alternation in [low]: *√ḱad ~ *ḱod? 'fall': Lat. *cadō*, *cecidī*.

iii) Minimal pairs: Among the roots listed in *LIV*, the following three pairs contrast in the [low] value of the root vowel.

| | | | |
|---|---|---|---|
| 1. | *√mad 'become wet,' OIr. *-maid*, Lat. *madeō* (Lubotsky 1989:54) | : | *√med 'become full,' Ved. *mádati*, ON *mettr* pr.ppl. |
| 2. | *√paḱ 'fasten,' OLat. *pacunt* | : | *√peḱ 'scratch hair,' Gk. *pékō*, Lat. *pectō* |
| 3. | *√las? 'be avid,' Gk. *lilaíomai* | : | *√les 'collect,' Hitt. *less-* |

[37] In terms of the Markedness Convention and the feature [vocalic] (Chomsky and Halle 1968:408), those segments whose [vocalic] value is unmarked (i.e. decided by context) group together in Proto-Indo-European.

If Proto-Indo-European actually had a low vowel *a, the value of the feature [low] as well as that of [high] was lexically specified.[38] In that case, the asymmetrical distribution of low and mid vowels, i.e. that the mid vowels *e and *o are much commoner than the low vowel *a, suggests that '+' is the marked value of the feature [low].

Redundancy rule: [ ] → [−high, −low]

This rule correctly predicts that *ə, which is considered to be the least marked vowel epenthesized in place of or after the loss of a stray laryngeal, was mid in height. The markedness relation between front and back vocoids cannot be determined, for the mechanism of ablaut between *e and *o is not very well understood. The gaps in the following feature matrix represent the underspecified feature values of Proto-Indo-European vowels based on what we know about their markedness:

| PIE | *i̯/i | *u̯/u | *e | *o | *a |
|---|---|---|---|---|---|
| [back] | − | + | − | + | |
| [high] | + | + | | | |
| [low] | | | | | + |

## §94 Vowel features in Indo-Iranian

In Proto-Indo-Iranian, on the other hand, the three non-high vowels in Proto-Indo-European, *a, *e and *o, and the nucleus-bearing nasals *n̥ and *m̥ in certain contexts, all collapse into *a. Since the contrast between low and mid vowels is lost in this merger, it is probably the feature [low] which is neutralized, and *a and the high vowels *i, *u are now dintinguished only by the feature [high]. The feature [high] might also have played a role as a triggering context of the RUKI rule (§102).

As for the relevant feature underlying Proto-Indo-Iranian *i̯/i and *u̯/u, either [back] or [rounded] is sufficient to make the distinction. If the merger of the non-high vowels and the SECONDARY PALATALIZATION (palatalization of velar and labiovelar stops before a front vowel) is complete and morphologized already in Proto-Indo-Iranian, the feature [back] need no longer be active. While the feature [rounded] does not condition any rule in Proto-Indo-Iranian, Indo-Aryan shows a faint trace of rounding assimilation in the development of Proto-Indo-European sequences of a liquid followed by a laryngeal:

| PIE | | Iranian | Indo-Aryan |
|---|---|---|---|
| *pl̥h₁ú- | Goth. *filu* | OYAv. *pouru-* | Ved. *purú-* |
| | Gk. *polús* | OP *paruv* | |
| *pl̥h₁-nó- | Lith. *pìlnas* | OYAv. *pərəna-* | Ved. *pūrṇá-* |
| *gʷr̥h₂ú- | Gk. *barús* | YAv. *gouru-*? | Ved. *gurú-* |
| *tr̥h₂-e/o- | Lat. *trāns* | YAv. *vī-θrəta-* | Ved. *tīrṇá-*, *titīrṣa-* (Br.) |
| | | but also | *tūrtá-* (ŚBr.), *tútūrṣa-* (ṚV) |
| *ǵr̥H- | | YAv. *zarəta-* | *jūrṇá-* (ṚV), *jīrṇá-* (AV) |

[38] Cf. the principle of invariance which states that "lexically specified features prefer to remain unchanged" (Steriade 1995:123).

Vowel features of Old Indo-Aryan do not interact with adjacent segments very often; e.g. vowels in neighboring syllables rarely affect each other, and qualitative ablaut of any sort is unknown there. It is thus not easy to decide which features are active or contrastive in the phonology of Old Indo-Aryan. This inertness or seeming equipollency of vowel features is a characteristic of Indo-Aryan.[39]

In my count of the vowels in the Ṛgveda, and in Whitney's statistics of all Sanskrit phonemes in specimens of various Sanskrit texts, the vowel /a/ accounts for more than half of all occurrences of vowels (Whitney 1889:26):

| vowel | *a* | *ā* | *i* | *u* | *ī* | *ū* |
|---|---|---|---|---|---|---|
| ṚV | 172,411 | 60,551 | 47,843 | 27,030 | 9,883 | 6,261 |
| | (53.22%) | (18.69%) | (14.77%) | (8.34%) | (3.05%) | (1.93%) |
| Whitney | 19.78% | 8.19% | 4.83% | 2.61% | 1.19% | .73% |
| | (52.99%) | (21.94%) | (12.94%) | (6.99%) | (3.19%) | (1.96%) |

### §95 Null vowels and epenthesis in Indo-Aryan

If we knew more about the markedness of vowel features in Indo-Aryan, it might be possible to explain the 'vocalization' of stray laryngeals as /i/ without stipulating the rule *H > i / C_{C, ]$_{wd}$}, namely, by epenthesis of a root node for which only [−consonant] or [+sonorant] is specified, and by redundancy rules which fill in feature values. Now let us turn to the actual evidence for vowel epenthesis.

/i/ as an epenthetic vowel:

a) connective /i/ in perfects: When a perfect stem ending in a consonant takes endings beginning with a consonant, i.e. *-t$^h$a, -va, -ma, -se, -vahe, -mahe, -d$^h$ve, -re,* an unoriginal /i/ is inserted between them. This epenthesis occurs more often in later periods (Whitney 1889:286, Edgerton 1943:87ff.). Cf. *cakr-i-ré, papt-i-má* to the roots √*kar/kṛ* 'do' and √*pat* 'fly,' which are probably both aniṭ.

b) quasi-seṭ forms with /i/: When the future suffix *-syá-* is added to a full-grade root, even aniṭ verbs sometimes take connective /i/ (§41): *kar-i-ṣya-, gam-i-ṣya-, han-i-ṣya-, naś-i-ṣya-.* Similarly, √*śaṃs* 'praise' : s-aor. *śaṃs-i-ṣ-am.*

c) /ī/ in the 2,3sg.act. of s-aorists: Aniṭ roots often take *ī* in the second and third active singular forms of s-aorists, where the endings would otherwise be lost by final cluster simplification, e.g. √*vah* 'carry' : s-aor.3sg.act. *áv-ā-kṣ-ī-t.* So is *ī* in *á-as-ī-s,* *á-as-ī-t* ipf.2,3sg.act. of √*as* 'be.' For the length of these *ī*s, see Jamison (1988).

d) *ṛH > *ir, ur* / _V : See §94 for the distribution of /i/ and /u/.

e) /i/ in ṚV *hárdi,* Ep. *vāri:* ṚV *hárdi* n.nom.acc.sg. of *hṛ́d-* 'heart' and Epic *vāri* 'water' have /i/ after the root, although they originally had no root-final laryngeal, in

[39] Cf. Pinnow (1969:270): "Somit ergibt sich die erstaunliche Tatsache, dass es ohne grosse Schwierigkeiten oder gar Künsteleien möglich, ja vom streng strukturalistischem Standpunkt aus sogar geboten ist, das Sanskrit als eine Sprache VÖLLIG OHNE VOKALPHONEME — natürlich nicht ohne phonetische Vokale! — zu interpretieren."

contrast to the nom.acc.sg. of heteroclitic nouns with a final laryngeal such as *ást$^h$i* 'bone' or *dád$^h$i* 'curds' (Debrunner and Wackernagel 1930:34).

Except for d), all these cases of epenthetic /i/ involve spreading of /i/ from the context of interconsonantal laryngeals to underlying clusters without stray laryngeals. Since interconsonantal laryngeals always underlie the oldest cases of /i/-epenthesis, we cannot exclude the possibility that some unknown phonetic property of the laryngeals made /i/ the epenthetic vowel; at any rate, it is not easy to attribute the /i/-quality to context-free redundancy rules which assign the features [+high] and [−back] to an epenthesized empty timing slot. If we extend the scope of our inquiry to Middle Indo-Aryan, we find more /i/'s used as an epenthetic vowel in forms such as Pāli, Pkt. *itt$^h$ī* 'woman' : Skt. *strī*, Pāli, Pkt. *purisa-* 'man' : Skt. *púruṣa-*, or Pāli *tasinā* 'thirst' : Skt. *tṛṣṇā*. There is, however, huge unpredictability alongside such favorable data for epenthesis in Middle Indo-Aryan, and an extemporaneous generalization should be avoided.

In the following three cases, /u/ might be functioning as an epenthetic vowel:

f) 'Sproßvokal': *ṛH > *ir, ur* / _V. See §94 for the distribution of *i* and *u*.

g) *ṛs]$_{wd}$ > *-uḥ*: *pitṛ-s > *pitúḥ* gen.sg. of *pitár-* 'father,' *u-us-ṛ́s > *ūṣúr* pf.3pl.act. of √*vas* 'shine' (Pāṇini, Aṣṭ. 6.1.111 *ṛta ut*; see Pinault 1989:39 for the literature on this change).

h) *púruṣa-*, *pūruṣa-* 'human being': Although the etymology of this word is not clear, the second *u* might be unoriginal.

Another candidate for a default vowel in Sanskrit would be the single non-high vowel /a/:

i) 'morphological zero grade' (Kuryłowicz 1956): Roots with consonants at both edges and no glides in between often have the root vowel *a* in the zero grade, e.g. *nadd$^h$á-* 'tied' instead of ×add$^h$á- < *ṇdd$^h$á-, *cakramúr* pf.3pl.act. of √*kram* 'stride' instead of ×cakṛmúr. It is probably the full-grade counterparts which supply a model for epenthesis of /a/ in these zero-grade forms. Epenthesis of this type is called 'morphological zero grade' (§13) and is distinguished from genuine cases of insertion of a non-high vowel as in Latin *magnus*;[40] *a* in these cases is acquired paradigmatically rather than by a phonological process of avoiding unpronounceable consonant sequences.

j) *ṇ, *ṃ > *a*: Proto-Indo-European nucleus-forming nasals *ṇ and *ṃ have probably merged with *a in Proto-Indo-Iranian, and both Iranian and Indo-Aryan reflect them as *a*: PIE *dékṃ(t) > OAv. *dasā*, Skt. *dáśa*; PIE *pṇth$_2$ás abl.sg. > OAv. *paθā*, Skt. *pat$^h$áḥ*. If this vocalization arose by epenthesis before an unsyllabifiable nasal and subsequent superimposition of the nasality on the vowel, then it is quite likely that a low vowel was epenthesized: PIE *ṇ, *ṃ > pre-PIIr. *$^a$n, *$^a$m > PIIr. *ã$^n$, *ã$^m$ > Av., Ved. *a* (§63).

[40] Even this can be a case of morphological zero grade (Ringe, p.c.).

k) svarabhakti: Another example of /a/ as an epenthetic vowel is the extra-short /a/ used in svarabhakti, an anaptyxis in /rC/ clusters described by native grammarians (§27). This rule describes phonetic details of certain dialects of Old Indo-Aryan,[41] and probably falls outside the context of the above historical developments.

Note that the epenthesis of /i/ occurs in inflectional paradigms except for d), where the context can be phonologically defined. Since Avestan does not have /i/ in corresponding forms, this /i/-epenthesis must have begun in the pre-Vedic period, if it is not just an analogical extention of /i/ from stray laryngeals but is an actual phonologically grounded process. On the other hand, the epenthesis of a low vowel, if any, is either pre-Proto-Indo-Iranian or synchronically Indo-Aryan.

I interpret these facts as follows. Before Proto-Indo-Iranian, there were three vowel heights, and [−high] was the marked value. As the mid and low vowels merged in Proto-Indo-Iranian, the markedness relationship of the height features was lost, and Iranian and Indo-Aryan individually chose /ə/ and /i/ as a null vowel. In Old Indo-Aryan, the original [+low] property of PIIr. *a becomes ambiguous when short /a/ shifts toward mid central position in Sanskrit, as is known from the traditional interpretation of Pāṇini's last rule, Aṣṭ. 8.4.68 *a a*, and from the term *saṃvṛta-* 'closed,' which ŚCĀ 1.1.36 *saṃvṛto 'kārāḥ* uses to describe the articulation of short *a*. When Sanskrit /a/ acquired the status of a neutral vowel, it may have taken over the role of /i/ as a null vowel.

| period | phenomenon | vowel inserted |
|---|---|---|
| PIE | schwa secundum | *ə∼*e |
| pre-PIIr. | *n̥, *m̥ > *a | *a |
| pre-Vedic | *H > X, X > *i | *i |
| OIA | *r*C > *r*$^{a}$C | *a* |

This explanation of the 'vocalization' of interconsonantal laryngeals in Indo-Aryan by general epenthesis has the significant advantage resolving the discrepancy between the vocalization of laryngeals and the Universal Scale of Sonority. As we saw in §16, there are no grounds for attributing the vocalization of laryngeals to their sonority, unless it is demonstrably higher than the sonority of the other fricative /s/. If the vocalization of *H can be independently motivated as epenthesis, which in turn is driven by maximization of the skeletal slot of *H in an interconsonantal context, the sonority scale need no longer be invoked to account for the so-called vocalization.

### §96 Summary

Proto-Indo-European has a stop system with a three-way contrast of laryngeal features (i.e. voicing and aspiration). Proto-Indo-Iranian has added a fourth series of voiceless aspirated plosives originating from a cluster of a voiceless stop and *$h_2$, or from an /ST/ cluster, and developed an apparently symmetrical system with a four-way laryngeal contrast (§69, §70, §74, §75, §90). Another characteristic of Old Indo-Aryan is that

[41] Other vowels are also used for svarabhakti, cf. Varma (1929:135f.).

laryngeal features are licensed on a plosive only when it is followed by a sonorant, in conformity with Lombardi's Laryngeal Constraint (§77).

Most of the Indo-European languages have reflexes of PIE */z/, a voiced allophone of PIE *s (§73), and Bartholomae's Law spreads voicing and aspiration to a cluster-final *s in Proto-Indo-Iranian (§72); in Proto-Indo-European and Proto-Indo-Iranian, the laryngeal features of *s were probably left unspecified. In late pre-Vedic Old Indo-Aryan, on the other hand, /s/ became prespecified for the feature [spread glottis] (§72). Since Avestan has voiced sibilants, this innovation most probably took place between Proto-Indo-Iranian and Indo-Aryan. One of the consequences of this prespecification is the so-called Aspiration Throwback, in which the [spread glottis] of a suffix-initial /s/ causes relinking of root-final aspiration (§72, §75, §76, §85).

The irregular progressive assimilation in Bartholomae's Law, which deviates from the normal Indo-European assimilation pattern of voicing and aspiration (§77), is due to the Indo-Iranian innovation of treating [spread glottis] as a marked feature, and requires that laryngeal features of a root surface with higher priority than those of a suffix. Bartholomae's Law may be understood as maximization of a root feature, and the asymmetry between root and suffix segments existed already in Proto-Indo-Iranian (§82, §83). The asymmetry is even more conspicuous in Indo-Aryan, where a verbal root forms a featural domain (§86), whereas the asymmetry is rather leveled off in Iranian, as the restitution of suffix-initial /t/ suggests (§82). The emphasis on maximizing marked features of a root morpheme develops into autosegmental spreading and delinking within the domain of the verbal root (§86) — another innovation of Indo-Aryan from Proto-Indo-Iranian.

In contrast to Proto-Indo-European, where [spread glottis] could occur only with [voiced], the two laryngeal features started spreading and delinking independently in pre-Vedic Indo-Aryan. At that point, Indo-Aryan began to treat voiced plosives as a little more marked compared to voiceless ones in order to distinguish voiced from voiceless aspirates. In Optimality Theoretic terms, Indo-Aryan added or promoted a faithfulness constraint on the feature [voiced] of the root alongside the existing markedness of aspiration (§84), and that innovation might have caused the shift from *-tá-* to *-ná-* as in ṚV *sattá-* : AV+ *sanná-* (§88).

It cannot be determined whether the three laryngeals of Proto-Indo-European have completely merged in Proto-Indo-Iranian, or *$h_2$ remained distinct until pre-Vedic Indo-Aryan (§90). Their interconsonantal reflex as Sanskrit /i/ might be explainable as a case of general epenthesis (§95), if a high unrounded vowel was the least marked in Old Indo-Aryan (§92, §94).

# Chapter VII. Place Features

## §97 Spreading of retroflexion

One of the most salient innovations of Indo-Aryan in the phonemic system of Proto-Indo-Iranian is the addition of the retroflex consonants /ṣ/, /ṭ/, /ṭʰ/, /ḍ/ (~*l̤*), /ḍʰ/ (~*l̤ʰ*) and /ṇ/. These sounds and /r̤, r/ spread retroflexion to dental obstruents and /n/ in different contexts:

/r̤, r/, together with high vowels and velar stops, trigger the 'RUKI' retroflexion of an immediately following /s/. It also spreads retroflexion to a following /n/, unless a coronal (including palatal) non-continuant intervenes.

/ṣ/ spreads retroflexion to an immediately following dental stop. Like /r/ and /r̤/, it spreads retroflexion to a following /n/. The RUKI retroflexion of /s/ is blocked when it is immediately followed by an /r/ or /r̤/, as in *tisráḥ* f.pl.nom-acc. 'three.' Unlike retroflex stops, a word-initial /ṣ/ does not cause assimilation of a preceding dental stop (Aṣṭ. 8.4.43 *toḥ ṣi* [41 *ṣṭuḥ*, 42 *na*]).

/ṇ/ is inert in sandhi rules of retroflexion spreading except that it retroflexes a following /n/, as in √*kṣod/kṣud* 'crush' + -ná- > /kṣuṇ-ná-/ > Ep. *kṣuṇṇa-*, √*kṣved/kṣvid* 'creak' + -ná- > /kṣviṇ-ná-/ > Cl. *kṣviṇṇa-* (Whitney 1889:67). There are clusters of /ṇ/ and a retroflex stop such as ṚV 8.17.12 *ā́kʰaṇḍala*, *āṇḍá-* 'testicle,' ṚV 1.29.6 *kuṇḍr̤ṇ ā́c ī*'?,' *daṇḍá-* 'stick,' *píṇḍa-* 'ball,' *maṇḍ ū́ka-* 'frog,' *śáṇḍa-* prop.n., but the process of retroflexion in these words is not clear.

At word boundary, /ṭ/, /ṭʰ/, /ḍ/ and /ḍʰ/ always retroflex a preceding dental, but usually not a dental which follows (Whitney 1889:67); *ṣaṭ-triṃśá-* num. 'thirty-six' while √*ī̱d* 'praise' + -te > *ī́ṭṭe* pres.3sg.mid. Unlike /ṣ/, /ḍ/ and /ḍʰ/ can be followed by /r/ or /r̤/, as in ṚV *kuṇḍr̤ṇ ā́c ī*'?,' AV *méḍʰra-* n. 'penis' and *s ā́ḍʰr̤-* 'vanquisher' in ṚV 7.56.23 *s ā́ḍʰ ā*.

The spreading relationship of retroflexion among Vedic phonemes is summarized as follows:

a) Medial sequences:[1]

| trigger | local | | | | nonlocal |
|---|---|---|---|---|---|
| target | /s/ | /n/ | /t,tʰ,d,dʰ/ | /r/ | /n/ |
| r, r̤ | always | always | no | *rr̤* : ×r̤r | almost always |
| ṣ | (always) | always | always | *sr* : ×ṣr | almost always |
| ṇ | — | always | unclear | ×nr : ×ṇr | no |
| ṭ, ṭʰ, ḍ, ḍʰ | no | — | internally | *Tr*( : *T̤r*) | no |

[1] Although there is no phoneme which is a retroflex counterpart of /r/, I list it under 'target' to show all possible combinations.

— : the combination does not exist
no : retroflexion does not take place
always : the second consonant is always retroflexed

b) Across word boundary:[2]

| | s- | ṣ- | T | Ṭ | n- | ṇ- |
|---|---|---|---|---|---|---|
| -s | -s/ḥ s- | -**ṣ**/ḥ ṣ- | -s T- | -**ṣ** Ṭ- | -r/∅ n- | -r/∅ ṇ- |
| -T | -t s- | -t ṣ- | -T T- | -**Ṭ** Ṭ- | -n n- | -n ṇ- |
| -Ṭ | -ṭ s- | -ṭ ṣ- | -Ṭ T- | -Ṭ Ṭ- | -ṇ n- | -ṇ ṇ- |
| -n | -n(t) s- | -n ṣ- | -n T- | -**ṇ** Ṭ- | -n n- | -n ṇ- |
| -ṇ | -ṇ s- | -ṇ ṣ- | -ṇ T- | -ṇ Ṭ- | -ṇ n- | -ṇ ṇ- |

(T and Ṭ here represent dental and retroflex stops respectively.)

### §98 Phonemicization of the retroflex consonants

This unevenness of the spreading of retroflexion is due in part to its multiple origins, including Pedersen's Law or the ruki rule, retroflexion of /n/ by preceding /r/, /ṛ/ and /ṣ/, and Fortunatov's Law (of disputed validity, §99), and in part to the chronological gap in the development of the retroflex consonants: e.g. the ruki rule is reconstructed for a period as early as pre-Proto-Indo-Iranian, while the spreading of retroflexion from /r/, /ṛ/ and /ṣ/ to /n/ is an Indo-Aryan innovation. The following are the sound changes which created the retroflex consonants, and the antiquity of those changes:

| phoneme | origin | locality | period |
|---|---|---|---|
| /ṭ/ | Fortunatov's Law (*l + *t > ṭ)? | contiguous | post-PIE~pre-Vedic? |
| | *t > ṭ / ṣ_ | contiguous | synchronic |
| | $P_{[pal]}]_{wd}$ | contiguous | pre-Vedic |
| /ṭ$^h$/ | Fortunatov's Law (*l + *t$^h$ > ṭ$^h$)? | contiguous | post-PIE~pre-Vedic |
| | *t$^h$ > ṭ$^h$ / ṣ_ | contiguous | synchronic |
| /ḍ/ | *d > ḍ / *ž_ | contiguous | pre-Vedic |
| /ḍ$^h$/ | *d$^h$ > ḍ$^h$ / *ž_ | contiguous | pre-Vedic |
| | *t,*d > ḍ$^h$ / *ž$^h$_ | contiguous | pre-Vedic |
| /ṣ/ | *s > *š /*i, *u, *r, *ṛ, *$T_{[velar]}$_ | contiguous | post-PIE |
| | *ć, *ǰ > *š /_t$^{(h)}$ | contiguous | PIIr.[i)] |
| | Fortunatov's Law (*l + *s)? | contiguous | post-PIE~pre-Vedic? |
| /ṇ/ | n > ṇ / [r, ṛ, ṣ] ... _ (nati rule) | non-local | synchronic |
| | ḍ > ṇ /_N | contiguous | synchronic |
| | n > ṇ / ṇ_ | contiguous | synchronic |

[i)] See Brugmann (1897:559 §615), Hoffmann and Forssman (1996:102).

From a synchronic point of view, the uneven spreading of retroflexion reflects the differences in the degree of phonemicization of the retroflex consonants:

[2] A detailed phonological explanation is given by Cho (1999:59ff.). See §104 for the alternation of word-final /s/ and /r/.

/ṇ/ is almost an allophone of /n/, but a few words with unconditioned /ṇ/ such as ṚV *pāṇí-* m. 'hand,' ṚV *maṇí-* m. 'necklace' or AV *guṇá-* m. 'part' give it phonemic status (Emeneau 1946:89). It can occur only when a homorganic non-continuant or a sonorant follows;[3] thus it has the same phonotactic restriction as a palatal plosive (§37). The retroflexion of /n/ after /ṣ/ or /r/ has relatively few lexical exceptions,[4] and the blocking of this retroflexion before a dental stop shows that the value of the feature [±anterior] of /n/ depends on that of the following stop; in other words, /n/ is unspecified for the feature [anterior] in the Underlying Representation (cf. Parasitic Licensing of laryngeal features, §77). The contrast of /n/ and /ṇ/ is neutralized in word-final position.[5] Minimal pairs of /n/ and /ṇ/ are not unknown, however: *ánu* prev. 'after, along' : *áṇu-* adj. 'minute.'

/s/ becomes *ṣ* almost regularly after /i, u, r/ or a velar stop, with a few lexical exceptions such as *ṛbīsa-*(ṚV 5.78.4a, 1.116.8c, 1.117.3b, 10.39.9c), *kīstá-*m. (ṚV 6.67.10a, 1.127.7a), *bṛ́saya-* m. (ṚV 6.61.3b, 1.93.4c), *bisa-kʰā* (ṚV 6.61.2a), and *busá-* (ṚV 10.27.24c),[6] and with blocking by a following /r/. /ṣ/ also comes from Proto-Indo-Iranian primary palatals before a voiceless dental stop. This multiple origin, and the existence of a few lexical items in the Ṛgveda with unexplained retroflexion of /s/ such as *kaváṣa-* prop.n., *kaṣaplaká-* '?,' *caṣāla-*m. 'top of a ritual post,' *cāṣa-* m. 'Corasius indica,' *jálāṣa-* '?,' *pāṣyà* '?' (ṚV 1.56.6), *baṣkáya-* a. 'full-grown (calf),' *váṣaṭ* '?' (ritual chant) and *ṣáṣ-* 'six,' have resulted in a complex context for retroflexion of /s/, so that *ṣ* is more than just an allophone of /s/ in the phonology of Old Indo-Aryan. There is at least one minimal pair of /s/ and /ṣ/: *ásta-* n. 'home' : *aṣṭá-* num. 'eight.'

/ṭ/ and /ṭʰ/ are usually retroflex alternants of /t/ and /tʰ/ when they are preceded by /ṣ/. This change is regular word-internally, and sometimes extends across word and compound boundaries, as in the Ṛgvedic sequences *níṣ ṭatanyuḥ*, *agníṣ ṭád* or *nákiṣ ṭanūṣu*. /ṭ/ and /ṭʰ/ also occur in a number of lexical items, some of which have been attributed to Fortunatov's Law, which allegedly changes *lt and *ltʰ into *ṭ* and *ṭʰ* respectively (Fortunatov 1881, Burrow 1971:542f., Hamp 1996): *araṭvá-* '?,' *āgʰāṭí(n)-* 'cymbal player (?),' *iṭátaḥ* gen.sg.(?), *káṭuka-* a. 'acrid,' *kāṭá-* 'pit,' *kīkaṭa-* prop.n., *kúṭa-* '?,' *kṛ́pīṭa-* 'scrub (?),' *kévaṭa-* 'pit,' *jaṭʰára-*, *jáṭʰara-*, *jáṭʰala-* n. 'belly,' *páṭʰarvan-* prop.n., *píṭʰīnas-* prop.n, *vaṭūrín-* '?,' *báṭ* 'surely,' *bīriṭa-* '?,' *bekanāṭa-* '?,' *váṣaṭ* (ritual chant), *víkaṭa-* 'monstrous,' *śakaṭī-* f. 'cart,' *śirímbiṭʰa-* prop.n.

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[3] Aṣṭ. 8.4.20 *antaḥ*, which allows occurrence of the radical *n* of √*an*$^{i}$ 'breathe' in word-final position, is an exception to this rule.

[4] E.g. JB *kṣubʰnuyus*, Aṣṭ. 8.4.39 *kṣubʰnādiṣu ca*.

[5] Although actual forms are not attested in Vedic, Aṣṭ. 8.3.32 *ṅamo hrasvād aci ṅamuṇ nityam* and ŚCĀ 3.2.2 *ṅaṇan ā hrasvopadʰāḥ svare* presuppose the existence of words ending in /ṇ/, and Aṣṭ. 8.4.20 *antaḥ* actually provides final /ṇ/ as in *prāṇ*, voc.sg. of the root noun of *pra* 'forth' + √*an*$^{i}$ 'breathe'.

[6] See Burrow (1976) for more examples. Cf. Kiparsky (1973a:61ff.) and Kiparsky (1993) for blocking in a non-derived environment.

The phonemic status of /ḍ/ and /ḍʰ/ seems to be more established than that of the other retroflex consonants. These phonemes originate from *d and *dʰ to which a preceding */ẓ/ < *ž spread retroflexion in pre-Vedic. /ḍʰ/ also comes from the Proto-Indo-Iranian sequence *ǰʰt by Bartholomae's Law. Since the original context of retroflexion is lost in pre-Vedic, they are synchronically treated as distinct and inherent phonemes (Deshpande 1979:250).

The sequence *-sd- in a RUKI context usually becomes *ḍ* with compensatory lengthening, as *ẓ in the expected outcome ˣẓḍ is eliminated by the unconditional prohibition of voiced sibilants in Vedic (§36):

| | | |
|---|---|---|
| *mr̥ḍá-*[i)] | *mr̥s-d- | adj. 'benevolent' |
| *pipīḍé* | *-pi-sd- | pf.3sg.mid. 'suppressed' |
| *nīḍá-* | *ni-sdó- | m./n. 'nest' |
| *vīḍú-* | *wiH-s-d | adj. 'firm' |

[i)] The initial syllable of *mr̥ḍá-* is metrically heavy (Oldenberg 1888:477).

Most of the apparent exceptions to this development reflect *sd in etymologically non-RUKI contexts, e.g. PIIr. *mn̥s-dʰaH > *medʰā* and *(a)s-dʰí > *edʰí*, except for the pres. stem *sīda-*, whose Proto-Indo-European preform is securely reconstructed as *si-sd-e/o-. Klingenschmitt explains the absence of retroflexion in this stem by analogy to the root √*sad* with dental /d/ (Klingenschmitt 1982:129ff., Görtzen 1998:314).

### §99 Fortunatov's Law and merger of *l and *r

Whether Proto-Indo-European *l and *r have merged in Proto-Indo-Iranian is one of the most heavily discussed questions in the reconstruction of Indo-Aryan (Bechtel 1892:388f., Bartholomae 1894). The main point at issue is whether the language of the Ṛgveda, with few occurrences of /l/,[7] or later Sanskrit with a more extensive phonemic contrast between /l/ and /r/ represents the original distribution of Proto-Indo-European *l and *r in Indo-Aryan. Under one view, PIE *l and *r completely merged in Proto-Indo-Iranian, and Sanskrit words with /l/ are all of secondary origin, such as borrowing from a dialect where Proto-Indo-Iranian *r < PIE *l/*r has changed into /l/ (Bartholomae 1895–1901:23, Hoffmann and Forssman 1996).[8] According to another view, the paucity

[7] According to my count of the electronic texts, the Ṛgveda has 548 instances of /l/ compared to 49,534 /r/'s, while the Atharvaveda in the Śaunaka recension has /l/ and /r/ in the ratio of 1457 to 25,064. The following is the ratio of /l/ and /r/ in each book of the Ṛgveda:

| book | /r/ | /l/ | book | /r/ | /l/ | book | /r/ | /l/ | book | /r/ | /l/ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 9,865 | 108 | 4 | 2,877 | 23 | 7 | 4,191 | 39 | 10 | 8,772 | 185 |
| 2 | 2,314 | 22 | 5 | 3,584 | 17 | 8 | 6,414 | 34 | | | |
| 3 | 3,131 | 36 | 6 | 3,930 | 25 | 9 | 4,456 | 59 | | | |

[8] Bartholomae (1895–1901:23) adds some reservations: "In Folge von Entlehnungen aus nichtarischen idg. Dialekten hat sich aber *l* bereits im Arischen neuerdings festgesetzt. Arisches *r* entspricht somit idg. *r* und *l*, arisches *l* idg. *l*. .... Da es aber auch einige Wörter giebt, deren *l* allen oder der Mehrzahl der neuiranischen Dialekte mit dem Indischen und mit den nichtarischen Verwandten gemeinsam ist, so möchte ich die Möglichkeit nicht in Abrede stellen, dass sich dialektisch das arische *l* im Iranischen als *l*

of /l/ in the Ṛgveda may be explained as a characteristic of the Northwestern dialect, which has undergone a development parallel to Iranian, and the distinction between Proto-Indo-European *l and *r is preserved in the Eastern dialects (Meillet 1912/13:124, 1922:8, Bloch 1965:75, Misra 1967:87, Burrow 1972:535, Cardona 1974:599, Deshpande 1979:263ff., Meier-Brügger 2002:96, Parpola 2002:49f.).

One of the advantages of assuming an *r/*l distinction in Old Indo-Aryan is that a few words with contextually unconditioned retroflex consonants may be explained by Fortunatov's Law, which states that a Proto-Indo-European sequence of *l and a dental consonant (*s, *t, *d, *d$^{h}$ and *n) becomes the corresponding retroflex (/ṣ/, /ṭ/, /ṭ$^{h}$/, /ḍ/, /ḍ$^{h}$/ and /ṇ/) in Indo-Aryan (Fortunatov 1881, Burrow 1971:542f., Hamp 1996). On the other hand, this rule requires either that we posit an *r/*l distinction for Proto-Indo-Iranian, which was then lost in Avestan and Old Persian within Iranian and in the Ṛgvedic dialect of Indo-Aryan, or that we assume two dialects for Proto-Indo-Iranian and Indo-Aryan, one with *r and *l and the other with merged *r. I have not done enough research myself to make a decision on the validity of Fortunatov's and Burrow's etymologies, but under traditional assumptions of historical linguistics, allowing dialectal variation within a reconstructed language could undermine the theoretical rigor of comparative reconstruction (§4).[9]

According to the complete merger hypothesis, Proto-Indo-Iranian *r (< PIE *l and *r) becomes /r/ in some Indo-Aryan dialects and /l/ in others;[10] although there is no /l/ dialect firmly attested in Old Indo-Aryan, it is not necessarily a fiction, for /l/ has actually replaced all *r's in Middle Indo-Aryan languages like Māgadhī (Pischel 1900:§256). Fortunatov's Law is precluded if we take this view, for, even if we suppose that it operated in an /l/-dialect and then the outcome was borrowed into an /r/-dialect (cf. Burrow 1976:40), it would apply to every Proto-Indo-Iranian *rs and *rt, and it would be impossible to limit the conditioning to Proto-Indo-European *l + a dental consonant.

Although Avestan and Old Persian lack /l/ almost completely, a few other Iranian languages such as Ossetic are said to preserve original *l in their vocabulary, e.g. Ossetic *læsæg* 'salmon,' Persian *lištan* and Kurdish *listin* 'lick' (Bartholomae 1895–1901:23, Hoffmann 1958:2, Mayrhofer 1989:10, Thordarson 1989:464, Beekes 1997:17). Among the Nuristani languages, furthermore, Kāmviri (Strand E11) and Kati (Konow 1913) of the Kati-Prasun group have a few words with /l/ which curiously correspond to post-Vedic Indo-Aryan words with /l/: Kāmviri *-kol* noun 'time, season' ~ Skt. *kāla-*; Kāmviri *nilá* adj. (*-i* f.) 'dark (colored), black' ~ Skt. *nīla-*; Kāmviri *lóṭc* adj. 'red (obsolete)' ~ Skt. *lākṣā-* f. 'lac'; Kāmviri *šālí* noun '(unhusked) rice' ~ Skt. *śāli-*; Kāmviri *lizá-* v. 'lick' ~ Skt. √*leh/lih*: *leḍ$^{h}$i*; Kāmviri *lúi*, Kati *luī* 'blood' ~ Skt. *lóhita-* adj. 'red,' n. 'blood' (AV+);[11] Kati *mol, mul* adj. 'dirty' ~ Skt. *mála-* (ṚV+) n. 'filth.' They also have

gehalten hat."

[9]Cf. Hamp (1996:107): "[S]uch a duplicate dialect theory provides a very rich set of sources from which too much might be too easily explained ..."

[10]See Witzel (1990:39ff.) for details of the geographical distribution of /l/ and /r/ dialects.

[11]This word has a parallel form with /r/, *róhita-* (ṚV+), which is not as common as *lóhita-* in later

words with /r/ corresponding to Indo-Aryan /r/: Kati *dār* noun 'wood' ~ Skt. *dāru-* n. 'wood'; Kati *dūr* adj. 'far' ~ Skt. *dūrá-* adj. 'far'; Kāmviri *mārā* noun 'death' ~ Skt. *maraṇa-* n. 'death'; Kati *drgr* adj. 'long' ~ Skt. *dīrghá-* 'long,' cf. Ossetic *darγ*, Gk. *dolikʰós*, Hitt. *daluki-*. As for the Nuristani distinction between /r/ and /l/, I am not sure to what extent it reflects the original Proto-Indo-Iranian state, for some of these words could have been borrowed from Indo-Aryan well after Nuristani branched off from Indo-Iranian. As Ossetic and Nuristani are on the periphery of the development of Indo-Iranian, there is a possibility that isogloss of the merger of Proto-Indo-European *r and *l did not encompass all of Proto-Indo-Iranian but left a relic area unaffected. The alleged examples of FORTUNATOV's LAW, however, lack solid cognates in Iranian or in Nuristani (cf. Burrow 1972:544), and the validity of the proposed law still remains unconfirmed.

### §100 Retroflexion of /n/

In the Prātiśākhyas, neither /ṛ/ nor /r/ is described as a retroflex sound (Varma 1929:6f, Deshpande 1979:284f., §105), but both sounds, along with /ṣ/, spread retroflexion, or the feature [−anterior] (Hall 1997b:47), to an /n/ to its right over any distance up to the end of a word (including compound boundaries),[12] unless a dental, retroflex or palatal plosive or nasal, namely a coronal non-continuant,[13] intervenes.[14] In Aṣṭ. 8.4.2 *aṭ-*, Pāṇini tacitly includes /l/ in the blocking context of this spreading (§66, Cho 1999:80). In the Ṛgveda, there is no context where /l/ occurs between /r, ṛ, ṣ/ and /n/, but the Atharvaveda has a few such words, i.e. AVŚ 1.23.3a *praláyanam* (=AVPO 1.16.3a), AVŚ 8.6.2d *pramīlínam*(=AVPO 16.79.2d), AVŚ 11.9(11).19a *práblīnaḥ*, AVŚ 14.1.60b *úṣpalāni*, AVPO 19.48.15a *śīrṣakapālāni* and /l/ blocks retroflexion of /n/ in all such cases. ŚCĀ 3.4.25 *vyavāye śa-sa-laiḥ* explicitly includes /l/ in the blocking context.

In feature geometry, the Coronal node of Sanskrit /r/, to which [anterior] and [distributed] belong, is said to link to /n/ (Schein and Steriade 1986:718). When /r, ṛ/ or /ṣ/ occurs, the [anterior] feature is set to the value '−', and spreads rightwards until it finds a Coronal node of /n/, whose value of [anterior] is unspecified (§98). This explanation does not preclude that [−anterior] would spread not only from /r/, /ṛ/ and /ṣ/, but also from a retroflex stop or a nasal to a following /n/. In order to exclude this undesirable result, the trigger must be limited to /ṣ/ and /r/. The feature [continuant] distinguishes these two phonemes, which are [+continuant], from plosives and nasals, so we need to stipulate that the trigger of the NATI rule should be [+continuant] (Cho 1999:82), and that the target should be [−continuant]. As mentioned above, /r/ and /ṛ/ themselves may not be [−anterior], for they are pronounced at or in front of the alveolar ridge. I do not

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Sanskrit.

[12] An /n/ at word boundary is excluded from the context (Aṣṭ. 8.4.37 *padāntasya*).

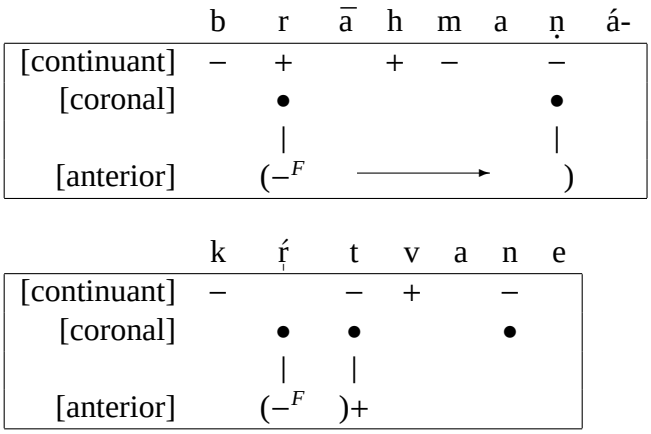
[13] See §40, §62, and Hall (1997b:6ff.) for the coronal status of palatal non-continuants.

[14] Also known as the 'NATI' rule, although *nati-* originally meant retroflexion in general, as ṚPr. 5.61 *eṣā natir dantyam ūrdhanyabʰāvaḥ* shows.

have an explanation for this paradox,[15] but let us assume that they project a token of [−anterior] which, although linked to a [coronal] node, has no [−continuant] node to link to, and remains floating until it finds a [−continuant] Coronal node to its right.

The fact that /l/, coronal plosives and nasals block the spreading of retroflexion can be understood as a result of the prohibition on crossing of association lines (Goldsmith 1976, McCarthy 1989:73). Coronal plosives are represented as a node on the coronal tier, which is dependent on a [−continuant] node. Unlike /n/ and /s/, the value of the feature [anterior] is probably prespecified for coronal plosives (see §98 for unspecification of the feature [anterior] for /n/ and /s/). Because the floating [−anterior] cannot spread across the association line, coronal plosives are opaque to the spreading of retroflexion.

Examples:




### §101 Blocking of the retroflexion of /n/

In Aṣṭ. 8.4.3 to 8.4.39, Pāṇini lists mostly lexical and morphological conditions where the retroflexion of /n/ exceptionally applies or fails to apply. They are very interesting when we consider to what extent this phenomenon is morphophonemic, but the question is beyond the scope of this monograph. One of the rules relevant to our discussion is Aṣṭ. 8.4.37 *pad ā ntasya* [1 *no naḥ*, 34 *na*], where Pāṇini precludes a pada-final /n/ from the context of the NATI rule, e.g. *vṛṣaṇ-aśvéna* :: *vṛṣan* voc.sg. 'male'; *ṛ́ṣ ī ṇ ām* gen.pl. :: *ṛ́ṣ ī n* acc.pl. 'seer.'

Another challenge to the purely phonological character of the retroflexion of /n/ comes from a few Vedic nominal endings with /n/. Two stems in the Ṛgveda ending in *-ṣṭra-*, *r ā ṣṭrá-* 'kingdom' and *úṣṭra-* 'camel,' form genitive plural forms with dental *n*, ṚV 7.34.11a *r ā ṣṭr á n ām* and ṚV 8.5.37, 8.46.22b *úṣṭr a n ām*. Normally, retroflexion spreads to /n/ even when the preceding /ṛ/ is in a cluster with retroflex non-continuants, as in ṚV 1.29.6a *kuṇḍṛṇ ácy ā* '?' (=AVŚ 20.74.6). Wackernagel (1896:166f.) suspects that *r* in these forms was not actually pronounced, as TS *tváṣṭ ī mat ī* (TS 1.2.5.2,

[15] If /r/ and the rhotic part of /ṛ/ are flaps as we assume (§66), the tongue tip strikes the alveolar ridge while it is being retracted. So the tongue tip might be behind the alveolar ridge, i.e. [−anterior], when the articulatory gesture is complete. The Śikṣā literature describes /r/ as cerebral (Varma 1929:6ff.). Cf. Hall (1997a:215n), who argues that alveolar *r developed into retroflex [ɽ] in Sanskrit.

6.1.8.5) has *tváṣṭīr-* instead of *tváṣṭrī-*. Forms of *rāṣṭrá-* and *tvāṣṭrá-* with expected *ṇ* are found in the Atharvaveda, AVŚ 6.78.2b *rāṣṭréṇa* (=AVPO 19.16.10b), AVŚ 7.74.3a *tvāṣṭréṇa* (=AVPO 20.31.9a), AVŚ 19.30.3d *rāṣṭrā́ṇi* (=AVPO 12.22.12d). Both the Ṛgveda and the Atharvaveda have forms with retroflex *ṇ* for stems ending in *-tra-*, i.e. ṚV 1.162.19c *gā́trāṇām*, ṚV 1.162.20d, 9.83.1b, AV *gā́trāṇi*, ṚV 10.85.2c, AV *nákṣatrāṇām*, *nákṣatrāṇi*, ṚV, AV *vástrāṇi*, ṚV 1.162.13b, 10.44.5d, AV *pā́trāṇi*, ṚV 2.24.10b *suvidátrāṇi*, ṚV 3.33.13b, AV *yóktrāṇi*, ṚV 6.61.14d, AV *kṣétrāṇi*, AV *kṣatrā́ṇām*, ṚV 8.49.2d, AV *dátrāṇi*, AVŚ *amítrāṇām*, *áritrāṇi*, AVPO *putrāṇām*.

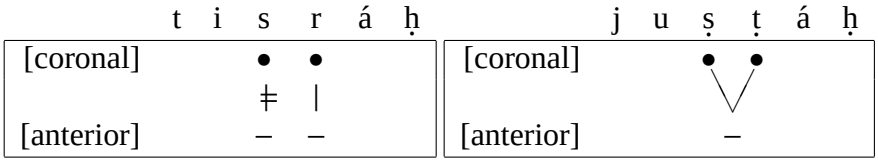
| | /ṣṭr...n/ | /tr...n/ | /ḍṛn/ |
|---|---|---|---|
| ṚV | always *n*[3] | always *ṇ* | *kuṇḍṛṇā́cyā* |
| AV | always *ṇ*[3] | always *ṇ* | =ṚV |

This problem will be discussed in further detail in §106.

### §102 Retroflexion of /s/ and /st/

The retroflexion of /s/ and /t/ is different from that of /n/: the former takes place when the trigger and the target are adjacent, while in the latter they have to be local only on the [coronal] autosegmental tier. Indeed, even the nature of retroflexion may be different between /s/ or /t/ and /n/, as we will argue in §103.

The retroflexion of /s/ and /t/ is triggered in different contexts: whereas /t/ becomes retroflex basically only when it is preceded by /ṣ/ (either from the RUKI rule, from Proto-Indo-Iranian primary palatal *ć and *ǰ, or from PIIr. *ćš; see Hall 1997a:213f.), /s/ becomes retroflex after any of the following phonemes, i.e. consonantal or nucleus-forming /r/, the high vowels /u/ and /i/ and their diphthongs /e/ /o/ /ai/ /au/, and velar stops. Instead of assuming successive retroflexion first of /s/ and then of /t/, it would be simpler to consider that the RUKI rule cerebralizes /s/, and /st/ as a unit. Both /s/ and /st/ are unspecified for the feature [anterior] in the Underlying Representation, and the RUKI context gives them a single token of [−anterior], which is multiply linked to /s/ and /t/ in the cluster /st/.[16] In the blocking of RUKI retroflexion before an /r/ as in *tisráḥ*, on the other hand, the RUKI context tries to assign [−anterior] next to the already existing [−anterior] of /r/, and is blocked by the Obligatory Contour Principle:




[16]That the /s/ in the cluster /st/ is licensed as an extrasyllabic sibilant (§31) should also be recalled. The left-to-right spreading of [−anterior] to the cluster /st/ in a RUKI context might suggest that /s/ is parasitically licensed (§77) to have [−anterior] as in BARTHOLOMAE'S LAW (§80) and the principle of COHESIVE CLOSURE (§28), although unassimilating sandhi as in *ṣaṭ-triṃśá-* speaks against this.

In Vedic, the RUKI rule often applies across a compound boundary (Wackernagel 1896:236), e.g. in *ágnī́-ṣóm ā* du.nom-voc. 'Agni and Soma' (ṚV) or in *su-ṣóma-* 'having much Soma,' as well as between a preverb and a verb as in *ní ṣeduḥ*. The rule strangely fails to apply when the first member ends in /k/, e.g. *ṛ́k-sāmá-* 'ṛc and sāman' (ṚV+), AVŚ 19.22.19 *pṛt$^{h}$ak-sahasraṁ́ āb$^{h}$y āṃ*, or Kātyāyana-Śrautasūtra 21.3.28 *dik-srakti-* adj. 'having edges in the four directions,' although there is also a retroflexed form, TS 4.3.2.2 *ṛ́k-ṣamam* 'equal to a ṛc.'

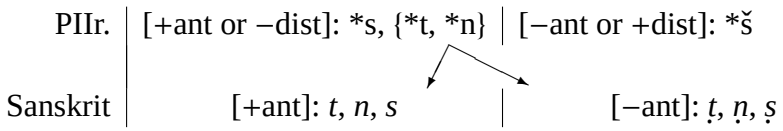
## §103 Features triggering and affected by the RUKI rule

The cognates of Sanskrit /ṣ/ in other Indo-European languages such as

| PIE | Skt. | Av. | Lith. | OCS. |
|---|---|---|---|---|
| *u̯r̥s- 'top' | *várṣman-* | | *viršùs* | *vrŭxŭ* |
| *pr̥s- | *pr̥ṣṭ$^{h}$a-* 'back' | *paršta-* 'backbone' | *pìršt*as 'finger' | *prŭstŭ* 'finger' |

(Meillet 1922:84f., Hock 1991:443)

suggest that /s/ in a RUKI context was originally alveopalatal or palato-alveolar and not retroflex. In terms of distinctive features, the retroflexion of /s/ and /st/ began either as a change from [+anterior] to [−anterior], or from [−distributed] to [+distributed], whereas the retroflexion of /n/ in Old Indo-Aryan can only be described as a change in the value of the feature [anterior]. The feature [anterior] distinguishes places of articulation, with [−anterior] covering places behind the alveolar ridge, while [distributed] is related to the contact, with [+distributed] referring to a broader contact of the tongue with the palate.




After Indo-Aryan branched off from Proto-Indo-Iranian, two changes took place, namely assibilation of PIIr. *ć to pre-Vedic */ś/ ([ɕ] or [ʃ], Hall 1997a:208n) and retroflexion of PIIr. *š to pre-Vedic */ṣ/ ([ʂ]).

Identifying the feature responsible for the RUKI rule is one of the most difficult questions in Indo-European phonology. Allen (1974:102f.) believes that there is no distinctive feature which characterizes the entire RUKI context. According to the Prātiśākhyas,[17] Sanskrit /r/ is articulated at an alveolar place. Since the other triggers of the RUKI rule, i.e. /i/, /u/, their diphthongs /e/, /o/, /ai/ and /au/, and obstruents originating from Proto-Indo-European fronted velar, velar and labiovelar stops (Hoffmann and Forssman 1996:104), have their primary places of constriction further back in the oral cavity, the original operation of the rule probably retracted a following /s/ from the pre-alveolar region. This suggests that the alternation of the Proto-Indo-European sibilant *s in the RUKI languages

[17] TPr. 2.41 *rep$^{h}$e jihv ā gramad$^{h}$yena pratyag dantam ūleb$^{h}$yaḥ* "In *r*, with the middle of the tip of the tongue, back of the roots of the teeth" (Whitney 1868:74). See Allen (1953:54) and Deshpande (1975:200).

primarily involved the feature [anterior], until Indo-Aryan added the third sibilant /ś/ by the deocclusion of PIIr. *ć, thereby restructuring the featural contrast among its sibilants. Among the places of articulation of Proto-Indo-European phonemes, namely labial, dental or alveolar, fronted velar, velar, labiovelar and pharyngeal, those consonants which trigger the RUKI rule have their primary places of constriction between the alveolar ridge and the soft palate. The high vowels are closer to the palates in vocoid space than the non-high vowels. If I may use loose terminology, all the phonemes triggering the RUKI rule are articulated on or close to the upper part of the jaw, and it is consistent with our observation that the RUKI rule originally affected the value of the feature [anterior] of PIE *s (§103), for the change from [+anterior] to [−anterior] means that the place of articulation shifts from the upper teeth or gum to the upper jaw.[18]

When PIIr. *ć was assibilated to */ś/, a contrast of three sibilants arose (Hall 1997a:217), which required at least two distinctive features, and [distributed] started serving to distinguish between */s/ and */ś/. Then, as PIIr. *š shifted to retroflex */ṣ/ in Indo-Aryan,[19] the contrast between */s/ and */ṣ/ came to be made only by the feature [anterior].[20]

The development of the sibilants would be chronologically ordered as follows:

| | events | contrasts and features involved |
|---|---|---|
| PIIr. | | *s : *š ([±ant]) |
| | Indo-Aryan diverges | |
| | palatal *ć loses occlusion | near merger with *š![i)] |
| | [dist] becomes distinctive | *s : *š ([±ant]+[±dist]),[ii)] *s : *ś ([±dist]) |
| | retroflex series emerges | *s : *ṣ ([±ant]), *s : *ś ([±dist]) |
| Ved. | | *ṣ/ṭ$^{(h)}$/ḍ$^{(h)}$/ṇ* : *s/t$^{(h)}$/d$^{(h)}$/n* ([±ant]), *s* : *ś* ([±dist]) |

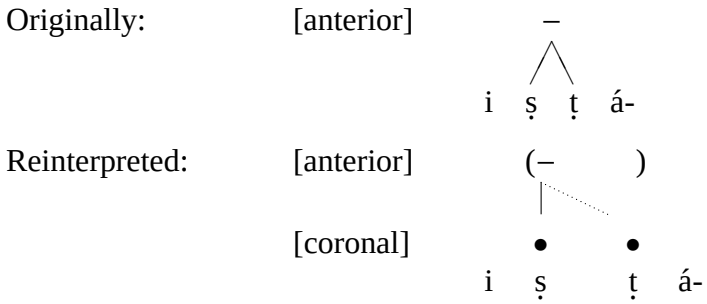
[i)] See Labov (1994:20) on near merger. Cf. Polish which distinguishes palatalized [ʃ] from alveopalatal [ɕ]. [ii)] [distributed] might first have been *added* to the existing [anterior] contrast (Buckley, p.c.).

Although /ṣ/ and /ṣṭ/ were initially limited to the RUKI context, non-RUKI /ṣ/, /ṣṭ/, and even /ṭ/ by itself begin to appear in the Vedic period. The phonemicization of retroflex obstruents must have caused a reinterpretation of the originally allophonic alternation of /s/ and /(s)t/ with /ṣ/ and /(ṣ)ṭ/. Retroflexion of /t/, which in the beginning was entirely concomitant with the retroflexion of /s/ and had nothing to do with that of /n/, came to be reinterpreted as caused by the spreading of [−anterior] from /ṣ/:

[18]Cf. Grammont (1916:248): “Avec cette position de la langue, toutes les fois que l’*s* est précédé d’un phonème qui demande une fermeture buccale considérable et par conséquent réduit l’espace où la langue peut se disposer, elle se trouve occuper la position ordinaire pour un *s* palatalisé ou chuintant.”

[19]See Hall (1997a) for a typological discussion of the motivation of this shift.

[20]Alternatively, if there is a feature which refers only to the configuration of the active articulator, for example [apical], it might be less confusing than the matrix of [anterior] and [distributed]. As Ladefoged and Bhaskararao (1983) show with regard to the articulation of /ṭ/ in modern Indian languages, however, different shapes of the tongue tip are possible in producing a retroflex sound, and it is impractical to discuss the tongue shape of pre-Vedic retroflexion without further philological evidence.




The reinterpretation of *ṣṭ* as spreading of [−anterior] from /ṣ/ to /t/ leads to the backward spreading of retroflexion from *ṭ* to /s/, as we will discuss in §107.

### §104 Merger of /s/ and /r/ at word boundary

Indo-Aryan /s/ and /r/ contrast phonemically, and there is no phonological rule which causes merger or alternation of them in initial or medial position. They differ in phonotactics as well: /s/ never follows /m/ while /r/ does (§62 and §67), and both voiced and voiceless, aspirate and unaspirated stops precede /r/ while only voiceless unaspirated ones can precede /s/. In word-final position, however, these sounds almost merge, alternating with each other depending on the context.

As Allen (1962:58) points out, two processes seem to underlie the near-merger of /s/ and /r/ in word-final position: voicing of /s/ to an intermediate phoneme *z, which is eliminated in the Surface Representation (§36); and the RUKI rule, which adds the feature [−anterior] to /s/ and changes it into retroflex *ṣ* (§103). To the best of my knowledge, however, native grammarians do not make any statement which supports the idea that the *r* coming from a word-final /s/ has fricative nature (cf. Allen 1953:54). In an ingenious argument couched in the theory of Radical Underspecification, Cho (1999:66f.) proposes that /s/ and /r/ differ only for the feature [voiced] in the Underlying Representation, and values of the features [−anterior] and [+sonorant] of /r/, which are also different from those of /s/, are filled by redundancy rules later in the derivation. Assuming that [voiced] is a privative feature, /s/, /ṣ/ and /r/ originally have the following values for each feature:

| | [sonorant] | [continuant] | [anterior] | [voiced] |
|---|---|---|---|---|
| /s/ | [−son] | | | |
| /ṣ/ | [−son] | | [−ant] | |
| /r/ | | | [−ant] | [voiced] |

Although /r/ itself need not necessarily be [−anterior] (§105), I list it here,[21] first because both /r/ and /ṣ/ trigger spreading of [−anterior] to an /n/ to their right (§100), and also because the RUKI rule is blocked before /r/ as in *tisráḥ*, f.nom.acc.pl. of *trí-* num. ‘three’ by the Obligatory Contour Principle (§106), which prohibits two independent tokens of [−anterior] from occurring next to each other.

Two rules which apply across a word boundary, namely the RUKI rule, which adds retroflexion ([−ant]) to /s/, and voicing assimilation which, as Allen (1962:58) suggests,

[21] See §100 and Varma (1929:6ff) for grammarians’ discussion on the place of the articulation of /r/.

voices /s/ (> /ṣ/) before it ends up as *r*, give rise to the following variation of word-final /s/ and /r/ in final position:

| right | _{$C_{[0vcd]}$, ##} | | _{V, $C_{[vcd]}$} | |
|---|---|---|---|---|
| left | a_ | {i,u,(r̥)}_ | a_ | {i,u(,r̥)}_ |
| /s/ | ḥ, s | ḥ, s(, ṣ)[i)] | /y/, /w/[ii)] | r |
| /r/ | ḥ, s | ḥ, s(, ṣ)[i)] | r | r |

i) Before /k, $k^h$/ or /p, $p^h$/. (Allen 1962:73).

ii) Allen (1962:61, 71).

Except in the third column, the alternation pattern of /r/ is the same as that of /s/. This can be counted as a case of contextual neutralization, which Kiparsky (1973a:14) illustrates with examples of final stop devoicing in German such as

| | | | | | | |
|---|---|---|---|---|---|---|
| *bunt* | /bunt̲/ | 'variegated' | ~ | *buntes* | /bunt̲əs/ | n.sg.nom.-acc. |
| *Bund* | /bunt̲/ | 'ally' | ~ | *Bundes* | /bund̲əs/ | sg.gen. |
| *Rat* | /ra:t̲/ | 'counsel' | ~ | *Rates* | /ra:t̲əs/ | sg.gen. |
| *Rad* | /ra:t̲/ | 'wheel' | ~ | *Rades* | /ra:d̲əs/ | sg.gen. |

Although the stem-final voicing distinction is neutralized word-finally in the pairs on the left, there is a clear voicing distinction in the forms with overt endings. There is usually no confusion with respect to the underlying voicing distinction, nor analogical spreading from one to the other. And both the voiced and voiceless finals are common enough that neither can be taken as a default case. The presence or absence of the feature [voiced] is considered to be lexically specified in the Underlying Representation of these German words.

In the case of Sanskrit final /s/ and /r/, on the other hand, it is not economical to specify the presence of the feature [voiced] in the Underlying Representation, because the former is much more common than the latter; this is particularly so as final /r/ after the vowels /i/ and /u/ patterns in exactly the same way as final /s/ after /i/ and /u/, and final /-ar/ is the only case in which words ending in /r/ show a distinct alternation pattern. It is a burden to memory and mental representation (§9) to invoke the prehistoric difference between *-s and *-r in order to explain the synchronically unpredictable sandhi alternation of *-ar, examples of which are few in number (*áhar*, *ū̀dʰar*, *púnar*, *pr ā́tár*, *svàr*, *dv ā́r*, *vádʰar*, *v ā́r*); instead, a more economical solution is to specify the underlying /-ar/ lexically. Synchronically, /r/ and /s/ do not contrast in word-final position, and their distribution is determined entirely by rule, except for a few lexical exceptions with etymological *-ar. In other words, the feature [sonorant] in addition to [anterior] is despecified for /s/ and /r/ word-finally.

Since Proto-Indo-Iranian is considered to have had *z and *ž (Hoffmann and Forssman 1996:104) which did not develop like pre-Vedic word-final *[z] supposedly did, a chronological order like the following is assumed:

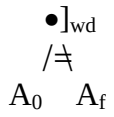
1. Proto-Indo-Iranian: *z and *ž are allophones of *s and its RUKI-rule alternant *š before voiced stops, i.e. in the context _$C_{[voiced,-sonorant,-continuant]}$.

E.g. PIIr. *mn̥z-d$^{h}$ā > Av. *mazdā*, Ved. *medʰā́*, *mižd$^{h}$a- > YAv. *mīždа-*, Ved. *mīḍʰá-*; *u̯aj-ž$^{h}$at > YAv. *-uuažat*, Ved. *vákṣat*.

2. Divergence of Indo-Aryan and Iranian.
3. Elimination of *z and *ž in pre-Vedic, with compensatory lengthening and transfer of retroflexion from *ž to a following *d or *d$^{h}$.
4. Synchronic voicing assimilation at word boundary in Sanskrit.

### §105 Alveolar place and coronalization

The alteration of a Proto-Indo-Iranian primary palatal into a retroflex stop in word-final position essentially amounts to delinking of a fricative root node which cannot appear in coda (§31), including at the end of a word (§30). This delinking is represented as follows:




PIIr. *ć > /ṭ/, *ǰ$^{(h)}$ > /ḍ/ / V$_{(¬r̥)__}$ ]$_{wd}$. The sequence ˣr̥ṭ/r̥ṭ might be avoided, for a final primary palatal preceded by /r/ or /r̥/ becomes *k* in Vedic, as in *dr̥ś-* : *-dŕ̥k*, *ūrj-* : *ūrk*, *d$^{h}$r̥h-* : *d$^{h}$r̥k* (Wackernagel 1896:173). However, such dissimilation does not occur in TS *ny àmārṭ* (TS 7.1.1.2, 7.1.1.3, 7.1.5.1), ipf. of √*marj/mr̥j* 'wipe,' Aṣṭ. 8.2.39 *j$^{h}$alāmjaśo 'nte* (Cardona 1997:348, 351).

If Sanskrit plosives of the palatal series are actually prepalatal or alveopalatal affricates (§46, §38), the closure part in itself would be a postalveolar or alveolar stop.[22] In that case, stops articulated at that place might have been taken as belonging to the retroflex series in the phonemic system of Old Indo-Aryan.[23]

While the idea that consonants originally articulated further back than the alveolar ridge in the hard palate developed as retroflex makes it easier to explain the origin of Sanskrit retroflex obstruents, the retroflexion of /ṇ/, which comes from second-hand spreading of [−anterior] from an /r/ or /ṣ/ to its left, might be due primarily to the configuration of the active articulator like [laminal] and [apical] or [sublaminal] and originally have had nothing to do with place (cf. the term *nati-* 'bending'; Allen 1953:66).

Of the places of articulation of Proto-Indo-European phonemes, fronted velars and palatalized velar and labiovelar stops (other than the voiced aspirates *ǵ$^{h}$, *g$^{h}$ and *g$^{wh}$) become palatal obstruents; in other contexts these dorsal stops collapse into a single

[22] On the basis of palatograms, linguograms and X-ray pictures, Recasens (1990:270) concludes that [ʃ] and [ʧ] are primarily lamino-postalveolar.

[23] This explanation is essentially along the lines of Bartholomae (1896:705f.) and Bloch (1965:56), except that Bartholomae estimates the original phonetic value of Sanskrit /ś/ at '*ṭš*.' L. Bloomfield (1911:50ff.) also considers that word-final primary palatals directly become retroflex, but explains the retroflexion as a consequence of apical articulation of Indo-Aryan palatals. Kuryłowicz (1956:373f.), Burrow (1965:91f.), Kuiper (1967b:113ff.), Hock (1975b:218) and Jamison (1991:83f.) give different explanations.

velar stop, neutralizing the original threefold contrast (§45). As a result, a significant portion of Proto-Indo-European consonants have been replaced by coronal obstruents.

Palatalization itself is a repeatable change which occurs in many languages including Iranian, Balto-Slavic, Celtic, Romance and Tocharian, and does not crucially mark off Indo-Aryan from the rest of the Indo-European languages. However, the alternation of the palatal obstruents originating from Proto-Indo-European fronted velars with retroflex obstruents in coda and word-final position, where frication cannot occur, is unique, as a retroflex series is unknown in other branches of Indo-European until modern times. Since coronal configuration, i.e. the shape of the front of the tongue which distinguishes apical from laminal, is added to the original contrast of place of articulation, this change can be called 'coronalization.'[24]

### §106 [−anterior] as an autosegment

The difference between /ṣ/ and /ṭ/ is that the former propagates retroflexion to its right, while the latter is only a target of retroflexion and does not itself spread retroflexion to its right.

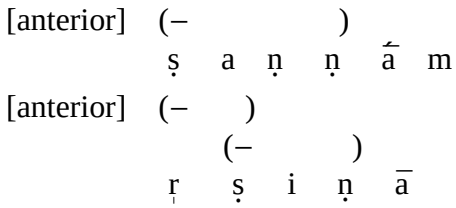
Spreading of retroflex articulation can be represented by an autosegmental tier of the feature [anterior]. On this autosegmental tier, being retroflex, i.e. [−anterior], is marked, and [+anterior] is the default value. Since the spreading of [−anterior] is blocked when an [$\alpha$anterior] value is prespecified, retroflexion can be represented as a domain on this tier. The segments which begin this domain, namely /r/ and /ṣ/, are represented as '(−' with a left parenthesis on this tier; on the other hand, /ṭ/, /ṭ$^{h}$/, /ḍ/ and /ṇ/ have a right parenthesis '−)' to their right, for the retroflexion domain ends there. This representation helps to illustrate the phenomenon that retroflexion of /n/ takes place only once and does not iterate.[25] The segments marked with left and right parentheses of the [−anterior] domain are respectively the trigger and the target of retroflexion.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| [anterior] | | | (− | | | ) | |
| | ś | ú | ṣ | k | a- | ]$_{wd}$ | |
| [anterior] | + | | ⋆− | (− | | | ) |
| | t | i | s | r | á | ḥ | ]$_{wd}$ |

As we saw in §102, the Obligatory Contour Principle blocks juxtaposition of two tokens of [−anterior] as in ˣtiṣráḥ or ˣárṭ$^{h}$a-. On the contrary, the domain of retroflexion has only one token of [−anterior], which is multiply linked to all coronals in the domain. One token of [−anterior] may be linked to more than two coronals in a domain, and one word may have more than one domain of [−anterior]:

[24]Cf. Grammont (1916:250): "L'indo-iranien est de tous les dialectes indo-européens celui où se manifeste avec le plus de netteté et d'énergie la tendance au rassemblement des articulations vers le milieu de la voûte palatine."

[25]Kiparsky (1985:113): "... that our version of the rule is fully compatible with the interpretation of unbounded processes as *iterations of local processes*. This view of long-distance propagation is supported by the well-known observation that processes only propagate when the target is itself a trigger of the rule (...)."



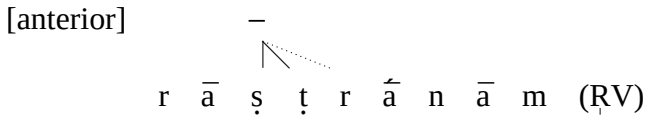

In §101, we noted a puzzling blocking of retroflexion in the Ṛgvedic gen.pl. forms of two stems in *-ṣṭra-*, ṚV 7.34.11a (poet: Vasiṣṭha) *r ā́ṣṭr ān ām* and ṚV 8.5.37 (Brahmātithi Kāṇva), 8.46.22b (Vaśa Aśvya) *úṣṭr ān ām*. There are several possible explanations for that blocking:

i) The retroflexion spreading to /n/ might originally have operated in a smaller domain than the word. However, the Ṛgveda has several examples of retroflexion spreading across a fairly long distance, e.g. *ṛg$^h$ āyám āṃ-*, 1.33.3c *coṣk ūyám āṃ*, 2.37.5a *nṛ-v áhaṇam*, 2.39.2a *pr ātar-yáv āṃ*, 4.32.24a *usrá-y āṃṣé*, 6.7.3d *spṛhay áyy āṃ*, 8.45.35b *ab$^h$iprab$^h$aṅgíṇaḥ*, or across word boundaries as in 9.103.4a *pári ṇet á*.

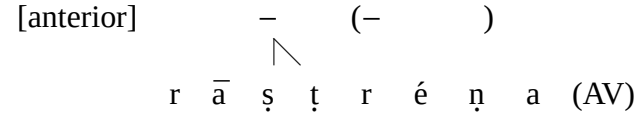
ii) The difference between the Ṛgveda and the Atharvaveda might be due to dialectal variation, but the three passages in the Ṛgveda do not give us any evidence to favor that possibility. Burrow (1971) argues that more and more dentals become retroflexed within Old Indo-Aryan, and the ratio of retroflex *ṇ* to dental *n* does increase slightly between the Ṛgveda and the Atharvaveda (ṚV 26.5% : AVŚ 28.9%).

iii) Another possibility is that the blocking in the Ṛgveda represents an original restriction on retroflexion spreading. We have no reasonable grounds to think that the /r/ in the cluster *-ṣṭr-* was not pronounced (cf. Wackernagel 1896:166f., §101); it is not inconceivable, however, that it did not form an autosegmental domain of [−anterior] as we assume for other cases of /r/. It is known that the RUKI retroflexion never applies to an /s/ followed by an /r/, e.g. *tisráḥ*, *sisrate*, *támisra-*, *parisrúta-*, *vísṛṣṭa-* (ṚV). In these forms, /i/ fails to cause retroflexion of the following /s/ because the /r/ which immediately follows the /s/ projects [−anterior], and two adjacent occurrences of the same feature violate the OBLIGATORY CONTOUR PRINCIPLE. If we assume that the /r/ following /ṣṭ/, /ṭ/, /ḍ/ or /ḍ$^h$/ does not begin a [−anterior] domain of its own, the strange blocking of /n/ retroflexion becomes understandable. In such sequences, the [−anterior] feature of /r/ is linked together to the [−anterior] of the preceding obstruent cluster, which does not trigger retroflexion further to its right.

According to the third explanation, *r ā́ṣṭr ān ām* is represented as follows:



Later in Vedic, autosegmental spreading of [−anterior] is introduced after the model of other forms with /r/:




The contexts for assimilation and dissimilation may be summarized as follows:

| unretrofl. | retrofl. | reason |
|---|---|---|
| *-{r/ṛ}j́ > -*ṛk* (*dṛ́k*) | : ×dṛ́ṭ, *am ārṭ* | blocking by OCP (except *am ārṭ*) |
| *tisráḥ* | : ×tiṣráḥ | blocking by OCP |
| *r āṣṭr ánām* | : ×rāṣṭrāṇām | multiple linking of the whole cluster to [−ant] (ṚV) |
| ×rāṣṭréna | : *r āṣṭréṇa* | analogical introduction of [−ant] domain? (AV) |
| ×justá- | : *juṣṭá-* | multiple linking of [−ant] to *st |
| ×kṣvinna- | : *kṣviṇṇa-* | /nn/ is unspecified for [ant] |
| ×havíssu | : *havíṣṣu* | /ss/ is unspecified for [ant] |
| ×sáṭ | : *ṣáṭ* | projection of the left boundary of the [−ant] domain (§107) |

### §107 Backward spreading of retroflexion to /s/

The stem form of the Vedic word for ‘six’ is traditionally given as *ṣáṣ-*. From a diachronic point of view, the quasi-intermediate stem form *ṣáṣ-* is not necessary, for PIE *su̯éḱs ‘six,’ which is reconstructed from Gk. *héks* (Heraclean *wéks*), Welsh *chwech*, Av. *xšuuaš* etc., can develop into Vedic *ṣáṭ* and its derivatives *ṣaṣṭí-*, *ṣaṣṭʰá-* and *ṣoḍʰā́* without positing an intermediate form *ṣáṣ- (Whitney 1889:51).

The initial /s/, which is preceded by no known RUKI context, shows unexpected retroflexion. Wackernagel (1896:224f.) points out on the one hand that initial *s- tends to be assimilated to a sibilant following it across one nucleus,[26] and on the other that the initial /s/ of the root √*sah* ‘subdue’ is retroflexed when the root ends in *ṭ*. Meillet (1905–1906:420) explains the retroflexion of the initial /s/ as assimilation to final *š before it became *ṭ*, like the initial *ś* in *śváśuraḥ*. Schindler (1972:48) suggests that the final *ṭ* of *ṣáṭ* may have assimilated the initial /s/,[27] and Renou (1952:110) appears to think likewise.[28]

The following are the Ṛgvedic forms in which *ṭ* is not directly preceded by *ṣ*:

√*īḍ* ‘praise’: *ī́ṭṭe* 1.180.2, 5.12.6, 3.52.5, *ī́ṭṭe*[9]. *aiṭṭa* 3.48.3.

[26] “Wurde gern anlautendes *s* an *ś ṣ*, das am Schluss der Silbe oder am Anfang der zweiten Silbe stand, assimiliert ...”

[27] “[D]as *ṣ-* in *ṣ ā́ṭ* spricht nicht für Ablösung aus Komposita (AiGr. 2.2.10), sondern ist wie in *ṣáṭ* “sechs” durch Assimilation von *s-* an das auslantende *-ṭ* zu erklären ...”

[28] “*pṛtan āṣā́h-* ... s’est constitué d’après les autres composés en *ṣ āh-* ... La présence d’une cérébrale finale a contribué sûrement à accréditer le *ṣ*, comme on le voit par le mot *ṣáṭ* “six”, qui comportait préhistoriquement un *s-* dental.”

√*naś/aś* ‘reach’: *ānaṭ*[10], *ānaṭ*[12]. *udānaṭ* 10.19.5, 10.19.5. *naḍ* 7.104.23.
√*bʰrāj* ‘shine’: *ábʰrāṭ* 1.66.6, 4.6.5. *bʰrāṭ* 10.123.2. *vibʰrāḍ* 10.170.1, 10.170.2. *viśva-bʰrāḍ* 10.170.3.
√*vah* ‘carry’: *’vāḍ* 10.15.12, *dakṣiṇā-vāḍ* 3.6.1. *havir-vāṭ* 1.72.7. *hávya-vāṭ* 5.6.5. *havya-vāḍ* 1.12.6. *havya-vāṭ* 1.67.2, 3.27.5, 8.56.5. Cf. TS[3] *paṣṭha-vāḍ* ‘four-year-old bull’ (Wackernagel 1986:180).
√*rāj* ‘shine’: *rāṭ* 6.12.5.
√*sah* ‘subdue’: *ṣāṭ* 1.63.3. *turāṣāṭ* 5.40.4, 6.32.5, 10.55.8. *niṣṣāṭ* 1.181.6. *pr̥tanāṣāṭ* 3.29.9. *virāṣāṭ* 1.35.6. *vr̥thāṣāṭ* 1.63.4. *vaneṣāṭ* 10.61.20. *satrāṣāḍ* 7.20.3.
√*spaś* ‘look’: *viṣpáṭ* 1.189.6.
√*prac*[h]*/praś* ‘ask’: *ápr̥āṭ* 10.32.7.
*ṣáṭ* num. ‘six’: *ṣáṭ*[5]. *ṣaḍbʰír* 2.18.4. *ṣáḍ-vidʰān āḥ* 7.87.5. *ṣaṭ-triṃśáṃś* 10.114.6.
*jaṭʰára-* n. ‘belly’: *jaṭʰára-*[30]. *vāja-jaṭʰaró* 5.19.4. *jáṭʰalasya* 1.182.6. *jáṭʰarasya* 1.112.17.
*rāj-* ‘ruler’: *rāṭ* 1.121.3, 5.46.8. *samrāṭ*[8]. *virāṭ* 1.188.5, 10.159.3. *vane-rāṭ* 6.12.3.
*sarágʰ-* f. ‘bee’: *saráḍbʰyas* 1.112.21.
*víś-* f. ‘settlement’: *víṭ* 1.72.8, 7.56.5, 9.88.7. *viḍbʰír* 10.28.8.
others: *araṭvé* 8.46.27. *āgʰāṭíbʰir* 10.146.2. *iṭáto* 10.171.1. *káṭukam* 10.85.34. *kāṭé* 1.106.6. *reṇúkakāṭo* 6.28.4. *kīkaṭeṣu* 3.53.14. *kúṭasya* 1.46.4. *kūṭam* 10.102.4. *kr̥pīṭam* 10.28.8. *kévaṭe* 6.54.7. *páṭʰarvā* 1.112.17. *píṭʰīnase* 6.26.6. *bīriṭa* 7.39.2. *báṭ* 8.101.12. *bekanāṭām* 8.66.10. *māṭr̥bʰyo* 1.95.7. *mahāvaṭūriṇā* 1.133.2. *víkaṭe* 10.155.1. *vípāṭ* 3.33.1. *vaṭūríṇā* 1.133.2. *váṣaṭ*[12]. *śakaṭīr* 10.146.3. *śirímbiṭʰasya* 10.155.1. *śráuṣaṭ* 1.139.1.

Among these cases, all /s/’s preceding *ṭ* are retroflex except in *samrāṭ* and *sáṭ*, namely *turāṣāṭ*, *niṣṣāṭ*, *pr̥tanāṣāṭ*, *vaneṣāṭ*, *váṣaṭ*, *vi-ṣpáṭ*, *virāṣāṭ*, *vr̥thāṣāṭ*, *śráuṣaṭ*. *ṣáṭ*, *ṣaṭtriṃśáṃś*, *ṣāṭ*.

Since the /s/ in *vi-ṣpáṭ*, *śráuṣaṭ* (and *niṣ-ṣāṭ*) is in a RUKI context anyway, the examples with *ṣ* occurring before *ṭ* are reduced to *ṣáṭ*, *ṣāṭ*, *váṣaṭ* (and possibly *niṣ-ṣāṭ*). Still, the following alternation pointed out by Pāṇini, Aṣṭ. 8.3.56 *saheḥ sāḍaḥ saḥ* [39 *ṣaḥ*, 55 *mūrdʰanyaḥ*], tempts us to pursue the regularity of this assimilation:

| | | | | |
|---|---|---|---|---|
| *satrāṣāṭ* | : *satrāṣāham* | but also | *pr̥tanāṣāṭ*[5] : | *pr̥tanāṣāham*[1] |
| *viśvāṣāṭ* | : *viśvāṣāham* | | | *pr̥tanāṣáham* |
| *turāṣāṭ* | : — | | | (SV *pr̥tanāṣáham*) |
| *janāṣāṭ* | : — | | | *pr̥tanāṣáhas* |
| *virāṣāṭ* | : — | | | |

(Lanman 1877:463, 499, Thieme 1935:29f.)

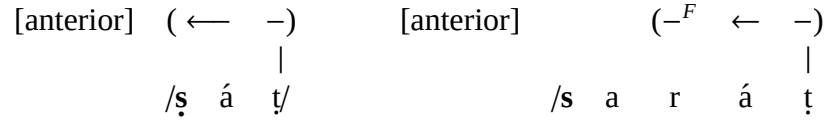
We remarked in §103 that the retroflexion of /st/, initially a strictly local spreading, would have been reinterpreted as an autosegmental spreading like the retroflexion of /n/. If that is the case, it is also possible that /ṭ/ spreads retroflexion backward until it finds an /s/, whose retroflex counterpart /ṣ/ functions synchronically as a trigger for the retroflexion of /t/. In other words, /ṭ/ is represented on the [anterior] tier with a right boundary of the marked ‘−’ domain. This /ṭ/ is reinterpreted as a target of retroflexion

spreading, and since a target must have a trigger (but not vice versa), the /s/ to its left serves as an available trigger.

The reason why *samr̄ā́ṭ* and *saráṭ* (nom.sg. of *sarág$^h$*-) do not become ˣṣamrā́ṭ or ˣṣaráṭ is that the left boundary anchors on the /r/ which intervenes between /ṭ/ and /s/, and fails to extend to the latter; the left boundary of the [−anterior] domain stops at the floating [−anterior] of /r/:

> Rule: /ṭ/ spreads retroflexion to an /s/ to its left, unless a coronal plosive or an /r/ intervenes.
>
> [anterior] (− ⟵ )
> /s ..... ṭ/

illustration:




The right-to-left spreading of [−anterior] also seems to work for final /ḍ/ which alternates with final /ṭ/, and probably for /ḍ$^h$/ as well, for /s/ in *á-ṣ r̄ā́ḍ$^h$a-* and *ṣoḍ$^h$ā́* is retroflexed although the context does not trigger the RUKI rule. Outside the Ṛgveda, Kātyāyana-Śrauta-Sūtra *ṣaṇḍ$^h$a-* 'eunuch' fits this pattern.

> Rule (revised): /ṭ/, /ḍ/ and /ḍ$^h$/ spread retroflexion to an /s/ to their left, unless a coronal plosive or an /r/ intervenes.
>
> [anterior] (− ⟵ )
> /s ..... {ṭ,ḍ,ḍ$^h$}/

A consequence of this rule is that a [−anterior] domain with only a left parenthesis is allowed, as are many forms containing a trigger but not a target of retroflexion, whereas a [−anterior] domain without a left parenthesis is ill-formed:

well-formed: (−ant ...)...]$_{wd}$, (−ant ....]$_{wd}$
ill-formed: ....−ant)

### §108 Backward spreading of retroflexion to non-continuants

When the [−anterior] of a segment disappears in the Surface Representation or is in a position subject to word sandhi, it sometimes spreads to the next coronal segment to its left. Since retroflex non-continuants do not trigger retroflexion as /ṣ/ does in autosegmental spreading, we cannot apply the same argument based on the well-formedness of a domain of retroflexion (§106, §107) to these forms. Nor are there a sufficient number of roots or stems which end in a palatal/retroflex obstruent and have a "retroflexible" segment to its left ({T,N$_{[dental]}$}...B$_{[pal./retrofl.]}$-), so it is not easy to draw generalizations on the context for backward retroflexion. Autosegmental relinking of [−anterior], however, helps us to understand these cases:

*anaḍvah*-m. ‘draft animal’ < ánas- n. ‘cart’ + √vah ‘carry’: According to the paradigm recovered by Jamison (1991:78), the /ḍ/ is columnarly retroflex, and the stem-final consonant is dental before pada-endings (and *n* in nom.sg.), although the sequence of /ḍ/ and /b$^{h}$/ is possible across a word boundary (§129). Jamison supposes that there was a prehistoric metathesis: *anaduḍ-b$^{h}$... > *anaḍud-b$^{h}$*... (Jamison 1991:84).[29]

*puroḍā́ś*-m. ‘ritual cake’ < purás ‘forward’ + √dāś ‘offer’: Nom.sg. *puroḍā́ḥ* and acc. sg. *puroḍā́śam* are attested in the Ṛgveda. The retroflexion might be due to an analogical spreading from *dūḍā́ś*- < *duž-ḍā́ś- (§67), another root-noun from √dāś, as Wiedenmann (1992:243) points out, but it might also be be a transfer of [−anterior] from stem-final position, where palatal obstruents are often subject to sandhi alteration, to a stem-internal onset /d/, just as in *anaḍuh*-.

*piṇak*: While the preceding two words have a columnar /ḍ/, √*peṣ/piṣ* ‘crush,’ ṚV *pináṣṭi* pres.3sg. : ṚV *piṇák* pres.inj.2,3sg. show a transfer of [−anterior] from the root-final consonant to the nasal infix. Recall that the alternation between /n/ and /ṇ/ is more allophonic than that between dental and retroflex stops (§98).

*prá-ṇak*: The final /ś/ of the root √*naś/aś* ‘reach’ does not become *ṭ* word-finally when the /n/ is retroflexed due to the /r/ in the preverb *prá*- (Pāṇini, Aṣṭ. 8.2.63 *naśer v̀ā* [62 *kuḥ*], Wackernagel 1896:174, Hoffmann 1952/57:121): *prá-ṇak* (ṚV$^{4}$) : *ab$^{h}$í-naṭ* (ṚV$^{1}$). This is probably not a case of dialectal variation, for both forms are attested in the seventh book of the Ṛgveda, the family book of the Vasiṣṭhas.

Retroflexion of /n/ after the preverbs *pári* and *prá*: The retroflexion of /n/ in the forms of the root √*naś* ‘be lost’ by the /r/ in *prá* curiously fails when the stem contains a retroflex consonant (Wackernagel 1896:189):

| [−ant] in stem-final C | [−ant] in stem-initial /n/ |
|---|---|
| *pra-naṣṭa-* | |
| *pra naṅkṣyati* | *pra ṇaśyate* |

One thing common to these forms is that the stem part of each inflectional form always has one occurrence of [−anterior]. In the first two cases, the retroflexion shifted once and for all to a word-internal stop, where it remains more stable than in stem-final position, while in the last two cases the retroflexion moves back and forth within the stem morpheme.

The case of *prá-ṇak* : *ab$^{h}$í-naṭ* illustrates how retroflexion throwback interacts with the NATI retroflexion of /n/ triggered by the /r/ in *prá*. Namely, when the /r/ in *prá* spreads [−anterior] to the stem-initial /n/, the root-final /ś/ does not undergo the normal final sandhi to *ṭ*, but is channeled into an optional sandhi /ś/ → *k* instead (Aṣṭ. 8.2.63), which often takes place when the syllable contains an /r/.

[29]Cf. Wiedenmann (1992:243): “vielleicht beeinflußt durch die Zerebrale in *paṣṭ$^{h}$av̀āt* “zweieinhalbjähriger Stier”.”

Those roots which begin with an /n/ and are listed with an initial *ṇ* in the Dhātupāṭha are subject to retroflexion from the /r/ in *prá* or *pári*, according to Aṣṭ. 8.4.14 *upasarg ād asam āse 'pi nopadeśasya*[1 *no ṇaḥ*]. As Pāṇini notes in his reservations to this general rule in Aṣṭ. 8.4.36 *naśeḥ ṣ ān tasya* [1 *no ṇaḥ*, 34 *na*],[30] the retroflexion of root-initial /n/ is blocked when a form of √*naś* has /ṣ/ at its end, so *pra naṅkṣyati* etc. Similarly, retroflexion fails in √*nakṣ* 'attain': ṚV 4.43.5 *pári nakṣati* as well,[31] but √*nej/nij* 'wash': *pr āṇ aikṣ īt* (AV, TS, ŚB), a slightly later form, does undergo retroflexion as expected, according to Aṣṭ. 8.4.14.

The NATI retroflexion may be blocked in *pra naṅkṣyati* and *pári nakṣati* because the stem already contains a retroflex consonant, as Wackernagel (1896:187) suggests.[32] If that is the case, it would be illustrated in the framework of Correspondence Theory (McCarthy and Prince 1995) by the ranking INTEGRITY > LINEARITY (§84). The first is a constraint which ensures that no element in the input has multiple correspondents in the output, and it dominates the second constraint, LINEARITY, which prohibits metathesis. A stem morpheme forms a featural domain, within which this ranking applies.

This kind of correspondence of the [anterior] feature between the underlying and surface forms does not seem to occur regularly, but at least it offers an explanation for anomalous alternations on the level of individual lexical items.[33]

### §109 Summary

In Proto-Indo-Iranian, the sibilants *s and *š were distinguished only by the feature [anterior] (or redundantly by [distributed] as well). As PIIr. *ć was assibilated to palato-alveolar or alveopalatal */ś/ [ɕ/ʃ] in pre-Vedic, a three-way contrast of sibilants came into being in Indo-Aryan. The feature [distributed] was first added to the existing [anterior] contrast, and then the two features came to distinguish */s, š/ : */ś/ and */s, ś/ : */š/ independently (§103). In order to remain distinct from */ś/ which is [+distributed], */š/ developed into [−distributed] /ṣ/ [ʂ] by introducing an apical or sublaminal articulation which was not present in the phonemic system of Proto-Indo-Iranian. The late Proto-Indo-European RUKI rule, which was originally related to the place or articulation of /s/, was thus transformed into an alternation which involves the configuration of the active articulator, i.e. the tongue (§103, §105).

The two-by-two matrix of [±anterior] and [±distributed] then spread to other dental non-continuants. /ḍ/ and /ḍʰ/ have acquired the most stable phonemic status due to their

[30] I thank George Cardona for this reference.

[31] Sāyaṇa considers this *pári* to be a karmapravacanīya construed with a following *dʰyā́m*, and not an upasarga from which NATI can spread to the verb. I thank George Cardona for this reference.

[32] "Auf Grund des § 145b besprochnen Dissimilationstriebs regelmässig vor *ṛ* und sehr oft vor einem Vokal, dem ein cerebraler Laut oder *(ṅ)kṣ* folgt."

[33] See Wackernagel (1896:187): "Aber es ist wol richtiger, das Simplex *piṇak* : *pinaṣṭi* einfach mit pā. *ḍasati* : ai. *daṃśati* „beisst" (vgl. pr. *ḍakka-* „gebissen") gegenüber pā. *daṭṭʰa-* : ai. *daṣṭa-* „gebissen", und mit pā. *ḍahati* : ai. *dahati* „brennt" gegenüber *daḍḍʰa-* (ai. *dagdʰa-*) „gebrannt" zu vergleichen: Wegen der Schwesterformen mit Cerebral wollte man auch *pinak dasati dahati* cerebralisch sprechen, tat es da aber notgedrungen auf einer frühern Silbe."

origins in the Proto-Indo-Iranian clusters */žd/ and */žd$^{h}$/ (§98). /ṭ/ and /ṭ$^{h}$/ have also acquired phonemic status, as they occur in quite a few words without any clear phonological conditioning (§99). On the contrary, /ṣ/ and /ṇ/ remain more or less allophonic (§98).

/ṣ/ and /r, ṛ/, sounds involving tongue retraction, set the Coronal node at the values [−anterior] and [−distributed]. Unlike place features, which are present in most sounds, the apical configuration of the tongue is relevant only to the coronals, and retroflexion spreads autosegmentally to an /n/ to its right within the same word across other sounds, unless a coronal consonant intervenes (§100). There are a number of cases where the retroflexion of /s/ and /n/ is blocked (§101). Retention of dental /s/ is either lexical (§98) or due to local dissimilation (§102), while adjacency on the autosegmental tier needs to be invoked to explain the blocked retroflexion of /n/. A representation with bracketed domains of [−anterior] is necessary to explain the spreading of retroflexion to /n/ and its blocking, but there are still a number of unexplained cases (§106).

In addition to retroflexion, Indo-Aryan has introduced another innovation. Since [−anterior] is a marked value, it forms a featural domain and spreads retroflexion backwards within that domain (§107, §108). This phenomenon shows a similarity to the Aspiration Throwback discussed in chapter VI (§85, §86).

# Chapter VIII. Convergence

## §110 Weight contrasts in Dravidian

As we saw in §15, Proto-Indo-European vowels alternate in length according to the morphological context, and long and short vowels do not contrast phonemically in primary morphemes such as roots and affixes. All geminate consonants, with the possible exception of the 'father' etymon, Hitt. *atta-* 'father,' Gk. *átta* etc., result from assimilation of heterorganic consonants in place and laryngeal features (i.e. voicing and aspiration), and there is no grammatical gradation of consonant length.

In Dravidian, short and long vowels do contrast phonemically (Krishnamurti 1955:237):

| | |
|---|---|
| PDr. *pal 'tooth' | Ta. *pal*, Te. *pal(l)u*, Konḍa *pal*, Kol. *pal*, Kur. *pall*, Mlt. *palu* |
| :: PDr. *pāl 'milk' | Ta. *pāl*, Te. *pālu*, Konḍa *pāl*, Brah. *pālh* |
| PDr. *kal 'stone' | Ta. *kal*, Te. *kallu*, Pe. *kal*, Brah. *xal* |
| :: PDr. *kāl 'leg' | Ta. *kāl*, Te. *kālu*, Pe. *kāl* |
| PDr. *√vay,vey 'put' | Ma. *vekka*, Te. *va(y)icu*, Nk. *vay* 'sow' |
| :: PDr. *√vāy 'swell' | Ma. *vāykka*, Te. *vācu*, Nk. *vāy* |
| (see Krishnamurti 1955:243f. for the length contrast before *y) | |
| PDr. *√paṭ/paṯ 'lie down' | Ta. *paṭu*, Te. *paḍu*, Ga. *par* |
| :: PDr. *√pāṭ 'sing' | Ta. *pāṭu*, Te. *pāḍu*, Ga. *pār*, Kur. *pāṃā* |
| PDr. *kaṇ 'eye' | Ka. *kaṇ*, Ga. *kaṇ*, Kur. *xann*, Brah. *xan* |
| :: PDr. *√kaṇ~kāṇ 'see' | Ka. *kāṇ*, Ga. *kaṇḍp* 'search,' Brah. *xaning* |
| (*DEDR*, Krishnamurti 1961) | |

Long or geminate consonants also contrast with their singleton counterparts, typically in derivational and inflectional suffixes:

> non-past transitive suffix *kk, *pp : non-past intransitive suffix *k, *p;
> past transitive suffix *tt : past intransitive suffix *t (Krishnamurti 1978:18f);
> nominative stem *-Ø, Ta. *kāṭu*, Pj. *key* : oblique suffix PDr. *-tt-, Ta. *kāṭṭ-*, Pj. *keyto* (Krishnamurti 1961:259, Kumaraswami Raja 1969:84).

Note however that there are Proto-Dravidian phonological rules, presumably representing an older state, which do not treat a root-final consonant as having its own mora:[1] e.g. *l + *t > *ṯ as in the pair Ta. *√nil* 'stand' : Ta. *√niṯu* 'place.'

## §111 Weight-sensitive rules in Dravidian

If Proto-Dravidian phonology had the notion of syllable weight, it might well be reflected as reconstructible weight-sensitive rules or restrictions on syllable weight as in

[1] Krishnamurti (1998a:66): "*niṯ, *niṯṯ, and *kaṯ are represented as bases within Proto-Dravidian, perhaps restructured with the past suffix incorporated as a derivative at a later stage, still within P[roto-]D[ravidian]."

Indo-European.[2]

In the derivation of verbal bases, a stem-formative vowel, which is either *a, *i or *u without any known semantic difference, is inserted between roots and suffixes beginning with consonants already in Proto-Dravidian (§122, Krishnamurti 1978:18): PDr. *tir-u-mpp- 'turn' > Ta. *tiruppu*; > *tirppu- > Te. *trippu*. Such anaptyxis does not necessarily imply the existence of weight-sensitive rules in Proto-Dravidian, however, for avoidance of unallowed clusters of heterorganic non-continuants, or of their undesirable assimilation, can also be the motivation.

Krishnamurti (1961:125) notes that vowels with different grades are sometimes reconstructed for Proto-Dravidian, e.g. *kāṇ- : *kaṇṇ- 'to see' etc. with -V̄C and -VCC rimes, and mentions the possibility of a type of reconstructible vowel length alternation. This possibly weight-driven alternation is formulated as a morphophonemic rule in Zvelebil (1967, 1970:185), who states that syllable weight tends to be preserved. Subrahmanyam (1983:168–171) and Krishnamurti (1991:165) argue against his claim of rule status, on the grounds of the fact that this pattern is limited to a small number of cases, and of the existence of a commoner alternation pattern -V̄C : -V̄CC as in PDr. *yāṯu 'river' : *yāṯṯu obl. etc.

### §112 Differences in Indo-Aryan and Dravidian length alternation

Indo-European rules on vowel length such as Osthoff's, Lachmann's and Sievers's Laws are usually phonological and are limited to a local context: they refer only to phonological contexts such as the syllable to which the vowel in question belongs.[3] Unlike this tendency of Indo-European, weight rules in Dravidian seem to operate on a morphemic basis. Krishnamurti (1955:248), for example, summarizes the distribution of Telugu root types caused by prehistorical vowel shortening as follows:

| suffix type | suffix | root |
|---|---|---|
| strong | -V̆(N/T)T | [1](C)V̆W-, [2](C)V̆R- |
| weak | -(N/T)T | [3](C)V̄-, [4](C)V̄R-, [5](C)V̆- |
| strong | -V̆R | [1](C)V̆W-, [2](C)V̆R- |
| weak | -R | [3](C)V̄- |

i.e. a long root vowel is shortened before a suffix beginning with a vowel, whereas it remains long before suffixes beginning with a consonant. This alternation makes reference to the morphological context and keeps the total weight of the root morpheme stable;[4] so does $C_1\bar{V}C_2$ : $C_1\breve{V}C_2$-V (Krishnamurti 1955) as in *yān- 'I' : *yan-V obl. Such length alternations based on the total length of the resulting morpheme are quite different from Sievers's Law, which eliminates overlong syllables created by suffixation.

[2]Most of the discussion in this and the following two sections has already appeared in Kobayashi (2001).

[3]See §114 for Indo-European weight-related rules based on prosody.

[4]Subrahmanyam (1983:160): "It should be noted that quantitative variation does not operate across a morpheme boundary."

## §113 Maximal syllables in Dravidian

We observed in §19, §21 and §22 that syllables longer than two morae exist, but tend to be avoided in the weight-sensitive parts of the Ṛgvedic verses. In contrast, Dravidian derivational morphology seems to presuppose the existence of syllables ending in V̄C, VCC or V̄CC, e.g. Ta. *ēṟu* 'to rise' : *ēṟṟu* 'to raise'; Ta. *maāṟu* 'to change (vi.)' : *maāṟṟu* 'to change (vt.)'; Ta. dir. *āṟu* 'river' : obl. *āṟṟu*; Ta. root. *pār* 'to see' : past stem. *pār-tt-*; Ta. root. *vāḻ* 'to live' : past stem. *vāḻ-nt-*. A Proto-Dravidian vowel, either short or long, can thus be followed by the sequences *-TT-, *-NT-, *-NTT-, *-RT-, *-RTT-, *-RNT- (R: liquids and y). Since Proto-Dravidian is considered to have allowed only one consonant in word-initial position, the syllable boundary should fall between the last and the last but one of a medial consonant cluster, by Vennemann's Law of Initials, which states that "medial syllable-initial clusters should be possible word-initial clusters" (Vennemann 1972:11). It follows from this that Dravidian allows only homorganic non-continuants across a syllable boundary.

i) Heaviest tautomorphemic syllable:

Proto-Dravidian roots are considered to be originally monosyllabic and fit the shape $C_0^1\breve{V}C_0^1$ (Krishnamurti 1992:374). If all nouns are ultimately derived from Proto-Dravidian roots, the heaviest tautomorphemic rime is that of the root, namely -V̄C, for suffixes do not have long vowels.

Subrahmanyam (1983:22) gives the following forms as possibly reconstructible cases of tautomorphemic *(C)V̄CC- sequences, which would be considered overlong in Indo-European terms:

| | |
|---|---|
| PDr. *kāk-ay 'crow' | Ta. *kākkaṟṟikkākkāy* |
| PDr. *tāṇṭ- 'cross' | Ta. *tāṇṭu* |
| PDr. *pāmp- 'snake' | Ta., Ma. *pāmpu* |

ii) Heaviest syllable, tautomorphemic or heteromorphemic:

Kumaraswami Raja (1969) reconstructs a Proto-Dravidian sequence *-NTT- to explain correspondences of the type Te. -NT- : Ta.-Ma. -TT-. If we accept his reconstruction, there are morphemes whose reconstructed forms must have ended in -V̄CCC in Proto-Dravidian, although they might originate from even earlier suffixation:[5]

| | |
|---|---|
| PDr. *cāṅkk- | Pa. *cākol* 'hunger' |
| PDr. *cīṅkk- | Te. *sīkili* 'broom,' Ta. *cīkku* (Kumaraswami Raja 1969:26) |
| PDr. *kāṇpp-/kāmpp- | Ka. *gāmpa, gāṇpa* 'rustic' (Kumaraswami Raja 1969:38) |

While stem-formative vowels *a, *i or *u prevent verbal bases from having excessively heavy rimes, formative vowels are not inserted in such noun formations. Since *-NTT- suffixes are reconstructed in noun formation, a few reconstructed forms contain a very heavy rime *(C)V̄R-NTT:

[5]Cf. Krishnamurti (1991:164) on verbal bases of this type: "It is also possible to set up a type *(C)VNPP for PDr., where CCC=NPP, but there is definitely a morph boundary here, descriptively +NP +P (transitive) as opposed to +NP (intransitive); e.g., *kānku 'to boil (v.i.)': *kānkku 'to boil (v.tr.).' "

| | |
|---|---|
| PDr. *nālnk-/*nālnkk- ‘tongue’ | Te. *nālu(u)ka*, OTa. *nākku*, Mlt. *naqlu* ‘uvula,’ etc. (Burrow 1944:337) |
| PDr. *cīy-ntt- | Ta. *tīy(tt)* |
| PDr. *vāy-(m)pp- | Ta. *vāyppu*, Te. *vāpu*, *vāpu* |
| PDr. *pūy-ntt- | Te. *būcu* ‘mould, mildew’ (Kumaraswami Raja 1969:48) |

**§114 Rhythm in Indo-European and Indo-Aryan**

Unlike phonemic segments (§4), a stress system can change in non-gradual and unpredictable manner; for example, Russian and Polish, which both belong to the Slavic branch of Indo-European, have developed totally different stress systems in a relatively short period. On the other hand, even genetically unrelated or remotely related languages can come to share the same stress pattern. Stress systems are therefore a promising field for typological or areal research, particularly in South Asia where few languages have phonemic stress.

In Indo-European languages, alternations of vowel length are usually connected to an adjustment of the weight of the syllable to which the vowel in question belongs (§111). For example,

| | | |
|---|---|---|
| Osthoff’s Law | $\bar{V} > V$ / _{L,N}]$_\sigma$ | Greek, Latin etc. |
| Sievers’s Law | $WV > \bar{V}_w WV$ / VX.C_ | Vedic, Germanic |
| Compensatory lengthening | $VC > \bar{V}$ / _..]$_\sigma$ | Greek, Latin etc. |
| Lachmann’s Law | $V > \bar{V}$ / _$T_{[voiced]}$-tó- | Latin |
| Shortening of an unaccented V | $\bar{V} > \check{V}$ | Anatolian |

There are also weight-related rules which make reference to morphological entities or prosodic contexts:

Brevis brevians or Iambic Shortening in Latin: Latin $\bar{V} > \check{V}$ / $\acute{\check{V}}$C_, $\check{V}$C_C$\acute{V}$. E.g. *am ā* > *ama*, *put ā* > *puta* (Sommer and Pfister 1977:104ff.).

Sievers’s Law in Germanic: Kiparsky (1998) proposes an explanation of Sievers’s Law in Germanic by ‘prosodic optimization.’

Quantitative Metathesis in Ionic and Attic Greek: *ēa*, *ēo* > *e ā*, *e ō* E.g. Hom. Gk. *basilêa* : Attic Gk. *basilé ā*, Hom. Gk. *n ēós* : Attic Gk. *ne ōs* (Rix 1992:57).

Vocalis ante vocalem corripitur: Latin: $\bar{V} > \check{V}$ / _V. Homeric Greek, Vedic: $\bar{V} > \check{V}$ / _]$_{wd}$ V- (Oldenberg 1888:465ff., Kuryłowicz 1927a:232, Rix 1992:56, Sommer and Pfister 1977:102f.).

Morphological templates: The Sanskrit reduplicated aorist, which functions as a causative preterite, exhibits a trochaic rhythm of heavy reduplicated syllable and light root syllable, e.g. √*pat*$^i$ ‘fly, jump,’ *áp īpatat* beside *ápaptat*; √*naś* ‘perish,’ *án īnaśat* beside *áneśan*; √*bod*$^h$/*bud*$^h$ ‘wake,’ *áb ūbud*$^h$*at*; √*dyot*/*dyut* ‘shine,’ *ádidyutat*; √*jan*$^i$ ‘give birth’: *áj ījanat* (Macdonell 1910:374, Thieme 1929:4). The reduplication is formed with the vowel /i/ (or /u/), which is limited to present reduplication in other Indo-European languages (Leumann 1962:153). Leumann

(1962:155f.) points out that the reduplicated aorist and some perfect stems have lengthening of the reduplication vowel in common, but lengthening in perfect stems such as √*dʰar*/*dʰṛ* 'hold,' *dādʰārа*, is an archaism and decreases in number over time. It might follow that the prosodic property of the reduplicated aorist stem, i.e. the trochaic rhythm (−∪), somehow came to bear a morphological function of causativity (Meillet 1920:198).

Insler (1997) points out the existence of a prosodic pattern in the Vedic denominative.

Optional lengthening of subminimal words: The vowel of an orthotonic monomoraic word is optionally lengthened, e.g. Ved. *nú* ~ *nū́* pcl. 'now.'

With the possible exception of Vocalis ante vocalem, these phenomena are either language/category-specific or crosslinguistic, and we could say that Indo-European does not have any particular rhythmic rule in its grammatical system. In Sanskrit, which has a phonemic length contrast, rhythm does not seem to play a central role in the alternation of syllable weight, and Pāli shows just a few more signs of rhythmic restrictions, such as that monosyllabic preterite stems are obligatorily augmented (Wackernagel 1906:154ff.=*Kleine Schriften* 156ff.); but by the time of Early New Indo-Aryan, "the word rhythm dominated the etymological quantity" (Bloch 1965:46f.).

As Liberman and Prince (1977:309ff.) point out, stress is not just an attribute of a segment but reflects a hierarchically organized rhythm, and the underlying rhythm of a language can be inferred from its stress pattern. Since, however, stress is not phonemically contrastive in most Indo-Aryan, Dravidian and Munda languages, good descriptions of stress are not available for many of these languages in the first place (R. P. Das 1985:98), and word stress, if any, is often weak and is not projected to phrase and utterance levels. Moreover, stress can be different in different dialects, and it is dangerous to compare the stress systems of South Asian languages on the basis of a single dialect of each language. Still, let us compare the available information on the stress of South Asian languages in the following sections to obtain a rough idea of their rhythmic patterns.

Prosodic Morphology attempts to analyze morphological phenomena by means of templates defined in terms of a universal set of prosodic constituents such as the mora, syllable, foot and prosodic word. It operates on the principle of Prosodic Circumscription, according to which "the domain to which morphological operations apply may be circumscribed by prosodic criteria as well as by the more familiar morphological ones" (McCarthy and Prince 1998). As such, it is different from the traditional notion of foot as in Greek meter, which constrains the number and sequencing of prosodic units. In Hayes (1995:71), rhythmic systems are divided into bounded and unbounded systems, depending on whether the size of rhythmic units is bounded. In bounded systems, Hayes (1987, 1995) and McCarthy & Prince (1986) propose a highly restrictive inventory of the basic types of foot, called an Asymmetric Inventory:

| | | |
|---|---|---|
| moraic trochee | left-strong, quantity-sensitive | $\acute{\sigma}_{(\mu)}\sigma_{(\mu)}$, $\acute{\sigma}_{(\mu\mu)}$ |
| syllabic (trochee) | left-strong, quantity-insensitive | $\acute{\sigma}_{(\mu \text{ or } \mu\mu)}\sigma_{(\mu\mu \text{ or } \mu)}$ |
| iamb | right-strong, quantity-sensitive | $\sigma_{(\mu)}\acute{\sigma}_{(\mu\mu)}$, $\sigma_{(\mu)}\acute{\sigma}_{(\mu)}$, $\acute{\sigma}_{(\mu\mu)}$ |

The theory of Hayes (1995) contains a few more parameters, of which the following bear on our argument: i) Direction of parsing (54), i.e. whether rhythmic units are formed from right to left or from left to right. ii) Extrametricality (56), i.e. whether a foot, a syllable, a mora, or a consonant at the end is ignored for purposes of stress computation. iii) End Rule (61), by which the primary stress is assigned to the rightmost or leftmost rhythmic unit. iv) Whether a degenerate foot (86ff.), or a "logically smallest possible," namely a monosyllabic foot in the system of syllabic trochees and a monomoraic foot in those of iambs and moraic trochees, is always banned (strong prohibition), allowed when it has stress (weak prohibition), or freely allowed. The stress systems of the main modern Indo-Aryan languages may be derived from the following parameter settings.

Old Awadhi (Mathur 1974): *ãguri* 'finger' < OIA aṅguli- but also *ã:gi:* 'jacket' < OIA aṅgika-; *biya:* 'seed' < OIA bīja-; *dĕva:ri:* 'Diwali' < OIA dīpāvalī-. Explainable as pretonal weakening if moraic feet are built from the right: ã(guri); bi(ya:); dĕ(va:)(ri:).

Hindi (A. Sharma 1969, M. Ohala 1983:656f., Fairbanks 1992, Hayes 1995:162ff.): Moraic trochees are constructed from right to left. Degenerate feet are prohibited. The final foot is usually extrametrical. Monosyllabic feet are preferred to disyllabic ones (apocope/syncope of /ə/).

Maithili (R. Yadav 1996:46ff.) and Awadhi (Saksena 1937:91f.): Moraic trochees are constructed from right to left. Degenerate feet are prohibited. No extrametricality.

Sadani (Thiel-Horstmann 1969:33f.): Priority of heavy syllables and syllables with /a/. Moraic trochees from left to right. Degenerate feet are allowed. E.g. (kéhu)(nì) 'elbow'; (pʌ̀ri)(áir) 'the year before last'; (kì)(ná˙)re 'bank.'

Gujarati (Cardona 1965:32ff.): /a/, /VC/ > /i,u,e,o,ɛ,ɔ/ > /ə/. Syllabic trochees from right to left. Degenerate feet with /ə/ are not allowed. Exx. sər(kár) 'government'; (júnuN) 'old'; cum(móter) 'seventy-four'; (nə́wo)/nə(wó) 'new.'

Punjabi (Bhatia 1993:343): Three-way syllable weight contrast VV > VC > V. Syllabic trochees from right to left.

Kashmiri (Kachru 1973, Morén 2000): Three-way syllable weight contrast VVC > VC > V. Moraic trochees from right to left. The rightmost foot is extrametrical.

Other Dardic and Nuristani languages (Èdelman 1983): Kati and Bashkarik (=Kalami): mobile. Waigali: long final. Katarkalai (=Wotapuri): stem-final. Dameli: final or penultimate, or $\acute{}\cup\cup$.

Sindhi (Khubchandani 1969:112f.): Stress on the rightmost but one of the heaviest syllables.

Marathi (Pandharipande 1997:556ff.): Three-way syllable weight contrast. Stress on the leftmost one of the heaviest syllables. Perhaps unbounded, but right-to-left moraic trochees with End Rule Left are also possible.

Bengali (Bloch 1917:363, Chatterji 1926:279ff., Klaiman 1987:82): Stress on initial syllables. Unbounded with End Rule Left, or syllabic/moraic trochees from left to right.

Sinhalese (Geiger 1938:26ff.): Stress falls on the initial foot with the pattern ˊ×, ∪ˊ and ˋˊ in the original Middle Indo-Aryan form. E.g. ˊ×: *áda* 'today' < *ajja*, *áňguṇu* 'courtyard' < *aṅgaṇa*, *úturu* 'northern' < *uttara*; ∪ˊ: *dahás* 'thousand' < *sahassa*; ˋˊ: *dumá* 'tree' < *druma*, *paná* 'again' < *puṇo* etc. An iamb is constructed at the left end, with End Rule Left.

## §115 Rhythm in Dravidian: evidence for an iambic structure

While each Indo-European morpheme or word has its own lexical accentual properties, there is no evidence that Dravidian had any stress system independent of syllable prominence.[6] K. V. Subbaiya (1909:161) postulates an accent shift from the first (root) to the second (suffix) syllable in order to explain the phenomenon which is now known as Apical Displacement. Instead of such a historically unverifiable hypothesis, Master (1948:344ff.), Krishnamurti (1955) and Krishnamurti (1978:18f.) develop theories based mainly on metathesis and syllable weight. As Krishnamurti points out,[7] rhythm seems to underlie this phenomenon.

The meter of early Old Tamil as represented by Sangam poetry takes word and morpheme boundaries into consideration when parsing verses into metrical feet, unlike the traditional notion of foot as in ancient Greek meter which constrains the number and order of prosodic units with little regard for morphological constituency, and its principles may be interpreted in terms of Prosodic Morphology (§114; Zvelebil 1970:41). The most basic constituent of Sangam Tamil meter is *acai* or a footlike metrical unit, which comprises the following variants (Rajam 1992:116ff.):

| | | |
|---|---|---|
| basic | *nēr* | (C){V̆,V̄}(C)(C) |
| extended | *nērpu* | (C){V̆,V̄}(C̄)(C)*u* |
| basic | *nirai* | (C)VC{V̆,V̄}(C)(C) |
| extended | *niraipu* | (C)VC{V̆,V̄}(C)(C)*u* |

Unlike the notion of *gaṇa* in Middle and New Indo-Aryan meter, *acai* cannot be defined in terms of the number of syllables or morae, and it does not correspond to any

[6] Krishnamurti (1955:238): "In the modern forms of these languages, there is, however, stress of a phonetic but not phonemic character. It is no doubt a fact that addition of suffixes reduces the length of the radical vowels in Dravidian but there is hardly any proof to show that they were accented." See also Krishnamurti (1961:59).

[7] Krishnamurti (1955:238): "The rationale of this gradation phenomenon seems to lie in the admissible number and grouping of syllables in a root morpheme rather than in a system of accentuation, for which we have no evidence. In short, *meter and rhythm* of a definable nature seem to control the vowel-length in derived bases." (italics mine)

prosodic notions in Indo-Aryan. According to the Asymmetric Inventory, however, these types match the iambic type of right-strong, quantity-sensitive feet, if the *u*-extension can be treated as extrametrical and a *nēr* consisting of a light syllable can be considered a degenerate foot. As far as *nirai* with a light second syllable and *nēr* are concerned, a moraic trochee is also possible, but *nirai* with a heavy second syllable are canonical iambs and are explained slightly better by assuming an iambic structure. Let us cite a few examples of Sangam words and their foot scansion from Rajam (1992:124ff.) to illustrate the rhythmic composition of Old Tamil:

| word | gloss | foot structure |
|---|---|---|
| *āmpal* | 'water lily' | nēr-nēr |
| *kaṇicci-y-um* | 'and the trident' | nirai-nirai |
| *tīm pukār[t]* | 'pleasant Pukār' | nēr-nirai |
| *āṭu vali* | 'while playing' | nērpu-nirai |
| *muṭaṅku tāl* | 'bending leg' | niraipu-nēr |
| *iṟavu-k kalittu* | 'the fish, being excited' | niraipu-niraipu |

Since Tamil metrics does not mention primary stress assignment, we have no information on the word layer rule which determines prominence among feet. If the treatment of an unparsable short syllable as a *nēr acai* is not simply a theoretical device to avoid stray syllables but reflects the actual rhythm, then it could be taken as a degenerate foot, i.e. a foot consisting of one light syllable. Degenerate feet are probably not freely allowed, because there are virtually no monomoraic words in Dravidian.[8] The rhythmic rules of Sangam Tamil may hence be stated as follows:

| | |
|---|---|
| Foot Construction | Form iambs from left to right |
| Degenerate Feet | Probably allowed in strong position[i)] |
| Extrametricality | $u \rightarrow \langle u \rangle$ if it is non-morphemic |
| Word Layer Construction | Data unavailable |

[i)]I.e. when there is some stress on the syllable in question (Hayes 1995:87).

Another possible argument for an iambic rhythm is the [high] umlaut in Old Tamil and Malayalam. The mid vowels *e and *o are reconstructed only in root morphemes in Proto-Dravidian, and they are considered to be marked (§121). In these languages, mid vowels are raised when the vowel of the following syllable is *a, e.g. PDr. *weḷ-V-, Ta. *veḷi* 'white,' *viḷaṅku*, Te. *velũgu* (Krishnamurti 1998a:69). If Old Tamil has an iambic rhythm in which the second mora is more prominent than the first, the less prominent first syllable in such forms may not be able to license a mid vowel, so the latter would be reduced to its high counterpart which is unmarked.

[8]Cf. Krishnamurti (1955) on monomoraic roots.

## §116 Rhythm in Dravidian: evidence for a trochaic structure

Reconstructed Proto-Dravidian has a contrast of five vowels only in the first syllable (§121),[9] and mid vowels do not appear in noninitial syllables. This might imply that stress fell on the initial syllable and that a stressed initial syllables prosodically licensed the five-vowel contrast in Proto-Dravidian;[10] but it could also be a by-product of the agglutinative morphology: the root, the only place where all five vowels contrast because of root-suffix asymmetry, always occupies initial position irrespective of stress.[11]

The correspondence of Ta. *kalaṅku* 'to be stirred,' Ka. *kalaṅku, kalaku* and Te. *kalãgu* suggests that heavy second syllables existed in an early period of Proto-South- and Proto-South-Central-Dravidian. According to the generalization of Krishnamurti (1955:239, 249), however, the second syllable of Telugu verbal bases is short without exception. Telugu verbal bases are grouped under the types CV̆CV̆CV̆, CV̄CV̆ and CVCCV̆; the original weight of the second syllable is eliminated by processes such as deletion of nasals, which leaves the preceding vowel nasalized, and Apical Displacement $(C_1)VC_{2([apical])}V > (C_1)C_2VX$, which makes the first two syllables, of which the first one is light, one heavy syllable. In the framework of the Asymmetrical Inventory (§114), the canonical shape of Telugu verbal bases is a moraic trochee, with an extrametrical final short *u*. Brown (1840:34f.) describes Telugu stress as falling on the first of a series of short syllables, or on the last of a series of heavy syllables. ◌́◡[◡...] (e.g. *púli* 'tiger,' *énimidi* 'eight'), –́◡, and [–...]–́. This pattern can be captured by construction of moraic trochees on heavy syllables from left to right with End Rule Right. Many other Dravidian languages, but not all, appear to share the trochaic system as in Telugu.

Malayalam (K. P. Mohanan 1982, 1986:112, T. Mohanan 1989:611): Malayalam stress falls on the initial syllable, unless the first vowel is short and the second vowel is long:

[◡◡ /pár̄aṯi/ 'searched,' /pár̄aṯṯi/ 'scattered,' /pákaṛṯṯi/ 'poured'
[◡–́ /paŕā́ːṯi/ 'complaint,' /kuppáːyam/ 'dress'

| | |
|---|---|
| Syllable weight | Decided by vowel length only |
| Foot Construction | Moraic trochee at the left edge |
| Degenerate feet | Disallowed |
| Word Layer Construction | End Rule Left |

Brahui (Elfenbein 1997:809): Stress falls on the first syllable unless the first is short and the second is long. Moraic trochees from left to right, with no degenerate feet; or an unbounded system with End Rule Left (Hayes).

[9]Note that Italian also makes a finer distinction of vowels in stressed syllables, e.g. *arɛ́na* 'arena' : *aréna* 'sand.' Mongolian and Turkic are also said to show a wider variety of vowels in the initial syllable, e.g. dialectal Turkish makes the distinction between *el* 'hand' and *el* 'people' (G. Lewis 2000:13).

[10]For examples of phonological licensing by an initial foot, see Buckley (1998).

[11]As R. P. Das (1985:95) points out, many scholars beginning with Caldwell (1961:189) have postulated initial stress as a common feature of Dravidian languages.

Alu Kurumba (Kapp 1982:41ff.): $\acute{\sigma}\sigma_{\{\breve{V}\}}$/ $\sigma\acute{\sigma}_{\{\bar{V}\}}$, $\acute{\sigma}\sigma\sigma$/ $\sigma\acute{\sigma}_{\{a\}}\sigma$, $\acute{\sigma}\sigma\acute{\sigma}\sigma$ with numerous exceptions.

Kannada: Stress in Kannada falls on the initial syllable according to Steever (1998:131) and a perceptual experiment by Savithri (1995:275). Syncopation of /ă/ in the second syllable, e.g. *hesaru* 'name' > *hesru*. Moraic trochees from left to right. No degenerate feet. Monosyllabic feet are preferred at the left edge.

Kolami and Toda (Emeneau 1955:8, 1984:18): Stress on the initial syllable.

Malto (S. K. Das 1973:34): Stress on the last syllable with a long vowel. Similar to Telugu, or the Awadhi type.

Konda (Krishnamurti 1969:188ff.): $\sigma_{\{\breve{V}\}}\acute{\sigma}$..., $\acute{\sigma}_{\{\bar{V}\}}$... Iterative secondary stress. Iambs from left to right. End Rule Left.

From the viewpoint of foot typology, the elimination of Proto-Dravidian heavy second syllables in Telugu root morphemes would best be explained by assuming that the foot type changed from an iamb to a moraic trochee as Proto-South- and Proto-South-Central-Dravidian developed into Telugu. This tendency swept away heavy second syllables in Telugu, but it affected South Dravidian languages to lesser degrees, and Early Tamil might have preserved the original iambic rhythm.

However, other data do not conform to this generalization. Lisker and Krishnamurti (1991) made acoustic measurements of the phonetic stress of Telugu words, and found the following tendencies. Words consisting of three light syllables have stress on the second syllable. If a word has two light syllables, the first syllable has stress. Initial heavy syllables are stressed.

According to the description of Jha (1940–1944, 1958), Maithili has the same stress pattern, which Hayes (1995:149ff.) analyzes as follows.

| | | |
|---|---|---|
| $[\acute{\cup}\cup]_{wd}$ | /pám$^{h}$a/ | 'little whiskers' |
| $[...\cup\acute{\cup}\cup]_{wd}$ | /d$^{h}$àn$^{a}$hár$^{a}$/ | 'thief' |
| $[(...)\acute{-}-]_{wd}$ | /sá:ṛi:/ | 'saree' |
| $[(...)\cup\acute{-}]_{wd}$ | /paṭ$^{a}$hí:/ | 'thin' |
| $[(...)\acute{-}\cup]_{wd}$ | /kìšá:n$^{a}$/ | 'cultivator' |
| $[(...)\acute{-}\cup\cup]_{wd}$ | /gá:b$^{h}$in$^{a}$/ | 'pregnant' |

| | |
|---|---|
| Foot Construction | Moraic trochees from right to left |
| Degenerate Feet | Allowed in strong position |
| Extrametricality | Ft $\rightarrow$ ⟨Ft⟩ / $\bar{V}$_] $_{wd}$ |
| Word Layer Construction | End Rule Right |

The North American language Hopi, another language analyzed by Hayes (1981:77–79, 1995:261), also has a similar stress pattern. La Verne Masayesva (1982:253)[12] describes the stress rule of Hopi as follows:

[12] I thank Eugene Buckley for this reference.

(a) "The second vowel, counting from the left, is stressed in polysyllabic words (i.e., words which are trisyllabic or longer) in which the first vowel is followed by a single consonant or directly by a vowel. (In calculating the length of a word, VV sequences count as disyllabic.)"

(b) "The first vowel is stressed otherwise—that is, in disyllabics and in polysyllabics whose first vowel is followed by a consonant cluster."

To wit, the first syllable receives stress only if it is heavy or if the word is disyllabic; otherwise the second syllable is stressed:

| | |
|---|---|
| $[\acute{}\cup]_{wd}$ | /náqvɨ/ 'ear,' /moóki/ 'to die' (/mó:ki/) |
| $[\acute{\cup}\cup]_{wd}$ | /cómo/ 'hill,' /wári/ 'to run' |
| $[\acute{}\cup...]_{wd}$ | /naátɨhota/ 'to hurt oneself' (/ná:tɨhota/), /léstavi/ 'viga, roof beam' |
| $[\cup\acute{\cup}...]_{wd}$ | /kɨyápi/ 'dipper,' /yɨ'á'ata/ 'to speak' |
| $[\cup\acute{}...]_{wd}$ | /caqápta/ 'dish' /mɨríkho/ 'hunting stick' |

In Hayes's analysis of Hopi, iambs are built from the left, and the final syllable is always extrametrical. In disyllabic words, this extrametricality forces the first light syllable to be parsed as a degenerate foot, hence the initial accent:

| | |
|---|---|
| Foot Construction | Iamb at the left edge |
| Degenerate Feet | allowed in strong position |
| Extrametricality | $\sigma \rightarrow \langle\sigma\rangle$ / _]$_{wd}$ |

I cannot add any further arguments about the stress rules of Modern Telugu. The historical development of the shortening of the second syllable cannot be captured by the rules as in these cases, and a shift from the iamb to the moraic trochee still seems to be the best explanation.

It should be noted that Tamil and Malayalam also offer data in favor of an analysis by the moraic trochees. Vaidyanathan (1971) and Scharfe (1973–76:274) point out a tendency for long vowels in the second syllable of Indo-Aryan words to be shortened when they are borrowed into Tamil:

> Long second vowel in Old Indo-Aryan is shortened in Tamil: *āyiram* ← Skt. *sahasra-* (Burrow 1947); *kāvatam* ← Skt. *gavyūti-* 'measure of distance' (Emeneau & Burrow 1962); *kōmaram* 'possession by spirits' ← Skt. *kaumāra-* 'possessed by Skandha' (Emeneau & Burrow 1962); *kōvalar* ← Skt. *gopāla-* 'cowherd' (Vaidyanathan 1971:36); *akaram* ← Skt. *akāra-* 'the letter *a*' (Vaidyanathan 1971:45); *ulakam* ← Skt. *loka-* 'world' (Vaidyanathan 1971:17); *uruppu, uruvu, uruvam* ← Skt. *rūpa-* 'shape' (Vaidyanathan 1971:113); *āciriyar* ← Skt. *ācārya-* 'preceptor,' Pāli *ācariya-*, Pkt. *āyariya-* (Vaidyanathan 1971:45); *akkuraṉ* ← Skt. *akrūra-* 'not cruel' (Vaidyanathan 1971:53); *kumari* (river name) ← Skt. *kumārī* 'maiden' or Pkt. *kumarī-* (Vaidyanathan 1971:77); *tampalam* 'refuse of betel leaf' ← Skt. *tāmbūla-* 'betel leaf' (Emeneau & Burrow 1962); *aracu*

← Skt. *rājya-* 'sovereignty' (Vaidyanathan 1971:32); *aruvi* ← Skt. *arūpī* 'shapeless' (Scharfe 1973–76:274); *ikalaṉ* ← Skt. *sṛgāla-* 'jackal' (Scharfe 1973–76:274).
Cf. Short second syllable in Old Indo-Aryan becomes heavy in Tamil: Skt. *samaya-* 'time, occasion' > *amaiyam* together with *amayam* (Burrow 1947).

In some cases, the long second vowels in Sanskrit words are shortened already in Middle Indo-Aryan, from which the Tamil forms might have been borrowed. Still, borrowing from Middle Indo-Aryan does not explain why such a high ratio of Tamil forms have either two light syllables or one heavy syllable at their left end, whereas so few forms begin with a light syllable followed by a heavy one. Among the three systems of bounded rhythm (§114), this pattern exactly fits the moraic trochee, and not the iamb.

### §117 Rhythm in Munda

Mundari (Osada 1992:36ff., Kobayashi, Murmu and Osada 2003:339f., cf. Hoffmann 1903, 1930:8, Donegan 1993:5f): If we assume that Mundari stress is realized as high pitch, the accentual pattern is different from that described by Hoffmann (1903, 1930:8),[13] even in the Hasadaʔ dialect on which he mainly worked, unless we assume that initial high pitch is somehow suppressed. Judging from the distinctive alternation of high and low pitch, the unit of stress assignment is either two morae or two syllables. Stress tends to fall on the second syllable in words of the shape (C)VCVC, (C)VCCVC, (C)VNCV, and often in (C)VCV words as well. In words of the type CVV, the first vowel often gets stress, e.g.

| | |
|---|---|
| (C)VCVC | /moloŋ/ 'forehead,' /tasadˀ/ 'grass' |
| (C)VCCVC | /seŋgél/ 'fire,' /balbál/ 'sweat' |
| (C)VNCV | /soŋgé/ 'friend,' /eŋgá/ 'mother' |
| (C)VCV | /berá/ 'hour,' /nidá/ 'night' |
| CVV | /súi/ 'needle,' /hái/ (also /haí/) 'fish' |

(Kobayashi, Murmu and Osada 2003:353ff.)

An iambic foot from the left end of the word best captures (CVCV́C), (CVC)(CV́C) and (CVCV́). An extrametrical foot is necessary to explain the type (CVN)(CV́), and the (CV́V) type needs to be explained as a diphthongal stress. An iambic foot also neatly explains variation as in /(upú)(nia)/ ~ /(up)(niyá)/ 'four' and /(pací)ri/ ~ /(pac)(rí˙)/ 'wall.' Verbal suffixes such as /-áka-/ seem to have lexical stress. A postposition and a personal ending form one stress domain with a stem.

Sample sentences (Osada 2001; stress marks mine). *hatú*$_{\text{village}}$-*re*$_{\text{loc.}}$-*lé*$_{\text{1pl.}}$ *jóm*$_{\text{eat}}$-*nú:*$_{\text{drink}}$-*kè*$_{\text{pf.}}$-*d*$_{\text{tr.}}$-*a*$_{\text{ind.}}$ 'We ate and drank in the village'; *uríʔ*$_{\text{cow}}$ *jilú*$_{\text{meat}}$ *ka*$_{\text{neg.}}$-*lé*$_{\text{1pl.}}$

[13] "In dissyllabic words it falls, with rare exceptions, on the first syllable... Whenever affixes of one or several syllables are added for functional purposes to mono- or polysyllabic words, the resulting compound has more than one accent; for the original word as well as the affix, keep their respective accents, v.g., *háturénko*, those in the village."

*jo*$_{\text{red.}}$-*jóm*$_{\text{eat}}$-*a*$_{\text{ind.}}$. ‘We don’t eat beef.’ *setág*$_{\text{morning}}$-*até*$_{\text{from}}$-*ñ*$_{\text{1sg.}}$ *dub*$_{\text{sit}}$-*áka*$_{\text{cont.}}$-*n*$_{\text{intr.}}$-*a*$_{\text{ind.}}$. ‘I have been sitting since this morning’; *ma*$^{n}$*ḍí*$_{\text{food}}$ *aló*$_{\text{prohib.}}$-*m*$_{\text{2sg.}}$ *jó:m*$_{\text{eat}}$-*a.* ‘Don’t eat the food.’

| | |
|---|---|
| Foot type | Iamb |
| Direction of parsing | Left to right |
| End Rule | End Rule Right |
| Degenerate foot | Allowed in strong position |
| Extrametricality | Final indicative /-a/ |

Santali (Bodding 1930:127ff., cf. Konow 1906:39):[14] The unit of stress is up to 3 syllables: *σ́*/ *σσ́*/ *σσ́σ*, e.g. *ñutúm* ‘name,’ *utú* ‘curry,’ *sáuṛi* ‘thatching grass.’ Suffixal stress is lexical as in Mundari: e.g. the middle suffix -*oʔ*- is stressed. The postpositions -*re* and -*te* form a stress domain with a stem.

Sample sentences: *ám*$_{\text{you}}$ *dó*$_{\text{topic}}$ *ám-te*$_{\text{by}}$-*gè*$_{\text{emph.}}$-*m*$_{\text{2sg.}}$ *sén*$_{\text{go}}$-*le*$_{\text{pf.}}$-*n-à.* ‘Did you go yourself?’ (Bodding 1930:143); *iñ*$_{\text{I}}$ *nowá[ñ]*$_{\text{that}}$ *kəmí*$_{\text{work}}$ *maṛáṅ*$_{\text{give precedence}}$-*a*, *ar*$_{\text{and}}$ *inə́-tayóm*$_{\text{then}}$ *eṭagáʔ*$_{\text{other}}$-*iñ*$_{\text{1sg.}}$ *kəmí*$_{\text{do}}$-*ya.* ‘I will do that work first, then this next’ (Minegishi and Murmu 2001:17; stress marks mine); *ám*$_{\text{you}}$ *ciṭ*$^{h}$*í*$_{\text{letter}}$-*m*$_{\text{2sg.}}$ *b*$^{h}$*ejá*$_{\text{send}}$-*akáwadèña.* ‘You sent a letter to me’ (61); *setá*$_{\text{dog}}$ *do hóṛ*$_{\text{man}}$ *lekáʔ*$_{\text{like}}$ *bakó róṛ*$_{\text{speak}}$ *daṛéya*$_{\text{can}}$-*ʔ-à.* ‘Dogs cannot speak like men’ (164).[15]

Korku (Zide 1960:170): Stress falls on final and initial stressable syllables, heavy syllables, and then every other unstressed syllable. /gadá/ ‘river’; /turúi/ ‘six’; /jée/ ‘who’; /kókoyobā́/ ‘shaves’; /mudā́kekúkibá/ ‘must have beaten them’; /kókosṓmoródd-én/ ‘in K.’. There are not enough examples given to test Zide’s stress placement rules, but the general pattern seems to be to construct iambic feet from the right.

Kharia (Pinnow 1959:432): ∪–́. Non-initial syllables are often stressed.

Sora (Ramamurti 1931:6f.): The stress is predominantly initial, except ∪–́ and the latter element of reduplicated forms (ə-*gu-gú-ben*).

## §118 Gemination across syllable boundaries in Indo-European

The doubling rules prescribed in the Prātíśākhyas create gemination across a syllable boundary if the aperture of the consonants across the syllable boundary is different (§23). Among other Indo-European languages, Latin[16] and Germanic (Krahe 1948:113)

[14]In *LSI* IV (1906:39), Konow observes: “In words of two syllables the accent usually rests on the first. Thus *sérma*, year. The final syllable is, however, accented when it ends in a semi-consonant, when the last syllable is long and the first short, when the word ends in *ñ*, and when it is a reduplicated or reflexive monosyllabic base. Thus, *sänâk’*, go; *ạg ṵ́*, bring; *tehéñ*, to-day; *da-d ā́l* and *da-pál*, the intensive and reciprocal bases of *d ā́l*, strike. There are many exceptions to the general rule, but we have no detailed information about the matter.”

[15]Recordings of the sentences cited from Minegishi and Murmu (2001) are available at [E16], under ‘Audio Archive.’

[16]I do not know the phonological motivation for a similar shortening in Avestan (Hoffmann and Forssman 1996:58f): *mazdā-i̯asna- : YAv. *mazdaiiasna-*; OAv. *r āii* ogen.sg.: YAv. *raiia* inst.sg.; Skt. *v āyúḥ*:

are also known to show doubling across a syllable boundary, as in Lat. *līt̄era* 'letter' : *littera*, Lat. *Iūpiter* : *Iuppiter*, and Lat. *gnārus* adj. 'versed' : *narrō* denom. (Sommer and Pfister 1977:156, Meiser 1998:77). In these cases, however, gemination is not regular, and the gemination accompanies compensatory shortening; it looks more similar to the reduplication in Middle Indo-Aryan than to the Prātiśākhya rules, which produce obstruents of the same aperture (not necessarily geminates) across a syllable boundary at the cost of an optimal syllable weight of no more than two morae (Geiger 1994:§7, Pischel 1900:§90, Turner 1970 and von Hinüber 1986:74, 2001:117f.):

| | |
|---|---|
| Skt. *krīḍā* 'sport' | Ardhamāgadhī, Jaina-Māhārāṣṭrī *kiḍḍā* |
| Skt. *evam* 'thus' | Māhārāṣṭrī, Śaurasenī, Māgadhī, Ḍhekkī *ĕvvam* |
| Skt. *taila* 'oil' | Māhārāṣṭrī, Ardhamāgadhī, Jaina-Māhārāṣṭrī, Śaurasenī, Māgadhī *tĕlla* |

Melchert (1994:295f.) points out the peculiar spelling custom in Lycian, to double consonants across a syllable boundary.[17] The exception that "the second consonant is never geminated in a cluster of obstruent plus liquid," and the doubling of second stops as in *astti* and *martti*, are strikingly similar to the Prātiśākhya rules discussed in §23. Unlike Sanskrit, however, Lycian also doubles initial clusters as in *pddẽ* and *km̃mi-*.

It is very interesting that the Sanskrit doubling taught in the Prātiśākhyas (see §23) is not what the meter of the Ṛgveda favors (see §22), but it is halfway similar to Proto-Dravidian, which requires the consonants across a syllable boundary to be homorganic and non-continuant regardless of the length of the rime preceding the boundary.[18]

### §119 Aperture in Dravidian

While Proto-Dravidian morphemes may contain geminated plosives or laterals (Zvelebil 1970:76), neither original nor secondary gemination of the rhotics *r and *ẓ is reconstructed (Krishnamurti 2003:152), although modern languages such as Gondi, Kurux or Brahui have /rr/.

The phonemic inventory of Proto-Dravidian is reconstructed without an oral fricative, a gap which characterizes the Dravidian sound system (Zvelebil 1990:1). As for the possibility of laryngeal fricatives, Krishnamurti (1963 and 1997) proposes reconstructing laryngeal *H in Proto-Dravidian to account for Old Tamil *ḥ* (called *āytam*), found in a few morphemes such as PDr. *aH- 'that,' which occurs in Ta. *aḥtu* 'that one' < PDr. *aH-tu and Ta. *avar* 'they' < PDr. *aH-ar, as well as the unexplained length alternation of root vowels as in Ta. *mūnru* 'three' < PDr. *muH-ntu vs. Ta. *muppa(ḥ)tu*, OTe.

YAv. *vaiiuš*. A similar development in Latin, *ViV* > *ViiV* such as in *Pompeius* prop. /pompeyyus/; *pedyōs : *peior* 'worse' /peyyor/; *maǵiōs : *maior* /mayyor/, is due to etymological clusters (Leumann, 1926–28:127, Sommer and Pfister 1977:124).

[17] I thank H. Craig Melchert for this reference.

[18] For the later situation in Dravidian and its possible parallelism with the Middle Indo-Aryan two-mora rule, Krishnamurti (1991:170) suggests that close contact between Indo-Aryan and Dravidian caused the parallel developments of OIA -VCCV- into non-Northwest MIA -VCV- and -VCCV- on the one hand, and of PDr. -VCCV- into -VCV- and of PDr. -VNP-, -VNPP-, -VNPP- into -VP-, -VPP-, -VPP- on the other.

*muppadi* ‘thirty’ < PDr. *muH-paHtu to PDr. *muH- ‘three.’

Proto-Dravidian initial palatal *c began to lose its occlusive constriction by the time of the branching-off of Central Dravidian (Burrow 1947, Krishnamurti 1998a:68f.). In Central, South Central and South Dravidian languages except Parji, Gadaba and Telugu, *c becomes a sibilant /s/ (or often /š/ in Tamil) by deaffrication, and Proto-Dravidian initial *c- is completely lost in South Dravidian through PDr. *c > *s > *h, e.g. Ta. *āṟu* ‘six’ : Go. *saiyūng*, Pj. *sējēn* (Burrow 1947:141), PDr. *cup ‘salt,’ > Pj. *cup*, Nk. *supp*, Te. *uppu*, Ta. *uppu*. The /s/ coming from PDr. *c is voiceless in initial position, but medial *c develops into *j* in a few languages such as Tuḷu, Koḍagu, Kuṛux and Malto (Subrahmanyam 1983:330f.).

Initial plosives in Dravidian were originally voiceless (§120). The Old Tamil forms *aḷapu* ~ *aḷavu* ‘measurement,’ *peyar* < PDr. *pecar ‘name’ and *tōl* < PDr. *tokal ‘skin’ (Subrahmanyam 1983:281, Krishnamurti 1961:31ff.) show that the lenition of /p/, /c/ and /k/ in intervocalic position has already started by that period. Unlike the debuccalization of voiced aspirates to /h/ in Sanskrit (§46), these cases of lenition do not incur delinking of place features.

Both continuant consonants, i.e. the glides *y and *w and the rhotics *r and *ṛ, and non-continuant consonants other than *ñ (Krishnamurti 1998a:64) occur word-finally, although the “enunciative vowel” inserted after a word-final consonant prevents words from ending in a consonant, particularly a plosive, in many daughter languages (§121). It is interesting to compare Sanskrit, where fewer phonemes can appear in word-final position:

| | onset | | | coda | | | absolute final | |
|---|---|---|---|---|---|---|---|---|
| | PIE | Skt. | Dr. | PIE | Skt. | Dr. | Skt. | Dr. |
| stop | yes | yes | yes | yes | yes | yes | yes | yes |
| affricate | — | yes | yes | — | yes | yes | no | yes? |
| sibilant | yes | yes | — | yes | yes | — | no | — |
| nasal | yes | yes | yes | yes | yes | yes | yes | yes |
| /l/ | yes | yes | no | yes | rare | yes | no | yes |
| /r/ | yes | yes | no | yes | (yes) | yes | no | yes |
| /w/ | yes | yes | yes | yes | yes | yes | no (*-o*) | ?[i] |
| /y/ | yes | yes | yes | yes | rare | yes | no (*-e*) | yes |

[i] Krishnamurti (2003:154).

A complete loss of an initial nasal is sometimes observed in Dravidian, e.g. Ta. *nīr*, *īr*, Te. *nīru*, *īmiri*, Nk. *īr*, Pj. *nīr* (Burrow 1943–46:73, Zvelebil 1970:39, Subrahmanyam 1983:383). Dravidian does not have an equivalent of Sanskrit anusvāra, which is a nasal without occlusive constriction or place. Initial *y in Proto-Dravidian is often lost when it is followed by a low vowel (Burrow 1945, Krishnamurti 2003:143); this reminds us of the anomalous loss of stem-initial /y/ in Skt. *prá-üga-*, and of the deletion of a final /y/ before a vowel in the Sanskrit sandhi rule /-e V-/ → *-a V-*, (§67), but the conditioning context there is not limited to low vowels but includes any vowel. There are originally no fricative in Dravidian to begin with, and the insertion of formative vowels (§122)

precludes the possibility of sequences of the type NR where nasal deocclusion might occur as in Indo-Aryan, although secondary sequences of the type NR have arisen by Apical Displacement (§115).

### §120 Laryngeal features in Dravidian

The laryngeal features [voiced] and [spread glottis] are not distinctive in Proto-Dravidian.[19] Bloch (1914:87) proposes reconstructing a voicing contrast for Proto-Dravidian on the basis of the fact that Kannada and Telugu have a phonemic contrast of voicing in word-initial position, whereas plosives are voiced only between sonorants in Tamil and Malayalam. Against this proposal, Burrow (1937–9) defends the view of Caldwell (1961:138) and others that Tamil-Malayalam represents the original situation, by showing that initial voiced plosives in Kannada and Telugu do not consistently correspond to each other in the first place, e.g. Ka. *gedalu* 'white ant' : Ta. *citalai* : Te. *ceda*; Ka. *kampu* or *gampu* 'fragrance' : Te. *kampu*, *gabbu* or *gammu*; that they are of secondary origin, e.g. Te., Ka. *b-* < PDr. *v-; that many Telugu or Kannada words with initial voiced plosives lack cognates in Tamil-Malayalam; and that the apparent cognates in these languages are actually later loanwords, e.g. Ta. *kaṭṭam* 'chin' < Te. *gaḍḍamu*; Ta. *keṭṭam* 'beard' < Te. *gaḍḍamu*, Ka. *gaḍa̅*

### §121 Vowel epenthesis in Dravidian: the enunciative vowel

Proto-Dravidian is reconstructed with five short vowels, *i, *u, *e, *o and *a, and their long counterparts. Since Proto-South-Dravidian has alternations between high and mid vowels and not between mid and low vowels (Bright 1966), e.g. PDr. *pur > PSDr. *por-ay, e.g. Old Ka. *pore* 'layer,' > Ta. *purai* 'cataract,' it follows that not the feature [±low] but rather [±high] serves a contrastive function. Of [+high] and [−high], the latter is the marked value, for the mid vowels *e and *o can occur only in a root morpheme, which occupies the initial syllable of a derived word.

Although not all polysyllabic words can be analyzed into attested monosyllabic morphemes, Dravidian root morphemes are believed to have had the shape (C)V̆(C) in the earliest period, because sequences of that shape can easily be reconstructed from corresponding forms while the part following them often show morphemic variation;[20] for example, *DEDR* 3133 Ta. *taḷai* 'bind,' Ka. *taḷ* 'be joined' and Te. *talugu* 'tether' all have *taḷ- in common.[21]

Since roots and suffixes often end in a consonant, many underlying forms inevitably

[19]Caldwell (1961:75ff.) points out common grammatical and lexical features in Dravidian and Australian languages. Dixon (1980:236f.) refers to the lack of sibilants and of contrasts in stop voicing, along with the three-way contrast of dental/alveolar stops, as a 'remarkable similarity' between Australian and Dravidian languages (Hall 1997:41f.).

[20]Krishnamurti (1955, 1961:134f), cf. Zvelebil (1970:177): "We are starting with the basic assumption that PDr. roots were monosyllabic. A further fundamental assumption of Dr. morphophonemics: *no consonant clusters within simple morphs*; in other words, *consonant-clusters occur only on morph-boundaries*."

[21]Te. *l̤ > l / V_V (Krishnamurti 1998b:202).

end in a consonant. At the same time, the lack of reconstructible clusters of tautomorphemic heterorganic non-continuants suggests that a coda plosive had to be licensed by a following homorganic non-continuant already in Proto-Dravidian. When coda consonants are left out of the context of such licensing, an epenthetic high vowel, traditionally called an "enunciative vowel" (Caldwell 1961:134f.), is added to the root-final consonant, which is doubled if the root vowel is short (Krishnamurti 1961:81). According to the studies summarized by Bright (1975) and Subrahmanyam (1983:103ff), the enunciative high vowel is distributed as follows (/ï/ is a high back unrounded vowel):

| | | | |
|---|---|---|---|
| SDr. | Tamil | /ŭ/, /i~u/ | B]$_{word}$__ |
| | | /u/ | VXT]$_{word}$__ |
| | (Tolkāppiyam) | | |
| | Malayalam | /ï/ | {B,(R)}]$_{word}$__ |
| | Tulu | /ï/ | {B,R}]$_{word}$__ |
| | | /u/ | $C_{[labial]}]_{\sigma}$__, $V_{[+back]}]_{\sigma}$__ |
| | Kannada | /u/ | C]$_{word}$__ |
| | | /i/ | y]$_{word}$__ |
| | Koḍagu | /ï/ | C]$_{word}$__ |
| | | /u/ | v]$_{word}$__ |
| SCDr. | Telugu | /u/ | C]$_{word}$__ |
| | | /i/ | y]$_{word}$__ |
| | Koya | | |
| | Koṇḍa | /u~∅/ | C]$_{word}$__ |
| | | /i/ | {r,ṛ,l,y}]$_{word}$__ |
| | | /∅/ | _$_{suffix}$[pl. |
| | Kui | /u/ | C]$_{word}$__ |
| | | /∅/ | __$_{suffix}$[pl. |
| | Kuvi | /i/ | {r,l}]$_{word}$__ |
| CDr. | Parji | /i/ | {n,r,l}]$_{word}$__ (sporadic) |
| NDr. | Malto | /u/ | C]$_{word}$__ [i)] |

[i)] Based on correspondences such as Mlt. *cicu* : Kur. *cicc* 'fire'; Mlt. *oṛku* : Kur. *oṛok* 'bark'; Mlt. *qēqlu*: Kur. *xēxel* 'earth'; Mlt. *pēnu*: Kur. *pēn* 'louse'; Mlt. *muŋyu* : Kur. *mũy* 'mouth' (Pfeiffer 1972), although final /e/ is also common in Malto, especially in verbal morphemes.

The attestation in all the four subfamilies of Dravidian does not necessarily ensure that Proto-Dravidian already had an enunciative vowel, particularly in a case like this where the phenomenon in question is so easily repeatable and crosslinguistically common. But the fact that derived verbal bases are reconstructed without a cluster, and that the onset allows only one consonant, supports the idea that occurrence of consonants in final position was also very limited or not allowed at all in Proto-Dravidian, and a high vowel was inserted if a word would end in one.

### §122 Vowel epenthesis in Dravidian: formative and suffixal vowels

While Dravidian roots often end in a consonant, there are suffixes whose reconstructible preform consists solely of a consonant(s) or begins with a consonant(s). In earlier cases

of suffixation, some of these suffixes have been directly attached to the root-final consonant, fusing into a different consonant, e.g.

> PDr. *√kāl ‘flow,’ Ta. √*kāl* : *√kāl + *-t- > *√kāṯ, Te. √*kāɲu* ‘ooze’ (Krishnamurti 1961:329).

In Proto-Dravidian bases formed by productive suffixation, however, a vowel of non-uniform quality called the ‘formative vowel’ is inserted between the root-final consonant and the suffix and separates them.

| *DEDR* | PDr. | V | gloss | |
|---|---|---|---|---|
| 664a | *ur-uḷ | *u | ‘to roll down’ | |
| 795 | *et-ir | *i | ‘to oppose’ | |
| 2684 | *cur-uḷ-ntt- | *u | ‘to roll up’ | |
| 2698 | *cuẓ-al | *a | ‘to turn’ | ~ *cūẓ ‘surround’ |
| 4285 | *pur-aḷ | *a | ‘to roll over’ | |
| 63 | *aṭ-a-nkk- | *a | ‘to control’ | |
| 169 | *am-u-nkk- | *u | ‘to press’ | |
| 240 | *al-a-nkk- | *a | ‘to shake’ | |
| 509 | *el-a-nkk- | *a | ‘to shake’ | |
| 516 | *eṯ-a-nkk- | *a | ‘to lower’ | |
| 851 | *eḷ-u-mpp- | *u | ‘to cause to rise’ | |
| 954 | *oṭ-u-nkk- | *u | ‘to subjugate’ | |
| 1292 | *kar-a-nk- | *a | ‘to melt’ | |
| 1303 | *kal-a-nkk- | *a | ‘to confuse’ | |
| 1817 | *kuẓ-a-nkk-, -mpp- | *a | ‘to confuse’ | |
| 3246 | *tir-u-mpp-, -nkk- | *u | ‘to turn’ | |
| 3359 | *tuḷ-a-nkk- | *a | ‘to move’ | |
| 3672 | *ner-a-mpp- | *a | ‘to fill’ | |
| 4645 | *maṭ-a-nkk- | *a | ‘to bend’ | |
| 4866 | *miẓ-u-nk- | *u | ‘to swallow’ | |
| 4975 | *mur-u-nkk- | *u | ‘to cut into bits’ | |
| 4989 | *moẓ-a-nkk- | *a | ‘to sound’ | |
| 5496a | *veḷ-a-nkk- | *a | ‘to clean’ | |

(Subrahmanyam 1983:52ff., *DEDR*)

Whether or not these vowels between roots and suffixes originally served any grammatical function, neither meaning nor a phonological condition may be adduced from their distribution in the daughter languages. In function, they merely prevent an undesirable cluster of heterorganic consonants, but their coloring is not uniquely determined by any phonological generalization. Krishnamurti (p.c.) observes that the distribution of formative vowels is not completely arbitrary, but shows some restrictions, such as that “/i/ does not normally occur before obstruent suffixes P, PP, NP.” Unlike the enunciative vowel, which is conditioned by a purely phonological context, the appearance of a formative vowel depends on morphological contexts: it occurs more regularly in verbal suffixation, which is often subject to paradigmatic pressure, than in nominal formation.

When a formative vowel is not inserted, the resulting heavy cluster is simplified, e.g. *nāl-nkk- 'tongue,' Ta. *nākku* etc. (§113).

If, as Krishnamurti believes, the formative vowel is inserted in order to avoid an undesirable fusion of root-final and suffix consonants,[22] the motive behind the epenthesis is probably to maximize the root segments, in the same way as Sanskrit inserts a 'connective /i/' between a root and a suffix or ending beginning with a consonant in perfect and future forms (§95).

Note that there is also a vocalic suffix which does have a grammatical function: the past suffix *-i- is reconstructed for Proto-Dravidian from Kuṛux and Malto *-y-*, OTe. *-itt-*, Tamil-Koḍagu *-i-* etc. (Emeneau 1967:382, Subrahmanyam 1970:214ff.).

### §123 Place features in Dravidian

Proto-Dravidian plosives are reconstructed at least at six places of articulation, namely labial *p, dental *t, alveolar *t̻, retroflex *ṭ, palatal *c and velar *k. Nasals are reconstructed as distinct phonemes for all these places except dental and alveolar. According to Shanmugam (1972), the dental nasal is limited to initial position and before a dental stop, and it stands in complementary distribution with alveolar *n̻. Alveolar and retroflex laterals are phonemic in Proto-Dravidian, unlike Ṛgvedic *l̤* and *l̤ʰ* which are just intervocalic allophones of /ḍ/ and /ḍʰ/.

The Proto-Dravidian palatal plosive *c has distinctive phonemic status, while Indo-Aryan palatals all arose secondarily from Proto-Indo-European dorsals. Just as Proto-Indo-European velar and labiovelar stops develop into palatal plosives in Proto-Indo-Iranian, so the Dravidian velar stop *k becomes palatal in South Dravidian, after Proto-Dravidian *c in initial position is lost (Caldwell 1961:152, Burrow 1943, 1944:332, 1947:145ff.). But the alternation between dorsal and palatal plosives is not a unidirectional change from the former to the latter as in the development from Proto-Indo-European to Indo-Aryan, for PDr. *c becomes velar before *u in North Dravidian (Emeneau 1961).

A more notable difference between the phonemic inventories of Indo-Aryan and Dravidian is the distinction between the retroflex and alveolar stops *ṭ and *t̻ (cf. §105). These sounds alternate with dental *t as follows:

| | alveolar | dental | retroflex |
|---|---|---|---|
| stop | t̻ | ← t → | ṭ |
| nasal | | n̻~n ⟶ | ṇ |
| lateral | l(→∅) | | l̤(→∅) |

This asymmetrical alternation makes one suspect that the three-way contrast originated from an earlier fusion of consonant clusters. Some coronal stops actually derive from a merger of dental *t plus the laminal and retroflex laterals *l and *l̤:

[22]The fusion of root-final consonants is limited to suffixes consisting of coronal non-continuants, such as *-t-, *-tt-, *-nt- and *-ntt-. It might mean that the non-coronal (i.e. velar and labial) suffixes such as *-mpp- or *-nkk- have a V slot before them in their underlying representation, which is lost after a vowel-final root by a sort of syllabic imbrication; but it might simply be due to the mutual effects of coronal articulations occurring in sequence ('coronal syndrome,' §63).

Apical Obstruent Formation (Ramaswami Aiyar 1937:23, Krishnamurti 1998a):
*l + *t > *t̪, *l + *nt > *nt̪ (=*nt̪)
*l̤ + *t > *t̤, *l̤ + *nt > *n̤t̤

The loss of the timing slot of the laterals in this rule bears some resemblance to Fortunatov's Law (§99) which allegedly occured in Indo-Aryan, except that Fortunatov's Law changes a sequence of an *l and a dental consonant into the corresponding retroflex (§97, §98), for alveolar place is not distinctive in Indo-Aryan (§105). The timing slot is not lost in later rules such as Old Tamil sandhi /-l/ + /t-/ → -ht̪-, e.g. in *kal* 'stone' + *tīmu* 'badness' → *kaht̪īmu* (Kuiper 1958:193).

Proto-Indo-European *l and *r are considered to merge into *r in Proto-Indo-Iranian; this state is represented by Iranian and largely by Ṛgvedic Sanskrit, but Indo-Aryan frequently reintroduces /l/, or possibly preserves the original *l in some dialects (§99). Dravidian, on the other hand, makes a clear phonemic distinction between *r and *l or *l̤.

In Telugu (Subrahmanyam 1983:200) and in South Dravidian languages except Old Tamil and Kannada (Subrahmanyam 1971:96, Emeneau 1967:383), the high front vocoids /i/ and /y/ palatalize a following dental non-continuant, particularly in the past suffixes *-nt- and *-tt- and in the Telugu causative suffix *-incu*. Modern Tamil has palatalization of /nt/ by a preceding front vocoid, as in *aintu* 'five' which is pronounced /anju/ (Schiffman 1999:16). See §61 for a possible case of left-to-right palatalization in Vedic.

### §124 Summary

i) Syllable:

Old Indo-Aryan as known from the recitation traditions described in the Prātiśākhyas shifts the emphasis of the criteria for well-formedness from the length of the rime to identical aperture across a syllable boundary. In the Prātiśākhyas, agreement of place and aperture, or at least an identical degree of aperture, of consonants across a syllable boundary becomes more important than keeping the rime up to two morae long; when the consonants across a syllable boundary have different apertures, a repair process geminates one of them in order to attain the same aperture across the syllable boundary, even though it may make the preceding rime overlong. Although agreement of the places of articulation of obstruents across a syllable boundary is not an obligatory requirement yet as in Middle Indo-Aryan, clusters at the same place across a syllable boundary have increased due to the doubling of cluster consonants. As a consequence of these new restrictions, the surface structure of Old Indo-Aryan syllables shows a partial similarity to the reconstructed syllable of Proto-South-Dravidian, and probably of Proto-Dravidian as well, where a long vowel is commonly followed by tautosyllabic consonants, and only clusters of homorganic non-continuants are allowed across a syllable boundary (§113).

The strong restriction on the distribution of sibilants in Indo-Aryan, namely that a sibilant can occur only before a sonorant or before a voiceless plosive followed by a

sonorant, is unique among the Indo-European languages, as are the prespecification of the feature [spread glottis] for /s/ and the prohibition of voiced fricatives. The limited variety of phonemes occurring at a word boundary, particularly neutralization of voice distinctions and prohibition of sibilants, is quite similar to the phonemic inventory of Dravidian (§113).

a) Vowel length:

| | nature | unit of alternation | weight transfer with C | boundary rule | weight rule |
|---|---|---|---|---|---|
| IE | mostly grammatical | syllable | yes | flexible | strict |
| Skt. | partly grammatical | syllable | yes → no | flexible →strict | strict →flexible |
| Dr. | lexical | morpheme | no | strict | flexible |

b) Consonant length:

| | gemin. plosive | gemin. nasal | /ll/ | /rr/ | gemin. glide |
|---|---|---|---|---|---|
| Av. | no | no | no | no | no |
| Skt. | assimilation →+doubling | assimilation →+doubling | assimilation | no | *yy* by derivation |
| Dr. | assimilation, doubling, phonemic | assimilation, doubling | assimilation, doubling | no | *yy* |

c) Syllable structure:

| | consonant syllabification | restrictions on consonants across syll. | maximal rime | maximal onset |
|---|---|---|---|---|
| Av. | maximize onset | N/A | V:W | FBKR |
| Skt. | rime = nucleus+B →nucleus+$B_iB_i$ | none→same aperture →homorganic | V:WB →V:W$B_iB_i$ | F)KR |
| Dr. | -WNP.P-, -WN.P- | homorganic noncontinuant | V:WNP | C |

ii) Rhythm:

Although no firm conclusions can be drawn from the scanty data cited here, the rhythmic patterns of South Asian languages may be roughly grouped under the following three types:

Right-to-left trochees: New Indo-Aryan (Hindi, Maithili, Awadhi, Gujarati, Kashmiri, Punjabi; §114).

Unbounded with End Rule Left, or left-to-right trochees: Most Dravidian languages (§116); Bengali; Sadani; Marathi? (§114).

Left-to-right iambs: North Munda languages except Korku, which constructs iambs from right (§117); Konda (§116); Old Tamil? (§115).

iii) Aperture:

In Old Indo-Aryan, clustered non-continuants are required to have uninterrupted occlusion across a syllable boundary (§28). Frication, aspiration and anaptyxis cooccurring with /r/ tend to be avoided across a syllable boundary. The lack of geminated rhotics (§66, §119), which is shared by Indo-Aryan and Dravidian, follows from this restriction.

Both Indo-Aryan and Dravidian deaffricate some of their palatal plosives (§40, §119), but it is unlikely that this deaffrication is due to convergence. Deocclusion of primary palatals in pre-Vedic is very early (§46), if not as old as Proto-Indo-Iranian, and other Indo-European languages of the 'satəm' group show similar changes; the deaffrication on the Dravidian side, on the other hand, is an inner-Dravidian development, and it is doubtful whether it is of comparable antiquity. In Sanskrit, debuccalization of intervocalic voiced aspirates to /h/ incurs delinking of place features (§56, §57), whereas Dravidian deocclusion of intervocalic single plosives does not.

iv) Laryngeal and vowel features:

With respect to laryngeal features, there is almost nothing in Dravidian to compare with Indo-Aryan, for laryngeal features are not distinctive there, and no aspiration or fricative may be reconstructed for Proto-Dravidian (§119). It is worth noting, however, that Sanskrit also neutralizes laryngeal features in the word sandhi of final stops (§78), which represents the synchronic distributional pattern better than internal sandhi.

In Indo-Aryan, the feature [spread glottis] of a root morpheme, and possibly [voiced] as well (§88), are maximized in output forms such as the cases of Bartholomae's Law, due to root-suffix asymmetry (§82, §83). Dravidian exhibits root-suffix asymmetry in the distribution of vowels, i.e. only the root vowel shows a five-way contrast (§116); this might also be due to licensing in word-initial syllables, however, and root-suffix asymmetry itself is not an uncommon phenomenon in any case.

Indo-Aryan assigns the feature [+high] to a phonologically epenthesized vowel (§95, §121), while other Indo-European languages insert non-high vowels in epenthesis (§90). The epenthetic vowel in Dravidian other than North Dravidian is either back *u or central *ï. *i is not reconstructed as a null vowel in Dravidian, but at least Dravidian and Indo-Aryan both treat [+high] as the least marked value of the vowel height feature.

v) Place features:

Proto-Indo-Iranian and Proto-Balto-Slavic introduced a [−anterior] sibilant with retracted coronal articulation (§103). Then in pre-Vedic Indo-Aryan, apical or sublaminal articulation became prominent, and the feature [−distributed] was added to the existing place contrast of [±anterior]. The emergence of the [−anterior] sibilant as a distinct phoneme, and then of retroflex stops and a retroflex nasal, may be explained as an internal development of Indo-Aryan, but retroflexion of the whole dental series and the resulting finer distinctions in coronal configuration might not have happened if Indo-Aryan had not been in contact with language groups which already had contrasts of coronal articulation (§123).

# Appendix: Combinations of Consonants

## §125 Clusters beginning with fricatives

The following is a list of the consonant clusters in the electronic texts of the Ṛgveda and other Saṃhitā's, intended as a supplement to the phonotactic index and table of Turner and Turner (1971) and Elizarenkova (1974:120ff.).

●: ten times or more in the Ṛgveda
○: less than ten times in the Ṛgveda
(): apparent clusters are included
ś: Atharvaveda, Śaunaka recension [E03]; p: Atharvaveda, Paippalāda recension in Orissa [E04], up to book 15 (by the courtesy of Arlo Griffiths); t: Taittirīya-Saṃhitā [E05]; m: Maitrāyaṇi-Saṃhitā [E15], books 1 and 2; v: Vājasaneyi-Saṃhitā [E14]; A: Atharvaveda (=ś and p); Y: Yajurveda (=t, m and v).

| C | sC- | -sC- | ṣC- | -ṣC- | śC- | -śC- | hC- | -hC- |
|---|---|---|---|---|---|---|---|---|
| k | ● | ● | ○ | ● | | | | |
| $k^h$ | | t | | t | | | | |
| c | | | | | ● | ● | | |
| $c^h$ | | | | | | | | |
| ṭ | | | ● | ● | | | | |
| $ṭ^h$ | | | ● | ● | | | | |
| ṇ | | | ○ | ● | | | | ○ |
| t | ● | ● | | | | | | |
| $t^h$ | ● | ● | | | | | | |
| n | ○ | ● | | | ● | ● | ○ | ● |
| p | ● | ● | ś,v | ● | | ● | | |
| $p^h$ | ○ | ● | ○ | ○ | | | | |
| m | ● | ● | ● | ● | ○ | ● | | ● |
| y | ● | ● | ● | ● | ● | ● | ● | ● |
| v | ● | ● | ● | ● | ● | ● | ● | ● |
| r | ● | ● | | ○ | ● | ● | ● | ● |
| l | | | | ś | ● | ● | ○ | ś |
| s | | ● | | | | | | |
| ṣ | | | | ● | | | | |

ṣṇ- 4.27.4, 4.28.2, 5.60.7, 5.87.4, 8.7.7, 9.107.8, 9.97.16, 9.97.19 *ṣṇú-*. -ṣp$^h$- 6.75.4 *viṣp$^h$urántī* -ṣr- 1.71.1 *ajuṣrañ*.
sn- 1.104.3 *snātaḥ*, 5.80.5 *snātī*, 7.88.3 *snúb$^h$iś*, 8.46.18 *snúb$^h$ir*, 8.96.13 *snéhitīr*, 9.97.54 *sneháyac*, 10.71.7 *snātvā* sp$^h$- 1.84.8 *sp$^h$urat*, 1.188.9 *sp$^h$ātim*, 3.32.11 *sp$^h$igyā*, 6.61.14 *sp$^h$arīḥ*, 6.67.11 *sp$^h$urān*, 8.1.23 *sp$^h$irám*, 8.4.8 *sp$^h$igyàṃ*, 10.34.9 *sp$^h$uranty*, 10.87.11 *sp$^h$ūrjáyañ*
hl- 10.16.14 *hlādikāvati*, 10.16.14 *hlādike*. hn- 8.31.7 *hnutaḥ*. -hṇ- 4.57.7 *gṛhṇātu*, 10.34.11 *pūrvāhṇé*.

**-sk$^h$- TS 5.7.15.1** *musk$^h$ābʰyām*.
**-ṣk$^h$- TS 6.1.9.1** *niṣk$^h$idáti*. **ṣp- AVŚ 6.56.1, 10.4.8** *ví ṣparad*, **VSM 6.36** *ni ṣpara*. **-ṣl- AVŚ 20.134.6** *ákṣlīḷ*.
**-hl- AVŚ 6.16.2** *viháhlo*.

## §126 Clusters beginning with semivowels

| C | -rC- | -r C- | -lC- | -l C- | -vC- | -v C- | -yC- | -y C- |
|---|---|---|---|---|---|---|---|---|
| k | ● | | ○ | | | | | |
| kʰ | t | | | | | | | |
| g | ● | ● | ● | | | | | |
| gʰ | ● | ● | | | | | | |
| ṅ | | | | | | | | |
| c | ● | | | | | | | |
| cʰ | A,Y | | | | | | | |
| j | ● | ● | | | | | | |
| ñ | ○ | | | | | | | |
| ṭ | t,m | | | | | | | |
| ṭʰ | | | | | | | | |
| ḍ | ● | | | | | | | |
| ḍʰ | | | | | | | | |
| ṇ | ● | ● | | | ● | | | |
| t | ● | ● | | | | | | |
| tʰ | ● | | | | | | | |
| d | ● | ● | ○ | | | | | |
| dʰ | ● | ● | | | | | | |
| n | ○ | ● | | | ● | | | |
| p | ● | | ● | | | | | |
| pʰ | ○ | | ○ | | | | | |
| b | ● | ● | ● | | | | | |
| bʰ | ● | ● | p,t | | | | | |
| m | ● | ● | ○ | | | | | |
| y | ● | ● | ● | | ● | | ● | |
| v | ● | ● | ○ | | | | ○ | |
| r | | | | | ● | | | |
| l | ś,m | ○ | ○ | ○ | ○ | | | |
| ś | ● | | ○ | | | | | |
| ṣ | ● | | | | | | | |
| s | ○ | | | | | | | |
| h | ● | ● | ś,t,v | | | | | |

-vl- 1.133.1 *abʰivlágya*, 1.133.2 *abʰivlágyā*, 1.133.4 *'bʰivlaṅgáir*.
-rñ- 6.47.25 *sārñjayá*. -rn- 1.135.9 *durniyántavaḥ*, 1.135.9 *durniyántavo*, 1.190.6 *durniyántuḥ*, 10.161.5 *punarnava*. -rpʰ- 10.106.6 *parpʰarík̂ā*, 10.106.6 *turpʰárītū*, 10.106.6 *turpʰárī*, 10.106.7 *parpʰarat*, 10.106.8 *turpʰárī*. -rs- 2.25.1 *sarsṛte*, 2.35.5 *prasarsré*, 3.7.1 *sarsrāte*, 5.12.6 *prasársrāṇasya*, 5.44.3 *prasársrāṇo*, 6.18.7 *sarsre*.
-r l- 1.100.16 *sumádaṃśur lalāmîr*.
-ld- 8.1.20 *gálday ā*. -lk- 4.4.2 *ulk̂āḥ*, 7.82.6 *śulk̂aya*, 8.1.5 *śulk̂aya*, 10.16.13 *vyàlkaśā*, 10.68.4 *ulk̂am*. -lm- 2.33.8 *kalmalīkínaṃ*, 2.35.12 *bílmair*, 7.50.3 *cʰalmaláu*, 10.85.20 *śalmalíṃ*. -lpʰ- 7.50.2 *kulpʰáu*. -lv- 5.62.7 *tílvile*, 7.78.5 *tilvilāyádʰvam*, 10.86.22 *pulvagʰó*.
-l l- 10.163.5 *vanaṃkáraṇāl lómabʰyas*, 10.163.6 *áṅgād-aṅgāl lómno-lomno*
-yv 10.106.6 *jark̂ayv ajáram*
-lś- 3.8.11 *śatávalśo*, 3.8.11, 7.33.9, 9.5.10 *sahásravalśā*

**-rkʰ- TS 7.1.6.4** *mūrkʰā*. **-rṭ TS, MS** *amārṭ*. **-rl- AVŚ 20.133.6** *antárlomamáti*, **MS**

**1.6.12:106,8**- *nirlúpya*.

**-lb$^{h}$- AVPO 17.15.10** *alb$^{h}$ag$^{h}$ āsāṃ*; **TS** *apagalb$^{h}$á-, pragalb$^{h}$á-*. **-lh- AVŚ** *bálhika-*, **VSM 23.51** *upavalhāmasi*; **TS** *malhā́-*.

## §127 Clusters beginning with nasals

| C | mC- | -mC- | -ṇC- | -ṇ C- | nC- | -nC- | -ñC- | -ṅC- |
|---|---|---|---|---|---|---|---|---|
| k | | | | | | | | ● |
| k$^{h}$ | | | | | | | | ● |
| g | | | | | | | | ● |
| g$^{h}$ | | | | | | | | ● |
| c | | | | | | | ● | |
| c$^{h}$ | | | | | | | ○ | |
| j | | | | | | | ● | |
| ḍ | | | ● | | | | | |
| ḍ$^{h}$ | | | p | | | | | |
| ṇ | | ● | p,t,m | | | | | |
| t | | | | | | ● | | |
| t$^{h}$ | | | | | | ● | | |
| d | | | | | | ● | | |
| d$^{h}$ | | ○ | | | | ● | | ○ |
| n | | ● | | ○ | | ● | | m |
| p | | ● | | ś | | | | |
| p$^{h}$ | | | | | | | | |
| b | | ● | | | | | | |
| b$^{h}$ | | ● | | | | | | |
| m | | ● | ○ | ○ | | ● | | t |
| y | ○ | ● | ● | | ● | ● | ś,t | |
| v | | (●) | ● | | (●) | ● | (○) | |
| r | ○ | ● | | | | | | |
| l | ○ | ○ | | | | | | |

my- 2.28.6 *myakṣa*. mr- 1.162.21 *mriyase*, 6.53.3 *mradā*, 8.61.10 *mrakṣakṛ́tvā*, 10.165.4 *mrityáve*. ml- 8.55.3 *mlātā́ni*, -ml- 2.35.13 *ánab$^{h}$imlātavarṇo*, 10.52.4 *ápamluktam*.

-ṇm- 7.16.4, 10.84.4 *kṛṇmahe*.

-ṇ n- 9.88.7 *prṭan āṣā́ṇná*. -ṇ m- 8.101.11 *báṇ mahā́m̐*, 10.130.5 *vir ā́ṇmitr ā́váruṇayor*.

-ṅd$^{h}$- 2.24.15 *pṛṅd$^{h}$i*, 6.75.12 *vṛṅd$^{h}$i*, 10.87.11 *vṛṅd$^{h}$i*, 10.87.4 *b$^{h}$aṅd$^{h}$y*, 10.156.3 *aṅd$^{h}$í*.

-ñv- 3.39.5, 8.92.3 *abhijñv ā́*.

**mr- AV** *mroká-*.

**-ṇḍ$^{h}$- AVPO** *piṇḍ$^{h}$i*. **-ṇṇ- AVPO 1.58.3** *a]vatṛṇṇasya*, **4.40.6d** *ṣaṇṇ āṃ*; **TS 2.4.2.3** *'b$^{h}$íṣaṇṇa-*, *níṣaṇṇa-*, *-tṛṇṇá-*, **5.1.7.4** *án ā́c$^{h}$ṛṇṇam*, **7.2.15.1** *ṣáṇṇavatyai*, **MS 1.8.10:130,16** *víṣyaṇṇam*.

**-ñy- AVŚ 14.1.43** *samr ā́jñy edhi*; **TS, VSM** *r ā́jñy asi*.

**-ṅn- MS 2.1.12:13,18, 14,4** *prastiṅnuy ā́d*, **14,5** *prástiṅnoti*. **-ṅm- AVŚ 5.1.1** *ṛ́dhaṅmantro*, **8.1.9** *pár āṅman āḥ*, **11.9[11].17** *ásṛṅmukh ān*, **AVPO 9.16.3** *asṛṅmat ī*, **TS 7.2.8.3** *triṣṭúṅmuk$^{h}$o*. **-ṅv- AVPO 3.8.2** *viṣvaṅvar ūpam* **(?)**.

## §128 Clusters beginning with voiceless stops

| C | kC- | -kC- | -k C- | $k^h$C- | -$k^h$C- | cC- | -cC- | $c^h$C- | -$c^h$C- |
|---|---|---|---|---|---|---|---|---|---|
| k | | ○ | ○ | | | | | | |
| $k^h$ | | t | p | | ○ | | | | |
| ṅ | | | | | | | | | |
| c | | | ○ | | | | ● | | |
| $c^h$ | | | ○ | | | | | | |
| ñ | | | | | | | t | | |
| ṭ | | | | | | | | | |
| $ṭ^h$ | | | | | | | | | |
| ṇ | | ● | | | | | | | |
| t | | ● | ● | | | | | | |
| $t^h$ | | ● | | | | | | | |
| n | | ● | | | A | | | ○ | |
| p | | | ○ | | | | | | |
| $p^h$ | | | | | | | | | |
| m | | ● | | | | | ○ | ○ | |
| y | ś | (●) | | ● | ● | ● | ● | ● | ○ |
| v | (●) | ● | | | ○ | | | ○ | ○ |
| r | ● | ● | | | | | ○ | ● | ○ |
| l | ○ | A,Y | | | | | | ○ | |
| ś | | m | A,v | | | | | | |
| ṣ | ● | ● | | | | | | | |
| s | | ○ | ● | | | | | | |

kl- 6.46.14 *klóśam*. -kk- 1.187.10 *vṛkká*. -ks- 10.114.6 *ṛksāmā́bʰyām*, 10.85.11 *ṛksāmā́bʰyām*.
-$k^hk^h$- 7.103.3 *akʰkʰalīkʰrtyā*. -$k^h$v- 2.14.4 *cakʰvā́ṃsaṃ*.
-cm- 9.29.5 *mumucmáhe*. -cr- 10.111.9 *mumucré*, 10.77.3 *riricré*.
$c^h$n- 1.63.5 *cʰnatʰihy*. $c^h$m- 2.11.17 *cʰmáśruṣu*. $c^h$v- 1.33.14 *cʰvaitreyó*, 1.33.15 *cʰvítryaṃ*, 1.66.6 *cʰvetó*, 10.18.11 *cʰvañcasva*, 10.42.9 *cʰvagʰnī́*, 10.88.4 *cʰvātrám*, 10.94.6 *cʰvasánto*, 10.142.6 *cʰvañcasva*. $c^h$l- 10.12.5 *cʰlóko*, 9.73.6 *cʰlókayantrāso*, 9.92.1 *cʰlókam*.
-$c^h$y- 1.60.2 *hótāpṛ́cʰyo*, 1.64.13 *āpṛ́cʰyaṃ*, 4.3.8 *pṛcʰyámānaḥ*, 4.5.11 *pṛcʰyámānas*, 5.42.10 *tucʰyā́n*, 8.40.3 *pṛcʰyámānā*, 9.107.5 *āpṛ́cʰyaṃ*, 10.129.3 *tucʰyénābʰv*. -$c^h$v- 9.86.43 *ucʰvāsé*, 10.18.12 *ucʰváñcamānā* -$c^h$r- 1.54.3 *bṛhácʰravā*, 3.53.21 *yācʰreṣṭʰā́bʰir*, 6.75.9 *kṛcʰreśrítaḥ*, 10.52.4 *kṛcʰrā́*, 10.66.1 *bṛhácʰravasaḥ*.
-t $p^h$- 10.117.7 *ít pʰā́la*.

**-kk- AVŚ 9.6.22** *srukkāréṇa*, **VSM 1.16** *kukkuṭó*, **24.32** *kakkaṭás*, **TS 2.2.3.3, 3.4.9.6** *rúkkāmaḥ*, **3.4.2.1** *kikkiṭā́*, **7.5.12.2** *svā́hātvákkāya*-**$kk^h$**- **TS** *akkʰidat*, **4.5.9.2** *ākkʰidaté ca prakkʰidaté ca*. **-k $k^h$- AVPO 9.11.9** *bʰiṣak kʰane*.
**ky- AVŚ 18.3.6** *kyā́mbūr*. **kl- AVŚ 2.2.5, AVPO 1.7.5** *klandās*, **AV, TS, VS, MS** *klība-*, **AVPO 1.68.2, 3, 4** *klīvam*, **TS 2.3.3.4** *kláivyād*, **AVŚ 9.4.15** *kláśo*, **AVPO 16.124.4, 5** *klinno*, **AV+** *kloman-*, **VSM 39.5** *klatʰan*. **-kl- AVŚ 7.76.1, AVPO 1.21.1** *vikledīyasīḥ*, **AV+** *śuklá-*, **AVPO 8.8.3** *yakaklomabʰyaḥ*, **AVPO 11.2.7** *ākläntaṃsaṃkläntaṃ*, **AV** *alíklava-*, **AVPO 16.104.2** *ariklavebʰyo*, **AVŚ 12.4.5** *viklíndur*, **MS 1.6,11:103,9** *púklakaś*.
**-kś- MS** √*kśā*. **-k ś- AVŚ 19.24.3, AVPO 15.5.10** *jyók śrótré*, **VSM 24.33** *puruṣavāk śvāvid*
**-$k^hn$- AVŚ 5.31.8, AVPO 16.36.8** *nicakʰnúḥ*.
**-cm- TS 1.1.3.1, VS 1.4** *tanacmi*. **-cñ- TS 1.5.7.3** *yācñ[ā́*

| C | ṭC- | -ṭC- | -ṭ C- | tC- | -tC- | -t C- | -tʰC- | pC- | -pC- | -p C- |
|---|---|---|---|---|---|---|---|---|---|---|
| k | | ○ | ○ | | ● | ● | | | | ś,t |
| kʰ | | | | | A,t | ○ | | | | |
| ṅ | | | | | | | | | | |
| c | | | ś,t | | | | | | | |
| cʰ | | | ○ | | | | | | t | t,v |
| ñ | | | | | | | | | | |
| ṭ | | ● | | | | | | | | |
| ṭʰ | | | | | | | | | | |
| ṇ | | t | | | | | | | ○ | |
| t | | ○ | ○ | | ● | ● | | | ● | t,v |
| tʰ | | | | | ● | ś | | | | |
| n | | | | | ● | | ○ | | ● | |
| p | | A,t,v | ○ | | ● | ● | | ○ | ○ | ś,v |
| pʰ | | | | | | ○ | | | | |
| m | | A | | ● | ● | | | | A,Y | |
| y | | ● | | ● | ● | | ● | ○ | ● | |
| v | ● | ○ | | ● | ● | | ● | | (○) | |
| r | | ● | | ● | ● | | ○ | ● | ● | |
| l | | | | | | | | ○ | ○ | |
| ś | | p | A,v | | | | | | ● | |
| ṣ | | m | | | | p,t,m | | | | |
| s | | ś | ● | ○ | ● | ● | | ○ | ● | |

-ṭk- 1.14.8, 1.31.5, 1.120.4, 2.36.1, 7.14.3, 7.15.6, 8.28.2, 10.17.12, 1.162.15 *váṣaṭkṛ-*. -ṭt- 10.114.6 *ṣaṭtriṃśā́ṃś*, -ṭv- 8.46.27 *araṭvé*,
-ṭ k- 6.15.11 *ā́naṭkaváye*, 8.6.48 *ānaṭkakuhó*. -ṭ kʰ- 8.77.3 *a]khidat kʰé*, 10.97.20 *riṣat kʰanitā́*, 10.106.7 *nā́pat kʰaramajrā́* -ṭ cʰ- 1.66.6 *ábʰrā́ṭcʰvetó*, 1.71.8 *ā́naṭcʰúci*. 3.33.1 *víp ā́ṭcʰutudrī*, 5.40.4 *turā́ṣā́ṭcʰuṣmī*, 7.90.2 *ā́naṭcʰúciṃ*. -ṭ t- 1.121.3 *rā́ṭturó*, 5.6.5 *hávyavā́ṭtúbʰyaṃ*, 6.12.3 *vanerā́ṭtodó*, 7.99.7 *váṣaṭ te*, 7.100.7 *váṣaṭ te*, 8.45.27 *ā́naṭturváṇe*. -ṭ p- 1.139.1 *śráuṣaṭ puró*, 1.181.6 *niṣṣā́ṭpūrvīr*, 10.19.5 *udā́naṭparā́yaṇam*, 10.102.11 *ānaṭpī́pyānā* ts- 1.71.5, 1.134.5, 7.50.1, 7.50.2, 7.50.3, 8.1.11 *tsar-*. -t pʰ- 10.117.7 *ít pʰā́la*
-tʰn- 1.127.7 *matʰnánto*, 1.93.6 *jabʰārā́matʰnād*, 10.171.3 *śratʰnā́*, 2.24.3 *áśratʰnan*, 9.69.3 *śratʰnīté*. -tʰr- 1.181.5 *matʰrā́*, 8.46.23 *matʰrā́*.
py- 1.91.16, 1.91.17, 1.93.12, 9.31.4, 9.67.28, 10.85.5 *pyāy-*. ps- 1.41.7, 9.2.2, 9.74.3, 9.96.3, 9.97.27 *psáras-*. 10.26.3 *psúraḥ*.
-pṇ- 1.110.1, 2.16.6, 2.36.4, 3.42.2, 4.19.3, 8.35.10 *tṛp-ṇu-*. -pv- 1.116.23 *viṣṇāpvàṃ*, 1.117.5 *suṣupvā́ṃsaṃ*, 1.117.7 *viṣṇāpvàṃ*, 1.161.13 *suṣupvā́ṃsa*, 8.86.3 *viṣṇāpvè*, 10.17.10 *gʰṛtapvàḥ*, 10.65.12 *viṣṇāpvàṃ*, 10.103.12 *apve*. pl- 1.182.5 *plavám*, 1.191.1 *plúṣī*, 8.1.33 *plā́yogir*, 10.63.17, 64.17 *platéḥ*, 10.155.3 *plávate*, 10.163.3 *plāśíbhya*. -pl- 8.33.19 *kaṣaplakáu*. -pś- 1.8.8, 1.64.10, 1.87.1, 1.166.8, 2.34.5, 3.36.4, 4.17.20, 4.20.2, 4.20.5, 4.45.1, 4.50.3, 6.18.12, 6.22.6, 6.32.1, 6.40.2, 7.101.4, 8.76.5, 10.113.2, 10.113.6, 10.115.3, 10.75.9 *(vi-)rapś-*.

**-ṭṇ- TS 5.6.5.3** *āṭṇāráḥ*. **-ṭp- AVŚ 9.3.21** *ṣáṭpakṣā*, **AV, TS, VS** *ṣáṭpada-*. **-ṭm- AVŚ 8.6.15, AVPO 16.80.2** *maṭmaṭā́ḥ*. **-ṭs- AVŚ 11.5[7].2** *ṣaṭsahasrā́ḥ*, **-ṭ c- AVŚ 19.47.4** *ṣáṭ ca*, **TS 5.6.10.3** *ṣáṭ cítayo*. **-ṭś- AVPO 9.21.6** *ṣaṭśarāvaṃ*. **-ṭ ś- AVŚ 9.5.21** *virā́ṭśíraḥ*, **AVPO 1.37.3** *ṣaṭ śatā́*, **VSM 20.5** *virāṭśrotram*, **33.11** *ānaṭśuci*. **-ṭṣ- MS 1.10.17:156,12** *ṣáṭṣaṭ*.
**-tkʰ- AV, TS** *utkʰidán*. **-t tʰ- AVŚ 10.1.29** *tvót tʰāpayāmasi*, **12.3.30** *út tʰāpaya*. **-t ṣ- AVPO 9.21.6** *nirvapet ṣaḍ*, **TS 5.5.2.6** *tásmāt ṣaḍahám*, **6.6.11.1** *tát ṣoḍaśy* **etc., MS 1.7.3:112.1** *tásmāt ṣáḍ*.

**-p k- AVŚ 8.9.20** *anuṣṭúp kat$^{h}$ám*, **TS 3.4.9.6** *tṛṣṭúg rākā ... anuṣṭúp kuhūr*. **-pc$^{h}$- AVŚ 6.48.3, AVPO 19.44.5** *triṣṭúpc$^{h}$andā*, **TS** *triṣṭúpc$^{h}$andas-*, **-p c$^{h}$- TS** *anuṣṭúp c$^{h}$ándaḥ* **etc., VS** *kakup c$^{h}$andaḥ* **etc. -p t- TS 1.8.13.1b** *triṣṭúp tvā* **etc., VSM 8.47** *anuṣṭup te* **etc. -p p- AVŚ 8.9.20** *triṣṭúp pañcadaśéna*, **VSM 23.33** *anuṣṭup paṅktyā*. **-pm- AV, TS, MS, VS** *pāpmán-*. **-p s- TS 5.1.3.5** *anuṣṭúp sárvāṇi*, **VSM 23.33** *kakup sūcī$^{h}$iḥ*.

## §129 Clusters beginning with voiced stops

| C | gC- | -gC- | -g C- | g$^{h}$C- | -g$^{h}$C- | jC- | -jC- | -ḍC- | -ḍ C- | -ḍ$^{h}$C- |
|---|---|---|---|---|---|---|---|---|---|---|
| g | | | ○ | | | | | ● | v | |
| g$^{h}$ | | ○ | ○ | | | | | | | |
| ṅ | | | | | | | | | | |
| j | | | ○ | | | | ● | | ○ | |
| j$^{h}$ | | | | | | | ○ | | | |
| ñ | | | | | | ○ | ● | | | |
| ḍ | | | | | | | | m | | |
| ḍ$^{h}$ | | | | | | | | ● | ○ | |
| ṇ | | ○ | | | | | | | | |
| d | | | ● | | | | | | ○ | |
| d$^{h}$ | ○ | ● | ○ | | | | | ś,t,v | | |
| n | ● | ● | | ● | ● | | | | | |
| b | | ś | ○ | | | | | ○ | ○ | |
| b$^{h}$ | | ● | ● | | | | | ○ | ○ | |
| m | ● | ● | | | ○ | ● | ● | | | |
| y | | ● | ● | t | ○ | ● | ● | ● | ○ | (●) |
| v | | ● | ● | | ○ | t | ● | ○ | ○ | ● |
| r | ● | ● | ● | ○ | ○ | ● | ● | A,t | t,m | ś,v |
| l | ○ | A | | | | | | | | |

gd$^{h}$- 1.158.5 *gd$^{h}$a*. -gṇ- 1.152.4 *ánavapṛgṇā*, 3.31.6 *rugṇám*, 6.39.2 *árugṇaṃ*. -gg$^{h}$- 1.64.3 *ab$^{h}$ogg$^{h}$áno*. gl- 1.164.10 *glāpayanti*.

-g g$^{h}$- 1.13.5 *ānuṣág g$^{h}$ṛtáprṣṭ$^{h}$am*, 1.51.7 *sad$^{h}$ryàg g$^{h}$itā*, 3.41.1 *madryàg g$^{h}$uvānáḥ*, 4.6.6 *saṃdṛ́g g$^{h}$orásya*, 6.11.5 *srúg g$^{h}$ṛtávatī*, 6.49.10 *ṛ́d$^{h}$ag g$^{h}$uvema*, -g j- 1.136.6f *jyóg jīvantaḥ*, 4.4.10 *ānuṣág jújoṣat*, 6.5.3 *ānuṣág jātavedo*, 7.18.13 *b$^{h}$āg jéṣma*, 7.71.1 *nág jihīte*, 8.8.23 *arvāg jīvéb$^{h}$yas*, 9.97.22 *vāg jyéṣṭ$^{h}$asya*, 10.37.7 *jyóg jīvā́ḥ*, 10.105.8 *ṛ́d$^{h}$ag jóṣati*. -g d$^{h}$- 1.146.3 *víṣvag d$^{h}$enū*. -g b- 4.53.4 *prāsrāg bāhū*, 9.112.1 *b$^{h}$iṣág brahmā*, 10.122.2 *g$^{h}$ṛ́tanirṇig bráhmaṇe*. -g b$^{h}$- 2.11.21, 2.15.10, 2.16.9, 2.17.9, 2.18.9, 2.19.9, 2.20.9 *d$^{h}$ag b$^{h}$ágo*, 2.14.7 *ā́vṛṃag b$^{h}$árat*ā, 4.7.2 *ānuṣág b$^{h}$úvad*, 5.16.2 *ānuṣág b$^{h}$ágo*, 8.75.12 *varg b$^{h}$ārab$^{h}$ṛ́d*, 8.97.7 *vṛṇag b$^{h}$ávā*, 8.102.19 *át$^{h}$ait ādṛ́g b$^{h}$ar āmi*, 9.70.7 *tvág b$^{h}$avati*, 10.60.11 *nyàg b$^{h}$avatu*.

g$^{h}$r- 1.116.8, 5.34.3, 5.44.7, 7.69.4 *g$^{h}$raṃsá-*. -g$^{h}$m- 10.70.4 *drāg$^{h}$mā*, 7.56.21 *dag$^{h}$ma*. -g$^{h}$y- 1.123.5 *dag$^{h}$yā*. -g$^{h}$v- 1.52.5, 4.41.9, 6.63.9 *rag$^{h}$vī-*, 6.42.1 *'paśc āddag$^{h}$vane*. -g$^{h}$r- 1.162.15 *jág$^{h}$riḥ*, 1.185.5 *ab$^{h}$ijíg$^{h}$rantī*.

jñ- 1.109.1 *jñāsá*, 2.10.6 *jñeyā*, 4.51.6 *jñāyante*, 6.1.6 *jñubādʰo*, 7.55.5, 10.66.14, 10.85.28, 10.117.9 *jñātí-*. -jj$^{h}$- 5.52.6 *jájj$^{h}$atīr*.

-ḍ ḍ$^{h}$- 4.21.10 *samrā́ḍ ḍ$^{h}$ántā*, 10.15.12 *'vāḍ ḍ$^{h}$avyā́ni*. -ḍb- 1.162.14, 1.162.16, 10.97.16 *páḍbīśa-*. -ḍb$^{h}$- 1.112.21 *saráḍb$^{h}$yas*, 2.18.4 *ṣaḍb$^{h}$ír*, 4.2.12, 4.2.14, 4.38.3, 5.64.7, 10.28.8, 10.79.2, 10.99.12 *paḍb$^{h}$ís*.

-ḍ j- 1.12.6 *havyavā́ḍ juhvā́syaḥ*, 7.20.3 *satrāṣā́ḍ janúṣem*. -ḍ d- 7.18.14 *ṣáḍ duvoyú*, 8.68.14

*ṣáḍ dvā́-dvā*, 10.20.4 *ā́naḍ divó*, 10.27.7 *ānaḍ dárṣan*, 10.104.6 *ānaḍ dāśvā́ṁ*, 10.108.1 *ānaḍ dūré*. -ḍ b- 7.28.2 *ā́naḍ bráhma*, 10.170.1 *vibʰrā́ḍ bṛhát*, 10.170.2 *vibʰrā́ḍ bṛhát*. -ḍ bʰ- 3.56.2 *ṣáḍ bʰārā́ṁ*, 10.170.3 *viśvabʰrā́ḍ bʰrājá*. -ḍ y- 1.23.15 *ṣáḍ yuktā́ṁ*, 7.7.7 *ānaḍ yūyám*, 7.8.7 *ānaḍ yūyám*, 7.104.23 *naḍ yātumā́vatām*, 10.70.9 *ā́naḍ yád*. -ḍv- 7.87.5 *ṣáḍvidʰān āḥ*, 10.59.10 *anaḍvā́haṃ*, 10.85.10 *anaḍvā́hāv* (1.118.9 *vīḷvàṅgam*, 6.47.26 *vīḷvàṅgo*, 4.3.14 *vīḷv áṃho*, 8.85.7 *vīḷvàṅge*, 8.77.9 *vīḷv ādhārayaḥ*). -ḍ v- 1.121.1 *ā́naḍ víśa*, 1.188.5 *samrā́ḍ vibʰvīḥ*, 3.6.1 *dakṣiṇā́vāḍ vājínī*, 8.42.1 *samrā́ḍ víśvét*, 10.7.2 *ā́naḍ váso*, 10.19.5 *udā́naḍ vyáyanaṃ*, 10.115.9 *váṣaḍ vāṣaḷ*.

**-gb- AVŚ 10.8.9** *tiryágbilaś*. **-gl- AVŚ 4.4.7, AVPO 19.13.12** *anavaglāyatā*, **AVPO 4.5.10** *nāvaglāyo*

**-gʰy- TS 6.3.3.1** *a]rvā́g gʰy èna*m. **TS 1.4.34.1e** *jválantīṃ*, **5.4.1.3** *jvalati*.

**-ḍ g- VSM 21.13** *dityavāḍ gaur* **etc. -ḍḍ- MS** *īḍḍe*. **-ḍ dʰ- AVŚ 7.97.7** *váṣaḍ dʰutébʰyo*, **TS 4.3.7.2b, VSM 14.21** *rā́ḍ dʰruvā́si*. **-ḍr- AV, TS** *ṣaḍrātrá-*. **-ḍ r- TS 5.6.7.1** *ṣáḍ rā́trīr*, **MS 1.11.9:10,7** *víḍ rā́jānam*

**-ḍʰr- AVŚ 7.95.3, VSM 6.14** *méḍʰraṃ*.

| C | dC- | -dC- | -d C- | dʰC- | -dʰC- | bC- | -bC- | -b C- | bʰC- | -bʰC- |
|---|---|---|---|---|---|---|---|---|---|---|
| g | | ● | ● | | | | | ○ | | |
| gʰ | | ś,t | ● | | | | | | | |
| ṅ | | | | | | | | | | |
| j | | | | | | | ● | ś,t | | |
| jʰ | | | | | | | | | | |
| ñ | | | | | | | | | | |
| ḍ | | | | | | | | | | |
| ḍʰ | | | | | | | | | | |
| ṇ | | | | | | | | | | ● |
| d | | ● | ● | | | | ● | ○ | | |
| dʰ | | ● | ● | | | | ● | t | | |
| n | | ● | | | ● | | | | | ● |
| b | | ● | ● | | | | | | | |
| bʰ | | ● | ● | | | | m | | | |
| m | | ● | | ○ | ● | | | | | ○ |
| y | ● | ● | ● | ○ | ● | | (○) | | | ● |
| v | ● | ● | ● | ● | ● | | (○) | ś | | ● |
| r | ● | ● | ● | ● | ● | ● | ● | | ● | ● |
| l | | | | | | | ś | | | t,v |

-dn- 1.112.12 *kṣódasodnáḥ*, 4.20.6 *udnéva* dʰm- 5.9.5 *dʰmātevā*, 5.9.5 *dʰmātárī*, 7.89.2 *dʰmātáḥ*. dʰy- 3.26.8, 4.41.7, 5.70.1, 5.74.4, 8.21.2, 8.92.5, 10.67.11, 10.76.2, 10.76.3 *dʰy*, 4.36.2 *dʰyáyā*. -b g- 10.14.16 *triṣṭúb gāyatrī*. -b d- 2.13.9 *unab dabʰītaye*. (-by- 8.72.5 *ambyàm*. -bv- 10.16.13c *kiyā́mbv átra*.) -bʰm- 1.139.10d, 10.47.1a *jagṛbʰmā́*, 8.45.20b *rarabʰmā́*.

**-dgʰ- AVŚ 5.21.8** *padgʰoṣaíś*, **TS 7.5.13.1** *tvārādgʰoṣā́ya*.

**-b j- AVŚ 19.21.1** *triṣṭúb jágatyai*, **TS** *triṣṭúb jágatī*. **-b dʰ- TS 3.4.9.7** *anuṣṭúb dʰā́tā*. **-bbʰ- MS 2.5.10:62,1** *kakúbbʰiḥ*. **-by- TS 2.3.3.4** *kláibyād*. **-b v- AVŚ 13.1.15** *kakúb várcasā*. **-bl- AVŚ 11.9[11].19** *práblīna*. **-bʰl- TS 4.5.2.1d, VSM 16.18** *babʰluśā́ya*.

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Abbreviations:

| | |
|---|---|
| *AirWb* | Bartholomae ed., *Altiranisches Wörterbuch* |
| *AJP* | *American Journal of Philology* |
| *AO* | *Acta Orientalia* |
| *ArOr* | *Archiv Orientální* |
| *BB* | *(Bezzenbergers) Beiträge zur Kunde der Indogermanischen Sprachen* |
| *BSL* | *Bulletin de la Société de Linguistique. Paris* |
| *BSOAS* | *Bulletin of the School of Oriental and African Studies* |
| *BSOS* | *Bulletin of the School of Oriental Studies, London Institution* |
| *CDIAL* | Turner ed., *Comparative Dictionary of the Indo-Aryan Languages* |
| *DEDR* | Burrow and Emeneau eds., *Dravidian Etymological Dictionary. Second Edition* |
| *EWAia.* | Mayrhofer, *Etymologisches Wörterbuch des Altindoarischen* |
| *IF* | *Indogermanische Forschungen* |
| *IIJ* | *Indo-Iranian Journal* |
| *IJDL* | *International Journal of Dravidian Linguistics* |
| *IL* | *Indian Linguistics* |
| *JA* | *Journal Asiatique* |
| *JAOS* | *Journal of the American Oriental Society* |
| *JASA* | *Journal of the Acoustic Society of America* |
| *JIES* | *Journal of Indo-European Studies* |
| *JPhon.* | *Journal of Phonetics* |
| *JRAS* | *Journal of the Royal Asiatic Society of Great Britain and Ireland* |
| *KEWA* | Mayrhofer, *Kurzgefaßtes Etymologisches Wörterbuch des Altindischen* |
| *KZ* | *Zeitschrift für vergleichende Sprachforschung auf dem Gebiete der indogermanischen Sprachen* |
| *Lg.* | *Language* |
| *LI* | *Linguistic Inquiry* |
| *LIV* | Rix ed., *Lexikon der indogermanischen Verben* |
| *MSL* | *Mémoires de la Société de Linguistique. Paris* |
| *MSS* | *Münchener Studien zur Sprachwissenschaft* |
| *NLLT* | *Natural Language and Linguistic Theory* |
| *PW* | Böhtlingk and Roth eds., *Sanskrit-Wörterbuch* |
| *ROA* | *Rutgers Optimality Archive* ([E12]). |
| *StII* | *Studien zur Indologie und Iranistik* |
| *TPS* | *Transactions of the Philological Society* |
| *ZDMG* | *Zeitschrift der deutschen morgenländischen Gesellschaft* |

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*I thank Dr. Toshiki Osada for his kind help with bibliographic information.

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