2 Phonology

2.1 Reconstruction and the comparative method

Current research into the Indo-European language family largely involves linguistic reconstruction. Reconstructing aspects of the parent language is both an end in itself and an aid to understanding the links between the languages in the family and explaining their historical development. In Indo-European studies, reconstruction has enabled linguists to interpret texts in languages which have left only scanty linguistic remains and which would be otherwise largely obscure (as in the case of Lusitanian discussed in section 1.2). It is possible to reconstruct any aspect of the parent language, but the crowning achievement of comparative linguistics is phonological reconstruction. There is a broad consensus among scholars that the phonemic inventory of PIE can be reconstructed fairly accurately, although there is still debate about the phonetic realisation of the phonemes. Most Indo-Europeanists would place greater confidence in the reconstructed phonemic system than in many of the reconstructions of individual lexemes or morphological or syntactic phenomena.

How does this confidence in reconstructed phonemes come about? As an example, let us consider the comparison of English, Dutch and German, which are all members of the Germanic branch of Indo-European. Any speaker of one of these languages will see similarities in the vocabulary and grammar of the other two. An English speaker learning Dutch and German, for example, cannot fail to notice that the words for ‘bread’ and ‘water’ in the two languages (*brood* and *water* in Dutch, *Brot* and *Wasser* in German) are extremely close. The words for ‘but’ and ‘onion’, on the other hand, are dissimilar in the three languages (*maar* and *ui* in Dutch and *aber* and *Zwiebel* in German). Then there are some words which are alike in two of the languages but different in the third, such as ‘bird’ in English but Dutch *vogel* and German *Vogel*. Among the similar words there are some which are similar in many other languages too, such as terms for ‘tea’, ‘chocolate’ and ‘music’ (Dutch *thee*, *chocola* and *muziek*, German *Thee*, *Schokolade* and *Musik*), but these mostly reveal themselves as recent imports into the languages. In contrast, words such as ‘bread’ and ‘water’ and terms for members of the family (English *mother*, *father*, *brother*, *sister*, Dutch *moeder*, *vader*, *broer*, *zuster*, German *Mutter*, *Vater*, *Bruder*, *Schwester*) seem to be more integral to the languages, and we can hypothesise that these words stem directly from the parent of the sub-group; they are 'inherited' rather than 'borrowed'.

We find an exactly comparable situation in the other sub-groups of Indo-European. In the Romance languages, for example, the words for 'bread' and 'water', for 'mother' and 'father', and many other lexemes are similar. In the case of the Romance languages, we have the bonus of having records of Classical Latin, which is close enough to the spoken variety from which the Romance group evolves to be considered the sub-group parent. We can see in Latin the word-forms which will eventually evolve to become the shared vocabulary of Romance: *aqua* 'water' can be considered the earlier form ancestral to Italian *acqua* and Spanish *agua*; *pater* 'father' develops into Italian *padre* and Spanish *padre*. For the Romance group, we can unearth the phonological changes which words have undergone in the centuries between Roman times and the present. We can identify which words are borrowings and which stem from Latin. We can see which languages have replaced an inherited word and where the meaning has changed between the ancient and modern language.

For the Germanic group, we have no attested sub-group parent, but we hypothesise that there must have been such a language. We can further hypothesise what the vocabulary of the sub-group parent must have been: from the English, Dutch and German words for 'bread', for example, we might guess that the original word was **brod* or something like it, and **water* the original word for 'water'. (The * before the word highlights the fact that the word is a hypothetical item, and not directly attested.) Yet our reconstructed items here are mere guesswork, worked out on a principle that the form which was found in two languages won out over a variant found in the other. Thus in reconstructing **brod* for 'bread' we take the vowel from the Dutch and German words, and the final consonant from English. In Dutch, final consonants written voiced are standardly devoiced, but we can assume that the spelling with *-d* represents an earlier stage of the language where final consonants could be voiced. In reconstructing **water* for 'water' we took the medial consonant from Dutch and English as against the German form.

If we followed this word-by-word reconstruction procedure further, we would soon run into difficulties. Consider the words for 'father' and 'sister': English *father*, *sister*, Dutch *vader*, *zuster*, German *Vater*, *Schwester*. No two languages agree about the medial consonant of the word for 'father', and it is not possible to say which of the three alternative consonants on offer would be the original. In the word for 'sister', only German has fricative *w* [v] after the initial sibilant, and yet it is more likely that a fricative has been lost historically than that speakers of German have added a sound to the word. Furthermore, if we reconstruct word by word, how can we be sure that we are not including words which are in fact unrelated, but just happen to look the same? And would we be able to capture words which were related, but where the sounds have changed more radically? The French words which stem from the same origin as Italian *padre* and *acqua* are barely recognisable as such: *père* 'father' and *eau* 'water'.

In order to avoid the pit-falls of reconstructing word by word, historical linguists use a reconstruction process known as the *comparative method* (CM). For

Table 2.1 *A correspondence set for English* t *and German* ss.

English	German
foot	Fuss
nut	Nuss
nit	Niss
white	weiss
great	gross
eat	essen
hate	Hass
bite	beissen
forget	vergessen
grit	Griess
gate	Gasse

the operation of the CM, a single example is not enough, and rather than comparing single words, the aim is to compare sets of words. Therefore, rather than seeing a similarity between the English and German words for 'water', the linguist using the CM would attempt to draw up a correspondence set of words which had *t* in English but *ss* in German. Such a set is given in table 2.1 (for convenience German *ß* is here written *ss*, but both are pronounced identically as [s]; the German orthography is based on the principle that *ß* is written following a long vowel).

Now, rather than one comparison, we have a set of ten comparisons between English and German. We may feel uncertain about a particular item in the set: perhaps the vowel difference between *great* and *gross* seems too much, for example, or perhaps the difference in sense between *gate* and *Gasse*, which means 'lane' or 'alley', is unacceptable, despite the existence of English street names such as *Micklegate* in York (in fact, this is a separate word from *gate* meaning 'opening'). However, there is strength in numbers. If two words from different languages sound similar, they may be related, but the similarity may just be chance or the result of earlier language contact. But if ten inherited words in one language can be matched to ten inherited words in a second language with the same correspondence of sound, then the likelihood is that the sound correspondence results from changes to an original sound. The correspondence between English medial *t* and German *ss* is more secure than the comparison of any pair in the set. The correspondence set can be further increased by taking in further languages or earlier stages of languages; we also know the word for 'water' and many of these other words in Old English, Old High German, Gothic and Old Norse (not to mention Friesian and Old Friesian, Old Saxon, Norwegian, Swedish, Danish and Icelandic). We can thus extend the correspondence set in table 2.2.

The correspondence set in table 2.2 has some gaps in it, where we do not have words attested in one language, but there is enough information there to

Table 2.2 *Extended correspondence set for medial* *t *in Germanic.*

English	German	Dutch	Old English	Old High German	Gothic	Old Norse
water	Wasser	water	wæter	wazzar	wato	vatn
foot	Fuss	voet	fōt	fuoz	fotus	fótr
nut	Nuss	noot	hnutu	nuz		hnot
nit	Niss	neet	hnitu	niz		gnit
white	weiss	wit	hwīt	wīz	hweits	hvítr
great	gross	groot	grēat	grōz		
eat	essen	eten	etan	ezzan	itan	eta
hate	Hass	haat	hete	haz	hatis	hatr
bite	beissen	bijten	bītan	bīzan	beitan	bíta
forget	vergessen	vergeten	forgitan	firgezzan		
grit	Griess		grēot	grioz		grjót
gate	Gasse			gazza	gatwo	gata

show that the English and German words fit into a much larger picture. In all the languages except Old High German and Modern German we further see that there is a regular correspondence between medial or final *t*. If we were to assign a value to the sound in the parent language from which all these sounds derive, it would make sense to set this sound as **t*. This is the most economical explanation, since we do not have to reconstruct any intermediary changes between the sound in the parent language and in the attested languages except for German. The CM is basically a two-fold process: the first task is to match recurrent patterns across different languages, the second, to find a value for the reconstructed sound which gives the best explanation for the correspondences.

Reconstruction of a sound may not always be so easy, particularly when we compare more language groups and attempt to go back further in the family tree. For example, we can look at the correspondences between some of the words featured in table 2.2 over a wider set of languages:

water	Hittite *widār*
	Umbrian (Sabellian language) *utur*
	Sanskrit *udan-*
	Greek *húdōr*
	Armenian *get* (Armenian *g-* corresponds to *w-* in other languages)
	Old Church Slavonic *voda*
foot	Old Hittite *pad-*
	Latin *ped-*
	Sanskrit *pad-*
	Greek *pod-*
	Armenian *ot-*
	Tocharian A *pe*

eat	Hittite *ed-* (*edmi* 'I eat') Latin *ed-* (*edō* 'I eat') Sanskrit *ad-* (*adánti* 'they eat') Greek *ed-* (*édomai* 'I shall eat') Armenian *ut-* (*utem* 'I eat') Lithuanian *ėd-* (*ė́du* 'I eat') Old Church Slavonic *jad-* (*jadętĭ* 'they eat')

In these three comparisons it is clear that where the Germanic languages have medial or final *-t*, other Indo-European branches generally have *-d*, except Armenian, which agrees with Germanic in having **t*. On the majority rule principle, it has been usual to reconstruct **d* for this sound in PIE. However, as we shall see at section 2.3 below, there is uncertainty about the actual phonetic value of this sound.

Exercise 2.1

The following set of words contains correspondence sets for two different IE consonants, in both the initial and medial / final position of the word. Sort out the material into the two different sets and speculate on likely reconstructions for the two sounds.

Sanskrit	Latin	Greek	English	Meaning
bhár-	*ferō*	*phérō*	*bear*	'carry'
mádhya-	*medius*	*mésos*	*middle*	'middle'
	forēs	*thurā́*	*door*	'door'
dhūmá-	*fūmus*	*thūmós*		'breath'
bhrā́tar-	*frāter*	*phrā́tēr*	*brother*	'brother'
nabh-	*nebula*	*nephelḗ*		'cloud'
	flōs		*blossom*	'flower'
édhā-	*aedēs*	*aíthō*		'burn' / 'house'
dhā́-	*faciō*, *fēcī*	*títhēmi*	*do*, *deed*	'do'
bhrū́-		*ophrûs*	*brow*	'eyebrow'
rudhirá-	*ruber*	*eruthrós*	*red*	'red'
bhū́-	*fu-*	*phúomai*	*be*	'become'
dhā́-	*fēlō*	*thēlús*		'suck'
vábh- / ubh-		*huphaínō*	*web*	'weave'

Phonological change provides the best field for the operation of the CM, for a number of reasons. The object of our reconstruction, the phonemic system of the parent language, forms a discrete, well-ordered and finite set. Attested histories of a number of different languages provide examples of possible sound-changes, with which hypothetical developments in prehistory may be compared. And finally, sound-change tends to be largely regular over time. Sounds in the same phonetic environment will undergo the same change, irrespective of other factors. It is this regularity which led scholars in the nineteenth century to class

Table 2.3 *Six sound-laws and a rule of Indo-European.*

Name	Language(s) affected	Effect
Brugmann's Law	Indo-Iranian	$^*o > \bar{a}$ in open syllables
Grassmann's Law	Greek and Indic (separately)	$C^hVC^h > CVC^h$ affects voiceless aspirates in Greek: *títhēmi* < earlier **thith*; voiced aspirates in Indic: *dádhāmi* < earlier **dhadh-*
Grimm's Law	Germanic	$^*b^h > \beta$, $^*b > p$, $^*p > f$ $^*d^h > ð$, $^*d > t$, $^*t > \theta$ $^*g^h > ɣ$, $^*g > k$, $^*k > h$, etc. often called 'the (first) consonant shift'
Osthoff's Law	Greek and possibly other languages	$\bar{v}RC > vRC$ (long vowel before $^*i$ $^*u$ $^*r$ $^*l$ $^*m$ $^*n$ and consonant is shortened) e.g. $^*luk^w\bar{o}is$ > Greek *lúkois*
Law of the Palatals	Indo-Iranian	Describes a series of changes of dorsal consonants before front vowels $^*k^we > ca$, $^*g^we > ja$, $^*g^{wh}e > jha$ (or *ha*) but $^*k^wo > ka$, $^*g^wo > ga$, $^*g^{wh}o > gha$ (or *ha*)
ruki Rule	Indo-Iranian, Slavic *et al.* (?)	Describes a conditioned change of $^*s$ when it follows $^*r$, $^*u$, $^*k$, $^*i$ Outcomes differ: in Sanskrit 'ruki' $^*s > ṣ$
Verner's Law	Germanic	Intervocalic voiceless fricatives become voiced unless preceded by the accent (a corollary to Grimm's Law) e.g. Old English *broþer* < **bhrā́ter*, *fæder* < **pətḗr*

sound-changes as 'sound-laws' by analogy with the laws of natural scientists. 'Sound-laws' named after their discoverers are still frequently encountered in IE studies (see table 2.3 for some famous laws). The regularity of sound-change is not an essential factor to ensure the success of the CM, although it has been championed as such since the late nineteenth century. Since the method operates on a majority rule basis, it is possible to reconstruct sounds as long as *most* (if not all) of the sounds in a language change in the same way.

With the benefit of sociolinguistic studies on language variation and change, we now have a better understanding of sound-change than the nineteenth-century promulgators of sound-laws. The 'laws' of phonological change are more analogous to the laws of economics or other social sciences rather than the absolute entities of the natural sciences. We now know, from the pioneering studies by Labov and others in the last few decades, that sound-change does not happen overnight, but spreads gradually through a community of speakers, borne along by factors such as sociolinguistic prestige. These modern studies have shown that sound-changes are not 'exceptionless': some changes may not spread to all words in the lexicon, and indeed some sound-changes may remain restricted to certain groups in a speech community. For the historical linguist, however, the regularity of sound-change is a convenient fiction, which gives a close approximation to actual phonological developments in real languages. Inevitably, when one undertakes detailed studies of sound-changes in progress the picture is much messier.

2.2 The sounds of PIE

The reconstructed phonemic inventory of PIE is displayed in table 2.4. It is important to stress that the reconstructed phonemes are slightly different entities from phonemes of attested languages, since we do not always have a clear idea of how they were realised in speech. As we shall see later in the chapter, in some cases it is possible to argue for widely divergent phonetic realisations of a PIE phoneme. Certain items within this table are also controversial. The reconstructed sound **b*, for example, is only rarely attested from correspondence sets across the IE languages, and the sound may have been absent from the language (hence it is enclosed within brackets in the table).

The PIE phonemes of table 2.4 are grouped into three different classes: consonants, resonants and vowels. The term *resonant* is used in a particular way in IE comparative philology to describe elements which can be realised as vowels, i.e. *syllabic resonants*, or as consonants, i.e. *non-syllabic resonants*. For these phonemes alone we can therefore reconstruct allophonic variation; in contrast, members of the consonant class can never function as a syllabic peak, and members of the vowel class can only function as such. Whereas the consonant sounds of PIE can be arrived at directly from the operation of the CM through the construction of correspondence sets, the reconstruction of the resonant class takes the results of the CM one step further. The reconstruction of one resonant, with consonantal allophone **w*, and vocalic allophone **u*, (and given as **w* in table 2.4) can serve to illustrate the process. Consider the following correspondences sets:

A. ‘settlement’: Sanskrit *víś-*, Mycenaean Greek *wo-ko*, Latin *uīcus*, Old Church Slavonic *vĭsĭ*, Gothic *weihs*, English *-wick* (in place-names)
‘know’: Sanskrit *véda*, Greek *(w)oîda*, Old Church Slavonic *vědě*, Armenian *gitem*, Gothic *wait*, English *wit*
‘see, find’: Sanskrit *vindáti*, Greek *(w)eîdon*, Latin *uideo*, Old Church Slavonic *videtĭ*, Lithuanian *véizdeti*, Armenian *gtanem*
‘year’: Hittite *witi*, Sanskrit *vát-*, Mycenaean Greek *we-to*, Latin *uetus* ‘old’, Old Church Slavonic *vetŭxŭ* ‘old’, Lithuanian *vẽtušas* ‘old’
‘water’: Hittite *widār*, Old Church Slavonic *voda*, Armenian *get* ‘river’, Gothic *wato*, English *water*
B. ‘yoke’: Hittite *iukan*, Greek *zdugón*, Sanskrit *yugá-*, Latin *iugum*, Gothic *juk*

Table 2.4 *Phonological inventory of PIE.*

Consonants				
Stops				
Labial	Dental	Palatal	Velar	Labio-velar
*p	*t	*k´	*k	*k^{w}
(*b)	*d	*g´	*g	*g^{w}
*b^{h}	*d^{h}	*g´^{h}	*g^{h}	*g^{wh}
Fricatives				
	*s			
‘Laryngeals’				
			*h$_1$, *h$_2$, *h$_3$	
Resonants				
Nasals				
*m	*n			
Continuants				
	*r, *l, *y, *w			
Vowels				
short	*e, *o, (*a)			
long	*ē, *ō, (*ā)			

‘red’: Sanskrit *rudhira-*, Greek *eruthrós*, Latin *ruber*, Lithuanian *raũdas*, Old English *rudian* ‘be red’
‘stock animinal’: Sanskrit *páśu*, Latin *pecū*, Umbrian *pequo*, Old Lithuanian *pẽkus*, Gothic *faihu*
‘last year’: Sanskrit *parút*, Greek *pérusi*, Armenian *heru*
‘water’: Sanskrit *udan-*, Greek *húdōr*, Umbrian *utur*

Correspondence set A can lead to the establishment of a consonant **w*, and correspondence set B of a vowel **u*. But the last two correspondences in sets A and B can be compared to each other. Sanskrit *parút* appears to be a compound, with final element *ut* comparable to the words relating to the meaning ‘year’ in set A, and the same form appears to lie behind the words in Greek and Armenian (in the Greek dialect where *pérusi* is attested, the combination *ti* develops to *si*, in Armenian *t* is regularly dropped in this position). The words for ‘water’ in the two correspondence sets share similar endings and declension patterns, and only disagree on the initial syllable.

We could reconcile the two different forms in which the words for ‘year’ and ‘water’ occur if we assume that **w* and **u* were originally allophones of the same phoneme and the different forms of the words are morphologically conditioned. We shall see in section 2.5 and in later chapters that our understanding of the morphology of PIE is reliant on a theory that the presence or absence of the reconstructed vowels **e*, **o*, **ē* and **ō* in different positions of a word is governed by morphological criteria. In support of this hypothesis, consider the reconstructed paradigm of the PIE word for ‘dog’:

	PIE	Sanskrit	Greek
Nominative	**k´wōn*	*śvā́*	*kúōn*
Genitive	**k´un-es*	*śúnas*	*kunós*

Once we allow that the **ō* of the nominative singular is a morphological device for indicating the nominative case, just as the affix **es* (with a variant **os* which survives in Greek) encodes the genitive case marking, then it becomes clear that the lexical root meaning 'dog' has the form **k´wn-*. In the sequence **k´wn-es*, the resonant **w* is realised as the vowel **u*, but it is non-syllabic in the nominative **k´w-ō-n*. In the same way we can explain that the different forms for 'year' and 'water' by hypothesising skeletons **wt-* and **wd-* with vowels inserted within these skeletons in some morphological environments. It follows from this that in all cases where we have reconstructed **w* or **u* we can posit a single phoneme with two allophones.

Exactly similar considerations apply to the reconstruction of other members of the resonant class, **n*, **m*, **r*, **l* and **y*, which have vocalic allophones conventionally written **n̥*, **m̥*, **r̥*, **l̥* and **i*. Compare the following parallel examples to the behaviour of **w* for **y* and **r* in the reconstructed paradigms of **dyew-* 'sky, sky-god' and **ph₂ter-* 'father' (fuller paradigms are given at section 4.2):

nominative singular **dy-e-w-s*: Sanskrit *dyáus*, Greek *Zdeús*
genitive singular **dyw-és* (/**diwes*/): Sanskrit *divás*, Greek *Di(w)ós*
dative singular **ph₂tr-éy*: Sanskrit *pitré*, Greek *patrí*
locative plural **ph₂tr-su* (/**ph₂tr̥su*/): Sanskrit *pitṝṣu,* Greek *patrási.*

An example of a syllabic realisation of the resonant **n* is found in the paradigm of PIE 'dog' discussed above. As we have seen, in this word **n* functions as a consonant in the nominative and accusative cases; but in other parts of this paradigm **n* may be realised as a vowel. For example, the instrumental case in the plural is reconstructed as **k´wn-bʰis* (realised as /**k´wn̥bʰis*/), a form from which the Sanskrit instrumental plural *śvábhis* directly derives (Sanskrit *a* is the regular outcome of **n̥*). The syllabification /**k´wn̥bʰis*/, rather than /**k´unbʰis*/, is accounted for by a rule for the distribution of the vocalic and consonantal allophones formulated by Schindler (1977b): the vocalic allophone is found between two non-syllabic elements, and the consonantal allophone occurs next to a syllabic peak; where two or more resonants are situated alongside each other, the rightmost is syllabified first (thus /**k´wn̥bʰ-*/ rather than /**k´unbʰ-*/). It would be completely consistent to follow a notation for the PIE resonants in which the allophonic variants are not indicated, but in the rest of this book the distinction between the consonantal and vocalic realisations of the semivowels will always be indicated (i.e. the symbols **w* and **u*, **y* and **i* will be used), but for the other resonants the symbols **r*, **l*, **m* and **n* will serve to indicate both syllabic and non-syllabic allophones.

The existence of this large set of resonants sets PIE apart from its daughter languages; in all IE languages the nasals *_n_ and *_m_ have lost their original vocalic allophones, and vocalic *_r_ is preserved only in Indic. Although, as we have already seen, there are examples of the high vowels _i_ and _u_ alternating with non-syllabic _y_ and _w_, no attested IE language treats _i_ / _y_ and _u_ / _w_ as allophones of single phonemes. This 'drift' away from the reconstructed picture is remarkable, and it is possible that the reconstructed phonology is not adequately described in terms of 'phonemes' and 'allophones'.

The reconstruction of a set of resonants has led to a paucity of true vowels in PIE, since *_i_ and *_u_ are covered in the resonant class, rather than among the vowels. We shall see later in this chapter (section 2.5) that the loss of the laryngeals in most of the PIE languages also had concomitant effects on the vowel system, and there is still debate about whether the reconstructed system really needs the vowels *_a_ and *_ā_, which accordingly have been bracketed in the phoneme inventory given in table 2.4. Over the last fifty years the scholarly consensus has swayed between accepting these vowels in the parent language and rejecting them. Some Indo-Europeanists have gone even further and reconstructed an original vowel system with only one vowel, *_e_. At present, the balance of opinion has settled in favour of reconstructing *_a_ and *_ā_, principally supported by correspondence sets such as the word for 'nose', which in different IE languages derives from a stem *_nas-_ or *_nās-_:

*_nas-_ / *_nās-_ 'nose': Sanskrit nominative dual _nā́s-ā_, genitive dual _nasóḥ_ 'nostrils', Latin _nārēs_ 'nostrils', Old High German _nasa_, English _nose_

If these _a_ vowels were attested in PIE, they were certainly not widespread: their occurrence is restricted mainly to a few nominal roots, and they were not used in inflection or derivational affixes.

The other category of sounds which appears to be underrepresented in PIE is fricatives. Only one fricative, the sibilant *_s_, is reconstructed, although this does have an allophone _z_ when it stands before a voiced plosive. A separate fricative, *_þ_, used to be reconstructed from the correspondence of a dental in Greek (and Irish) with a sibilant elsewhere, as in the words for 'bear' and 'earth':

*h_2_rkþo-_ 'bear': Sanskrit _ŕ̥kṣa-_, Greek _árktos_, Latin _ursus_, Middle Irish _art_
*g^h_þom-_ 'earth': Sanskrit _kṣám-_, Greek _khthṓn_, Lithuanian _žẽmė_, Old Irish _dú_

However, the elucidation of Anatolian and Tocharian has provided further cognates to words in this set, and the reconstruction now looks much less straightforward. Both languages show sequences with dental before velar in these words. The word for 'bear' in Hittite is normally written _hartagga-_ in the cuneiform syllabary, but represents spoken /_hartka-_/; the word for 'earth' in Hittite is _tekan_, in Tocharian A _tkaṃ_. The agreement between Tocharian and Hittite here seems significant, and it is now thought that these clusters with *_þ_ are the end-result of a metathesis of clusters with dental and dorsal stop which may have taken place in the parent language after the Anatolian and Tocharian branches split off. The words for 'bear' and 'earth' are therefore now reconstructed as *h_2_rtḱo-_ and

Table 2.5a *Comparative IE phonology: stops.*

PIE	Hittite	Sanskrit	Avestan	Greek	Latin	Gothic	Old Church Slavonic	Lithuanian	Old Irish	Armenian	Tocharian
*p	p	p	p f	p	p	f b	p	p	ø	h w ø	p
*b	b p	b	bβ	b	b	p	b	b	b	p	p
*b^h	b p	bh	bβ	ph	f b	b	b	b	b	b	p
*t	t	t	t θ	t	t	þ d	t	t	t	t‘ y	t c
*d	d t	d	d ð	d	d	t	d	d	d	t	ts ś
*d^h	d t	dh h	d ð	th	f d b	d	d	d	d	d	t c
*k´	k	ś	s	k	c	h g	s	š	c	s	k ś
*g´	g k	j	z	g	g	k	z	ž	g	c	k ś
*g´^{h}	g k	h	z	kh	h g f	g	z	ž	g	j z	k ś
*k	k	k c	k c	k	c	h g	k č	k	c	k‘	k ś
*g	g k	g j	g j	g	g	k	g ž z	g	g	k	k ś
*g^h	g k	gh h	g j	kh	h g	g	g z	g	g	g	k ś
*k^w	ku	k c	k c	k p t	qu	hw g	k č	k	c	k‘ č‘	k ś
*g^w	ku	g j	g j	g b d	gu u	q	g ž z	g	b	k	k ś
*g^{wh}	ku gu	gh h	g j	ph th kh	f gu u	g b	g ž z	g	g	g ǰ	k ś

Table 2.5b *Comparative IE phonology: other consonants and consonantal resonants.*

PIE	Hittite	Sanskrit	Avestan	Greek	Latin	Gothic	Old Church Slavonic	Lithuanian	Old Irish	Armenian	Tocharian
**s*	*s*	*s ṣ*	*s š h*	*s h- ø*	*s r*	*s z*	*s x*	*s š*	*s ø*	*s ø*	*s ṣ*
**l*	*l*	*r l*	*r*	*l*	*l*	*l*	*l*	*l*	*l*	*l*	*l*
**r*	*r*	*r l*	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*r*	*r*
**m*	*m -n*	*m*	*m*	*m -n*	*m*	*m*	*m*	*m*	*m*	*m -n*	*m*
**n*	*n*	*n*	*n*	*n*	*n*	*n*	*n*	*n*	*n*	*n*	*n*
**w*	*w*	*v*	*v uu*	*ø*	*u*	*w*	*v*	*v*	*f b*	*g w v*	*w*
**y*	*y*	*y*	*y*	*h zd ø*	*i ø*	*j ø*	*j*	*j*	*ø*	*ø*	*y*
$^*h_1$	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*
$^*h_2$	*h-*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*
$^*h_3$	*h- ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*	*ø*

The sign *ø* is used to indicate loss of a sound in the relevant language.

Table 2.5c *Comparative IE phonology: vowels, vocalic resonants and diphthongs.*

PIE	Hittite	Sanskrit	Avestan	Greek	Latin	Gothic	Old Church Slavonic	Lithuanian	Old Irish	Armenian	Tocharian
**e*	*e*	*a*	*a*	*e*	*e*	*ai*	*e*	*e*	*e i*	*e i*	*ä a ø*
**o*	*a*	*a ā*	*a ā*	*o*	*o*	*a*	*o*	*a*	*o*	*o u*	*e a*
**a*	*ha a*	*a*	*a*	*a*	*a*	*a*	*o*	*a*	*a*	*a*	*a ā*
**ē*	*i e*	*ā*	*ā*	*ē*	*ē*	*e*	*ě*	*ė*	*í*	*i*	*e a*
**ō*	*a*	*ā*	*ā*	*ō*	*ō*	*o*	*a*	*o uo*	*á*	*u*	*a o*
**ā*	*a ahh*	*ā*	*ā*	*ē ā*	*ā*	*o*	*a*	*o*	*á*	*a*	*a o*
**i*	*i*	*i*	*i*	*i*	*i*	*i ai*	*ĭ*	*i*	*i e*	*i ø*	*ä a ø*
**u*	*u*	*u*	*u*	*u*	*u*	*u au*	*ŭ*	*u*	*u o*	*u ø*	*ä a ø*
**ī*	*i ihh*	*ī*	*ī*	*ī*	*ī*	*ei*	*i*	*y*	*í*	*i*	*i*
**ū*	*u uhh*	*ū*	*ū*	*ū*	*ū*	*u*	*u*	*u*	*ú*	*u*	*u*
**l̥*	*al*	*r̥*	*ərə*	*la al*	*ul*	*ul*	*ĭl ŭl lĭ lŭ*	*il*	*li al*	*al*	*äl al*
**r̥*	*ar*	*r̥*	*ərə*	*ra ar*	*or*	*aur*	*ĭr ŭr rĭ rŭ*	*ir*	*ri ar*	*ar*	*är ar*
**m̥*	*am*	*a*	*a*	*a*	*em*	*um*	*ę*	*im*	*é im*	*am*	*äm am*
**n̥*	*an*	*a*	*a*	*a*	*en*	*un*	*ę*	*in*	*é in*	*an*	*än an*
**ei*	*i e*	*e*	*ae*	*ei*	*ī*	*ei*	*i*	*ei ie*	*é ia*	*ê i*	*i*
**oi*	*e*	*e*	*ae*	*oi*	*ī ū oe*	*ai*	*ě*	*ai ie*	*oi ai*	*ê i*	*i e ai*
**eu*	*u*	*o*	*ao*	*eu*	*ū*	*iu*	*u*	*au*	*ó ua*	*oy u*	*u*
**ou*	*u*	*o*	*ao*	*ou*	*ū*	*au*	*u*	*au*	*ó ua*	*oy u*	*o au*

*$d^h g^h$*om-*. This leaves PIE again with only one fricative, although it is possible that all or some of the consonants reconstructed as 'laryngeals' may in fact have been fricatives of one kind or another (section 2.5).

We have already given some indications of the comparative material on which the reconstruction of some sounds is based. For the other phonemes listed in table 2.4 we shall only present a summary of the correspondence sets in table 2.5. It should be stressed that the data given in table 2.5 has been established gradually over the last two hundred years, and we ask the reader to take the equivalences on trust. It is true that some uncertainties in the IE correspondence sets remain, particularly for sounds in languages which are not well-attested or for which written records do not go back very far, but for the most part the work of finding which sounds are cognate in different languages has been done. Some of the detailed comparative evidence in support of the correspondences given in table 2.5 is presented in other handbooks and specialist works, and the recommended reading at the end of the chapter should be consulted for further details if necessary. (Note that where the table gives more than one equivalence in a particular language for a reconstructed sound, the reader should assume that a phoneme split has occurred. Full details of the factors affecting these splits have not been provided. Note also that table 2.5 gives the evidence for the vocalic and consonantal allophones of the resonant series separately, and includes the development of the diphthongs **ei,* **eu*, **oi*, **ou* for reference.)

An adequate description of the phonology of a language should also include details of the distribution of phonemes. In the case of a reconstructed language, this is clearly impossible, owing to the absence of any complete texts. However, an idea of the relative frequency of different reconstructed phonemes may be gained by a survey of reconstructed roots. Table 2.6 gives frequency counts for the frequency of initial segments of roots in the *Lexikon der Indogermanischen Verben* (Rix *et al*. 1998), or *LIV*. There are drawbacks to calculating phoneme frequency in this way: sounds which are widely used in inflectional and derivational affixes (such as **t*, **n* and **m*) are liable to be underrepresented in the sample, and the calculation relies on the judgement of Rix *et al*. Note in particular that the number of plain velars **k* etc. is high, since in many cases Rix *et al*. reconstruct a plain velar where other scholars would reconstruct a palatal **k´*. However, some things emerge clearly from the table, particularly the relative infrequency of the phoneme **b* compared with the other labials, and the uneven frequency of the dorsal consonants, with the labio-velar series underrepresented.

2.3 The realisation of PIE phonemes: the glottalic model

The traditional values assigned to the three separate stop series of PIE, and the notation used for them, reflect the history of work in comparative reconstruction. In the nineteenth century *four* separate stop series were reconstructed:

Table 2.6 *Frequency of reconstructed phonemes in PIE roots in* LIV.

	$^*p$	$^*b$	$^*b^h$	$^*t$	$^*d$	$^*d^h$	$^*k\acute{}$	$^*g\acute{}$	$^*g\acute{}^h$	$^*k$	$^*g$	$^*g^h$	$^*k^w$	$^*g^w$	$^*g^{wh}$	$^*s$	$^*h_1$	$^*h_2$	$^*h_3$	$^*m$	$^*n$	$^*r$	$^*l$	$^*y$	$^*w$
Frequency – total number	139	14	119	168	139	104	91	40	45	192	93	57	29	30	17	312	129	212	50	108	142	315	205	225	351
Frequency – percentage	4.2	0.4	3.6	5.1	4.2	3.1	2.7	1.2	1.4	5.8	2.8	1.7	0.9	0.9	0.5	9.4	3.9	6.4	1.5	3.2	4.3	9.5	6.2	6.8	10.6
Rank	10	25	13	8	10	15	17	21	20	7	16	18	23	22	24	3	12	5	19	14	9	2	6	4	1

Exercise 2.2

The following correspondence set gives Latin, Greek and English words which contain PIE **t*. In one language a phoneme split has occurred. Identify it and speculate on what phonological factors may have led to the split.

Latin	Greek	English	Meaning
trēs	*treis*	*three*	'three'
stella	*astḗr*	*star*	'star'
tenuis	*tanu-*	*thin*	'thin'
stāre	*hístēmi*	*stand*	'stand'
-to- (in *iste*)	*to-*	*the*	pronominal stem
tū	*tú*	*thy*	'you'
torreō	*térsomai*	*thirst*	'dry'
tegō	*stégō*	*thatch*	'cover'
stultus	*stéllō*	*stall*	'set'

Exercise 2.3

Re-examine the data given in exercise 2.1. In which language has a phoneme split taken place, and what factors govern the split?

Exercise 2.4

Use the following words to work out the phonetic environments in which original **s* develops to a retroflex sibilant, transcribed *ṣ*, in Sanskrit:

varṣá- 'rain'	*ṛṣi-* 'seer'
uṣā́s 'dawn'	*duṣ-*'ill-'
vákṣati 'let him come'	*mátsya-* 'fish'
ádikṣam 'he showed'	*íṣu-* 'arrow'
vasná- 'price'	*ásu-* 'breath'
ásmi 'I am'	*pā́rṣṇi-* 'heel'
ási 'you are'	*māmsá-* 'flesh'
ásti 'he is'	

Hint: if you are stuck, one of the laws in table 2.3 will help.

voiceless (for example, *t), voiceless aspirate (*t^h), voiced (*d) and voiced aspirate (*d^h). Only one of the daughter languages has such a four-way contrast, Sanskrit. However, Sanskrit was viewed as the most conservative IE language, and correspondence sets could be set up to support a four-way division of stops, as in

Table 2.7 *Reconstructed four-way stop system of PIE.*

	Greek	Skt	Latin	Gothic	O.C.S.	Lith.	Arm.	O.Irish
*t	*t*	*t*	*t*	*þ*	*t*	*t*	*t‘ / ø*	*t*
__t__reyes 'three'	*__t__reis*	*__t__ráyas*	*__t__rēs*	*__þ__rija*	*__t__rije*	*__t__rỹs*	*erek‘*	*__t__ri*
*t^h	*t / th*	*th*	*t*	*þ*	*t*	*t*	*t‘*	*t*
-t^ha Verbal morph	-__th__a	-__th__a	**-t**ī	-**þ**				
*d	*d*	*d*	*d*	*t*	*d*	*d*	*t*	*d*
*dek´m 'ten'	*__d__éka*	*__d__áśa*	*__d__ecem*	*__t__aihun*	*__d__esętĭ*	*__d__ẽšimt*	*__t__asn*	*__d__eich*^{N}
*d^h	*th*	*dh*	*f/b/d*	*d*	*d*	*d*	*d*	*d*
***d^h**ē- 'put, do'	*é__th__ēka*	*á__dh__āt*	*__f__ēcī*		*-__d__ě*	*__d__émi*	*e__d__i*	

table 2.7 (for reasons which will become clear, laryngeals are not used in this table).

Cognates from the Anatolian languages and Tocharian are not included in table 2.7 (they were not known to the nineteenth-century scholars who reconstructed the stop-system with four different manners of articulation). In these branches, the reflexes of reconstructed **t*, **d* and *d^h are reasonably clear. All Anatolian languages merge the reflexes of **d* and *d^h, but maintain **t* distinct. In Tocharian the reflexes of **t* and *d^h appear to be merged as *t* or *c* (an affricate); but **d* develops differently, to *ts* or *ś*. Neither Anatolian nor Tocharian shows evidence for a reconstructed *t^h differing from **t*; the second person singular marker cognate to Sanskrit *-tha* takes the form *-ti* in Hittite, and this may also be the origin of the second singular marker *-t* in Tocharian.

In the four-way reconstructed stop system the position of the voiceless aspirate series is anomalous. There are few words or morphological items which necessitate the reconstruction of *t^h, or any other voiceless aspirated consonant. In contrast, there are many cognate sets which necessitate the reconstruction of the voiced aspirates including *d^h. Furthermore, it is only in Indo-Iranian and Greek that the outcome of a voiceless aspirate is regularly distinct from the outcome of a plain voiceless stop.

The eventual acceptance of the laryngeal theory (detailed in section 2.5) led to a radical revision of the stop system. Nearly all cases of the PIE voiceless aspirates could be explained through the combination of voiceless stop and the laryngeal consonant *h_2. Indeed, in Indo-Iranian any voiceless or voiced stop is aspirated when followed by *h_2. The evidence in support of this development is overwhelming and includes the celebrated reconstruction of the paradigm of the word for 'path'. This word has an irregular declension in both Sanskrit and Avestan. From comparison of the two it is possible to reconstruct the Proto-Indo-Iranian paradigm as follows:

	Proto-Indo-Iranian	Vedic Sanskrit	Avestan
nom. sing.	**pántās*	*pánthās*	*pa̦ntā̊*
gen./abl. sing.	**pathás*	*pathás*	*paθō*

The reconstructed paradigm is very anomalous. There is variation between an unaspirated and an aspirated consonant at the end of the stem, which is not found in other words (leading to the levelling of the paradigm in Sanskrit). Furthermore, there is a complementary distribution between aspiration and length: the nominative has unaspirated **t* but a long vowel in the final syllable, the genitive has a short vowel but aspirated **th*. We know that the laryngeal *h_2 causes lengthening of a preceding vowel, and if we suppose that it can also lead to the aspiration of a preceding consonant, we can reconstruct a paradigm that would be regular in PIE, and which explains the anomalies of Sanskrit and Avestan:

	PIE	Proto-Indo-Iranian
nom. sing.	**pént-oh₂-s*	**pántās*
gen./abl. sing.	**pn̥t-h₂-és*	**pathás*

Nearly all voiceless aspirates in Indo-Iranian can therefore be explained through a combination of voiceless stop and *h_2. For Greek, the picture is not so clear-cut, and there is a very small number of forms which cannot be explained by the combination of a voiceless stop and a laryngeal, and which appear to support the reconstruction of voiceless aspirates. For the voiceless aspirated *t^h the evidence comprises the following correspondences:

*$k^w ent^h$- 'suffer': Greek *épathon* 'I suffered', Lithuanian *kentù* 'I suffer', Old Irish *cesaid* 'suffers'
*$skeh_1t^h$- 'injure': Greek *a-skēthḗs* 'unharmed', Gothic *skaþ is* 'harm', Old Irish *scís* 'tiredness'

There is too slender a correspondence set from which to reconstruct a PIE phoneme, and accordingly in current IE studies the voiceless aspirate series is not now reconstructed, and most scholars now reconstruct three separate stop series for PIE, in line with the three different series which survive in Greek, Armenian, Proto-Italic and Proto-Germanic.

However, the reconstruction of a three-way, rather than a four-way, division of stops brings with it new problems for the reconstruction. Do we need to change the description of the stops now that we have only three series? The course of least effort for the Indo-Europeanist is to retain the earlier reconstruction intact, and still talk of 'voiceless', 'voiced' and 'voiced aspirate' stop series, and still retain the asterisked forms **t*, **d* and *d^h, and indeed, in most handbooks (including this one) these symbols are retained. However, the reconstruction of a three-way voiceless, voiced and voiced aspirate stop series does not correspond to

Table 2.8 _Glottalic and traditional PIE reconstructed stop system._

Glottalic PIE	Traditional PIE	Greek	Sanskrit	Latin	Gothic
*$t^{[h]}$	*_t_	_t_	_t_	_t_	_þ_
	*_**t**reyes_ 'three'	_**t**reis_	_**t**ráyas_	_**t**rēs_	_**þ**rija_
*t'	*_d_	_d_	_d_	_d_	_t_
	*_**d**ek´m_ 'ten'	_**d**éka_	_**d**áśa_	_**d**ecem_	_**t**aihun_
*$d^{[h]}$	*d^h	_th_	_dh_	_f/b/d_	_d_
	*$\mathbf{d^h}eh_1$- 'put, do'	_é**th**ēka_	_á**dh**āt_	_**f**ēcī_	

the phonology of any early IE language. Moreover, voiced aspirate consonants without a corresponding voiceless aspirate series is unusual not only in IE, but also among all the languages of the world, as Jakobson pointed out fifty years ago (Jakobson 1958). The course of least effort results in a reconstructed stop system with barely a good parallel anywhere, and this has seemed unsatisfactory to many scholars.

Typological considerations have consequently led to attempts to reassign phonetic values to the three series. Among several different proposals the one that has won most adherents is the _glottalic model_. The correspondences set up in table 2.7 (except for the 'voiceless aspirate series') are maintained in the glottalic model, although the reconstructions arrived at differ, as seen in table 2.8, where we have also included the values in the so-called 'traditional model'.

The glottalic reconstruction replaces the traditional voiceless and voiced aspirate series with voiceless and voiced series, where aspiration is seen as allophonic. The voiced series in the traditional model is replaced by a _glottalic_ series, that is, plosives using airflow generated by closing and raising the glottis, rather than the airstream from the lungs. When discussing the glottalic model we shall continue to use the notation of the traditional model, i.e. *_t_, *_d_ and *d^h. We shall further use the same notation to refer to the stops which share the same manner of articulation; for instance, we shall term *_p_, *_t_, *_k´_, *_k_ and *k^w the *_t series_, and refer to the other two stop series as the *_d series_, and the *d^h _series_.

The revised system proposed under the glottalic model may at first seem counter-intuitive. The typologically unusual plosive series in the traditional model are the voiced aspirates. The PIE *d^h series develop to voiced aspirates only in Indic and in some Modern Armenian dialects (see Vaux 1998), and in both cases they exist alongside a voiceless aspirate series. In all other language branches they have developed differently. They become voiced stops in Iranian, Baltic, Slavic and Celtic, where they merge with the *_d_ series; voiceless aspirate stops in Greek; voiceless or voiced fricatives in Latin and Sabellian and Germanic (with some subsequent development to voiced stops). Yet in the glottalic reconstruction these typologically marked voiced aspirates are left virtually intact. To be fair, the glottalic model sees the voiced aspirates as allophonic variants of plain voiced stops, but in practice the aspirated allophone appears to have occurred in most environments. It is, however, the traditional voiced consonants, the **d* series, which are reconstructed as glottalic stops, even though these consonants develop to voiced stops in most of the IE language branches.

The rationale behind this reconstruction lies in the odd behaviour of the **d* series, which is more highly marked than either of the other two series. This marking is shown not only by the rarity of the labial voiced stop (there are no secure reconstructions which have an initial **b-*, and only very few with medial **-b-* – see the frequency distribution in table 2.6), but also by the avoidance of the **d* series in inflexional affixes. The consonants $*b^h$, **t*, $*d^h$ and **k´* are all widely used in inflectional or derivational affixes, but **b*, **d*, **g´*, **g* and $*g^w$ are only rarely employed. (Note that, although the ablative singular case marker of one nominal declension is sometimes reconstructed **-ōd*, with **d* in final position, this is not significant, since at word-end the opposition between **d*, **t* and $*d^h$ is neutralised.) Other evidence to support the marked nature of the **d* series comes from phontotactics: there is no cluster **dg* reconstructed for PIE, although the clusters **tk´* and $*d^h g^h$ can be reconstructed (see section 2.2 for the reconstructions $*h_2rtk´os$ 'bear' and $*d^h g^h om$- 'earth'). Furthermore, there is no reconstructed PIE root with two consonants of the **d* series, such as **deg-* or $*g^w eid$-, a restriction which does not affect the other series (for example, **tep-* 'be warm' reconstructed from comparison of Latin *tepeō* 'I am warm' and Sanskrit *tápati* 'be hot'; $*d^h eg^{wh}$- 'burn' with reflexes including Latin *foueō* 'I heat' and Sanskrit *dáhati* 'burn'). Proponents of the glottalic model argue that the markedness of the **d* series supports their view that these consonants were produced with glottal, rather than pulmonic, airstream. To speakers of languages without glottalic consonants, this may seem a strong point in its favour, but it should be noted that in languages which do have such sounds constraints of this type are not typical (see the discussion of Job 1995). Indeed, Allen reports how non-literate native informants of both the North West Caucasian language Abaza and the Indic language Marwari perceive a glottalised series to be unmarked against other phonation types (Allen 1976: 239).

The glottalic model is held not only to account for the synchronic phonology of PIE better than the traditional model, but also for peculiarities of the diachronic development of the PIE daughters. For example, the presence of lengthened vowels in some words in Baltic and Slavic is supposed to reflect an earlier glottalic consonant:

Lithuanian *ė̃du* 'I eat' < $*h_1ed$-, with lengthening of **e* before **d*
Lithuanian *vedù* 'I lead' < $*wed^h$-, with no lengthening of **e* before $*d^h$.

This process of lengthening, sometimes called *'Winter's Law'* (see Collinge 1985: 225–7), is explained through the reconstruction of **d* as a *pre*-glottalised stop [ʔt]. When this sound merged with the outcome of PIE $*d^h$ as a voiced stop [d], it is argued that the glottal stop [ʔ] was reanalysed as a separate segment and was subsequently lost with compensatory lengthening of the preceding vowel. Although this suggestion is ingenious, it is not the only possible explanation. All the long vowels in the words under discussion can all be explained in other ways, not reliant on the glottalic theory. In comparison with Lithuanian *ė́du*, for example, a long vowel is found in the present tense stem of the root **h₁ed-* elsewhere, including Hittite (*edmi* 'I eat'), and a morphological explanation seems likely.

According to the glottalic model, Armenian and Germanic best preserve the PIE stop system: in Germanic, one need only assume the deglottalisation of the glottal series to arrive at a system not far removed from Proto-Germanic; and some Modern Eastern Armenian dialects could preserve the PIE system exactly. Under the traditional model, both language branches had undergone independent, but similar, sound shifts in which the voiced **d* series were devoiced and the voiceless **t* series became aspirates in Armenian and fricatives in Germanic. The glottalic model would therefore appear to give a better account of these languages. However, further investigation reveals that the picture is not so simple: comparison of all Modern Armenian dialects reveals that the three-way opposition between voiceless aspirated, glottalic and voiced aspirated stops in some varieties is likely to be secondary, and the original system most probably constituted an aspirated, a plain voiceless and a plain voiced series (Vaux 1998: 238f.). Moreover, very early loanwords into Germanic and Armenian appear to have undergone the devoicing of voiced stops postulated by the traditional model. The word for 'kingdom' in proto-Germanic is **rīkja-* (OE *rice*, Goth. *reiki*, Old Saxon *riki*), which is borrowed from Celtic **rīg-yo-* 'kingdom', and Iranian **pardaiza* 'walled enclosure' is borrowed by Armenian, giving the word for 'garden' *partêz*.

The most controversial aspect of the glottalic model is the reconstruction of changes assumed for language branches other than Armenian and Germanic. If the **d* series is reconstructed as glottalic consonants, then a shift from glottalic to voiced consonant must have been made independently in at least seven separate branches of IE: Latin and Sabellian, Celtic, Baltic, Slavic, Albanian, Greek and Indo-Iranian, and probably also Anatolian, although the writing systems of the early Anatolian language cause some uncertainty about the actual realisation of the stops transcribed as *d* etc. Not many languages with glottalic stops are known over a long time-span, but, among those that are, the change from glottalic stop to voiced stop is infrequent (Job 1989, 1995). It therefore seems less than likely that this change should take place independently in seven different proto-languages. The glottalic model therefore prioritises the *synchronic* typology of PIE over the *diachronic* typology of phonological change of the daughters.

Adherents of the glottalic theory like to present the rejection of the traditional model of PIE consonants as a 'paradigm shift' in the study of PIE (note the title of the volume of papers devoted to the glottalic theory: *The New Sound of Indo-European* (Vennemann 1989)). However, recent publications in PIE phonology show that the traditional paradigm remains resolutely in place, and the number of articles published in support of the glottalic model seems to be declining.

In retrospect, the glottalic model was never likely to provide the paradigm shift which it promised, since it actually affected our picture of PIE very little: there is no difference to the number of phonemes reconstructed for PIE; all that has really changed are the labels attached to the phonemes. We shall always be in a position of some ignorance about the phonetic realisation, and even the distinctive features, of reconstructed phonemes, and consequently the debate between adherents of the glottalic model and the traditional model is to a large extent a non-argument. The debate has, however, had the unfortunate effect of polarising views between 'glottalicists' and 'traditionalists', and the demise of the glottalic model has been seen in some quarters as vindication of the traditional model and as justification of the reconstruction of the $*d^h$ series as both voiced and aspirated. However, as we have seen, there is some evidence to suggest that PIE $*d$ was in fact more marked than $*d^h$, and consequently the impression given from the terminology that $*d^h = *d + \textit{aspiration}$ is misleading.

In conclusion, it is time to seek a reconstruction of the stop series that combines the diachronic explanatory power of the traditional model, while seeking to explain the apparent markedness of the $*d$ series. There is a growing awareness among phoneticians of the complexity of different stop systems, and there are increasing numbers of languages which oppose stop series not easily described simply in terms of oppositions such as voiced / unvoiced, aspirated / unaspirated and glottalic / pulmonic. The process of voicing itself can be realised in many different ways, depending on the airflow through the glottis, the space between the vocal folds and the amount of vibration of the vocal folds. Ladefoged and Maddieson propose a continuum of five voicing types, from 'breathy voice', where the glottis is most open, to 'creaky voice', where the glottis is constricted (1996: 49):

breathy voice   slack voice   modal voice   stiff voice   creaky voice.

Several languages oppose two stop series with different types of voicing, but there is not always agreement among phoneticians about how exactly these differences should be classified. Hence, Javanese, for example, has two series labelled 'stiff voice' and 'slack voice' by Ladefoged and Maddieson, although these series have also been labelled 'light versus heavy, tense versus lax, voiceless unaspirated versus voiceless aspirated, and unaspirated versus aspirated' (Ladefoged and Maddieson 1996: 63). The idea of a continuum of voicing types has clear pay-offs for Indo-European. Some scholars have already noticed that the traditional label 'voiced aspirates' for PIE $*d^h$ could be replaced with the more accurate 'breathy-voiced stops' or 'murmured stops' (e.g. Garrett 1991), and this is how the Sanskrit and Hindi descendants of these stops, *dh* etc. are now usually described. We could correspondingly make a case for relabelling the $*d$ series as 'stiff-voiced' or 'creaky-voiced', and this might make clearer the status of $*d$ etc. as more 'marked' than the $*d^h$ series. Such a change in terminology would bring the traditional model closer to a system which has some typological support.

Exercise 2.5

The words in the following table are all cognate, yet the correspondences for the initial consonants do not fit into any of the correspondence sets. Use the correspondence tables 2.5, the results from exercises 2.1 and 2.3, and one of the laws given in table 2.3 to explain how these forms are all cognate.

Sanskrit	Latin	Greek	English	Meaning
	fīdēs	*peíthomai*	*bide*	'trust'
budh-		*punthánō*	*bode*	'make aware'
bandh-	*-fend-*		*bind*	'bind'
dih-	*fingō*	*teĩkhos*	*dough*	'daub'
bāhu-		*pē̃khu*		'fore-arm'

Exercise 2.6

Assume that the glottalic reconstruction is true, and work out possible pathways of change for the derivation of a) the Latin stop system and b) the Greek stop system from PIE (material from exercises 2.1 and 2.2, and table 2.2, may be useful). Is it possible to derive either stop system without going through a 'typologically illegal' phase?

Exercise 2.7

Proponents of the glottalic theory argue that *Grassmann's Law* (see table 2.3) can operate as a phonological rule of PIE, rather than a separate process within Greek and Sanskrit, since aspiration is an allophonic feature of the $^{*}t$ and $^{*}d^{h}$ series. Assess the results of exercise 2.5 in the light of this claim. What changes must be assumed in order to arrive at the attested Greek and Sanskrit forms?

2.4 Mergers and splits: PIE velars

In the PIE phonemic inventory given in table 2.5 the dorsal consonants were grouped into three different places of articulation: 'palatal' ($^{*}\acute{k}$ $^{*}\acute{g}$ $^{*}\acute{g}^{h}$); 'velar' ($^{*}k$ $^{*}g$ $^{*}g^{h}$); and 'labio-velar' ($^{*}k^{w}$ $^{*}g^{w}$ $^{*}g^{wh}$). The basis for this reconstruction can be seen by comparing the correspondence sets for the voiceless member of each set in table 2.9 (gaps in the table reflect gaps in the evidence).

The 'palatals' are widely attested and are characterised by their development to affricates and sibilants in Indo-Iranian, Baltic, Slavic, Albanian and Armenian. These languages are often called *satem* languages, after the Avestan word for 'hundred' (*satəm*), and contrasted with the *centum* languages (Latin *centum* 'hundred'). The velars surface as velars in all languages; and the third series, the labio-velars, have velar reflexes in the *satem* languages, but in *centum* languages are retained either as velars with simultaneous lip-rounding (Latin

Table 2.9 *The PIE dorsal series.*

	Hittite	Greek	Sanskrit	Latin	Gothic	Old Church Slavonic	Lithuanian	Armenian	Old Irish
*k´	*k*	*k*	*ś*	*k*	*h*	*s*	*š*	*s*	*k*
**k´erd*-'heart'	*kard-*	*kardía*		*cor*	*hairto*	*srĭdice*	*širdìs*	*sirt*	*cride*
**k´won*-'dog'		*kuón-*	*śván-*	*can-is*	*hund*		*šuõ*	*šun*	*cú*
*k	*k*	*k*	*k*	*k*	*h*	*k*	*k*	*k'*	*k*
**krewh*$_2$- 'flesh, blood'		*kréas*	*kráviṣ-*	*cruor*	*hrár*[1]	*krŭvĭ*	*kraũjas*		*crú*
*k^w	*ku*	*k/p/t*	*k*	*qu-*	*hw*	*k / č*	*k*	*k'*	*k*
**k^{w}i-/*	*kuis*	*tís*		*quis*		*čĭto*	*kàs*		
**k^{w}o*- 'who, what'			*ká-*	*quod*	*hwa*	*kŭto*			

[1] meaning 'raw'; the form is Old Norse.

qu, Mycenaean Greek *q* and Hittite *kw*), or show various independent and sometimes complex developments. For example, in most dialects of alphabetic Greek (i.e. Greek in the first millennium BC), $*k^w$ becomes *t* before front vowels, *p* before back vowels and consonants, and *k* in the vicinity of *u*. The designations '*satem* languages' and '*centum* languages' reflect a now discredited theory that the different behaviour of the velars reflected a dialectal division within the parent language, with the *satem* group positioned on the east of the IE language area and the *centum* group on the west. This theory was exploded by the discovery of two new *centum* languages, Tocharian and Hittite, at the beginning of the twentieth century, both of which were situated in the east. It is now clear that the *centum* languages share nothing other than a failure to participate in the palatalisation of the palatal series, and as such they cannot be held to be a subgroup of PIE. It is not clear, however, whether the palatalisation found in the *satem* languages is a common innovation or merely separate developments along the same lines. There are parallel palatalisations of velar consonants and loss of labio-velars even within the *centum* branches of IE: the Anatolian language Lycian and the Western Romance languages have independently undergone these developments.

The question of the reconstruction of velar series may therefore seem better suited to be discussed as a matter of IE dialectology or language contact rather than as an issue of PIE phonology. However, if the palatalisation of *ḱ, *ǵ and $*\acute{g}^h$ is a shared innovation of the *satem* languages, it would have important ramifications for the picture of PIE phonology. This arises out of the fact that the only languages to make a distinction between the palatal and the plain velar series are the *satem* languages. If they have innovated in common, there is the possibility that the palatal and velar series were not originally separate in PIE, but represent a post-PIE split. Two alternative pictures of the PIE dorsals are therefore possible, as set out below:

A. The two-dorsal series theory. PIE originally opposed velars (*k, *g and $*g^h$), in words such as **kerd-* 'heart', **kwon-* 'dog' and $*krewh_2$- 'flesh', to labio-velars ($*k^w$, $*g^w$ and $*g^{wh}$), in words such as $*k^wi$-/$*k^wo$- 'who, what'. These two series were retained in the ancestors of the *centum* languages, with specific developments in the later history of some languages. In the *satem* languages, most of the velar phonemes were palatalised (including **kerd-* 'heart' and **kwon-* 'dog'), but some were not (including $*krewh_2$-). The unpalatalised velars then merged with the old labio-velars, which lost labialised co-articulation.

B. The three-dorsal series theory. PIE originally opposed three dorsal series, as set out in table 2.9. In the *centum* languages, the opposition between palatal and velars was lost, but in the *satem* languages the velar and labio-velar series merged, with independent development of the palatal series in different languages.

Proponents of the two-dorsal series theory offer in support the observation that the number of roots reconstructed with plain velars is relatively small, and many of them are of a phonetic shape that could have inhibited palatalisation:

**yug-óm* 'yoke': Hittite *iukan*, Greek *zdugón*, Sanskrit *yugá-*, Latin *iugum*, Old Church Slavonic *igo*, Gothic *juk*
**g^h osti-* 'guest / stranger': Latin *hostis*, Gothic *gasts*, Old Church Slavonic *gostĭ*

The paradigm of the word for 'yoke' **yug-om* would have shown a palatalising environment only in the vocative **yug-e*, which is unlikely ever to have been in common usage, and the word for 'stranger' **g^h osti-* only ever appears with the vocalism *o*. It is possible, however, to find words with velars in the same environments as words with palatals: compare the word for 'flesh' given in table 2.9, *$krewh_2$-, with a form with palatal **k´* such as **k´red* found in the collocation **k´red* *$d^h eh_1$- 'trust, believe' reconstructed from Sanskrit *śrad dhā-* 'believe' and Latin *crēdō* 'I believe'.

A further argument given for the two-dorsal series reconstruction is that the supposed merger of palatal **k´* with velar **k* in the *centum* languages is unparalleled and *a priori* unlikely, since palatal stops generally develop forward in the mouth rather than to back consonants. However, this objection rests upon the phonetic identification of **k´* as a palatal and **k* as a velar, which is not required by the three-dorsal series theory. If we follow Huld (1997) and reconstruct **k´* as a true velar and **k* as a uvular stop (and there is nothing to prevent this), then the problem disappears. Finally, proponents of the two-dorsal theory point to the presence of words in Baltic which show unpalatalised velars alongside palatalised consonants in other *satem* languages, and doublet forms with both the palatalised and unpalatalised forms side by side:

**pek´u-* 'stock animal': Old Lithuanian *pẽkus*, Sanskrit *páśu-*, Avestan *pasu-*
**k´leus-* 'hear': Sanskrit *śruṣṭí-* 'obedience', Old Church Slavonic *slušatĭ* 'listen', Lithuanian *kláusiu* 'ask' (with semantic shift)
*$h_2ek´mon$- 'stone': Sanskrit *áśman-*, Avestan *asman-*, Greek *akmōn*, Lithuanian *akmuõ* 'stone', *ašmuõ* 'knife-edge' (see further section 7.1 for this word)

Such forms could be taken to reflect the fact that Baltic is geographically peripheral to the *satem* languages and consequently did not participate in the palatalisation to the same degree as other languages. Proponents of the three-dorsal theory would claim that such words result from an earlier mixture of palatalising and non-palatalising dialects, and as such they have little weight in the debate on the PIE forms.

In favour of the three-dorsal system, there is disputed evidence that some languages actually show an alternation between **k´* and **k*. Albanian and Armenian are sometimes brought forward as examples of the maintenance of three separate dorsal series. However, Albanian and Armenian are both *satem* languages, and, since the **k´* series has been palatalised in both, the existence of three separate series need not disprove the two-dorsal theory for PIE; they might merely show a failure to merge the unpalatalised velars with the original labio-velars. More convincing evidence comes from the *centum* Anatolian branch, where there is some evidence to suggest that the three-dorsal series have different outcomes:

*k'	**k'erd*- 'heart' > Luwian *zart*- 'heart'
	**k'ey*- 'lie down' > Luwian *zī*- 'lie down'
**k*	**ker*- 'cut' > Luwian *kars*- 'cut'
	**kes*- 'comb' > Luwian *kisa*- 'comb'
*k^w	*$k^w i$- / *$k^w o$- 'who?, what?' > Luwian *kui*- 'who?'

This is strong independent evidence for three separate dorsal series, but the number of examples in support of the change is small, and we still have a far from perfect understanding of many aspects of Anatolian historical phonology. However, it is likely that this is one controversy in the reconstruction of PIE which may be laid to rest with an increased understanding of the Anatolian branch.

Exercise 2.8

The following table gives PIE reconstructions for the comparative material, except that the cover symbol *K*, *G* and G^h are used to indicate sounds that belong to one of the velar series (i.e. **K* could be *k', **k* or *k^w). Where possible, identify which is the correct reconstruction to replace these cover symbols (n.b. you may need to refer back to the 'Law of the Palatals' in table 2.3 in order to understand the Sanskrit forms).

PIE	Sanskrit	Greek	Latin	English	Meaning
**Ke*	*ca*	*te*	*que*		'and'
**derK*-	*dárś*-	*dérkomai*			'see'
**Gmti*-	*gáti*-	*básis*	*-uenti-ō*	*gait*	'going'
**Ge/onu*	*jā́nu*	*gónu*	*genū*	*knee*	'knee'
*$d^h eG^h$-	*dah*-	*tep*^{h}-	*febris*, *fou*-		'burn'
**leiK*-	*rik*–	*leípō*	*linquō*		'leave'
**rGro*-	*rjrá*-	*argós*			'quick'
**nGen*		*adḗn*	*inguen*		'gland'
**deKm*	*dáśa*	*déka*	*decem*	*ten*	'ten'
**leiG*^{h}-	*réh*-	*leíkhō*	*lingō*	*lick*	'lick'
*G^h*en*-	*hán*-	*theínō*	*-fendō*		'kill'

2.5 Reconstructing lost phonemes: laryngeals

We have argued above that the glottalic model of the PIE stop system has not proved to be a paradigm shift in Indo-European studies. In contrast, the laryngeal theory really was a paradigm shift in the Kuhnian sense. A hundred years ago it would have been difficult to find an Indo-Europeanist teaching in a university post who would have accepted any need to reconstruct the laryngeal consonants $^*h_1$, $^*h_2$ and $^*h_3$ (as we now designate these consonants); now it would be difficult to find one who does not accept it. In the first decade of the twentieth century the only scholars to write on the laryngeal theory were on the intellectual fringe of Indo-European and on the geographical fringes of German-speaking central Europe. The label 'laryngeal theory' itself dates from a period before its general acceptance, and most scholars would now hold that 'laryngeals' are no more nor any less theoretical constructs than any other phonological reconstruction.

The story of the genesis of the laryngeal theory has been told many times. In the simplest version, it features Ferdinand de Saussure, at the extraordinarily young age of 21, publishing in December 1878 the *Mémoire sur le système primatif des voyelles dans les langues indo-européennes* (Saussure 1879), which rethought the reconstruction of the vowel system in Indo-European and laid out a series of systematic vocalic alternations now commonly known as ablaut. Ablaut is as much a morphological as a phonological process, and we shall discuss it further in the next chapter. In its most basic form, it involves alternation between the vowel *e* and the vowel *o* in different formations from a verbal base. For example:

Latin ***te**gō* 'I cover': ***to**ga* 'toga (a garment that covers)'
Greek *é-**te**k-o-n* 'I gave birth' (aorist): *té-**to**k-a* 'I have given birth' (perfect)

In other cases, where there was a member of the class of *resonants* (see section 2.2) in the vocalic base, there was a threefold alternation, between forms with an internal *e*, *o* and absence of either vowel:

Greek ***leí**p-o* 'I leave' (present): *lé-**loi**p-a* 'I have left' (perfect): *é-**li**p-on* 'I left' (aorist)
Greek ***pén**th-os* 'suffering': *pé-**pon**th-a* 'I have suffered' (perfect): *é-**pa**th-on* 'I suffered' (aorist) (with medial *a* in Greek stemming from a vocalic $^*\mathring{n}$)

These three different forms are termed the *e-grade* (as *leip-)*, *o-grade* (as *loip-)* and *zero-grade* (as *lip-)*. Saussure incorporated into these ablaut patterns reconstructed sounds such as vocalic nasals $^*\mathring{n}$ and $^*\mathring{m}$ which had only recently been posited for the parent language, and which were to remain controversial, since they did not survive as vocalic nasals in any single language, but always developed to a vowel or a combination of vowel and nasal.

Saussure isolated the morphological environments in which different ablaut grades were expected. Thus participles with a suffix **-to-* were formed in the zero-grade, present tenses of verbs could be formed by reduplication, and some aorist tenses were formed without any suffix and used the e-grade of the root in the singular active paradigm. Derived nouns often used the o-grade of the verbal root. Having set up these categories, Saussure attempted to reconcile the ablaut behaviour of roots which did not appear to show regular e-grades and o-grades, and it is here that we have the postulation of new reconstructed elements in the system. Three very widely attested roots which show anomalous ablaut patterns

Table 2.10 *'Irregular' ablaut series.*

'zero-grade'	**'e-grade'**	**'o-grade'**
	**ē*	*ō
	**dʰē* -	**dʰō*-
Greek ***the****tós* 'put'	Greek *tí****thē****mi* 'I place'	Greek ***thō****mós* 'heap'
Skt ***hi****tá*- 'placed'	Skt *dá****dhā****mi* 'I place'	
Latin ***fa****ctus* 'made'	Latin ***fē****cī* 'I made'	English ***doom***
	**ā*	**ō*
	**stā*-	**stō* -
Greek ***sta****tós* 'standing'	Greek *é****stē****n* 'I stood'	
Skt ***sthi****tá*- 'stood'	(dialectal *e****stā****n*)	
Latin ***sta****tus* 'stood'	Skt. *a****sthā****m* 'I stood'	
	**ō*	**ō*
	**dō* -	**dō*
Greek ***do****tós* 'given'	Greek *dí****dō****mi* 'I give'	
Skt -***di****tá*- 'given'	Skt *dá****dā****mi* 'I give'	
Latin ***da****tus* 'given'		Latin ***dō****num* 'gift'

are given in table 2.10. Exactly the same ablaut patterns are found in several other roots.

It will be seen from table 2.10 that some roots show long vowels in the e-grade and o-grade. In the e-grade the vowel appears as a long **ē*, **ā* or **ō*; in the o-grade it is always long **ō*. But the vowels given in the zero-grade forms differ from language to language. In Sanskrit, and in other languages of the Indo-Iranian family, the result is *i*, in Latin *a*, but in Greek it appears to vary between *e*, *o* or *a*.

Faced with this anomaly, Saussure's next move is rightly famed. He suggested that by reconstructing two elements **A* and **O*, which were not independently attested in any language, these 'irregular' ablaut types could be brought into line with the e / o / zero ablaut-type. Thus the root meaning 'give' could be reconstructed as **deO*-, with a prehistoric change of *-*eO*- to *ō*, and the root meaning 'stand' could be reconstructed **steA*- with a change of *-*eA*- to *ā*. The diverse developments seen in the zero-grade reflect language-specific treatments of **dO*- and **stA*-. Saussure reconstructed only **A* and **O*, but realised that the ablaut series of the root **dhē*- was problematic. It was left to others to point out that a third element **E* could be reconstructed and to derive the root **dʰē*- from **dʰeE*- analogous to **deO* and **steA*-.

Saussure also showed how these reconstructed elements could make sense of other areas of comparative grammar, most famously in the reconciliation of morphological alternations in Sanskrit verb classes. Compare the present tense forms of the verbs and their associated participles listed in table 2.11.

Table 2.11 *Sanskrit nasal infix verbs.*

Present	Past participle	Present class in Sanskrit grammatical works
riṇákti 'leaves'	*riktá-* 'left'	VII
**li-ne-kʷ-ti*	**likʷ-to-*	
yunákti 'joins'	*yuktá-* 'joined'	
**yu-ne-k-ti*	**yuk-to-*	
śr̥ṇóti 'hears'	*śrutá-* 'heard'	V
**k̑l̥-ne-u-ti*	**k̑lu-to-*	
punā́ti 'purifies'	*pūtá-* 'purified'	IX
pu-ne-A-ti* (=pu-neh₂-ti*)	**puA-to-* (=**puh₂-to-*)	

Using the new reconstructed elements, Saussure was able to unify the three different verb classes under a single morphological type, with the present formed by infixation of an element **-ne-*. (It is necessary to remember that Sanskrit *-no-* is the regular development from **-neu-* in order to understand the Class V verb.) Verbs of Class IX had previously been thought to show the addition of a suffix **-nā-* to form the present stem, but by utilising the element **A*, Saussure could show that here again we had an infix. The length of the vowel in the uninfixed root in zero-grade, Sanskrit *pū-*, could easily be seen to be the result of the loss of **A*, in just the same way as **oA* became **ō*.

In the condensed form of the story of laryngeals, we skip forward fifty years after Saussure to 1927, when the Polish scholar Jerzy Kuryłowicz showed that in the recently deciphered Anatolian language, Hittite, the sound *h* corresponded to Saussure's predicted **A*, which he redesignated $^*H_2$ (**E* became $^*H_1$ and **O* became $^*H_3$ at the same time; we here use the same notation, but with a lower-case **h* rather than upper-case **H*; in our notation **H* without a subscript numeral refers to any of $^*h_1$, $^*h_2$ or $^*h_3$). In these intervening fifty years, however, the theory had developed far beyond Saussure's postulated **A* and **O*, which he clearly thought of as vocalic elements, rather than something which might surface as an *h* in a newly discovered language. The principal scholars involved in formulating the laryngeal theory, as Kuryłowicz used it, were the 'outsiders' Möller and Cuny, who developed the theory in the hope of finding a way to connect Indo-European to the Semitic language family, and who are forever in danger of being written out of history. It was Möller who first recognised that Saussure's system needed an **E*, and it was he who first identified **A* and **O* as consonants, and it is Möller's term, *laryngeals*, that has stuck. Cuny was the first to show clearly why the reconstructed **E*, **A* and **O* had to be consonants, arguing that if any of them followed a member of the class of resonants (**r, *l, *m, *n*) it was the resonant

Table 2.12 *Laryngeal developments in some early IE languages.*

After vowels PIE	Latin	Sanskrit	Greek	Hittite
$^*iH$	*ī*	*ī*	*ī*	$^*ih_2 > ihh$
$^*uH$	*ū*	*ū*	*ū*	$^*uh_2 > uhh$
$^*oH$	*ō*	*ā*	*ō*	
$^*eh_1$	*ē*	*ā*	*ē*	*e*, *i*
$^*eh_2$	*ā*	*ā*	*ē* (dialectal *ā*)	*ahh*
$^*eh_3$	*ō*	*ā*	*ō*	(?)
Before Vowels PIE	**Latin**	**Sanskrit**	**Greek**	**Hittite**
$^*Hi$	*i*	*i*	*i*	$^*h_2i > hi$
$^*Hu$	*u*	*u*	*u*	$^*h_2u > hu$
$^*Ho$	*o*	*a*	*o*	$^*h_2o > ha$
$^*h_1e$	*e*	*a*	*e*	*e*
$^*h_2e$	*a*	*a*	*a*	*ha*
$^*h_3e$	*o*	*a*	*o*	(?)

which became a vowel. Therefore $^*E$ / $^*A$ / $^*O$ were more consonantal than the resonants. Cuny also stated clearly, and prophetically, that the lost consonants were ‘a sort of *h*’.

The phonetic value of Hittite *h* (which is often written *ḫ* in handbooks) is uncertain. Hittite utilises the cuneiform writing system of Akkadian, where the same writing seems to represent a voiceless velar fricative, although this does not necessitate that it has the same value in Hittite. Our uncertainty about the value of this sound in Hittite means that there is still debate about the phonetic nature of the laryngeals in PIE, much of which is highly speculative. Current consensus tends to give $^*h_1$ the value of a glottal stop, $^*h_2$ is reckoned to be a back fricative of some sort, whether velar or pharyngal, and $^*h_3$ a voiced back fricative, possibly also with lip-rounding.

In the period since Kuryłowicz’s work on laryngeals a great deal of comparative work has been devoted to understanding their behaviour in different IE languages and their presence in particular reconstructed items. A real advance in our knowledge in recent years has been in the behaviour of laryngeals not just in Hittite, but in the Anatolian branch as a whole, and we are beginning to get a better picture of the phonetic environments in which laryngeals are lost in the Anatolian languages, their effects on neighbouring consonants and their outcomes in the different branches of the Anatolian group. It is clear that $^*h_2$ is well attested in Anatolian, and there are now a sizable number of reliable etymologies with $^*h_2$ exactly where Saussure would have predicted an $^*A$. The following word-equations are just an illustration.

peh_2-(s)- 'protect': Hittite *pahhs-*, Sanskrit *pā́ti*, Latin *pāscō*, *pāstor*
$d^h uh_2$- 'breath / smoke': Hittite *tuhhuis*, Latin *fūmus*, Greek *thūmós*, Sanskrit *dhūmá-*
$h_2$ent-: Hittite *hant-* 'front', Latin *ante*, Greek *antí*
$h_2$erǵ- 'white': Hittite *harki-* 'white', Sanskrit *árjuna-* 'silver', Greek *árguron* 'silver', Latin *argentum* 'silver', Tocharian A *ārki* 'white'
$h_2$owi- 'sheep': Luwian *hawi-*, Lycian *xawa-*, Sanskrit *ávi-*, Greek *ó(w)is*, Latin *ouis*

It is clear from these and other comparisons that *h_2 is as securely reconstructed as any other PIE consonant. By contrast, *h_1 and *h_3 have proved more elusive, although there are recent claims that each of these might show clear and distinct reflexes in Anatolian languages other than Hittite. For the most part, however, our reasons for reconstructing these sounds come from aberrant ablaut patterns of the type noticed by Saussure and, more curiously, from Greek.

It is indeed not Anatolian, but Greek, which is now seen as the most reliable guide to when to reconstruct laryngeals in Indo-European, even though laryngeals nowhere survive as consonants in Greek. However, it has now become generally accepted that Greek shows a 'triple reflex' of laryngeals, preserving distinct outcomes of the laryngeals when they occur between consonants (that includes zero-grade forms such as *thetós* 'put' of table 2.10, which we now hypothesise comes from *$d^h h_1$to-*). Greek also shows a distinct outcome for each of *h_1, *h_2 and *h_3 when they follow a vocalic **r*, **l*, **m* or **n*, or stand initially before a consonant. The comparison of the Greek (Doric) outcomes of these sequences with the Latin and Sanskrit is shown in table 2.13.

In no other IE language is the 'triple reflex' of Greek paralleled. Indeed, Armenian is the only IE language outside the Anatolian branch to show a reflex of laryngeals in initial position before a consonant. However, there is some good corroborative evidence to their earlier presence in this position, in some cases from Anatolian, as shown in the examples below. More tantalising evidence comes from Indo-Iranian, where some compound words show lengthening of the vowel before a root presumed to have earlier had an initial laryngeal. Note the following:

$h_2$ster- 'star': Hittite *hasterza*, Greek *astḗr*, Latin *stella*, Armenian *astł*, Sanskrit *tár-*
$h_2$wes- 'live, spend time': Hittite *huis-* 'live', Greek *á(w)esa* 'I spent a night', Sanskrit *vásati* 'spend the night', English *was*
$h_2$ner- 'man': No Anatolian cognate yet known, Greek *anḗr*, Armenian *ayr* (from **anir*), Oscan *niir*, Sanskrit *nár-*, compound *sūnára-* 'vital' (*su-* 'well-')
h_2uh_1-nt- / *h_2weh_1-nt-* 'wind' (*h_2weh_1-* 'blow'): Hittite *huwantes* 'winds', Latin *uentus*, Sanskrit *vā́ta-* 'wind', Greek *á(w)ent-* 'blowing'

The final example, the word for 'wind', provides further interesting evidence for the survival of laryngeals in an earlier stage of Indo-Iranian. When the Sanskrit word appears in the earliest, orally transmitted texts, the Vedic hymns, it regularly

Table 2.13 *The triple reflex of laryngeals in Greek.*

		**CHC*	**HC-*	**r̥H*	**l̥H*	**m̥H*	**n̥H*
$^*h_1$	Greek	*e*	*e*	*rē*	*lē*	*mē*	*nē*
	Latin	*a*	*lost*	*rā*	*lā*	*mā*	*nā*
	Sanskrit	*i*	*lost*	*īr/ ūr*	*īr/ ūr*	*ā*	*ā*
$^*h_2$	Greek	*a*	*a*	*rā*	*lā*	*mā*	*nā*
	Latin	*a*	*lost*	*rā*	*lā*	*mā*	*nā*
	Sanskrit	*i*	*lost*	*īr/ ūr*	*īr/ ūr*	*ā*	*ā*
$^*h_3$	Greek	*o*	*o*	*rō*	*lō*	*mō*	*nō*
	Latin	*a*	*lost*	*rā*	*lā*	*mā*	*nā*
	Sanskrit	*i*	*lost*	*īr/ ūr*	*īr/ ūr*	*ā*	*ā*

has to be scanned as a trisyllable, *vaata-*. This scansion is not a usual metrical licence in these texts, and the trisyllabic form may reflect the reconstructed syllabification $^*h_2weh_1$*-n̥t-*, showing that during the time of the composition of the hymns there was still hiatus between two vowels which had once been separated by a laryngeal.

The example of Sanskrit *vā́ta-* ‘wind’, earlier *vaata-*, is not unique. Other forms in Vedic Sanskrit and the earliest Avestan hymns show similar examples of hiatus where laryngeals once stood between vowels. This phenomenon, and the examples of lengthening caused by laryngeals in compounds such as *sū-nára-* ‘vital’, show that laryngeals seem to have remained as consonants in some environments in Proto-Indo-Iranian, only to be lost just before the earliest texts. If we look at the other early language branches we find a similar picture. The ‘triple reflex’ of laryngeals in Greek precedes our earliest Greek texts, but since it is found in no other IE language it must have been a development unique to Greek. Greek must therefore have kept the three laryngeals as distinct elements in its prehistory. Recent work on Latin has also posited complex laryngeal developments which must be unique to its branch of IE.

The reconstruction of three laryngeals is now firmly accepted in IE linguistics, and there is much agreement on where laryngeals should be reconstructed and which laryngeal to reconstruct. The inclusion of laryngeals in the PIE phoneme inventory has proved an extremely powerful and effective tool in the comparative philologist’s armoury, and is well supported by the historical data of the languages. Most Indo-Europeanists now see little need to tamper with the laryngeal theory as it is sketched out in this section.

However, some questions still remain. Particularly puzzling is the paradox that laryngeals are lost nearly everywhere, in ways that are strikingly similar, yet apparently unique to each language branch. We can of course assume some common developments already within PIE, such as the effect of the laryngeals

$*h_2$ and $*h_3$ to change a neighbouring **e* to **a* or **o*, but the actual loss of laryngeals must be assumed to have taken place separately after the break-up of the parent language. We have already seen in section 1.4 that there is currently broad agreement on the family tree for the IE languages, and that the Anatolian branch is presumed to have split off from the other languages first. Given this model, it would have seemed a plausible assumption that the retention of $*h_2$, and possibly also $*h_1$ and $*h_3$, is an archaism of Anatolian, and the loss of the laryngeals was made in common by the other languages. But the current picture of laryngeal reconstruction necessitates repeated loss of laryngeals in each language branch. One could, of course, think up sociolinguistic reasons to explain this apparent 'time-lag'. If the IE languages outside the Anatolian branch were at one stage in close contact with languages without equivalent sounds to the laryngeals, it may have led to a widespread loss. It is certainly noticeable that the Semitic languages (such as Maltese and Modern Hebrew) which have been through stages of close contact with non-Semitic varieties have all tended to drop their inherited pharyngal and laryngal consonants, and these would provide a typological parallel for the loss of laryngeals.

If such a scenario is envisaged for the IE languages, it might lead to a reconsideration of the formulistic treatment of laryngeal developments in IE languages. To return to the example of Greek, current treatments search for rigid sound-laws in the development of laryngeals in Greek, which are supported by only a small set of definite correspondences. If we view the loss of guttural consonants in Maltese as a typological parallel to the diachronic development of laryngeals in Greek, the results may be instructive. The Maltese situation is well summarised by Comrie (1993: 94–5):

> These Maltese data shows that in cases where guttural consonants are lost, sometimes with changes in the quality of adjacent vowels, there are often idiosyncratic developments, and this is the case where we have access (via Classical Arabic and Modern Arabic vernaculars) to the original state before the loss of the gutturals and before the phonologisation of the changes in vowel quality. The idiosyncrasies discussed include loss of a guttural where it should have been retained, retention of a guttural where it should have been lost and irregular developments of vowel quality.

If the loss of laryngeals in Greek, and indeed in other IE languages, is viewed as comparable to the developments in Maltese, it would provide a challenge to the hypothesis that sound-change is regular and exceptionless. The loss of guttural consonants does not appear to have been a 'regular' change in Maltese, particularly as it affected neighbouring vowels. In both Maltese and PIE, vowel alternations are used as markers of morphological categories, and the interaction between morphology and phonology is therefore most apparent in the loss of consonants which may determine vowel quality. It would be wrong to imagine that there is no regularity at all in the sound-changes relating to laryngeals, but perhaps the researcher should not be surprised if laryngeal developments are not completely regular and exceptionless. As we saw in section 2.1, the comparative method does not rely on absolute regularity, and the PIE laryngeals may provide an example of where reconstruction is possible without the assumption of rigid sound-laws.

Exercise 2.9

An 'irregular' ablaut series not so far discussed involves roots which appear to have reflexes with two syllables in the e- and o-grades, and in the zero-grade a vowel which used to be reconstructed as a long syllabic resonant. Some examples are given in the table below (we have used the cover symbol *V* in the reconstructed e-grade forms, to show that a vowel occurs in the second syllable in the reflexes of the root).

zero-grade	e-grade
**ǵn̥̄-*	**ǵenV-*
**ǵn̥̄-tó-* 'born' Sanskrit *jātá-* Greek *-gnētos* Latin *(g)nātus*	**ǵenV-tor-* 'parent' Sanskrit. *janitar-* Greek *genétōr* Latin *genitor*
*b^h*ū-*	*b^h*ewV-*
*b^h*ū-tó-* 'created' Sanskrit *bhūtá-*	*b^h*éwV-tu-* 'being' Sanskrit *bhávitum*
**ḱr̥̄-*	**ḱerV-*
**ḱr̥̄-to-* 'mixed' Sanskrit *śīrtá-* Greek *-krātos*	**e-ḱerV-s-* Greek *ekéras(s)a* 'I mixed'
*g^w*r̥̄-*	*g^w*erV-*
*g^w*i-*g^w*r̥̄-* 'swallow' Greek *bibrṓskō*	*g^w*erV-tu-* 'swallowing' Sanskrit *garitu-*

Use the laryngeal theory to rewrite this ablaut series, bringing it into line with the other ablaut series discussed in this section. (Hint: the sound-changes given in table 2.13 may be helpful.)

Exercise 2.10

One of the laws given in table 2.3, known as Brugmann's Law, states that in an open syllable, short **o* develops to *ā* in Indo-Iranian languages. For example, compare Sanskrit *jā́nu* 'knee' with Greek *gónu* 'knee', Sanskrit *dā́ru* 'wood' with Greek *dóru* '(wooden) spear', Sanskrit *pā́dam* 'foot' (accusative) with Greek *póda* 'foot' (accusative). There are many exceptions to this law, including the following:

Sanskrit *jána-*, Greek *gónos* ‘offspring’
Sanskrit *-gara-*, Greek *-boros* ‘swallowing’ (both second elements in compounds)
Can the results of exercise 2.9 help to explain these exceptions?

Further reading

Sound-change and reconstruction are both topics which have had an extensive scholarly coverage. Fox (1995), the articles in Joseph and Janda (2003) and handbooks of historical linguistics are good indications of some of the current issues and theories. A handy guide to the ‘sound-laws’ of PIE is given by Collinge (1985), with supplements at Collinge (1995) and Collinge (1999). The handbooks of Beekes (1995), Meier-Brügger (2003) and Fortson (2004) all offer extensive examples of correspondence sets to reconstruct PIE phonology. There is also a large number of publications devoted to specific developments in the IE branches: note especially Melchert (1994a) for Anatolian, Wackernagel (1896) and Hoffmann and Forssman (1996) for Indo-Iranian, Sihler (1995) and Rix (1976) for Greek, and Sihler (1995) and Meiser (1998) for Latin. Fortson (2004) also contains excellent overviews of the sound-developments from PIE to all the separate branches. Mayrhofer (1986) gives a detailed overview of the reconstructed phonology of PIE, with discussion of the realisation of allophones and combinatory effects; we have followed his analysis of PIE **þ*, which in turn follows Schindler (1977a).

The glottalic model has attracted a great deal of discussion and debate. Vennemann (1989) includes many arguments in favour of glottalic consonants in PIE, and some against (for example, Job (1989)), and Salmons (1992) presents an attractive synthesis. Arguments against are marshalled most recently by Barrack (2002) and (2003). Job (1995) is an important investigation into the typology of change in language systems with glottalics.

Hiersche (1964) collected most of the evidence relating to voiceless aspirates in PIE; more recently their reconstruction has been defended by Elbourne (1998, 2000 and 2001). The history of the laryngeal theory from Saussure to the 1930s is well described by Szemerényi (1973); Mayrhofer (1981) gives a reassessment of the work in the light of contemporary research. Two volumes of collected papers have been very influential in the development of the laryngeal theory: Winter (1965) and Bammesberger (1988), and many of the articles in them are still very useful. Lindeman (1997) is useful but in disagreement with much current thinking. The most accessible account of the ‘triple reflex’ of laryngeals in Greek is given in Rix (1976: 68–76), but see Lindeman (1982) for criticism. Schrijver (1991) gives a detailed, and still in some respects controversial, review of the development of laryngeals in Latin. There is discussion of the possible phonetic realisation of laryngeals in Beekes (1994). For the developments referred to in Maltese and their use as a typological parallel to laryngeals in PIE, see Comrie (1993). Separate reflexes of $^*h_1$ and $^*h_3$ in Anatolian languages (Hieroglyphic Luwian and Lycian respectively) are argued for by Kloekhorst (2004) and Kimball (1987).

Discussion points

1. How much is it possible to know about the phonetic realisation of PIE phonemes?
2. In what respects is the phonology of a reconstructed language a) different from b) similar to the phonology of an attested language?
3. How important are typological considerations of sound-systems and sound-changes for PIE reconstruction?
4. Does the sociolinguistic study of sound-changes in progress have any bearing on the reconstruction of PIE phonology?