7
Phonological systems

7.1 The status of systems

One justification for having a construct in a theory is 'instrumental': if the desired generalizations can be stated better with it than without it, this is a *prima facie* (but criticizable and provisional) justification. So if some phenomenon P seems inexplicable without a construct C; and if C is not implausible or impossible with respect to the rest of our reasonably well-established knowledge (or better, follows from it); then there is a case for C as a provisional theoretical term. Even better: if C allows us to predict some further phenomena P′, P″, or proves applicable to phenomena it was not devised for, this gives it further substance. But the argument from inexplicability alone isn't compelling; it's the quality of the explication that counts.

We have mentioned systems without defining them or establishing their theoretical status. Simplistically, it's obvious that given notions like 'phoneme', 'distinctiveness', etc. one must conclude that languages have segment-inventories, phonological and phonetic. The question is whether these *de facto* inventories are mere trivial lists, or (a) whether they have general, cross-linguistically definable properties (can any old assembly of segments be a system?), (b) whether they have any internal structure, and (c) whether they function as wholes in any interesting way.

There are two basic approaches to these matters, leading to rather different uses of 'system'. One is descriptive or **typological**: do (phonemic) segment-inventories fall into reasonably natural types, and is there anything interesting to say about languages from this point of view? One offshoot of this is the area characterized as the study of **universals** (§§7.4ff); are there 'laws' governing the content and/or structure of phonological systems?

The second is the 'dynamic' or 'process' approach: are there

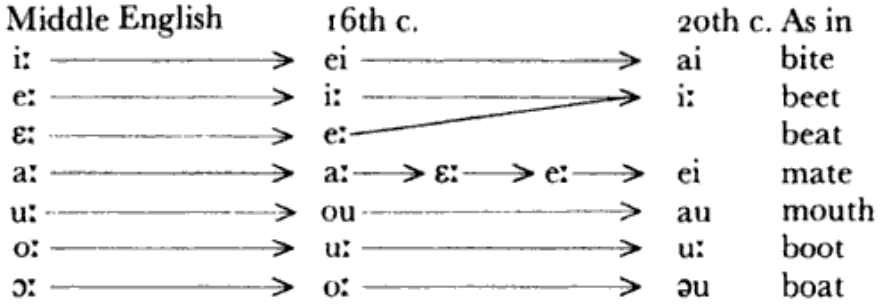
phenomena best stated (or apparently only statable) in terms of systems-as-wholes (ideally, derivable from them) – rather than in terms of rules acting on mere units not 'embedded' in a larger structure?

I begin with some arguments designed to show that (at least some types of) systems have interesting properties that do not derive merely from the elements they happen to contain, but from the structures the elements occur in, and conditions on the whole. With this basis, we can proceed to a typological overview of phonological systems, not exhaustive, but sufficient to give an idea of what kinds occur and the constraints on their composition.

7.2 The English Vowel Shift: the argument from non-participation

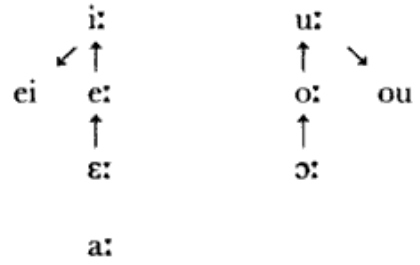
One of the major events in the history of English is the so-called 'Great Vowel Shift' (GVS) – a radical transformation of the long-vowel system that began in the 15th century. Its overall effects were:

(7.1)



The part of this complex development that concerns us is the ME → 16th century transition. It is clear from the values in (7.1) that what happened, overall, was this:

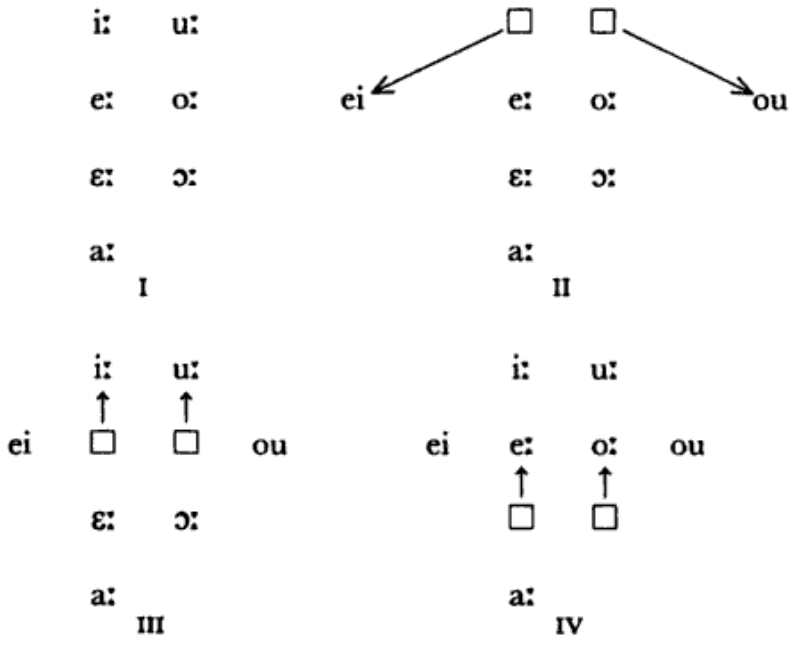
(7.2)



That is, non-low long vowels raise one height; high vowels diphthongize.

This can be seen as a **chain**: a series of changes each of which in some way entails the next. Assuming the propriety of describing (7.2) this way, there are two possible chain-interpretations. One, that the high vowels diphthongize, leaving 'empty slots', and the half-close ones 'move up' into the vacated positions, leaving slots behind them, which the half-open ones move up to fill:

(7.3)



This is called a **drag chain**.

Alternatively, retaining the chain metaphor, we could have the movement begin from below, each vowel 'pushing' the next one up out of place. The high vowels, having no higher height to raise to, diphthongize. This is a **push chain**, and can be visualized by reading (7.2) from /ɛ: ɔ:/ up. Here there are no empty slots, but a uniform chain progression, each raising entailing the one above. (Otherwise one vowel would merge with the next higher.)

Still a third possibility is that there was a mixture: say a push chain beginning with /e: o:/, and then a drag chain involving /ɛ: ɔ:/. For reasons not relevant here, no one has seriously entertained the push chain alone; the serious competitors have been either an overall drag chain or a push/drag mechanism starting with the half-close vowels. The problem is that the historical evidence itself does not tell us what the sequence was.

But there is a solution, with interesting theoretical implications. It

hinges on range of data: one solution accounts neatly for an important discontinuity in the English dialect picture, and the other doesn't. The discontinuity is this: the most local forms of English descending from northern Middle English have one feature in common: ME /u:/ does not diphthongize. These dialects typically have [u:] in *house, mouth* etc. in England, and [u] or a fronted variant in Scotland.

Consider some typical **reflexes** (historical developments) of four of the ME long vowels in northern and non-northern dialect types:

(7·4)

ME	Northern: Lowick, Northumberland	Northern: Morebattle, Roxburghshire	Southern: RP
i:	ɛ̈ɪ	ɛ̈i	aɪ
e:	i:	i	i:
u:	u:	u	aʊ
o:	i:	ø	u:

An interesting implicational relation is apparent here (and is borne out by further data): any dialect that has an undiphthongized ME /u:/ has a front reflex of ME /o:/. Why should this be, and what does it mean?

The answer involves a connection between the GVS and another well-known change. In the ME dialects ancestral to modern northern English, in the 14th century, /o:/ fronted to /ø:/ (later raised to /y:/ in England, hence modern /i:/). The effect can be seen by comparing the systems before and after this fronting:

(7·5)

Before		After	
i:	u:	i:	u:
e:	o:	e:, ø:	□
ɛ:	ɔ:	ɛ:	ɔ:
a:		a:	

The 'after' system is input to the GVS.

In addition to the implicational relationship between unshifted ME /u:/ and front ME /o:/, we can add the following: no dialect shifted ME /e:/ 'out of place' (i.e. leaving an empty slot for /e:/ like that for /o:/ after the fronting); and no dialect has undiphthongized ME /i:/. The correlation looks too neat to be accidental, and makes sense in a chain model. If the GVS began with a push chain from /e: o:/, then in the north there is nothing to do the pushing, so /u:/ remains.

The condition on diphthongization can be stated this way:

(7.6) A high vowel diphthongizes unless the slot below it in the same series (front, back) is empty.

Diphthongization of /u:/, that is, can be predicted from the shape of the system it appears in. If this is 'complete' (the top two heights filled), then raising of the half-close vowel will initiate a push chain (as in all dialects for the front series); if there is an empty slot at half-close, then the high vowel is unaffected. This suggests that the GVS can be visualized as a kind of general 'instruction' (or metarule) to the non-low vowels in the system to raise; coupled with another general condition that in the basic shift no phonemic distinctions are to be lost. Such a programme of shifting is best visualized in terms of a whole system as a structural primitive, with the behaviour of individual elements determined, not just by their own content, but by their place as well.

7.3 The argument from cyclical shifts

From the preceding we get the idea of a vowel system as a kind of 'spatial' inventory, where relations like 'above', 'below', etc. are phonologically relevant. Certainly there is a gain in descriptive and predictive precision if we think of processes like the GVS as operating in a **phonological space** (to use the common term). This also illustrates nicely the point that despite the articulatory/acoustic asymmetry in vowel characterization (§6.6), the parameters we are calling height and backness do have some phonological reality: processes can apparently utilize them in a clearcut way, regardless of their physical implementation. The GVS treats the system as a set of positions in a two-dimensional space, where [n height] in front is 'the same' as [n height] in back, etc. From now on I will use the traditional terms without apology, as before §6.6.

Consonant systems as well exhibit patterns of dynamic coherence under chain shifting, which suggests the same 'systemic integrity' we saw above for vowel systems. Or at least one could say that there are many attested phonological processes implying systems-as-whole – as it were 'predefined' – being among the terms in which language evolution operates.

Perhaps the point can be made more clearly this way: the best motivation for a concept of system (in the 'dynamic' sense) is the existence of 'global' mutations where a statement in terms only of rules operating on individual segments or segment classes appears to

be non-generalizing, but one in terms of **constraints** or **conditions** on whole systems captures the obvious generalizations. We saw this to some extent with the GVS: however one might formulate the individual raisings and diphthongizations, the change as a whole HAS A SHAPE, and this is best described in terms of the system it occurs in. For example, 'All non-low vowels raise one height; any high vowel with a raisable vowel below it diphthongizes.'

Another illustration is a famous global consonant shift, the so-called 'First Consonant Shift' or **Grimm's Law**. This defines the transition from the parent Indo-European protolanguage to the ancestor of Germanic, and involves a change in articulatory type of every member of the obstruent system except /s/ – but no change in the number of distinctive entities or oppositions. (One might say – in terms of contrast – that nothing happened: see §13.1.)

Phonetically, the shift was:

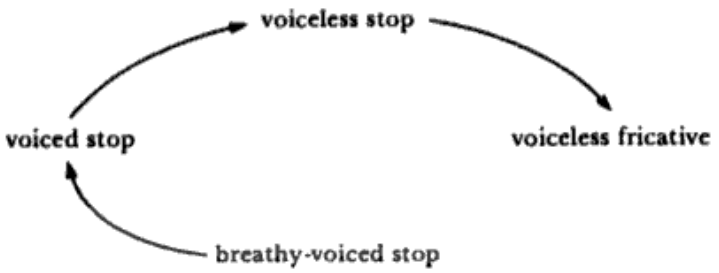
(7.7)

Proto-IE					Proto-Germanic			
p	t	k	k^w	→	f	θ	x	x^w
b	d	g	g^w		p	t	k	k^w
b̤	d̤	g̤	g^w̤		b	d	g	g^w
	s					s		

(/b̤/ etc. are breathy-voiced stops, traditionally 'voiced aspirates' /bh/, etc.)

The overall pattern is something like the diagram in (7.8).

(7.8)



Leaving aside the stable /s/, one category (breathy-voiced stop) vanishes at one end, and a new category (voiceless fricative) emerges at the other. The system of oppositions remains unaltered, and two of the original three non-sibilant types remain: but with different sources. These 'musical chairs' phenomena are common, and seem

to be best treated in terms of predefined or pre-existent systems of contrasts, with variable membership of distinctive 'places'.

7.4 Phonological universals and markedness

Two strands of inquiry tend to be grouped under the heading of 'universals' research: (a) the attempt to discover the (absolute) defining properties of natural languages (**absolute universals**), and (b) the rather different attempt to sort languages into types on the basis of their possession or not of certain (not obligatory) properties. Thus under (a) the search for universals comes up with statements like:

(7.9)
(a) All languages use a pulmonic egressive airstream.
(b) All languages have at least one high vowel.
(c) All languages have consonants and vowels.

While under (b), one would be concerned with statements like:

(7.10)
(a) Some languages also use a glottalic egressive airstream.
(b) Some languages have systems with only one low vowel.
(c) Some languages have consonant systems with no voice contrast, and some have vowel systems with no rounding contrast.

But there is a point where absolute universals and typology intersect, in so-called **implicational universals**. These are statements of the form '$P_i \supset P_j$', i.e. 'possession of property P_i implies possession of P_j – but not vice versa'. (7.9a) and (7.10a) in fact are parts of such a universal: here P_i is glottalic egressive, and P_j pulmonic. Implicational universals in effect define minimal or obligatory properties of phonological systems, as well as opening up the options: a natural language is by definition an object that contains at least P_j, and may be an object containing $P_i \ldots$, etc. It is uncertain whether a large and interesting set of such statements can be made; steps have been taken, but we're nowhere near knowing yet if the goal is attainable.

There is one interesting and problematic area at the universal/typological interface: the existence of what might be called **statistical universals**. These have the form '$p(P_i \supset P_j) = n$', where $n < 1, > 0.5$; i.e. languages with P_i will have P_j with a sample frequency exceeding (often greatly) what would be expected as a result of chance. (If the only choice is presence vs. absence of a property, a random distribution should be roughly 50% with and 50% without for a reasonably large

sample, i.e. p = 0.5.) There are also non-implicational statistical universals of the type: P_j occurs in nearly all (or a very high percentage of) languages, but P_i is very rare (even if there's no implicational relation). Examples of statistical (or pseudo-statistical, since we don't really have precise figures) universals: (i) a front rounded vowel at a given height implies a back rounded one at the same height; (ii) voiced obstruents imply voiceless ones (both implicational); (iii) if a language has one front rounded vowel it will be /y/; (iv) no language has more than three front rounded vowels (non-implicational).

The problem is what these mean. They have been known for a long time, and for some (perhaps the majority) of linguists they are an important fact about languages, usually treated (following Prague terminology) under the heading of 'markedness'. According to the many divergent positions that can be grouped roughly under the heading of **markedness theory**, an important distinction can be made between two types of segments, **marked** and **unmarked**.

For any minimally distinct segment-pair, marked and unmarked are defined according to these criteria: a marked segment is (i) less common cross-linguistically than its unmarked counterpart; (ii) tends not to appear in positions of neutralization; (iii) generally has lower text-frequency; (iv) is later in appearing during language-acquisition; (v) tends in cases of phonemic merger (coalescence) to be absorbed into the unmarked category; (vi) tends to be less stable historically; (vii) tends to imply the existence of its unmarked counterpart.

This could be merely definitional or circular, were it not that for a given pair it is normally the same member that fairly consistently meets at least conditions (i, ii, iv) anyhow; the evidence with regard to (iii) is unclear, and (vi, vii) seem not to be true (see Lass 1975). For example, voiceless obstruents, front unrounded vowels, and stops are relatively 'unmarked' in this sense *vis-à-vis* voiced obstruents, front rounded vowels, and fricatives.

It is debatable, however, if these observations can be pushed much further, i.e. given a non-formal, non-statistical interpretation, and used as the basis for an explanatory (predictive) theory. The view that they can is widespread: e.g. markedness is interpreted as 'complexity' (psychological, perceptual, articulatory), and is built into procedures to 'evaluate' grammars or language states in terms of 'cost' or 'non-optimality' (see §8.6). But it is not clear that the predictive power of any form of markedness theory is enough to make it interesting – as

anything but a set of inductive generalizations about the distributions of properties in the world's languages. In particular there seems to be no good way of accounting for the 'failures' of markedness predictions.

The difficult cases (really quite common) are those where a system goes from an unmarked to a marked state, and yet the new segments show high stability. Thus the advent of *i*-umlaut (§8.2.1) in the Germanic languages added the segments [y ø] to what were otherwise fairly unmarked systems; and even though some of the dialects (e.g. Southern English) have lost all traces of these vowel types, most of the others have kept them, and even added new ones. Now the original umlaut was a very 'natural' assimilatory process whereby back vowels fronted before a following /i j/: thus pre-OE */mu:s/ 'mouse', */mu:si-/ 'mice' → [mu:s], [my:si]. The new [y:] becomes phonemic when the final /i/ is later lost (see §§13.1–2).

But cases where front rounded vowels arise **context-free** (i.e. without conditioning environments) are more troublesome: e.g. there are unconditioned frontings of [u] to [y] in Ancient Greek, Albanian, French, Dutch, Icelandic, and Scottish English. In some of these cases (Greek, French, Dutch) the 'lost' [u] is restored by other changes; in others, like Scots, it is not. Thus the history of some varieties of Scots, from pre-OE times to the present, shows the pattern:

(7.11)

i	u	i	y	u	i	u	i	y
I		II			III		IV	

Between stages III and IV there has been an unconditioned merger to a marked category: /y/ and /u/ have fallen together in /y/ (hence /y/ in *house*, *loose*). In terms of overall markedness (with U 'unmarked' and M 'marked'), the transitions are U → M, M → U, U → M. And the last stage has been stable for several centuries. Thus markedness theory predicts II → III, and counter-predicts I → II, III → IV. Not to mention the fact that the system at stage IV violates a supposed implicational universal.

Data like this focusses on an important methodological problem: the status of so-called 'explanation by tendency'. Many linguists see overall statistical tendencies like those embodied in the concept of markedness as explanations of changes or synchronic states: the transition II → III occurred to 'minimize markedness'. But what about I → II, III → IV? The problem with 'tends to' statements is that they

explain nothing because they predict everything (i.e. they predict nothing in particular). If the aim of an explanation is to account for some given SINGLE event, i.e. by predicting its occurrence, markedness seems to be empty, since it allows for all possible outcomes. No single event can refute a claim about the marked or unmarked status of a category. If any given event is – in the larger picture – compatible with a segment being unmarked or marked, then what is the content of 'marked'? (This critique will be slightly tempered in §7.6.3.)

7.5 System typology, I: vowel systems

7.5.1 *Introduction: what phonemes does a language 'have'?*

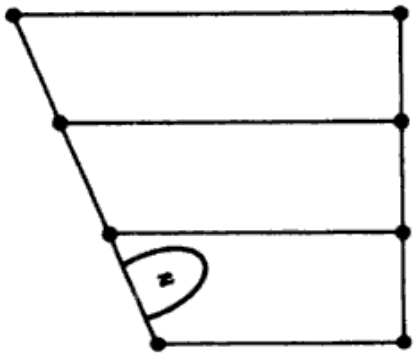
The aim of a typology is to reduce the bewildering array of items in the universe of discourse to a tractable number of classes, on the basis of (significant) shared properties. The size of the data-base, and the number of analytical options available have so far prevented any fully satisfactory classifications. I won't attempt another here; but I will consider some basic problems in system typology, and take a critical look at what has been proposed. Then I will look at a sample of the data these attempts have rested on, and some of the generalizations that emerge. This will give some idea of what remains to be done, and the often important issues that come into focus when you try to do it. Above all, this chapter will give some indication of what phonological systems in general are like.

To begin with, just about everybody agrees that system typology is based on arrays of distinctive segments, organized (for vowels) along the primary axes of height and backness, intersected by rounding, diphthongization, length, nasalization, etc. But the construction of vowel systems is not simply the random choice of items on these parameters: some system types are apparently impossible, others common, and others rare; and almost all seem to be built along certain very basic lines. But before we get to this, we have to discuss two basic problems: the choice of items to represent the phonemes of a language, and the status of long vowels and diphthongs (§7.5.2).

What do we mean by saying 'Language L has phoneme X'? For example, everyone would agree that many varieties of English 'have /æ/': but this symbol stands, in any given dialect, for a spread of allophones. In my own, for instance, '/æ/' subsumes a short peripheral [æ], (*cat*), a short nasalized [æ̃] (*manner*), a long centralized and raised

[æ̈:] (*bad, fast*), a nasalized version [æ̃:] (*hand*), and a short retracted and lowered [ǣ] (*carry*). So /æ/ stands for an AREA in the vowel space, not a point, as shown in (7.12).

(7.12)



In choosing a symbol for a category, we typically select something like the 'centre' of an allophonic range: if not 'geometrical', a 'phonetic centre', i.e. the least modified form, not the one appearing in perceptually noisy environments (e.g. before /r/ or nasals). Or the one least subject to conditioned modifications (here, lengthening before voiced segments and the like). Failing clearcut applicability of these criteria, one can take the most widely distributed allophone as basic.

But how am I so sure that short [æ] is basic, rather than a shortened version of a long vowel? The answer illustrates a typical argument, and ties in with the next topic. The determining factor is the structure of the phonology as a whole: in my dialect, the long vowels and diphthongs (except for [æ:]) have certain distributional properties, notably the ability to appear in stressed final open syllables (*bee, boo, law*, etc.). No short vowels appear in this position, and the only long quality missing is [æ:]. Therefore we assign the basic quality [æ] to the short series, and represent the category in question as /æ/.

7.5.2 *Long vowels and diphthongs*

Specification of systems with a length contrast and/or phonemic diphthongs has been treated most unsatisfactorily, and the difficulties are interesting. If we take a vowel system as a two-dimensional array, then in the simple case of a language with long and short vowels of (at least roughly) the same quality, we can fit them in as pairs:

(7.13)

i:	i	u	u:
e:	e	o	o:
a:	a		

We could call this (say '5-V + length', and it then qualifies as a 'type'. Classical Latin may have been like this, as is Maltese. But what about a language with the same number of segments, but the following phonetic character?

(7.14)

i:				u:
e:	ɪ		ʊ	o:
	ɛ		ɔ	
	a			ɑ:

(A similar system probably characterized 17th-century London English; with the addition of /y: ʏ ø: œ/ this would be standard German.) Is this still just '5-V + length'? Or a separate (sub)type, with length and quality not matched? The difficulty is that there is a tendency in much of the literature to 'normalize' systems like (7.14) into (7.13), and treat them as 'alike' for typology.

Here is a concrete example, as a warning. Hockett (1955: 76f) gives the Fox vowel system as /i: i e: e ä: ä o: o/ (Notation altered to conform with the practice in this book: /ä/ is open central.) These are 'the phonemes': their characteristic allophones, he tells us, are [i: ɪ æ: ɛ ʌ ä: o: ʊ], where [ʌ] is central. If we line the two representations up in a 'phonetic space', we get:

(7.15)

Phonemic					Phonetic				
i:	i				i:				
e:	e		o:	o		ɪ		ʊ	o:
	ä:	ä				ɛ	ʌ		
					æ:		ä:		

Yet Hockett tells us (p. 76) that 'the proper pairing is quite obvious', i.e. 'two of the shorts are high, and two low; two of them front, and two back; and the same classifications apply to the longs'. Fox thus becomes an example of a simple '2 + 2' system (with length extracted – see below), representable as:

(7.16)

i	o
e	a

Obviously we have to ask how much normalization is allowable, and what it means to call a segment 'phonemically high' when its

closest realization is half-close. Wouldn't we be better representing Fox as

(7.17)
```
i
e       o
    a
```

(even at the expense of the neat 2 × 2 symmetry)? This way, we can see that Fox uses three heights (even if not distinctively in any one series), as opposed to a language like Amuesha which apparently has /e o/ as its closest vowels, and a low central one, and thus only uses two heights. Equating 'highest vowel in a system' with 'high vowel' enables us, if we're not careful, to come up with 'universals' of the type that all languages have /i u/ (see Crothers 1978: 115). Crothers, even knowing of languages like Amuesha, takes /o/ in such systems as 'reasonably close to' /u/ – thus in fact defining typology in terms of an *a priori* notion of what a natural language ought to contain. I will return to Crothers later on.

This kind of normalization is perhaps the major problem for a reader first embarking on the literature on system classification; Hockett (1955) and Sedlak (1969) are particularly dangerous in this regard – especially when one does not have access to phonetic data from the language being discussed. Crothers escapes this problem in a way, by at least presenting phonetically rather precise examples of his types, so that one has the data for quarrelling with him (see §7.5.3).

Leaving aside normalization, there are further problems with long vowels and diphthongs. While both of these types are usually listed in displays of vowel systems in individual language descriptions, the major tradition of typological studies is ambiguous about length, and nearly unanimous in excluding diphthongs. This latter exclusion – if we take it as a serious theoretical claim – has paradoxical consequences. Such a position would claim implicitly that when ME /i: u:/ diphthongized in the Great Vowel Shift (§7.2), they somehow 'left' the vowel system; but when, as in some Southern U.S. dialects, /ai/ from ME /i:/ (as in *white*) monophthongized to /a:/, it 'returned'. (Needless to say no one has said this explicitly; but if diphthongs are not members of vowel systems it follows.)

Hockett (1955) manages to exclude both length and diphthongization in a rather interesting way. He divides the syllable **nuclei** in a language into **simple** and **complex peaks**, so that the 'basic'

vowel system (THE system proper) is always a set of short monophthongs. Long vowels and diphthongs are then simple nuclei clustering with either a '**co-vowel**' of length /ː/, or a 'semivowel' /j w/, etc. This in effect reduces anything but short monophthongs to the status of 'tactical' arrangements or clusters, so that (say) 'the English vowel system' no more includes the phonemes /ai au/ as members than 'the consonant system' includes /st fr/, etc.

Phonologically, however, this position is shaky. At least in some languages diphthongs and long vowels must be taken – whatever their phonetic structure – as 'units' in precisely the same way as short monophthongs: and this suggests the need for a classificatory framework including them both.

For instance: in Icelandic, diphthongs behave exactly like simple vowels with respect to the assignment of length. In environments where monophthongs are long, diphthongs are as well: thus /i/ is long in *ís* 'ice' (nom sg) and short in *íss* (gen sg), and /ai/ is long in *læs* 'literate' (non-neuter) and short in *læst* (neuter): length is controlled by the following consonantism, with monophthongal or diphthongal nuclei short before long consonants or clusters and long before single consonants.

Or consider English, where diphthongs participate as units, parallel to long and short vowels, in MP alternations. Thus *div*[aɪ]*n* ~ *div*[ɪ]*nity*, *ser*[iː]*n* ~ *ser*[ɛ]*nity*, *hum*[eɪ]*n* ~ *hum*[æ]*nity*, *prof*[aʊ]*nd* ~ *prof*[ʌ]*ndity*, etc. Here one position is always occupied by a long vowel OR a diphthong, and the other by a short monophthong. So long vowels and diphthongs are on a par; if we admit one, we admit the other. And their behaviour parallels that of the short vowels, with which they alternate, so that unit status for one of the three entails the same for the others.

The primary problem with diphthongs, of course, is that there is no obvious 'place' for them in the typical height vs. backness system display. Assuming the independence of diphthongs, where do they go? Should we take say /ei/ as a member of a front vowel system, and /ou/ as back? And what about diphthongs with two backness values, like /oi/? The usual solution in descriptive work is simply to put diphthongs 'somewhere else': cf. the Yiddish system in (2.11), which is a fairly typical way of fudging the issue. The question at the moment is insoluble, and diphthongs remain in a kind of systemic limbo.

An alternative would be to accept an abstract analysis like that of

SPE, where [+ tense] marks underlying vowels that surface as long or diphthongal, and [– tense] marks the others. This however can't serve as a basis for typology, because the constraints in manipulating 'underlying' systems are too loose. Anything can pass for a system, pretty much, regardless of the phonetics (see §9.3). For example in *SPE*, the underlying nucleus of *boy* is /ɔ̈æ/ (low front round tense) and that of *cue* is /i̱/ (high back unround tense) – neither of which ever appear phonetically. Such representations are artifacts of a certain kind of MP analysis, and not a data-base for the study of systems: it seems close to lunacy to characterize any variety of English as 'having' a low front round vowel. 'Systems' here will refer to something like sets of phonetic norms for distinctively opposed entities, based on some sort of 'classical' phonemic analysis.

7.5.3 *Basic vowel system types*

Leaving aside the vexed question of where to put diphthongs, we can look at some of the basic monophthongal system types in the world's languages. There have been three major approaches to vowel-system classification, exemplified by Trubetzkoy (1939), Hockett (1955), and Crothers (1978). Trubetzkoy bases his primarily on what we might call 'axes of contrast': systems are built along the parameters of **degree of aperture** or **sonority** (= height), and **localization** or **timbre** ('clear' vs. 'dark'), with the latter apparently the intersection of backness and rounding ([y] is a 'dark' [i]). This leads to a classification of systems as **linear** (with only aperture contrasts, and no backness or rounding oppositions), **quadrangular** (all vowels opposed in height and backness) and **triangular** (all vowels opposed in aperture, and all but the openest distinct in timbre, the open vowel alone being 'unpartnered').

To illustrate:

(7.18)

i̱	i u	i u
ə	e o	e o
a	a ɑ	ɑ
Linear (Adyghe)	Quadrangular (Montenegran)	Triangular (Northern Ostyak)

Systems can be further divided according to the number of timbre classes: so 'two-degree, three-class quadrangular' K'üri:

(7.19)

i	y	u
e		ɑ

((7.18) from Hockett (Adyghe) and Trubetzkoy; (7.19) Trubetzkoy.) The equation of heights /e/ = /ɑ/ reflects Trubetzkoy's concern with opposition numbers ('degrees') rather than phonetic exponents: cf. Hockett on Fox (§7.5.2).

In Hockett's scheme, the number of distinctions in particular dimensions is primary; thus types are identified by numbers, indicating how many vowels there are at a given height:

(7.20)

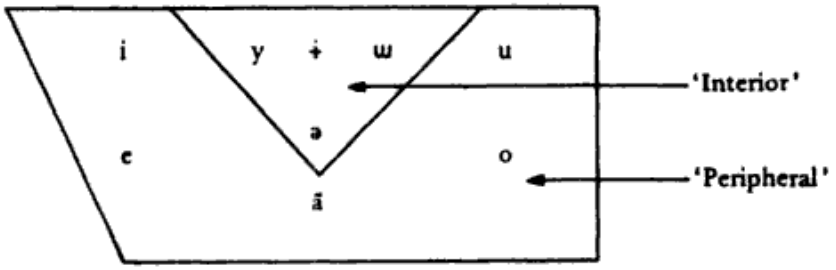
i u	i ə a	i u ə a
2 + 1	1 + 1 + 1	2 + 1 + 1
Cree	Adyghe	Ilocano

And so on. This is not too different from Trubetzkoy: his basic types can be read off the code-numbers for the lowest height for triangular or quadrangular systems (1 and 2 respectively), or off all heights for linear.

Both these classifications are fairly insensitive to phonetic detail – or they treat it as irrelevant. (This makes Hockett's extreme normalization a bit less reprehensible, given his purpose.) The one scheme so far that has really attempted to come to grips with quality – so as to be able to state implications between vowel types – is Crothers (1978). He also includes long vowels (if only by the back door – see below), though he does not allow for diphthongs. His scheme is worth looking at (even though it has problems, and in the end probably can't be accepted), because of the way it combines auditory and articulatory information, and attempts to furnish a basis for a theory of universals.

Crothers begins with the (apparent) observation that the smallest known systems (aside from the 'linear' Caucasian ones, which he calls 'reduced') tend to contain only high and low vowels, in certain quality ranges: they are of the type /i u a/, etc. Then he notes that perceptually, front rounded and non-low back unrounded vowels tend to sound more central than their oppositely rounded counterparts: rounded back vowels are 'backer', unrounded front vowels 'fronter' than their opposites. So [y ø] are acoustically closer to [ɨ ə] than to [i e], and to [ɯ ʏ] than [u o]. Thus we get a classification as in (7.21).

(7.21)



(Slightly modified from Crothers' original.) Because of their perceptual salience, etc., peripheral vowels are 'unmarked', and 'primary'. This leads to a classification which assigns a language a binomial label x.y, where x = the total number of vowel qualities, and y the number of interior vowels. So:

(7.22)

i	ʊ	i		u
ɛ	ɑ		ə	
			ä	
4.0			4.1	
Cayapa			Margi	

But there are some inconsistencies in his application of (7.21), which raise familiar problems. For a number of languages, /ɯ/, which ought to be interior, is taken as peripheral (e.g. in a system /i ä ɯ/, with no /u/, /ɯ/ is 'a kind of /u/': so this, like /i ä u/, is 3.0 instead of 3.1. In fact he gives no examples of 3.1, though he lists what I would take to be 3.1 as 3.0). Further, a language with a system /i a ɯ o/, also with no /u/, is called 4.1: i.e. HERE /ɯ/ counts as interior, with /o/ as the peripheral 'high' vowel. I find it hard to see how the same quality type can legitimately – at this level of system typology – be counted as interior and peripheral in different languages. At the very least, by forcing languages to conform to a scheme where all must have /i u/, we miss out some empirically attested possibilities, and sweep inconveniences under a procedural rug.

Another problem is that while Crothers lists both long and nasalized vowels for the languages in his sample, he types them only by short vowels: it doesn't seem helpful to call both a language with /i a u/ and one with /i: i a: a u: u/ 3.0, and lump them together as 'the same'.

With these taxonomies as a background, I will not attempt a firm classification, but look in a general way at some of the major basic shapes available for vowel systems, on an essentially numerical basis.

We can take the building of vowel systems as a partially non-random selection from the inventory of possible vowels. Aside from the 'linear' systems, whose status is problematical (see §7.7), we can specify the construction of a minimal system as follows: take one vowel in the range [i–ɪ–e], one from [ɯ–u–ʊ–o], and one low vowel from [a/æ–ä–ɑ]. Typical minimal systems of this kind are:

(7.23)

i		u	i	u
	ä		a	
Aleut			Moroccan Arabic	

The 'point' seems to be maximal dispersion of vowel-quality towards the corners of the vowel space; languages like this (not surprisingly) often have very wide ranges of allophonic variation (see §7.7). With length as an added dimension:

(7.24)

i	u	iː	uː	e	o	eː	oː	i	ɯ	iː	ɯː
	ä		äː		ä		äː		ä		äː
Alaskan Eskimo				Amuesha				Jaqaru			

These are all essentially 'high/low' systems; mid vowels, when they appear, do not function as third terms in a height opposition (which tends to justify Hockett's normalizing procedure: though one still ought to note the flexibility of 'high' in this systemic sense).

The next step up is 4-quality systems, which usually have a high : mid opposition. Sometimes – but rarely – there is no high/mid contrast in any one series, but high/low in one and either high or mid in the other two (Chacobo below):

(7.25)

i			i	u	i	ɨ	
e	o			ə			ɔ
	ä			ä		ä	
Campa			Margi		Chacobo		

In the examples that follow, I will represent /i ɪ/, /e ɛ/, /o ɔ/, /u ʊ/ as 'the same height', if they function as SOLE members of a high or mid range in a given series; front/back asymmetries in systems with one mid or high vowel in a series are not uncommon.

With length added, the strategy still seems similar: though the long systems may be structurally rather different:

(7.26)

i	u	e:	o:		i	ɯ	i:				
ɛ		ɛ:				o		o:			
	ɒ		ɒ:		ä		ä:				
Wichita					Adzera						

With nasalization, and nasalization + length:

(7.27)

i		ĩ			i	ɯ	î	ɯ̃			
ɛ	o	ɛ̃	õ			o		õ			
ä		ä̃			ä		ä̃				
Mazateco						Amahuaca					

ɪ		i:		ĩ							
ɛ	ɔ	ɛ:	o:	ɛ̃	ɔ̃						
a		ä:		ä̃							
Navaho											

Even with 4-quality systems we still get (rarely) two-dimensional high/low types, as in Wapishana:

(7.28)

i	ɨ	u	i:	ɨ:	u:	ĩ	ɨ̃	ũ			
	ä			ä:			ä̃				

5-vowel systems are the commonest: the most typical contrast two heights in front and back with a low central vowel, though there are variants with three heights in front, or two central:

(7.29)

i	u	i	ʊ		ɪ	ʊ	i	ʉ			
ɛ	o	ɛ	ɔ		ɛ	ɔ	ɛ		o		
ä		a			ä		ä				
Ainu		Georgian			Yiddish		Garo				

i	y	u									
		ʏ									
ä											
Mandarin											

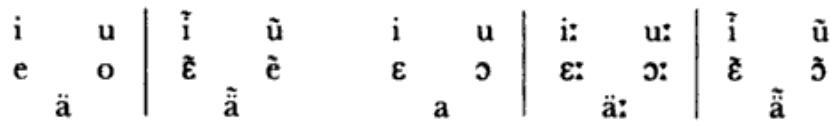
Mandarin is unusual, for a system this small, in that it has vowels of the same height and backness contrasting only in rounding. According to Crothers' sample, and my own experience, front rounded vowels seem not to occur in systems with fewer than five qualities; there appears to be a statistical preference for the unrounded types /ɯ i ə/ as

'extras' in the smaller systems. Front rounded vowels are in any case areally and genetically restricted: the bulk of examples seen to be Western Indo-European (especially Germanic), Uralic, Altaic, and Sino-Tibetan, with scattered instances elsewhere.

5-V with either length or nasalization or both:

(7.30)

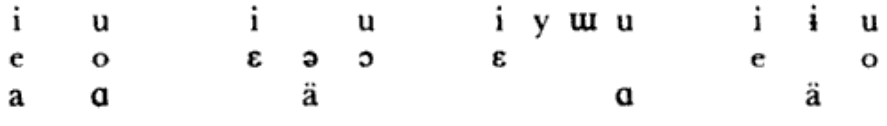
Hawaiian Papago



Kharia Beembe

6-V systems show more variety: some use three heights in one or both series, others have rounding contrasts at one height in a series:

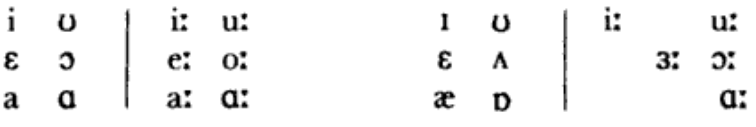
(7.31)



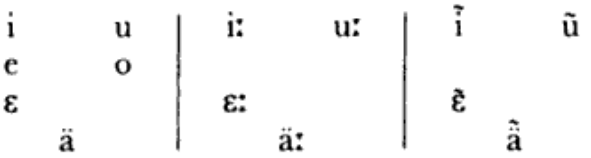
Persian Chuckchi Chuvash Itonama

With length (and nasalization):

(7.32)



Lithuanian English (RP)



Chipewyan

Up to now, no system appears to use more than three heights distinctively; 4-height oppositions seem to appear at 7-V, and are not uncommon above that. Two other points to note: (a) long and short vowels do not have to match in either number or quality; (b) the number of nasalized vowels is often smaller than, and never larger than, the number of oral ones.

7-V systems:

(7·33)

Italian	Albanian	Sundanese	Naga
i u	i y u	i ɨ u	i ɯ u
e o			
ɛ ɔ	ɛ ə ɔ	ɛ ə o	ɛ ə ɔ
a	ɑ	ä	ä

Note the wide disparities in 'density', from the rather condensed Italian to the dispersion of Albanian; given the high–low 'anchor points', there seem to be few constraints on filling in the rest of the places.

More spatial distribution types occur with length; aside from neatly symmetrical matching systems, we find the common type where (at least some) shorts are lower and/or more central than longs, and the long and short low vowels have opposite backness:

(7·34)

Nengone		German	
i u	i: u:	ɪ ʏ ʊ	i: y: u:
e o	e: o:		e: ø: o:
ɛ ɔ	ɛ: ɔ:	ɛ œ ɔ	
ä	ä:	a	ɑ:

Hungarian	
i y ʊ	i: y: u:
ɛ œ ɔ	e: ø: o:
ɒ	ä:

7-V with nasalization and length:

(7·35)

Burmese		Kpelle	
i u	i ũ	i u i: u:	ĩ ũ
e o		ɪ ʊ ɪ: ʊ:	ẽ õ
ɛ ɔ		ɛ ɔ ɛ: ɔ:	ɛ̃ ɔ̃
ä	ä̃	ä ä:	ä

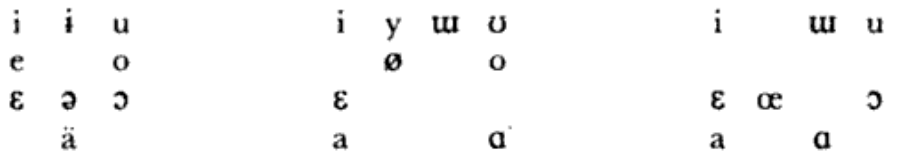
8-V systems show still more variety:

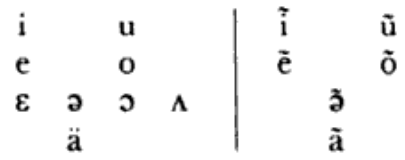
(7·36)

Javanese	Turkish	Finnish	
i u	i y ɯ u	i y u	i: y: u:
e o		e ø o	e: ø: o:
ɛ ə ɔ	ɛ œ ɔ	æ ɑ	æ: ɑ:
a	ɑ		

Above this size, systems become somewhat less common. For 9-V we have:

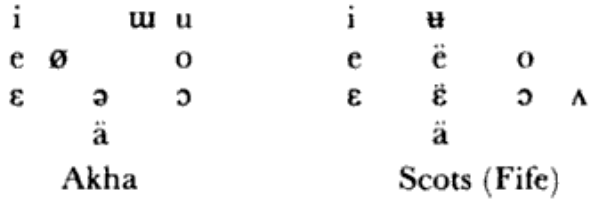
(7·37)

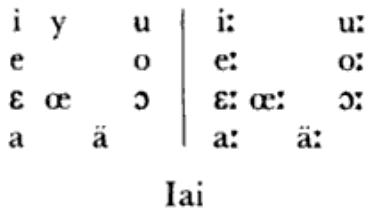




10-V without and with length:

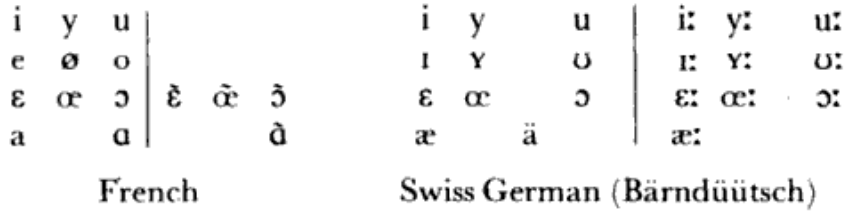
(7·38)





For 11-V:

(7·39)



Systems much larger than this present analytical difficulties, and most seem to be controversial; I will end this survey with about the largest monophthongal system I know of, an Alsatian German type with ten short and eleven long vowels, which can also be loosely interpreted as having a five-height front series:

(7.40)

i	y			iː	yː		
ɪ			ʊ	ɪː			ʊː
e	ø		o	eː	øː		oː
	œ			ɛː	œː		
a			ɑ	aː			ɒː

7.6 System typology, II: consonant systems

7.6.1 *Obstruents, 1: stops*

The classification problem with consonants is obviously greater than with vowels. Aside from the enormously greater range of inventory sizes (Hawaiian with 8 to Ubykh with 80), there are more parameters of contrast. Compared with say four or five vowel heights, three degrees of backness, two lip attitudes, length, diphthongization, and nasalization, here we have the primary opposition obstruent vs. sonorant, at least three degrees of stricture, two release types, aspiration, (conservatively) twelve places of articulation, apical vs. laminal, secondary and double articulations, at least four glottal states and four airstreams, nasality, laterality, trill vs. tap vs. flap . . . and so on. And these interact in such complex ways, and the range of choice is so great, that even relatively crude classificatory schemes like those in §7.5.3 are virtually unworkable.

We can however outline something of a 'choice' procedure for constructing consonant systems, from minimal to maximal, and look at some of the generalizations that emerge.

All languages have obstruents. The minimal system normally involves at least two pulmonic oral stops from the 'cardinal' set /p t k/, with the third either one of this set or /ʔ/. Thus the simplest known are of the type:

(7.41)

Hawaiian	p			k	ʔ
Maori	p		t	k	

The next option is adding one 'intermediate' place, usually palatal or palato-alveolar (the latter typically an affricate), as in:

(7.42)

Burera	p	t	c	k
Ainu	p	t	tʃ	k

At this point, using Hockett's (1955) term, we are dealing with 'affricates as positions': /tʃ/ clearly belongs 'between /t/ and /k/'. The

picture is not so clear when the stop onset of an affricate is at the same place as a non-affricated stop already in the system. If a language has /t/ and /ts/, is the latter a 'position' or a 'manner'? In the examples below, when /ts/ contrasts with /t̠/, we will take it as a position (alveolar); in a type with /t/ and /ts/, we will take the affricate as belonging to a different subsystem (compare Greenlandic (7.43) with German (7.47)).

The next expansion – five voiceless types – can add retroflex, uvular, a dental/alveolar contrast, /ʔ/ or /ts/:

(7.43)										
	Ao	p		t		c	k		ʔ	
	Amahuaca	p		t	tʃ		k		ʔ	
	Western Desert	p	t̠	t	ʈ		k			
	Greenlandic	p	t̠	ts			k	q		

Larger systems with only voiceless stops are rarer, but we do have:

(7.44)									
	Nunggubuyu	p	t̠	t	ʈ	c	k		
	Chuckchi	p		t			k	q	ʔ
				ts					

Beyond six we normally get some other parameter, most often voice; though we can also get non-pulmonic airstreams, secondary strictures, and aspiration. There are also systems with only one series, but voiced; these are restricted, as far as I know, to Australian languages. A typical example is Yidiɲ, which has:

(7.45) b d ɖ g

(where /ɖ/ is a palatalized lamino-alveolar).

There are also some with a voiceless/aspirated contrast only, though these analyses are for the most part controversial. One language not usually analysed this way, but which ought to be, is Icelandic, which should probably be represented as:

(7.46)				
	p	t	c	k
	p^h	t^h	c^h	k^h

In the literature, the unaspirated set is usually given as /b̥ d̥/, etc. (i.e. 'lenis' voiceless stops: but they sound plain voiceless to me). This is probably an orthographic prejudice, as well as a reflex of the notion that aspiration contrasts do not occur in Germanic: it is worth noting that the unaspirated series is written *b, d, gj, g*.

With a simple voice contrast, the number of possibilities is enormous.

We have symmetrical and asymmetrical systems of various sizes – in the latter case with one or more voiced segments missing more often than voiceless ones. A few types:

(7.47)

p	t	k
	d	

Sentani

p	t	k
		g

Rotokas

	t	k
b	d	

Chuave

p	ɻ	k
b	ɖ	g

French

p	t	tʃ	k
p	t	dʒ	g

English

p	t	ts	k
pf			
b	d		g

German (standard)

p	t	k	ʔ
	ts		
	dz		
b	d	g	

Chamoro

p	t	ʧ	k	q
b	d	ɟ	g	

Yugakhir

p	ɻ		ʧ	k	ʔ
b	ɖ	ɖ	ʤ	g	

Papago

We can also add aspiration, or aspiration and breathy voice:

(7.48)

p	t	tʃ	k
b	d	dʒ	g
p^h	t^h	$tʃ^h$	k^h

Burmese

p	t	ʈ	tʃ	k
b	d	ɖ	dʒ	g
p^h	t^h	$ʈ^h$	$tʃ^h$	k^h
b̤	d̤	ɖ̤	d̤ʒ	g̈

Bengali

And larger systems may add some other airstream type, e.g. Sindhi, with the above plus an implosive series:

(7.49)

p	t	ʈ	tɕ	k
b	d	ɖ	dʑ	g
p^h	t^h	$ʈ^h$	$tɕ^h$	k^h
b̤	d̤	ɖ̤	d̤ʑ	g̈
ɓ		ᶑ	ᶑʐ	ɠ

(/tɕ dʑ/ are alveopalatal affricates, i.e. palatals with alveolar coarticulation.)

Aspiration – without voice – is combined with a glottalic egressive airstream in Eastern Armenian:

(7.50)

p	t	ts	tʃ	k
p^h	t^h		$tʃ^h$	k^h
p'	t'	ts'	tʃ'	k'

Further modifications may include double stop articulations, prenasalization, and velaric ingressives (clicks), which themselves may be subject to secondary modifications, e.g. aspiration, simultaneous stop closures, breathy voice, and so on. To illustrate the latter, Zulu has three basic click types: lamino-dental/ǀ/, apical postalveolar /ᶜ/, and alveolar lateral /ǁ/, which can be voiced, voiceless, aspirated, nasal, and nasal/breathy-voiced:

(7·51)	p		t		k
	b		d		g
		ǀ	ᶜ	ŋǁ	
		ǀʰ	ᶜʰ	ǁʰ	
		ɡǀ	ɡᶜ	ɡǁ	
		ŋǀ	ŋᶜ	ŋǁ	
		ŋ̈ǀ	ŋ̈ᶜ	ŋ̈ǁ	

A further dimension of contrast is length: we find it, for instance, with aspiration and breathy voice in Brahmin dialects of Kannaḍa:

(7·52)	p	t	ʈ	ʦ	k
	b	d	ɖ	dz	g
	pʰ	tʰ	ʈʰ	ʦʰ	kʰ
	b̤	d̤	ɖ̤	d̤z	g̈
	pː	tː	ʈː	ʦː	kː
	bː	dː	ɖː	dzː	gː

A very large system, including the rare contrast of long vs. short ejectives and a laterally exploded affricate is Avar:

(7·53)	p	t		k	q	ʔ
	b	d		g		
		ts	tʃ			
				kː		
		tsː	tʃː			
	pʼ	tʼ		kʼ	qʼ	
		tsʼ	tʃʼ			
		tsːʼ	tʃːʼ			
		tɬːʼ				

And we can add secondary strictures; the most common are labialization and palatalization, though pharyngealization, uvularization, etc. also occur. Both palatalization and labialization are used in Abkhaz:

(7·54)

p	t	ts	tʃ	tɕ	k	
	t^w				k^w	q^w
					k^j	q^j
b	d	dz	dʒ	dʑ	g	
	d^w	dz^w			g^w	
p'	t'	ts'	tʃ'	tɕ'		
	tw'	$ts^{w'}$				

All the systems so far, whatever their shape, contained labials. Systems without them do occur, though they are rare, and genetically and geographically restricted. The most typical occur in languages of the north-western U.S., e.g.

(7·55)

t	tʃ	k	q		ts	tʃ	tɬ	k	q
ts	tɬ				ts'	tʃ'	tɬ'	k'	q'
		k^w	q^w						
Tlingit					Tillamook				

This brief survey by no means exhausts the possibilities; for more details it is worth looking closely at Hockett and Nartey.

7.6.2 *Obstruents, 2: fricatives*

Implicationally, fricatives are a 'secondary' category: a sample studied by Nartey (1979) gives twenty-one languages with none at all. There are usually fewer fricatives in a system – often many fewer – than stops: e.g. Klamath with sixteen stops and /s/, and Adzera with nine and /fs/.

If only one fricative is to be added to a basic stop system, there is a strong cross-linguistic preference for some kind of /s/; of Nartey's 36 one-fricative languages, 30 have /s/, and 2 each have only /β/, only /f/, or only /ɣ/. Of systems with more than one, only a handful lack /s/, e.g. Abipon with /x ɦ/, Koiani with /fð/, and Lakkia with /fθ ɬ/. So the 'basic' fricative type is an anterior, coronal sibilant. We now have something like a minimal 'archetype' for an obstruent system, i.e. /p t k s/.

We can get some idea of the relations between stop and fricative systems if we look at the fricatives correlating with the stop inventories in the previous section. Of the systems there, Burera, Western Desert and Nunggubuyu have no fricatives at all, Maori and Sentani only /f/, Rotokas only /β/, and Hawaiian only /h/ (see (7.41–4), (7.47)). All the rest have /s/ plus one or more others – with no particular correlation

between stop and fricative numbers except that the stops outnumber the fricatives, or between places of articulation. Some systems are highly symmetrical, others quite asymmetrical (French vs. Icelandic in (7.57) below).

Taking some of the simpler ones as examples, with the stops and fricatives together, to show some possible patterns, we find:

(7.56)

p		k	ʔ		p	t	k			p	t	tʃ	k		
			h		f			h			s				
Hawaiian					Maori					Ainu					

Ainu is something like an 'average' small system; no real fricative/stop symmetry, four places for stops, and /s/ alone.

As systems increase in size, the patterns become more complex; we find fricatives in positions unmatched by stops, and the kind of voiced/voiceless asymmetries or 'gaps' we saw with stops:

(7.57)

p	t		c		k					p	t			tʃ	k				
pʰ	tʰ		cʰ		kʰ					pf	ts								
f	θ	s				h				b	d				g				
v			j							f	s			ʃ	x	h			
										v	z								
Icelandic										German									

p	ʈ				k					p	ʈ			tʃ	k	ʔ			
b	ɖ				g					b	ɖ	ɖ	dʒ	g					
f		s	ʃ								s	ʂ							
v		z	ʒ																
French										Papago									

Secondary articulations, length contrasts, and alternative air-streams are also available for fricatives. These do not usually occur in the smaller systems, but the large Caucasian ones are quite striking. Thus Avar:

(7.58)

p	t			k	q		ʔ												
b	d			g															
	ts	tʃ																	
				kː															
	tsː	tʃː																	
p’	t’			k’	q’														
	ts’	tʃ’																	
	tsː’	tʃː’																	
	tɬː’																		

	s	ʃ	x	χ	ħ	h
	ɬ					
	sː	ʃː	xː	χː		
	ɬː					
v	z	ʒ		ʁ	ʕ	

Here, with fricatives added, a new place previously unrepresented: pharyngeal, with voiced and voiceless /ʕ ħ/. Even without secondary articulation, this brings the fricative inventory to seventeen. But with secondary strictures and length we get this, in Abkhaz:

(7·59)

p	t	ts	tʃ	tɕ	k	
	t^w				k^w	q^w
					k^j	q^j
b	d	dz	dʒ	dʑ	g	
	d^w	dz^w			g^w	
p'	t'	ts'	tʃ'	tɕ'		
	t^w	ts^w				
f	s		ʃ		χ	ħ
					$χ^w$	$ħ^w$
					$χ^j$	
				$ɕ^w$ː		
v	z		ʒ		ʁ	
					$ʁ^w$	
					$ʁ^j$	
				$ʑ^w$ː		

For aspiration and other airstreams in fricatives, we can turn to Burmese with the sibilant series /s s^h z/, and Amharic with /s s'/.

7.6.3 *Some generalizations about obstruents*

On the basis of the material so far, and the rest of the languages in Nartey's survey, we can derive a set of probabilistic (largely implicational) statements about the structure of obstruent systems. The most important are these, based loosely on Nartey's 'Universals':

(i) Languages usually have at least three simple oral stops, most likely /p t k/.

(ii) If a language has an affricate it most likely also has at least three plain stops.

(iii) If there is only one affricate, it is most likely /tʃ/.

(iv) The number of voiceless stops is usually greater than the number of voiced, or equal.

(v) The number of affricates is less than the number of plain stops (but cf. Tillamook, (7.55)).

(vi) A language is highly unlikely to have 'secondary' stops (i.e. coarticulated, double, non-pulmonic, aspirated, etc.) unless it has 'primary' (voiceless or voiced) plain stops.

(vii) A language is highly likely to have at least one primary (in the sense of (vi)) fricative.

(viii) If a language has only one, it is most likely /s/, next most likely /f/.

(ix) The number of voiceless fricatives is likely to be greater than that of voiced; and there is likely to be an implicational relation between a voiced fricative and its voiceless cognate. The second statement is more weakly predictive than the first, and truer for fricatives than for stops.

(x) The number of fricatives is unlikely to be greater than that of stops.

(xi) No language has secondary fricatives unless it has primary; and primary normally outnumber secondary.

There are also cross-linguistic frequency hierarchies for place of articulation for stops (different for affricates and plain stops) and fricatives. According to Nartey's figures, they seem to be as follows (X > Y = 'X is more frequent across languages than Y'):

(7.60) Obstruent frequency hierarchies
Stops: Dental/Alveolar > Labial > Velar > Palatal > Uvular
Affricates: Palatal > Dental/Alveolar > Labial > Velar
Fricatives: Dental/Alveolar (central) > Labial > Palatal > Velar > Uvular/Pharyngeal > Dental/Alveolar (lateral) > Retroflex
(Glottal stops and fricatives are excluded, since they do not figure in Nartey's survey; 'palatal' for affricates and fricatives probably conflates palatal and palato-alveolar at least; and 'dental/alveolar' for fricatives conflates various sorts of /s/ and the rare /θ ð/. As an offhand guess, I would think /ʔ/ might be about as common as uvular stops, and glottal fricatives somewhat more common than retroflex: but this needs testing.)

These observations suggest that cross-linguistically:

(i) The dental/alveolar region is 'preferred' (except for affricates), in that if a language has only one place of articulation for a given obstruent type this is what it is most likely to be. (This appears not to hold for implosives.)

(ii) Voicelessness is preferred for obstruents in the same sense; the majority in any language are likely to be voiceless, and there is a tendency for voiced ⊃ voiceless.

The notions 'preferred' and 'likely' need some explication: what do they mean? From one point of view, the greatest value of these statistical 'universals' is to enable us to set up something like a language-general '**index of oddity**', where e.g. Ainu with its /p t tʃ k s/ is distinctly 'normal' or 'basic', and Avar and Abkhaz are 'odd'. Such judgements serve in part to sharpen our expectations when we meet new languages. Remembering that these are phonemic – not phonetic – 'normalcy statements', we can be justified in suspecting that, for instance, if a language has a pharyngeal fricative or uvular stop phonetically, it is more likely than not to be better characterized as an allophone of something else than a primary allophone. (For example, many varieties of English have uvular allophones of velar stops before low back vowels, and pharyngeal allophones of /h/ in the same context; but one would not want to characterize any variety of English as having /q G ħ/.) In addition, the frequency distributions can serve as a partial check on the reconstruction of unattested language-states: the 'odder' the system we reconstruct, the more argumentative support it needs.

But there is an important *caveat*: 'likely' must be used with genetic and areal 'tact'. That is, many cross-linguistic distributions conceal very strong anti-tendential local clusterings. For instance, while pharyngeals are rare overall, there is a very high concentration in Semitic, Caucasian, and some Amerindian languages; while breathy-voiced stops are rare in general, they are common in the Indo-European languages of India, and in upper-caste dialects of Dravidian languages that have borrowed extensively. In fact, one characteristic of areal and genetic groups is the way they often concentrate 'oddities': a particularly striking example is the virtual restriction of phonemic clicks to a portion of southern Africa. So what's rare universally may actually be the NORM for a family or area: we may have '**family universals**'.

7.6.4 *Sonorants, 1: nasals*

The preference for dental/alveolar articulation is even more striking for sonorants than for obstruents; but the voicing preference is reversed. This might be a cross-linguistic definition of the feature

[± obs]: segment types showing a clear statistical preference for voicelessness are obstruents, those with a preference for voice are sonorants. This would tend, for instance, to classify lateral fricatives as obstruents (as we did, following Nartey and Hockett): /ɬ/ is much commoner than /ɮ/.

For nasals, the most complete survey is again Nartey (1979). According to his data, nearly all languages have 'primary' nasals – non-coarticulated voiced pulmonic nasal stops. There are eight in his sample with none, covering a fairly wide geographical and genetic range, including Quileute from North America, Rotokas from the South Pacific, and Apinayé from South America. Hockett adds Duwamish and Snoqualmie (also Coast Salishan, like Quileute); but remarks (p. 119) that these languages once had nasals and have now lost them. (I don't know if this is the case for Rotokas and Apinayé.) If all languages without nasals can be shown to have had them, this may be a rather bizarre case of an 'extinct universal' – a property that once was obligatory for natural languages but is no longer.

Aside from a few odd cases, then, languages normally have at least one nasal, most likely /n/. If there are two, the second is most likely /m/ (see the basic fricative distributions: /s/, /f s/); though /ŋ/ occurs as well. For three, the dominant pattern is /m n ŋ/ (cf. oral stops), though we get others as well. Some 1, 2, and 3-nasal systems:

(7.61)

n Chipewyan	ŋ Mixtec	m Taoripi
m n Ainu	m ɲ Wapishana	
m n ŋ English	m n ɳ Pashto	m ɰ ɲ Papago

4-N and larger systems spread the contrasts out in much the same way as for stops and fricatives:

(7.62)

m ɰ ɲ ŋ Yiddish	m ɰ n ɲ Diegueño	m n ŋ N West Greenlandic
m ɰ n ɲ ŋ Araucanian	m n ɳ ɲ ŋ Ostyak	

Nasals can also have secondary articulations, voice contrasts (though phonemic voiceless nasals are rare), as well as length and double articulation contrasts:

(7.63)

The cross-linguistic implications are the same type as for obstruents: in general, complex implies simple, voiceless implies voiced. The frequency hierarchy is:

(7.64) Dental/Alveolar > Labial > Velar > Palatal > Retroflex > Uvular

7.6.5 *Sonorants, 2: 'liquids'*

'Liquids' covers a disparate set of segments, primarily lateral approximants and '*r*', i.e. alveolar and post-alveolar trills, taps, and approximants, and occasionally fricatives, and some uvular and velar trills, fricatives and approximants. (Whether a fricative 'counts as' an obstruent or a liquid is a matter of phonological analysis: German /ʁ/ counts as a liquid with /l/ because of its distribution and other phonological behaviour.)

The widest-ranging survey of liquid types is Maddieson (1980a). This is unfortunately (for our purposes) largely a statistical exercise, with little citation of anything but cross-linguistic frequencies, and few particular descriptions. But the sample is large (321 languages), and the findings of interest. I will sketch his results, and illustrate the major types – including some he doesn't mention – from other sources.

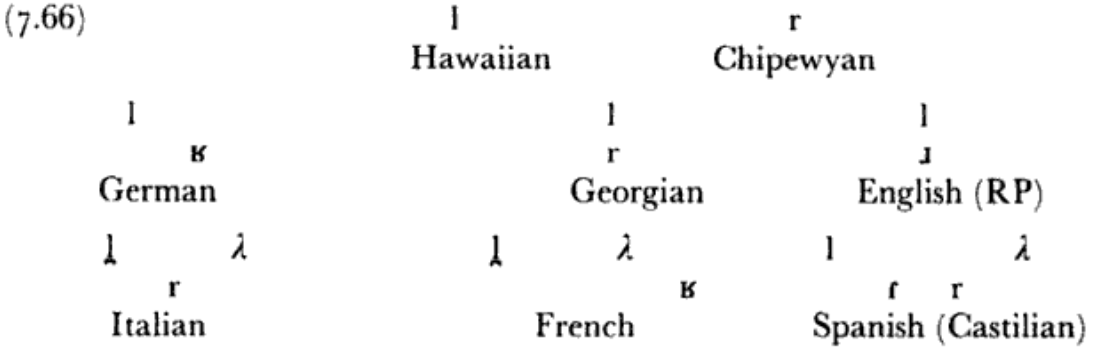
Virtually all languages (95% in the sample) have at least one liquid, and 72% have more than one. The largest systems appear to have seven, but these are rare (1%). Of the total, 79% have one or more laterals, and 76% one or more *r*-types. Overall, the preference is for simple segments, voiced as for nasals. Place for liquids is predominantly denti-alveolar, both for laterals and non-laterals; the manner preference for non-laterals appears to be for trills. The frequency hierarchies are:

(7.65) *Laterals:* Dental/Alveolar > Retroflex > Palatal > Velar

Non-laterals:
- *Place:* Dental/Alveolar > Retroflex > Velar > Uvular
- *Manner:* Trill > Tap/Flap > Approximant

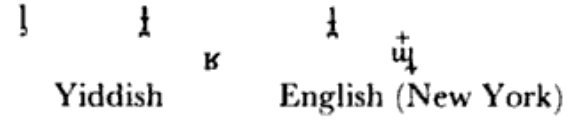
Some relatively simple liquid systems:

(7.66)



The simple vs. complex implication doesn't hold for all liquid systems; some have only liquids with secondary strictures in one or both categories (not mentioned by Maddieson):

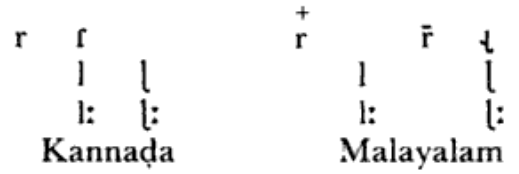
(7.67)



The symbol /ɻ̟ʷ/ is a pharyngealized palato-velar approximant, the New York '/r/'.

More complex systems add length or further place contrasts. Two Dravidian examples illustrate alternative strategies:

(7.68)



(/r̪/ is an advanced alveolar trill, /r̠/ is a retracted one; /ɻ/is a retroflex approximant.) Other languages add voice contrasts, e.g. Burmese with /l l̥/.

Maddieson's data gives the following main generalizations:

(i) Languages with two or more liquids are likely to have at least one lateral, and a lateral/non-lateral contrast.

(ii) A language with one or more laterals has a voiced lateral approximant.

(iii) Languages with two or more laterals may contrast them either in manner or voice, but not both (e.g. a language will not have a voiced lateral flap vs. voiceless approximant).

(iv) Languages with two or more *r*-types are unlikely to restrict the contrast to place alone (unlike laterals).

(v) A liquid with both lateral and non-lateral allophones is the

likeliest candidate for the single liquid in a system (e.g. Nasioi with an alveolar tap realized as [l] before /u o/).

7.6.6 *Sonorants, 3: 'semivowels' ('glides', vocoid approximants)*

These terms refer to the familiar /j w/ types that appear in so many languages, as well as the less common labial-palatal approximant /ɥ/, the labiodental /ʋ/, and the velar, /ɰ/. Except for /ʋ/, these can be characterized as 'raised high vowels' in consonantal function. A recent survey (Maddieson 1980b), while producing the same problems as his (1980a), nonetheless comes up with some interesting generalizations. The most important seem to be:

(i) 90% of the sample languages have one or more vocoid approximants. Among the rare languages lacking them are Chipewyan, Crow, Samoan.

(ii) The vast majority (86%) have /j/; a smaller majority (75%) have /w/.

(iii) There is no apparent implicational relationship between /j/ and /w/, though 71% of the sample have both.

(iv) The other types are rare.

The preference hierarchy is notably different from those for all other segment types:

(7.69) Palatal > Labial-Velar > Labial-Palatal > Velar

(I'm not sure where labiodental /ʋ/ fits in; I suspect that at least some reported '/w/' are in fact /ʋ/ – as in some varieties of Scottish English – and it may be somewhat less common than /w/ and more common than /ɥ/.) Here are some characteristic systems:

(7.70)

j	w	j w	j ɥ
Navaho	Hawaiian	English	Polish

w ɥ j	ʋ j
French	Kannaḍa

Contrasts in voicing and glottal state can be added as well:

(7.71)

w j	w j
ẘ	ẘ
	ẅ j̰
Scots	Margi

(where /w̰ j̰/ have 'laryngealized voicing', i.e. creaky voice).

7.7 What phonemes does a language 'have'? revisited

In discussing phonemic norms for vowel symbols (§7.5.1), we specified something like the 'centre' of a range of phonetic variation as basic – what the language 'really has' – and the rest of the allophonic range as 'derived' from that. Thus the typical allophonic statement is a rule operating on a PHONETICALLY SPECIFIED 'underlying representation' of some kind, and producing a set of 'surface' phonetic entities. In this respect the Unique Underlier Condition (§4.4) that was suggested as a condition on MP analyses seems to hold for phoneme–allophone relations as well. And it is usually assumed to hold in the same terms: the 'base form' of a phoneme is taken as having PHONETIC CONTENT (see the discussion of binary vs. n-ary feature specifications in §6.2). But there are difficulties with this view, which suggest alternative ways of approaching the concepts 'phoneme' and 'phonemic system', and a new dimension for typology.

Consider a rather extreme case: the 'linear' vowel systems of the NW Caucasian languages (Abkhaz, Abaza, Adyghe, Kabardian, and Ubykh). These languages all have phonemically minimal systems, varying apparently between two and three distinctive units. The problem is that the allophonic spread is so enormous that the units expounded by the qualities have to be specified quite abstractly. Thus Kabardian has the vowel phones:

(7.72)

i			ɨ	ü	u
e		ɪ		ʊ	o
		ë	ə	ö	ʌ
a					ɑ

But (for instance) [i ɪ] appear only in the vicinity of /j/, the rounded vowels only near labialized consonants or /w/, etc. Given the usual criteria for phonemic analysis, we arrive at three large-scale units, which might be specified this way:

(7.73)

/'Close'/ ⟶ [i ɪ ɨ ʊ ü u . . .]
/'Mid'/ ⟶ [e ë ʌ ö . . .]
/'Open'/ ⟶ [a ɑ . . .]

The 'units' here are not phonetically specifiable in the normal sense; should they even be called 'phonemes' at all? It seems quite arbitrary to assign a phonetic symbol (with the implication of some underlying phonetic representation) to one of these monster phonemes. Though

one has to do something, and we typically get displays in the literature like the /i ə ä/ cited earlier for Adyghe, and assumed by Trubetzkoy's term 'linear'.

The best one can say about languages like this is that they are difficult, and do not fit in a satisfying way into the usual analytical framework. (After all, /i ə ä/ is really no less arbitrary than /i e a/ or /u o ɑ/, is it? The central symbols are, to be sure, graphically in the 'middle' of the range: but this doesn't make them phonetically 'basic' in any realistic sense.)

But this difficulty appears in a number of much less exotic system types as well, and suggests a new analytical strategy. Consider a language which – on a traditional analysis – is often said to 'have no fricatives or voiced stops': Tamil. The distribution of obstruent phones in native Tamil words is:

(7.74)

# ____	V ___ V	VN ___ V
p	v	b
t	ð	d
–	ɖ	ɖ
tʃ	s	dʒ
k	x	g

With this kind of distribution, a phonemic analysis would be built on the fact that voiceless stops (including [tʃ]) are in complementary distribution with both fricatives (voiced and voiceless) and voiced stops (the missing [ʈ] is an 'accidental' gap in distribution, but is what we'd expect). Given this, and given that the environments where the fricatives and voiced stops occur are precisely those where one would expect these 'weaker' segment types (see §8.3 for discussion of 'strength'), it seems reasonable to take the voiceless stops as basic. Thus the Tamil obstruent system is /p t ʈ tʃ k/, and belongs to the simple type with no voice contrast.

But does complementary distribution like this force a choice of detailed phonetic representation? That is, just because we have the possibility of predicting say intervocalic [x] from a 'basic' /k/, do we have to make a choice of phonetic specification with respect to continuancy and/or voice in 'underlying' (= non-phonetic or non-realized) representations? Granted, to make NO commitment to a basic representation would miss an obvious generalization; (7.74) looks like the precursor to a structural statement. There is clearly some kind of patterning or organization here. But given the phonetic inventory,

fully-specified 'phonemes' of the usual sort may, as in Kabardian, be an unmotivated choice.

The choice problem resolves itself to this: motivating a **direction of derivation**, i.e. what justifies a direction /t/ → [ð], rather than the reverse? Characteristically such judgements are made (though rarely explicitly) on the basis of intuitions about typological 'naturalness' (there seem to be no languages with systems of only fricatives and voiced stops), and characteristic directions of historical change (see §8.3). But do these considerations dictate the analysis of a synchronic system? My judgement is that there is no necessary connection between these two sets of criteria and the analysis of a phonemic system – or at least no one seems to have demonstrated one. In this case, perhaps we ought to refrain from detailed specification of underlying forms, except for obstruency and place? Then Tamil too would have rather 'abstract' phonemes, not as bad as Kabardian, but still nothing as precise as /t/, etc.

Perhaps the best approach is to say that what Tamil has is not /p t k/, etc., but merely an obstruent system, underlyingly UNSPECIFIED for voice or continuancy; in other words, obstruents with only place features, and a set of 'strengths' or 'grades'. Thus we would have [obs, lab], [obs, dent], and so on, with no particular realization type given any special status as 'primary'. This avoids arbitrary (and ultimately redundant) underlying specification for voice or continuancy – since these features are predictable in ALL cases by word-position, and no particular value is – overall – 'characteristic' (unlike the case of, say, English /p t k/). This is in fact the real generalization that emerges from (7.74). We might envision a structure like this:

(7.75)

Place	*Grade I*	*Grade II*	*Grade III*
Labial	p	b	v
Dental	t	d	ð
Retroflex	–	ɖ	ɖ
Palatal	tʃ	dʒ	s
Velar	k	g	x

Or we could use something like archiphonemic symbols, e.g. /P T K/, and so on, to show that this is a system with all features but place non-distinctive.

This is not the place to spell out the arguments in detail; but it is worth noting that the same data, under different theoretical requirements, yields very different systemic organizations. And this last view

(which is essentially my own, and in no way 'standard') raises the possibility of a new dimension in system typology.

For instance: under the standard phonemic interpretation, Tamil with its /p t ʈ tʃ k/ would appear to belong to the same type as Maranungku with /p t c k/ or Western Desert with /p̪ t̪ ʈ k/ – a language with only voiceless stops and no fricatives. Yet the Australian languages apparently do not show the same kind of realizational variation as Tamil: voicing, for instance, if it occurs, is restricted and usually optional. Thus the inventories – on the 'basic phoneme' interpretation, with 'directional' realization rules – show the languages as similar in type. Provided, that is, 'type' is defined within such a 'base-and-derivation' theory. But given a theory where languages may either have or lack 'full' underlying specification for particular features, Tamil comes out as belonging to quite a different category.

Thus we might propose a typological framework enriched by categories like 'place language' as opposed to 'phoneme language', or 'minimally-specified-phoneme language' vs. 'fully-specified-phoneme language'. These terms are *ad hoc* coinages; I merely want to suggest that there's room for a lot more research into the bases of a respectable theory of phonological typology. If this turns out to be a fruitful direction, we may want to say that the phoneme (as a fully-specified distinctive segment) is not a universal; that there are different language types at a level of description that has not been taken seriously, since all typologies to date have been phonemic in a more or less standard sense.

7.8 **Polysystematicity and neutralization**

Let us ask a question we have not asked, since we've been taking a positive answer for granted: is it always legitimate to identify a phone type in one position in a word with the same type in another position (aside from obvious cases like phonemic overlap)? Or, on a phonemic level, if a language has [m] vs. [n] in initial and final positions, are these phones to be referred to the phonemes /m/ and /n/ in both cases, as members of a single phonological system? Most theories implicitly answer yes; but at least one major phonological school (the 'Firthian' or 'prosodic' – see §§10.2ff for details) has made the premises explicit, and answered no. And under the conditions imposed by this negative answer, a new view of systems emerges, and an

old problem – neutralization and how to characterize it – disappears.

In a pioneering paper of 1935, J. R. Firth treated the distribution of nasals in Marathi, which has a set-up rather similar to Kannaḍa (§3.3). In Marathi, only [m] and [n] occur initially, and [n ɲ] finally; but medially there are eight nasal phones, [m ɱ w̃ ɳ n ɳ ɲ ŋ]. Firth remarks that in transcriptions he uses the symbol [n] for all alveolar nasal phones, i.e. the initial [n] that contrasts with [m] only, the final one which 'functions in a three-term alternance', and the pre-consonantal one before [ts t d]. But he does not identify all these [n]'s 'as linguistically or functionally the same unit' (1935a [1957]: 51). 'Surely', he says, 'we are free to use the same letter without being compelled to concoct a rationalized "derivation" from the letter in the shape of a phoneme theory. Similarity of sound is no safe guide to functional identity'. (Up to a point, of course, this is obvious: in a Praguian account initial and final [t] in German are not 'the same' either – but Firth carries this much further. It is also worth noting that he raises the question of a distinction between notational practice and a theory of linguistic 'realities': we will return to this important notion in §8.5.)

Here (without saying so) Firth is in fact being more Praguian than the Praguians: if systems of oppositions ('three-term alternances', etc.) are what count, then Marathi has three nasal systems, not one: an [n] in the system {[n] vs. [m]} is just not the same thing as an [n] in {[n] vs. [ɲ] vs. [m]}, and so on. 'Sameness' is in phonology a **relational** concept, not a phonetic one. But note that the 'different-ness' of the two [n]'s here is not the same as the difference between the 'non-derived' [k] in Latin [priːnkeps] and the 'derived' [k] in [reːks] (see §4.5): the distinction is functional and 'static' (in terms of place in a system of oppositions), not a matter of morphophonology or derivation; the concepts 'underlying' and 'superficial' don't come into it.

This leads to a theoretical view of languages as at least potentially **polysystemic**, not **monosystemic** as in most classical phonological analysis. Languages may have different systems for different word-positions, different accentual conditions, even different morpho-syntactic or lexical categories. Let us look again at the German obstruents (see §5.4) through this polysystemic telescope, i.e. not considering the distribution of phones to be the deployment of elements of a single system:

(7.76)

(1) # ____		(2) V ____ V		(3) ____ #
p	b	p	b	p
t	d	t	d	t
k	g	k	g	k
	z	s	z	s
ʃ		ʃ		ʃ
x		x		x

Each segment in context (1) participates in a 9-way opposition; each one in (2) in a 10-way one; and each one in (3) in a 6-way. Further, systems (1) and (2) are characterized by a voice contrast, but system (3) belongs to a different 'language type' (though Firth would not have put it this way, and indeed was not concerned with typology). On this interpretation, we don't talk about 'the German stop system', but 'the German initial/medial/final stop systems', and so on.

If we adopt this view, of course, the problem of neutralization vanishes, because in final position there's no /p/–/b/ contrast to BE neutralized, and final /p/ is not a member of the initial or medial /p b/ systems. (In effect we reduce neutralization to something that looks like defective distribution – though even this concept is out here, since we can't identify initial and final [p] as exponents of one category.)

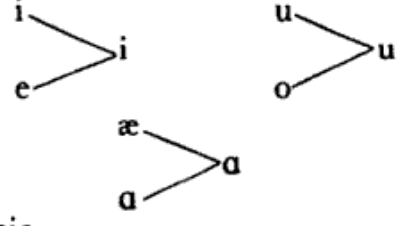
In a similar way, and perhaps more insightfully, the Old English vowel-neutralization discussed in §3.4 can be resolved not into neutralization of particular oppositions, but into a matter of the different content of separate systems. Compare the neutralization analysis in (3.17) above (repeated below as 'monosystemic') with a polysystemic analysis:

(7.77)

(a) Vowel phonemes

i	u
e	o
æ	ɑ

(b) Neutralization / ____ NC



monosystemic

(a) V-system 1

i	u
e	o
ɑ	ɑ

(b) V-system 2

i	u
	ɑ

polysystemic

The /u/ in system 1 is not identified with that in 2, because its function is utterly different.

What do we achieve with this approach? We solve the problem of what phone represents what archiphoneme very simply – since the question can't be asked. It is in fact a legitimate – if occasionally dangerous – move to dispose of questions by letting your theory make them unaskable. (For example, our cosmology doesn't allow us to ask 'Which god makes the crops come up in the spring?') The problem is, as always, whether in the long run we gain or lose by the exclusion.

In the OE vowel case, we do gain; with the German obstruents we lose. That is, since neutralization of gradual oppositions like vowel height leads to indeterminate or arbitrary results, a neutralization-free polysystemic account captures the facts better. But in a case like German, where the initial/medial pairs and the final singles are systematically related in a way that can be stated once and for all, and has a clear phonetic characterization, this seems to be more significant than the mere brute fact that the inventories are different. And – if we want to admit this – since the morphophonology shows a relation between the voiced and voiceless members of each pair, any account that makes the two systems unrelated is less revealing.

It looks as if we ought not to make either monosystemic or polysystemic analyses binding in advance, but let the totality of facts about the language make the decision for us – if we can. And this decision may well be different for different (sub)systems in different languages. Complementarity yet again (see §§5.5, 7.7).

NOTES AND REFERENCES

7.1 Theoretical constructs: there is a philosophical position called **instrumentalism** which in its crude form claims that theories are neither true nor false, but only more or less satisfactory devices for calculation, prediction, or description. It is opposed to **realism**, which in ITS crude form claims that theories are either true or false, and that theoretical objects have potential existence in the real world (see §6.1). Galileo, for instance, was not, as the popular mythology has it, condemned by the Inquisition for teaching Copernican astronomy *per se*; but rather for insisting it was a true picture of the world, that the earth REALLY moved around the sun – instead of saying that the phenomena were most elegantly treated AS IF this were so. The position taken in this book is often ambiguous between the two. (If you find this sort of thing interesting – and it is relevant to linguistics or any other theoretical subject – a good introduction to the philosophical discussion can be found in Chalmers 1978: chs. 10–11.)

7.2 For the GVS in detail, see any history of English; for the argument sketched here, Lass (1976a: ch. 2). On push and drag chains, Martinet (1955). On chain shifts in general, Labov *et al.* (1972).

7.3 On Grimm's Law, any standard Germanic handbook; the best treatment in English (if a bit dated now) is Prokosch (1938). The picture here is oversimplified, and bypasses various allophonic and other complications.

7.4 There is an enormous literature on 'universals', beginning with the important collection edited by Greenberg (1963). Of particular interest are the papers by Ferguson, Saporta, and Greenberg. Much important work in this area appears in the working papers of the *Stanford Universals Project* and the most recent large-scale effort is the four volumes edited by Greenberg, of which vol. 2** (Greenberg *et al.*, 1978) is devoted to phonology. For some very clear discussion of typology in general, *Comrie (1981a: ch. 1).

On markedness theory in this sense see **Postal (1968: ch. 8), **Chomsky & Halle (1968: ch. 9), Greenberg (1966a, b), Gamkrelidze (1978) and his references. The extremely negative position I take on the markedness issue is perhaps eccentric: compare the material cited above with my own extended arguments (**Lass 1975, **Lass 1980: ch. 2), and see §8.6 below.

On the universals (i)–(iv) given in this section, it is worth noting that they are generally taken as absolute, but aren't. For example, (i) is falsified by varieties of Scottish English with /y/ but no /u/; (ii) by Australian languages (see §7.6.1) with voiced obstruents but no voiceless ones; (iii) by varieties of English with /øː/ (e.g. [bøːmɪŋəm] 'Birmingham' in that city) but no /yː/; (iv) by Austrian dialects with /y ø œ Œ/. The chances are that nearly all absolute universals are artifacts, due to defects in the data-base; no one knows everything. And any specialist in a language family is likely to have data (often unpublished material from his own field notes or from specialist colleagues) that others know nothing about, and that 'generalist' theoreticians have no access to.

Thus the counter-examples to (i) and (iii) come from simple observation in the course of my own work; (ii) is the result of happening to pick up Dixon (1977) on impulse; and (iv) comes from a colleague's field notes. This just suggests something of what a genuine universals project has to cope with. There are also problems in deciding what 'counts' as an instance of a particular category, and this also destroys some supposed universals (§7.5).

7.5.1 On the general problems of typology, with a good literature survey, see Thrane *et al.* (1980: chs. 4–5). The most noteworthy attempts at vowel-system typology are **Trubetzkoy (1939), **Hockett (1955), Sedlak (1969), and **Crothers (1978). These are all worth reading with care.

7.5.4 The bulk of the material here is based on Crothers (1978: Appendix III), except for Yiddish, RP, German, Scots, Kabardian, and Swiss and Alsatian German (after Keller 1961), and the Hungarian system, which is courtesy of Veronika Kniezsa.

I have altered Crothers' notation to conform more closely to IPA conventions, and have conflated his /ɛ E/, /ɔ O/, where the capitals stand for 'mean mid' values, roughly between half-close and half-open, as /ɛ̞ ɔ̞/.

One further remark on the consequences of omitting long vowels from Crothers' typological index is in order: he gives English (RP) as a six-V system with no interior vowels on the basis of /ɪ ɛ æ ʌ ʊ ɒ/ (with /ʌ/ interpreted as open central); but it has FIVE long vowels, one of them (his /əː/, my /ɜː/) interior. Therefore RP (even if /ʌ/ is allowed as peripheral) should not be grouped with Persian.

7.6 Much of the material here is based on the system-inventories in **Nartey (1979) which is the most complete survey of obstruent systems available (based on a sample of over 300 languages). Germanic and Dravidian systems from my own notes, Caucasian from Catford (1977b), Sindhi, Zulu from Ladefoged (1971), Yidiɲ from Dixon (1977). Nartey's interest is in implicational universals, and he has little to say about symmetry: for a good treatment of this, Hockett (1955). Nartey also omits glottal fricatives (on dubious grounds: he includes /ʔ/ under stops); so data on /h ɦ/ is partly from Hockett, partly from my own notes. Burmese and Amharic fricatives after Ladefoged (1971).

7.6.4 Data on nasals from Nartey (1979), except for West Greenlandic (Rischel 1974), Yiddish and Kannaḍa.

7.6.5 Liquid systems not from Maddieson are Hawaiian, Chipewyan, Georgian (Hockett 1955), Malayalam (Ladefoged 1971), German, English, Italian, Spanish, Kannaḍa (my notes).

7.6.6 Navaho, Hawaiian from Hockett (1955), Margi from Ladefoged (1971); all others my own observation.

7.7 Kabardian after Catford (1977b). There have in fact been attempts to reduce the inventory still further: Kuipers (1960) gives it NO vowels, but only a 'feature of openness', taken as a kind of secondary articulation of consonants. This is pretty well demolished by Halle (1970). See discussion in Catford.

7.8 On polysystemic theory see **Firth (1948), and the elaborate discussion of Thai in Henderson (1951).