different phonemes, while in Language A [ɛ] and [ɔ] might be non-distinctive variants of [a], and [e, o] respectively of [i, u]. Both languages might seem to show two durations of vowels, but these might be phonemic in Language A (as in German), while in Language B they might be non-distinctive variants. Both might show plain and aspirated unvoiced stops, as different phonemes in Language A and as mere non-distinctive variants in Language B. Both might have a series of voiced spirants, but these might be distinctive in Language B, while in Language A they existed merely as variants of stops between vowels.

Only the phonemes of a language are relevant to its structure — that is, to the work it does. A description of the non-distinctive features might be of great interest, but for this it would have to be more complete and more copious than any that have so far been made.

8. 2. A list or table of the phonemes of a language should therefore ignore all non-distinctive features. Such lists or tables are usually made on the basis of practical-phonetic classifications, thus:

AMERICAN ENGLISH (CHICAGO)

stops, unvoiced			p				t					k		
voiced			b				d					g		
affricate, unvoiced								č						
voiced								ǰ						
spirants, unvoiced				f	θ		s	š					h	
voiced				v	ð		z	ž						
nasals			m				n					ŋ		
lateral							l							
inverted							r							
semivowels								j		w				
vowels, high								i		u				
higher mid								e		o				
lower mid								ɛ		ɔ				
low								a		ɑ				
secondary phonemes:														
stress	ˈˈ	ˈ	ˌ											
syllabic-stress							ˌ							
pitch	.	¿	?	!	,									

Tables like these, even when they exclude non-distinctive features, are nevertheless irrelevant to the structure of the language,

because they group the phonemes according to the linguist's notion of their physiologic character, and not according to the parts which the several phonemes play in the working of the language. Our table does not show, for instance, that two of the nasals, [m] and [n], sometimes serve as syllabics in unstressed syllables as in *bottom* ['bɑtm̩], *button* ['botn̩], while the third one, [ŋ], does not. It fails to show that [l] serves as a syllabic in unstressed syllables only, as in *bottle* ['bɑtl̩], while [r] may serve as a syllabic regardless of stress, as in *learner* ['lr̩nr̩]. It does not show which vowels and semivowels combine into compound phonemes. To show these structural facts, we should need a supplementary table something like this:

I. *Primary phonemes:*
  A. *Consonants*, always or sometimes non-syllabic:
    1. *Mutes*, always non-syllabic: [p t k b d g č ǰ f θ s š h v ð z ž ŋ]
    2. *Sonants*, sometimes syllabic:
      a. *Semi-consonants*, syllabicity determined by surroundings and by syllabic-stress:
        (1) *Consonantoids*, syllabic only in unstressed syllables: [m n l]
        (2) *Vocaloid*, syllabic also in stressed syllables: [r]
      b. *Semivowels*, syllabicity determined also by manner of articulation; diphthong-forming:
        (1) *Non-syllabic:* [j w]
        (2) *Syllabic:* [i u]
  B. *Vowels*, always syllabic:
    1. *Diphthongs and triphthong*, compound phonemes: [ij uw ej ow aj aw ɔj juw]
    2. *Simple vowels:* [e o ɛ ɔ a ɑ]
II. *Secondary phonemes:*
  A. *Syllabic-stress*, applied to semi-consonants: [̩]
  B. *Form-stress*, applied to meaningful forms: ['' ' ˌ]
  C. *Pitch*, relating to end of utterance:
    1. *Medial:* [,]
    2. *Final:* [. ¿ ? !]

8. 3. The parts which our phonemes play in the structure of our language are in reality much more diverse than this; in fact, we can easily show that no two of them play exactly the same part.

Since every utterance contains, by definition, at least one syllabic phoneme, the simplest way to describe the phonetic structure of a language is to state which non-syllabic phonemes or groups of non-syllabic phonemes (*clusters*) appear in the three possible positions: *initial*, before the first syllabic of an utterance; *final*, after the last syllabic of an utterance; and *medial*, between syllabics.

In this respect the diphthongs and triphthong play in English the same part as do the simple vowels; it is precisely this fact that compels us to class them as compound phonemes and not as mere successions of phonemes.

For convenience, I shall place a number before each phoneme or group of phonemes that shows any peculiarity in its structural behavior.

Taking first the initial non-syllabics, we find at the outset that two phonemes never begin an utterance; they are (1) [ŋ, ž]. We ignore foreign forms, such as the French name *Jeanne* [žan].

Further, six of the non-syllabics that occur in initial position never appear as members of an initial cluster: (2) [v, ð, z, č, ǰ, j].

The initial clusters all begin with one of the following non-syllabics: (3) [p, t, k, b, d, g, f, θ, s, š, h]. Here we find an accord between the structural grouping and our physiologic description, since our structural group (3) embraces exactly the physiologic groups of stops and unvoiced spirants.

If the first consonant of the cluster is (4) [s], it may be followed by one of the set (5) [p, t, k, f, m, n], as in *spin, stay, sky, sphere, small, snail.*

All the initials of group (3) and the combinations of (4) [s] with (6) [p, t, k] may be followed by one of the set (7) [w, r, l], with the following restrictions:

(8) [w] never comes after (9) [p, b, f, š], and never after the combination of (4) [s] with (10) [t]. The actual clusters, then, are illustrated by the words *twin, quick, dwell, Gwynne, thwart, swim, when* [hwen], *squall.*

(11) [r] never comes after (12) [s, h]. The clusters, therefore, are those which begin the words *pray, tray, crow, bray, dray, gray, fray, three, shrink, spray, stray, scratch.*

(13) [l] never comes after (14) [t, d, θ, š, h], and never after the combination of (4) [s] with (15) [k]. The clusters, accordingly, are those which appear in *play, clay, blue, glue, flew, slew, split.*

8. 4. We come now to the final clusters. These are subject to

the general rule that the same phoneme never occurs in two adjoining positions: there are no such final groups as [ss] or [tt]. This rule holds good also for initial clusters and is implied by our description of them, but it does not hold good, as we shall see, for medial clusters.

We have undertaken to view combinations of vowel plus [j] or [w] as compound phonemes (diphthongs) and accordingly cannot count the semivowels in these combinations as final non-syllabics or parts of clusters. If, accordingly, we eliminate these cases (e.g. *say* [sej], *go* [gow]), we find that (16) [h, j, w] do not occur as final non-syllabics or members of final clusters. All the remaining non-syllabics occur in both of these functions.

English final clusters consist of two, three, or four non-syllabics. One can describe the combinations most simply by saying that each cluster consists of a *main final* consonant, which may be preceded by a *pre-final*, which in turn may be preceded by a *second pre-final;* further, the main final may be followed by a *post-final.* This gives us six possibilities:

	Without post-final	With post-final
main final alone:	*bet* [-t]	*bets* [-ts]
pre-final plus main final:	*test* [-st]	*tests* [-sts]
second pre-final plus pre-final plus main final:	*text* [-kst]	*texts* [-ksts].

The consonants which occur as post-finals are (17) [t, d, s, z]. In a form like *test* or *text* we call the [-t] a main final, because there exist forms like *tests*, *texts*, in which a further consonant (a post-final) is added, but in a form like *wished* [wišt] we call the [-t] a post-final because the cluster [-št] is not paralleled by any cluster with the addition of a further consonant: we have no such final cluster as, say, [-šts].

The occurrence of the post-finals is limited by three important restrictions. The post-finals (18) [t, s] are the only ones that occur after the main finals (19) [p, t, k, č, f, θ, s, š]; these same post-finals never occur after any other sounds; and the post-finals (20) [t, d] are the only ones that occur after the main finals (21) [č, ǰ, s, z, š, ž]. It is worth noticing that set (19) agrees, except for the absence of [h], with the physiological class of unvoiced sounds,

and that set (21) embraces the physiological classes of affricates and sibilants. These restrictions group the main finals into six classes:

Those in (19) but not in (21) may be followed by [t, s], as [p] in *help, helped, helps;*

those in neither (19) nor (21) may be followed by [d, z], as [b] in *grab, grabbed, grabs;*

those in (19) and (21) may be followed only by [t], as [č] in *reach, reached;*

those in (21) but not in (19) may be followed only by [d], as [ǰ] in *urge, urged;*

[t] in (19) but not in (21), owing to the rule of no doubling, may be followed only by [s], as in *wait, waits;*

[d] in neither (19) nor (21), owing to the same rule, may be followed only by [z], as in *fold, folds.*

We turn now to the pre-finals. The main consonants (22) [g, ð, ž, ŋ, r] are never accompanied by a pre-final, and the consonants (23) [b, g, č, ǰ, v, š] never occur as pre-finals. The combinations that remain are subject to the following further restrictions:

The pre-finals (24) [l, r] do not occur before the main final (25) [z]. Their combinations, accordingly, are those which appear in the following examples: *harp, barb, heart, hard, hark, march, barge, scarf, carve, hearth, farce, harsh, arm, barn; help, bulb, belt, held, milk, filch, bilge, pelf, delve, wealth, else, Welsh, elm, kiln.*

The pre-final (25) [n] occurs only before the main finals (27) [t, d, č, ǰ, θ, s, z], as in *ant, sand, pinch, range, month, once, bronze.*

The pre-final (28) [m] occurs only before the main finals (29) [p, t, f, θ], as in *camp, dreamt, nymph;* the combination with (30) [θ] occurs with the second pre-final (11) [r]: *warmth.*

The pre-final (31) [ŋ] occurs only before (32) [k, θ], as in *link, length.*

The pre-final (4) [s] occurs only before (6) [p, t, k], as in *wasp, test, ask.* Before (10) [t] it may be preceded by the second pre-final (15) [k], as in *text.*

The pre-finals (33) [ð, z] occur only before the main final (28) [m], as in *rhythm, chasm.*

The pre-final (10) [t] occurs only before the main finals (34) [θ, s], as in *eighth* [ejtθ], *Ritz* (compare, with post-final [t] added, the slang *ritzed* [ritst] 'snubbed'). The combination with the main final (4) [s] occurs also with second pre-final (11) [r] in *quartz.*

The pre-final (35) [d] occurs only before (36) [θ, z], as in *width, adze.*

The pre-finals (37) [p, k] occur only before the main finals (18) [t, s], as in *crypt, lapse, act, tax.* Of these two, the pre-final (15) [k] before the main final (4) [s] occurs also with the second pre-final (31) [ŋ], as in *minx* (compare, with a post-final [t] added, the slang *jinxed* [jiŋkst] 'gave bad luck'); the other, [p], occurs with the second pre-final (28) [m]: *glimpse, tempt.*

The pre-final (38) [f] occurs only before (10) [t], as in *lift.*

The medial non-syllabics of English consist of all the combinations of final plus initial, ranging from *hiatus*, complete lack of a non-syllabic, as in *saw it* ['sɔ it], to such clusters as in *glimpsed strips* [-mpst str-], including repetitions of the same phoneme, as in *that time* [-t t-] or *ten nights* [-n n-].

8. 5. A survey of the 38 functional sets of non-syllabics will show that this classification suffices to define every non-syllabic phoneme in our language. In the same way, most or possibly all of our syllabic phonemes could be defined by the parts they play in the structure of our language. Since different types of standard English differ in the distributions of the syllabic phonemes, I shall mention only a few of the pattern features.

Of the semi-consonants, only [ɻ] occurs in stressed syllables; it never occurs before [r]. The syllabic semivowel [u] is distinguished by the fact that it does not occur initially, and occurs medially only before [t, k, d, s, š, l], as in *put, took, wood, puss, push, pull;* it occurs also before [f, m], as in *roof, room*, but here always beside a more elegant variant with [uw]. Neither [i] nor [u] occurs in final position.

Of the vowels, [ɛ, ɑ] do not occur before semivowels (in diphthong combinations) and [ɔ] does not occur before [w]. Only [ɔ, a] occur in final position, as in *saw, ma.* The vowel [a] occurs only before [ž, m, r], as in *garage, calm, far*, and before medial [ð], as in *father.* The phonemes [i, e, ɛ, ɑ] occur before [r] only if another vowel follows, as in *spirit, herring, marry, sorry;* [o] occurs before [r] only when the [r] is a pre-final, as in *horn, horse, north;* in many types of pronunciation the combination [or] is entirely lacking. The vowel [ɔ] occurs before [r] only if [w] precedes, as in *war, dwarf.* The vowel [ɑ] occurs before [g] only as a less common variant of [ɔ], as in *log, fog.*

Of the diphthongs, only [ij, ej, ow] occur before [rs], as in *fierce,*

scarce, course; before the other combinations of pre-final [r] the only permitted diphthongs are [ow], as in *cord, fork, torn,* and, in only a few dialectal-sounding words [ej]: *laird, cairn.* Before pre-final [l] the only permitted diphthongs are [ij, aj, ow], and the first two occur only when [d] follows, as in *field, mild, old, colt.* Before pre-final [n] only [aj, aw] occur with any freedom, as in *pint, mount, bind, bound;* [ɔj, ej] occur when [t] follows, as in *paint, point.* The diphthongs do not occur before [ŋ].

The triphthong [juw] differs from ordinary combinations of [j] plus vowel or diphthong (*yank, year, Yale*) in that it occurs after initial consonants; it occurs after [p, k, b, g, f, h, v, m, n] as in *pew, cue, beauty, gules, few, view, muse, new,* and after the clusters [sp, sk], as in *spew, skew;* after [n] there is a less elegant variant with [uw] instead of [juw], but, on the other hand, [juw] occurs in an elegant pronunciation after [t, d, θ, s, l, st], where [uw] is the commoner variant, as in *tune, dew, thews, sue, lute, stew.*

We shall find that the grammatical structure of a language implies groupings of the phonemes which supplement the groups definable on the basis of succession (§ 13.6).

8. 6. The structural pattern differs greatly in different languages, and leads us to recognize different types of compound phonemes. German, for instance, has, on the whole, a structural scheme much like that of English, but with some striking differences. The voiced stops and spirants [b, d, g, v, z] never occur in final position. The initial groups can be simply described only if one takes the affricate combinations [pf, ts] as compound phonemes, as in *Pfund* [pfunt] 'pound,' *zehn* [tse:n] 'ten,' *zwei* [tsvaj] 'two.' The only diphthongs are [aj, aw, oj]; the simplicity of structure in this respect, leads phoneticians to transcribe them rather by [ai, au, oi], since no ambiguity can arise. The French system differs not only as to the particular clusters, but also in more general respects. The diphthongs are rising, such as [jɛ, wa]. The greatest difference is in the use of the vowel phoneme [ə], whose occurrence is governed largely by the phonetic pattern, so that it may be said to play the part of a secondary rather than of a primary phoneme. The phoneme [ə] occurs wherever without it there would arise an unpermitted cluster of consonants. Thus, it occurs in *le chat* [lə ša] 'the cat,' because [lš] is not permitted as an initial cluster, but not in *l'homme* [l ɔm] 'the man,' where no cluster arises. It ap-

pears in *cheval* [šəval] 'horse,' since the cluster [šv] is not permitted initially, but since this cluster is permitted in medial position, one says *un cheval* [œ^{n} šval] 'a horse.' The medial clusters are limited, for the most part to two consonants; thus, [rt] is permitted as a final cluster, as in *porte* [pɔrt] 'carries,' but if an initial consonant follows, [ə] is inserted, as in *porte bien* [pɔrtə bjɛ^{n}] 'carries well.' An entirely different system appears in a language like Plains Cree. The structure groups the phonemes into five sets: (1) the vowels [a, a:, e:, i, i:, u, o:]; these are the only syllabic phonemes; (2) consonants of four types: stops [p, t, k], including the affricate [č]; spirants [s, h]; nasals [m, n]; semivowels [j, w]. The initial possibilities are: no consonant; any one consonant; stop, spirant, or nasal plus semivowel. The medial possibilities are: any one consonant; stop, spirant, or nasal plus semivowel; spirant plus stop; spirant plus stop plus semivowel. The only final possibility is one consonant. The Fox language, with a somewhat similar patterning, permits of no final consonant: every utterance ends in a short vowel.

While English is especially rich in consonant clusters, it is easy to find others, such as initial [pf-, pfl-, pfr-, ts-, tsv-, šv-, kn-, gn-] in German, e.g. *Pflaume* ['pflawme] 'plum,' *schwer* [šve:r] 'heavy,' *Knie* [kni:] 'knee,' or the clusters in Russian [tku] 'I weave,' [mnu] 'I squeeze,' [šči] 'cabbage-soup,' [*l*šču] 'I flatter.' Final clusters foreign to English appear, for example, in German *Herbst* [herpst] 'autumn' and Russian [borščˇ] 'beet-soup.'

8. 7. Once we have defined the phonemes as the smallest units which make a difference in meaning, we can usually define each individual phoneme according to the part it plays in the structural pattern of the speech-forms. We observe, especially, that the structural pattern leads us to recognize also compound phonemes, which resemble successions of other phonemes, but play the part of a simple phoneme, and that very slight acoustic differences, such as, in English, the syllabic-stress on [r, l, m, n], or the greater tensity of [j, w] compared to syllabic [i, u], may give rise to separate phonemes.

The phonemes so defined are the units of signaling; the meaningful forms of a language can be described as arrangements of primary and secondary phonemes. If we take a large body of speech, we can count out the relative frequencies of phonemes and of combinations of phonemes. This task has been neglected

by linguists and very imperfectly performed by amateurs, who confuse phonemes with printed letters. Taking the total number of phonemes in the text used as 100 per cent, a recent count for English shows the following percentage frequencies for consonant phonemes:

n	7.24	ð	3.43	p	2.04	g	.74
t	7.13	z	2.97	f	1.84	j	.60
r	6.88	m	2.78	b	1.81	č	.52
s	4.55	k	2.71	h	1.81	ǰ	.44
d	4.31	v	2.28	ŋ	.96	θ	.37
l	3.74	w	2.08	š	.82	ž	.05.

The figures for [r, l, m, n] include the occurrences in syllabic function; those for [j] and [w] do not include the occurrences of these phonemes as parts of diphthongs or triphthong. The count of vowel phonemes is too confused to allow of plain reading. Apparently, [e] is the most-used, with a frequency of over 8 per cent; next comes [ij], with over 6 per cent; then [ɛ], with 3.5 per cent. The figures for groups of phonemes are unusable. From this and similar counts it is evident that the phonemes of a language perform very different rôles as to frequency. Moreover, there seems to be some resemblance between languages; thus, in languages which use two types of stops, such as our [p, t, k] versus [b, d, g], the stop of the unvoiced type in each pair is more frequent than its voiced mate, — for instance, [t] more frequent than [d]. A serious study of this matter is much to be desired.

8. 8. We have seen three ways of studying the sounds of speech. Phonetics in the strict sense — that is, laboratory phonetics — gives us a purely acoustic or physiological description. It reveals only the gross acoustic features. In practice, the laboratory phonetician usually singles out for study some feature which his lay knowledge recognizes as characteristic of a phoneme. Practical phonetics is an art or skill, not a science; the practical phonetician frankly accepts his everyday recognition of phonemic units and tries to tell how the speaker produces them. The term phonology is sometimes placed in contrast with the two forms of phonetics: phonology pays no heed to the acoustic nature of the phonemes, but merely accepts them as distinct units. It defines each phoneme by its rôle in the structure of speech-forms. It is important to remember that practical phonetics and phonology presuppose a

knowledge of meanings: without this knowledge we could not ascertain the phonemic features.

The description of a language, then, begins with phonology, which defines each phoneme and states what combinations occur. Any combination of phonemes that occurs in a language, is *pronounceable* in this language, and is a *phonetic form*. The combination [mnu], for instance is unpronounceable in English, but the combination [men] is pronounceable and is a phonetic form.

When the phonology of a language has been established, there remains the task of telling what meanings are attached to the several phonetic forms. This phase of the description is *semantics*. It is ordinarily divided into two parts, *grammar* and *lexicon*.

A phonetic form which has a meaning, is a *linguistic form*. Thus, any English sentence, phrase, or word is a linguistic form, and so is a meaningful syllable, such as, say, [mɛl] in *maltreat*, or [mon] in *Monday;* a meaningful form may even consist of a single phoneme, such as the [s] which means 'more than one' in plural-forms like *hats*, *caps*, *books*. In the following chapters we shall see how meanings are connected with linguistic forms.