PHONEME-GRAPHEME CORRESPONDENCES IN ENGLISH

Kyoko Tamura

0. Introduction. It is often said that English spellings are inconsistent and therefore difficult to learn, and nobody would argue against this broad generalization. On the other hand, as Hall points out, it must be admitted that

> English orthography shows a nearly perfect fit between sound and spelling in a great many words, particularly those with lax ("short") vowels:*cat, fat, hat, rat, bid, ten, but, sop,* and thousands of others whose spelling is completely regular. In many others, there is less perfect fit, but the irregularities show a certain amount of patternings. The really irregular spellings such as *choir* / kwájr / and *laugh* /lǽf/ are relatively few.[1]

In this paper an attempt will be made to describe some of the patterns of regularities and irregularities of the English writing system in which the segmental phonemes are represented by graphemes.

1. English phonemes. The segmental phonemic system used in this paper is the one which is presented by Hockett in his *A Course in M.dern Linguistics,*[2] with a modification of /j/ into /y/. This version of English may be regarded as the so-called "General American" with r-coloring.   It has twenty-four consonant phonemes and fourteen vowel phonemes. The inventory of the phonemes is as follows:

Consonant phonemes : /p/, /b/, /t/, /d/, /č/, /ǰ/, /k/, /g/, /f/, /v/, /θ/, /ð/, /s/, /z/, /š/, /ž/, /m/, /n/, /ŋ/, /l/, /r/, /w/, /y/, /h/.

Vowel phonemes:/i/, /e/, /æ/, /ə/, /a/, /u/, /ɔ/, /iy/, /ey/, /oy/, /aw/, /uw/.

2. English graphemes. The writing system of English is alphabetic, that is, one phoneme or sound is usually represented by one grapheme, "a significant unit of visual shape."[3] The English alphabet consists of twenty-six letters, twenty-one usually representing consonant phonemes and five, vowel phonemes. The former twenty-one will be called "consonantals" and the latter five "vocalics" after Francis.[4]   It would be possible to add further the marks of punctua-

tion and the use of different varieties of letters, capitals and small capitals, and so on, to represent suprasegmental features as Francis suggests.[5] But here the discussion is restricted to the twenty-six graphemes which represent segmental phonemes.

The inventory of the graphemes is as follows:

Consonantals: <b>, <c>, <d>, <f>, <g>, <h>, <j>, <k>, <l>, <n>, <m>, <p>, <q>, <r>, <s>, <t>, <v>, <w>, <x>, <y>, <z>.

Vocalics: <a>, <e>, <i>, <o>, <u>.* (*<>encloses graphemes)

3. Graphemic representations.   The following table shows possible representations of phonemes by graphemes in English, also indicating positional occurrences of the graphemes.   Each grapheme or a sequence of graphemes is assigned a phoneme or a sequence of phonemes.   The positional occurrence of the grapheme or the sequence of graphemes is shown by giving an example, non-occurrence by (−) and non-occurrence of the phoneme itself by an asterisk. Those graphemes which presumably have no corresponding phonemes and are difficult to combine with either the preceding or following grapheme as a unit are omitted from the table.   Those vocalics which, immediately following consonantals, seem to indicate that the preceding consonantals are palatalized sounds are here taken as forming compound graphemes with the vocalics after them.[6] Examples given in parentheses are forms made up by adding inflectional affixes. Proper names given as examples are only those which are very common.

3.1. Consonant phonemes:

Phonemes	Graphemes	Initial	Medial	Final
/p/	<p>	pen	open	stop
	<pp>	(−)	happy	(−)
	<gh>	(−)	(hiccoughs)	hiccough*
				(*also hiccup)
	<ph>	(−)	shepherd	(−)
/b/	<b>	bag	barber	cab
	<bb>	(−)	rabbit	(−)
	<pb>	(−)	cupboard	(−)
/t/	<t>	ten	steel	cat

(5) *Ibid.*
(6) The alternative would be as follows :
/š/ <ce>(ocean),<se>(nausea),<che>(cache),<si>(tension),<ci>(vicious),<ti> (nation),<sci>(conscious),<ssi>(mission),<chsi>(fuchsia)
/č/ <ti>(question)
/ǰ/ <di>(soldier)
/ž/ <zi>(brazier), <si>(division)

	⟨tt⟩	(—)	bottle	mitt
	⟨th⟩	Thomas	Anthony	(—)
	⟨(e)d⟩	(—)	(—)	(linked)
	⟨pt⟩	ptomaine	(—)	receipt
	⟨bt⟩	(—)	subtle	debt
/d/	⟨d⟩	door	window	kind
	⟨dd⟩	(—)	sudden	add
	⟨(e)d⟩	(—)	(—)	(killed)
/k/	⟨c⟩	cat	picnic	cynic
	⟨cc⟩	(—)	account	(—)
	⟨ch⟩	character	echo	stomach
	⟨k⟩	kite	sky	milk
	⟨ck⟩	(—)	tackle	neck
	⟨cq⟩	(—)	acquaint	(—)
	⟨q⟩	quite	liquor	Iraq
	⟨kh⟩	khaki	(—)	(—)
	⟨cch⟩	(—)	bacchant	(—)
/g/	⟨g⟩	glad	eagle	bag
	⟨gg⟩	(—)	beggar	egg
	⟨gh⟩	ghost	aghast	(—)
/č/	⟨ch⟩	chess	merchant	march
	⟨tch⟩	(—)	catcher	pitch
	⟨t⟩	(—)	natural	(—)
/ǰ/	⟨j⟩	just	injure	raj
	⟨g⟩	gem	margin	(—)
	⟨gg⟩	(—)	exaggerate	(—)
	⟨d⟩	(—)	educate	(—)
	⟨dg⟩	(—)	judge	(—)
	⟨dj⟩	(—)	adjust	(—)
/f/	⟨f⟩	foot	after	scarf
	⟨ff⟩	(—)	office	cliff
	⟨ph⟩	philosophy	philosopher	graph
	⟨gh⟩	(—)	laughter	laugh
/v/	⟨v⟩	vain	oven	Slav
	⟨vv⟩	(—)	flivver	(—)

	⟨f⟩	(—)	(—)	of
	⟨ph⟩	(—)	Stephen	(—)
/θ/	⟨th⟩	thick	method	myth
/ð/	⟨th⟩	this	mother	mouth (vi.)
/s/[7]	⟨s⟩	see	mist	politics
	⟨ss⟩	(—)	missile	miss
	⟨c⟩	city	dancer	(—)
	⟨sc⟩	scene	candescent	(—)
	⟨sch⟩	schism	(—)	(—)
	⟨ps⟩	psychology	(—)	(—)
/z/	⟨z⟩	zoo	crazy	quiz
	⟨zz⟩	(—)	dazzle	jazz
	⟨s⟩	(—)	music	is
	⟨(e)s⟩	(—)	(—)	(goes)
	⟨ss⟩	(—)	scissors	(—)
	⟨sc⟩	(—)	discern	(—)
	⟨x⟩	xenon	anxiety	adieux
	⟨cz⟩	czar	(—)	(—)
/š/	⟨sh⟩	she	bishop	wash
	⟨ch⟩	chandelier	machine	(—)
	⟨s⟩	sure	censure	(—)
	⟨ss⟩	(—)	issue	(—)
	⟨c⟩	(—)	vicious	(—)
	⟨t⟩	(—)	nation	(—)
	⟨sc⟩	(—)	conscious	(—)
	⟨chs⟩	(—)	fuchsia	(—)
	⟨sch⟩	schnapps	(—)	(—)
/ž/	⟨z⟩	*	azure	(—)
	⟨s⟩	*	measure	(—)
	⟨g⟩	*	rouge	(—)
	⟨ss⟩	*	scission	(—)
/m/	⟨m⟩	man	among	ham
	⟨mm⟩	(—)	common	(—)

---

(7)   cf. ⟨z⟩ Pulitzer

	<mb>	(—)	plumber	comb
	<mn>	(—)	condemns	column
/n/	<n>	no	into	in
	<nn>	(—)	cannon	inn
	<gn>	gnaw	physiognomy	sign
	<kn>	know	unknown	(—)
	<mn>	mnemonic	(—)	(—)
	<pn>	pneumonia	(—)	(—)
/ŋ/	<ng>	*	hanger	sing
	<n>	*	ink	(—)
/l/	<l>	luck	early	tail
	<ll>	llama	million	tall
/r/	<r>	red	card	star
	<rr>	(—)	carrot	err
	<rh>	rhythm	(—)	(—)
	<rrh>	(—)	hemorrhage	(—)
	<wr>	write	awry	(—)
/h/	<h>	hit	ahead	*
	<wh>	who	(—)	*
/w/	<w>	wet	sweet	cow
	<u>	(—)	quite	(—)
/y/	<y>	yell	beyond	key
	<j>	(—)	hallelujah	(—)

3.2. Vowel phonemes.

/i/	<i>	it	sit	*
	<e>	English	pretty	*
	<ee>	(—)	been	*
	<ie>	(—)	sieve	*
	<u>	(—)	busy	*
	<o>	(—)	women	*
	<y>	(—)	myth	*
	<ui>	(—)	build	*
	<a>	(—)	surface	*
	<ei>	(—)	forfeit	*

	<ae>	(—)	archaeology	*
	<ea>	ear	rear	*
/e/	<e>	end	ten	*
	<a>	any	many	*
	<u>	(—)	bury	*
	<ea>	(—)	bread	*
	<ie>	(—)	friend	*
	<ei>	(—)	heifer	*
	<eo>	(—)	leopard	*
	<ai>	(—)	(said)	*
	<ay>	(—)	(says)	*
	<oe>	(—)	foetid	*
	<ae>	aesthetic	(—)	*
	<ey>	eyre	(—)	*
/æ/	<a>	at	sat	*
	<au>	aunt	laugh	*
	<ai>	(—)	plaid	*
/ə/	<u>	utter	cup	(—)
	<o>	(—)	son	(—)
	<ou>	(—)	couple	(—)
	<oo>	(—)	blood	(—)
	<a>	along	tenant	sofa
	<ai>	(—)	fountain	(—)
	<ia>	(—)	parliament	(—)
	<io>	(—)	tension	(—)
	<ei>	(—)	villein	(—)
	<eo>	(—)	dungeon	(—)
	<i>	(—)	easily	(—)
	<e>	err	movement	the
	<oi>	(—)	purpoise	(—)
	<y>	(—)	myrtle	(—)
	<iou>	(—)	vicious	(—)
	<eou>	(—)	righteous	(—)
	<ae>	earth	heard	(—)
	<ie>	(—)	brazier	(—)
	<eau>	(—)	bureaucrat	(—)
	<wo>	(—)	twopence	(—)
/a/	<a>	art	father	spa

	<e>	(—)	sergeant	(—)
	<ea>	(—)	heart	(—)
	<o>	option	hot	(—)
	<ow>	(—)	knowledge	(—)
	<aa>	aardwolf	bazaar	(—)
/u/	<u>	(—)[8]	put	*
	<o>	(—)	wolf	*
	<oo>	(—)	book	*
	<ou>	(—)	could	*
/ɔ/	<o>	order	coffee	(—)
	<oa>	oar	broad	(—)
	<ou>	ought	brought	(—)
	<a>	all	tall	(—)
	<au>	author	fault	(—)
	<aw>	awful	lawn	law
	<oo>	(—)	door	(—)
/iy/	<ee>	eel	meet	see
	<e>	equal	secret	me
	<ea>	eat	meal	sea
	<i>	(—)	machine	ski
	<ie>	(—)	field	movie
	<ei>	(—)	receive	(—)
	<ae>	aeon	Caesar	formulae
	<eo>	(—)	people	(—)
	<oe>	oestrum	amoeba	(—)
	<ey>	(—)	(keys)	key
	<y>	(—)	(—)	lovely
	<uay>	(—)	(quays)	quay
/ey/	<a>	ape	gate	(—)
	<ei>	eight	veil	lei
	<ea>	(—)	break	yea
	<ai>	aid	chain	(—)
	<au>	(—)	gauge	(—)
	<ey>	(—)	obeyance	they
	<ay>	aye	wayward	flay
	<e>	(—)	(—)	fiance
/ay/	<i>	isle	kind	alibi

---

(8) cf. Ullmann, Unna

	⟨ai⟩	aisle	(—)	(—)
	⟨ay⟩	aye	(—)	(—)
	⟨ey⟩	eye	geyser	(—)
	⟨ei⟩	(—)	height	(—)
	⟨uy⟩	(—)	buyer	buy
	⟨y⟩	(—)	style	spy
	⟨ie⟩	(—)	pied	lie
	⟨ui⟩	(—)	guide	(—)
/oy/	⟨oi⟩	oil	boil	(—)
	⟨oy⟩	oyster	boycott	toy
	⟨uoy⟩	(—)	(buoys)	buoy
/aw/	⟨ou⟩	out	house	thou
	⟨ow⟩	owl	cowl	now
/uw/	⟨u⟩	ulema	rule	flu
	⟨o⟩	(—)	move	do
	⟨oo⟩	ooze	root	too
	⟨ou⟩	ouzel	group	you
	⟨oe⟩	(—)	(canoes)	canoe
	⟨ue⟩	(—)	(clues)	blue
	⟨ui⟩	(—)	fruit	(—)
	⟨eu⟩	(—)	maneuver	(—)
	⟨ew⟩	(—)	news	blew
	⟨wo⟩	(—)	(twos)	two
	⟨ieu⟩	(—)	(adieux)	aideu
/ow/	⟨o⟩	old	cold	go
	⟨oa⟩	oat	coat	cocoa
	⟨oe⟩	(—)	(foes)	toe
	⟨ou⟩	(—)	soul	(—)
	⟨ow⟩	own	bowl	blow
	⟨eo⟩	(—)	yeoman	(—)
	⟨au⟩	(—)	hautboy	(—)
	⟨ew⟩	(—)	sewing	sew
	⟨oo⟩	(—)	brooch	(—)

3.3. From the table above the following statements will be made on the English graphemic representations of phonemes.

(1) Except /θ/ and /ð/, all of the English phonemes, both vowels and consonants, are represented in more than one ways, reaching nine in the case of /š/, and twenty in the case of /ə/. The average number of the ways of rep-

resentations is four per consonant and seven per vowel if the position is ignored. This fact shows that vowel representation is more complex than consonant representation in English.

(2) The number of the graphemes representing one phoneme is from one to three. Out of ninety-nine graphemic representations of consonant phonemes thirty-six are by single grsaphemes, fifty-seven are by sequences of two graphemes and six are by sequences of three graphemes. Out of one hundred and eighteen representations of vowel phonemes thirty-three are by single graphemes, seventy-nine are by sequences of two graphemes and six are by sequences of three graphemes. These facts show that more than half of the representations are by two-grapheme sequences, and that three-grapheme seqences are rare.

(3) As to the positional representations, the medially appearing graphemes are most various, eighty-five varieties being medial, forty-eight initial, and fifty final for consonant phonemes; one hundred and twelve being medial, forty-five initial, and forty final for vowel phonemes.

(4) We find that the English phonemes are represented by the following graphemes in all of their possible positions.

Consonants

/p/	<p>	/s/	<s>
/b/	<b>	/z/	<z>, <x>
/t/	<t>	/š/	<sh>
/d/	<d>	/ž/	—
/k/	<c>, <k>, <ch>, <q>	/m/	<m>
/g/	<g>	/n/	<n>
/č/	<ch>	/ŋ/	<ng>
/ǰ/	<j>	/l/	<l>, <ll>
/f/	<f>, <ph>	/r/	<r>
/v/	<v>	/h/	<h>
/θ/	<th>	/w/	<w>
/ð/	<th>	/y/	<y>

Vowels

/i/	<i>, <e>	/iy/	<ee>, <e> <ea>, <ae>
/e/	<a>, <e>		
/æ/	<a>, <au>	/ey/	<ei>, <ay>
/ə/	<u> (with ˘) <a> (with ˘) <e> (with ˘)	/ay/	<i>
		/oy/	<oy>
		/aw/	<ou>, <ow>
/a/	<a>	/uw/	<u>, <oo> <ou>, <ew>
/u/	—		
/ɔ/	<aw>	/ow/	<o>, <oa> <ow>

4. Graphemes representing phonemes.

4.1. Classification of graphemes. The graphemes presented in 3.1. and 3.2. may be classified as follows:

(1) Single grapheme: a grapheme which represents a phoneme or a sequence of phonemes by itself.

(2) Double grapheme: a sequence of two identical graphemes which represents a phoneme as a unit.[9]

(3) Compoud grapheme: a sequence of two or three different graphemes which represents a phoneme or a sequence of phonemes as a unit.

(4) Special compound grapheme: a sequence of different graphemes which represents a phoneme, with one of the graphemes corresponding to no phoneme.

To the four groups of graphemes above we may add the fifth:

(5) Silent grapheme: a grapheme, single or compound, which corresponds to no phoneme.

Below, the tables are given to show which phoneme or sequence of phonemes an English grapheme represents by rearranging the tables given in 3. The positional occurrence is shown by giving an example, and non-occurrence by (−).

4.2. Consonantals.

4.2.1. Single consonantals.

Graphemes	*Phonemes*	*Positional occurrences*		
		Initial	*Medial*	*Final*
\<b\>	/b/	bag	barber	cab
\<c\>	/k/	cat	picnic	cynic
	/s/	city	dancer	(−)
\<d\>	/d/	door	window	kind
	/ǰ/	(−)	educate	(−)
\<f\>	/f/	foot	after	scarf
	/v/	(−)	(−)	of
\<g\>	/g/	glad	eagle	bag
	/ǰ/	gem	margin	(−)
	/ž/	(−)	rouge	(−)
\<h\>	/h/	hit	ahead	(−)
\<j\>	/ǰ/	just	injure	raj
	/y/	(−)	hallelujah	(−)
\<k\>	/k/	kite	sky	milk
\<l\>	/l/	luck	early	tail
\<m\>	/m/	man	among	ham
\<n\>	/n/	no	into	in
	/ŋ/	(−)	ink	(−)

---

(9) In some words two identical graphemes appear before and after a morpheme boundary as in roommate /−mm−/, in which case /−mm−/ is not considered as a "double" grapheme, but as a sequence of "single" graphemes.

$<p>$	/p/	pen	open	stop
$<q>$	/k/	quite	liquor	Iraq
$<r>$	/r/	red	card	star
$<s>$	/s/	see	mist	politics
	/z/	(—)	music	is
	/š/	sure	censure	(—)
	/ž/	(—)	measure	(—)
$<t>$	/t/	ten	steel	cat
	/č/	(—)	natural	(—)
	/š/	(—)	nation	(—)
$<v>$	/v/	vain	oven	Slav
$<w>$	/w/	wet	sweet	cow
$<x>$	/z/	xenon	anxiety	adieux
	/ks/	(—)	exercise	mix
	/gz/	(—)	examine	(—)
	/kš/	(—)	anxious	(—)
	/gž/	(—)	luxurious	(—)
$<y>$	/y/	yell	beyond	key
	/i/	(—)	myth	(—)
	/iy/	(—)	(—)	lovely
	/ay/	(—)	style	spy
	/ə/	(—)	myrtle	(—)
$<z>$	/z/	zoo	crazy	quiz
	/ž/	(—)	azure	(—)

The following statememts will be made about the single consonantals from the table above:

(1) Compared with the number of the ways of representations of a phoneme, the number of phonemes which a single consonantal represents is much lower: ten single consonantals out of twenty-one represent only one phoneme each, six represent two, two represent three, one represents four, and two represent five.

(2) When a single consonantal has more than one phonemes to represent, its occurrence in all of the positions is restricted to one of the phonemes: for example, $<c>$ represents /k/ and /s/, but it represents /k/ in all of the positions whereas it represents /s/ only initially and medially.

(3) Here we may assign the basic grapheme-phoneme correspondences of single consonantals as follows:

$<b>$	/b/	$<g>$	/g/	$<l>$	/l/
$<c>$	/k/	$<h>$	/h/	$<m>$	/m/
$<d>$	/d/	$<j>$	/ǰ/	$<n>$	/n/
$<f>$	/f/	$<k>$	/k/	$<p>$	/p/

\<q\>	/k/	\<t\>	/t/	\<x\>	/ks/[10]
\<r\>	/r/	\<v\>	/v/	\<y\>	/y/
\<s\>	/s/	\<w\>	/w/	\<z\>	/z/

4. 2. 2. Double consonantals.

\<bb\>	/b/	(—)	rabbit	ebb
\<cc\>	/k/	(—)	account	(—)
\<dd\>	/d/	(—)	sudden	add
\<ff\>	/f/	(—)	office	cliff
\<gg\>	/g/	(—)	beggar	egg
	/ǰ/	(—)	exaggerate	(—)
\<ll\>	/l/	llama	million	tall
\<mm\>	/m/	(—)	common	(—)
\<nn\>	/n/	(—)	cannon	inn
\<pp\>	/p/	(—)	happy	(—)
\<rr\>	/r/	(—)	carrot	err
\<ss\>	/s/	(—)	missile	miss
	/z/	(—)	scissors	(—)
	/š/	(—)	issue	(—)
	/ž/	(—)	scission	(—)
\<tt\>	/t/	(—)	bottle	mitt
\<vv\>	/v/	(—)	flivver	(—)
\<zz\>	/z/	(—)	dazzle	jazz

The following statememts will be made about the double consonantals of English:

(1) The number of the phonemes which are represented by double conso-nantals is even lower. Out of fourteen, one represents two phonemes (\<gg\>: /g/ and /ǰ/), and one represents four (\<ss\>: /s/, /z/, /š/, and /ž/), all the others representing one phoneme.

(2) Double consonantals do not occur initially, except \<ll\> in *llama, llanero, llano, Llanelly* and *Llano Estacado.*   Thus we may say that English double conso-nantals usually occur in medial and final positions.

(3) Double consonantals occur after a vowel grapheme which represents a simple nucleus. The only exception to this is again \<ll\>, which may occur after \<o\> representing /ow/, e. g. *toll, roll, poll* and so on.

(4) The basic grapheme-phoneme correspondences of double consonantals are as follows :

---

(10) \<x\> representing /z/ occurs in all of the positions, but a final \<x\> represents /ks/, which composes part of a stem, more often than /z/ which indicates the rather foreign plural formation. Furthermore, the number of words beginning with \<ex\> (/ks/ or /gz/) is about five times as many as that of those beginning with\<x-\>(-/z/). These facts have led to the decision here. (cf. Kenkyusha's New English-Japanese Dictionary)

<bb>	/b/	<nn>	/n/
<cc>	/k/	<pp>	/p/
<dd>	/d/	<rr>	/r/
<ff>	/f/	<ss>	/s/
<gg>	/g/	<tt>	/t/
<ll>	/l/	<vv>	/v/
<mm>	/m/	<zz>	/z/

4.2.3. Compound consonantals.

<ch>	/k/	character	echo	stomach
	/č/	chess	merchant	march
	/š/	chandelier	machine	(—)
<ck>	/k/	(—)	tackle	neck
<cq>	/k/	(—)	acquaint	(—)
<dg>	/ǰ/	(—)	judge	(—)
<dj>	/ǰ/	(—)	adjust	(—)
<gh>	/f/	(—)	laughter	laugh
	/p/	(—)	(hiccoughs)	hiccough
<ng>	/ŋ/	(—)	hanger	sing
<ph>	/f/	philosophy	philosopher	graph
	/v/	(—)	Stephen	(—)
<sc>	/s/	scene	candescent	(—)
	/z/	(—)	discern	(—)
	/š/	(—)	conscious	(—)
<sh>	/š/	she	bishop	wash
<th>	/θ/	thick	method	myth
	/ð/	this	mother	mouth (vi.)
<cch>	/k/	(—)	bacchant	(—)
<chs>	/š/	(—)	fuchsia	(—)
<sch>	/s/	schism	(—)	(—)
	/š/	schnapps	(—)	(—)
<tch>	/č/	(—)	catcher	pitch

The following statements will be made about the compound consonantals of English:

(1) Compound consonantals consist of either two or three consonantals.

(2) They are divided into three groups according to the members of the sequences.

(a) None of the graphemes show the basic correpondences given in 4.2. and 4.3 : <ch> /č/, /š/ ; <gh> /f/, /p/ ; <ph> /f/, /v/; <th> /θ/, /ð/; <sc> /š/ ; <sh> /š/ ; <dg> /ǰ/ ; <ng>/ŋ/ ; <chs> /š/ ; <sch> /š/.

(b) Each of the graphemes shows the basic correspondences given in 4.2. : <ck> /k/ ; <cq> /k/.

(c) Either one shows the basic correspondences given in 4.2. and 4.3. :

<ch> /k/ ; <sc> /s/ ; <cch> /k/ ; <sch> /s/ ; <dj> /j/.

(3) Three-member compound consonantals all contain <ch>, and it seems that the grapheme occurring before or after <ch> plays an important role in the representation of the phonome.

(4) We may assign the basic grapheme-phoneme correspondences of compound consonantals as follows:

<ck>	/k/		<dg>	/ǰ/
<cq>	/k/		<dj>	/ǰ/
<ph>	/f/		<ng>	/ŋ/
<th>	/θ/, /ð/		<cch>	/k/
<sh>	/š/		<tch>	/č/

<ch> plays a great part representing three phonemes with wide distribution and is rather difficult to be assigned any one phoneme as basic, but considering the non-occrrence of <ch> representing /š/ in the final position and the rather limited number of words ending with <ch> representing /k/, we might take /č/ as basic.

4.2.4. Special compound consonantals.

Special compound consonantals are those in which one of the graphemes represents its basic phoneme and the other is assigned no phoneme, that is "silent". They are divided into two groups according to the positions in which the silent grapheme occurs.

(a) This group includes those sequences in which the first grapheme represents its basic phoneme and the second is silent:

<gh>	/g/	ghost	aghast	(—)
<kh>	/k/	khaki	(sheikhs)	sheikh (*also sheik)
<mb>	/m/	(—)	plumber	comb
<mn>	/m/	(—)	(condemns)	column
<ph>	/p/	(—)	shepherd	(—)
<rh>	/r/	rhythm	(—)	(—)
<rrh>	/r/	(—)	hemorrhage	(—)
<th>	/t/	Thomas	Anthony	(—)
<xc>	/ks/	(—)	excel	(—)

(b) This group includes those sequences in which the second grapheme represents its basic phoneme and the first is silent:

<bt>	/t/	(—)	subtle	debt
<cz>	/z/	czar	(—)	(—)
<gn>	/n/	gnaw	physiognomy	sign
<kn>	/n/	know	unknown	(—)
<mn>	/n/	mnemonic	(—)	(—)
<pb>	/b/	(—)	cupboard	(—)
<pn>	/n/	pneumonia	(—)	(—)

<ps>	/s/	psychology	(—)	(—)
<pt>	/t/	ptomaine	(—)	receipt
<wr>	/r/	write	awry	(—)

The following statements will be made about the special compound conso-nantals of English :

(1) In group (a) <h>, which appears in six sequences out of ten, is silent in its every occurrence. In group (b) every<p> is silent in <pb>, <pn>, <pt> and <ps>.

(2) We may assign the basic grapheme-phoneme correspondences as follows:

	(a)			(b)	
	<kh>	/k/		<bt>	/t/
	<rh>	/r/		<gn>	/n/
	<rrh>	/r/		<pb>	/b/
	<xc>	/ks/		<pn>	/n/
				<wr>	/r/

4.2.5. Silent consonantals.

<c>	/Ø/	(—)	victuals	(—)
<d>	/Ø/	(—)	handsome	(—)
<g>	/Ø/	(—)	phlegm	(—)
<h>	/Ø/	honest	John	oh
<l>	/Ø/	(—)	calm	(—)
<s>	/Ø/	(—)	island	(—)
<t>	/Ø/	(—)	wrestle	(—)
<w>	/Ø/	(—)	sword	(—)
<ch>	/Ø/	(—)	yacht	(—)
<gh>	/Ø/	(—)	eight	though
<lf>	/Ø/	(—)	halfpenny	(—)
<th>	/Ø/	(—)	isthmus	(—)

We may regard these silent consonantal as exceptional cases since those which are regularly silent in their occurrences are treated in the previous section as part of special compounds, although we may be able to find certain contexts in which they may be regularly silent for some of them.

4.2.6. So far we have shown basic correspondences of consonantals, and those which have been left over as non-basic may be regarded regular to some degree if we can define contexts in which they may occur. Here a table will be given to show (a) basic correspondences, (b) non-basic regular correspondences with contexts if possible, and (c) exceptional cases. (Positional occurrences in (b) and (c) are indicated as follows: <p-> initial ; <-p-> medial; <-p> final (including stem-final) ; <(-)p-> initial and medial ; <(-)p-> medial and final).

Phonemes	(a) Basic Correspondences	(b) Non-basic Regular Correspondences	(c) Exceptions
/p/	\<p\> \<pp\>		\<-ph-\> \<-gh\>
/b/	\<b\> \<bb\> \<pb\>		
/t/	\<t\> \<tt\> \<bt\>	\<pt-\> \<-ed\>	\<-pt\> \<(-)th-\>
/d/	\<d\> \<dd\>	\<-ed\>	
/k/	\<c\>\<cc\>\<ck\> \<cch\> \<k\> \<kh\> \<q\> \<cq\>	\<ch\>	
/g/	\<g\> \<gg\>	\<(-)gh-\> before \<V\>*	
/č/	\<ch\> \<tch\>	\<-t-\> before \<u\>, in \<-s__ion\>	
/ǰ/	\<j\> \<dg\> \<dj\>	\<-d-\> before \<u, i\> \<(-)g-\> before \<e, i\>	
/f/	\<f\> \<ff\> \<ph\>		\<-gh(-)\>
/v/	\<v\> \<vv\>		\<-ph-\> \<-f\>
/θ/	\<th\>		
/ð/	\<th\>		
/s/	\<s\> \<ss\>	\<(-)c-\>before \<e, i, y\> \<(-)sc-\> before \<e, i\> \<ps-\>	\<sch-\>
/z/	\<z\> \<zz\>	\<-s(-)\> \<x\> \<cz-\>	\<-sc-\> \<-ss-\>
/š/	\<sh\>	\<(-)s-\> before \<-ion,-u-\> \<-t-\>before\<-ion, -ien-\> \<-c-\> before \<-ial, -ean, ...\> \<-chs-\> \<(-)ch-\>	\<sch-\> \<-sc-\>
/ž/	—	\<-s-\> before \<-ion,-u-\> \<-ss-\> before \<-ion\> \<-z-\>before \<-u-, -i-\>	\<-g\>
/m/	\<m\> \<mm\>	\<-mb\> \<-mn\>	
/n/	\<n\>\<nn\>\<-gn\>\<kn\> \<pn\>	\<mn-\>	
/ŋ/	\<ng\>	\<-n-\>before\<c, g, k, q\>	
/l/	\<l\> \<ll\>		
/r/	\<r\>\<rr\>\<rh\> \<rrh\> \<wr\>		
/h/	\<h\>	\<(-)wh-\> before \<o\>	
/w/	\<w\>	\<-u-\> after \<q\>, in\<s__a-\>	
/y/	\<y\>		\<-j-\>
/ks/	\<x\> \<xc\>		

/gz/		<-x-> before <V̇>*	
/kš/			<-x->
/gž/			<-x->
/ø/		<-g-> before <-m> <-l-> in <-a__m, -a__f, -ou__d> <-t-> in <-s__l-, -s__en, -f__en>	<-c-> <-l-> <-d-> <-h-> <-s-> <-w-> <-ch-> <-gh(·)-> <-lf-> <-th->

*<V>=Vocalic

4.3. Vocalics
4.3.1. Single vocalics.

<a>	/ey/	ape	gate	(—)
	/a/	art	father	spa
	/e/	any	many	(—)
	/ə/	along	tenant	sofa
	/æ/	at	sat	(—)
	/ɔ/	all	tall	(—)
	/i/	(—)	surface	(—)
<e>	/iy/	equal	secret	me
	/e/	end	ten	(—)
	/a/	(—)	sergeant	(—)
	/i/	English	pretty	(—)
	/ə/	err	movement	the
	/ey/	(—)	(—)	fiance
<i>	/ay/	isle	kind	alibi
	/i/	it	sit	(—)
	/ə/	(—)	easily	(—)
	/iy/	(—)	machine	ski
<o>	/a/	option	hot	(—)
	/ow/	old	cold	go
	/ə/	(—)	son	(—)
	/ɔ/	order	coffee	(—)
	/uw/	(—)	move	do
	/u/	(—)	wolf	(—)
	/i/	(—)	women	(—)
	/wə/	one	anyone	(—)
<u>	/ə/	utter	cup	(—)
	/u/	(—)	put	(—)
	/uw/	ulema	rule	flu

/yuw/	union	music	menu
/i/	(—)	busy	(—)
/e/	(—)	bury	(—)

The following statements will be made about the single vocalics of English:

(1) The number of phonemes which a single vocalic represents is from four to eight, the average being six. This number is higher than any of the other groups; that of compound vocalics is about three, that of single consonantals is about two, and that of compound consonantals is less than two.

(2) About one third of the total positional occurrences are initial, one half are medial and the rest one sixths are final. The rate of initial occurrences is higher than in the case of compound vacalics in which one fifths of the total occurrences are initial, two thirds are medial and the rest one sixths are final. This shows that the positional distribution of single vocalics is less limited than that of compound vocalics.

(3) It is rather difficult to assign the basic grapheme-phoneme correspondences out of these diverse representations, but we might present the followings as basic by using contextual references from the beginning:

⟨a⟩	/æ/ in⟨(C)*‿C⟩,	⟨C‿CC⟩;	/ey/ in ⟨C‿Ce**⟩;	/ə/ in ⟨-‿r⟩♯
⟨e⟩	/e/	〃	〃	/iy/ 〃	/ə/ 〃
⟨i⟩	/i/	〃	〃	/ay/ 〃	/ə/ 〃
⟨o⟩	/a/	〃	〃	/ow/ 〃	/ə/ 〃
⟨u⟩	/ə/	〃	〃	/yuw/ 〃	/ə/ 〃

(*C=consonantal **e=silent⟨e⟩)

(4) Complexity of vowel representations is partly due to stress placement.

4.3.2. Double vocalics.

⟨aa⟩	/a/	aardwolf	bazaar	(—)
⟨ee⟩	/iy/	eel	meet	see
⟨oo⟩	/ə/	(—)	blood	(—)
	/uw/	ooze	root	too
	/u/	(—)	book	(—)
	/ɔ/	(—)	door	(—)
	/ow/	(—)	brooch	(—)

The following statements will be made about the double vocalics:

(1) Out of five vocalics, three form double graphemes, and among these three ⟨aa⟩ is not common appearing only in *aardwolf*, *aardvark* and a few proper names.

(2) ⟨ii⟩ appears in *Hawaii* but it does not represent a single nucleus and so is ommitted from consideration.

(3) The basic grapheme-phoneme corressondences are as follows:

<aa>   /a/
<ee>   /iy/
<oo>   /uw/

4.3.3.   Compound vocalics.

<ae>	/iy/	aeon	Caesar	formulae
	/e/	aesthetic	(—)	(—)
		(*also /iy/)		
<ie>	/iy/	(—)	field	movie
	/e/	(—)	friend	(—)
	/i/	(—)	sieve	(—)
	/ay/	(—)	pied	lie
	/ə/	(—)	brazier	(—)
<oe>	/ow/	(—)	(foes)	toe
	/uw/	(—)	(canoes)	canoe
	/iy/	oestrum	amoeba	(—)
	/e/	(—)	foetid	(—)
<ue>	/uw/	(—)	clues	blue
	/yuw/	(—)	cues	cue
<ea>	/iy/	eat	meal	sea
	/e/	(—)	bread	(—)
	/ey/	(—)	break	(—)
	/a/	(—)	heart	(—)
	/ə/	earth	heard	(—)
	/i/	ear	rear	(—)
<ia>	/ə/	(—)	parliament	(—)
	/yə/	(—)	(dahlias)	dahlia
<oa>	/ow/	oat	coat	cocoa
	/ɔ/	oar	broad	(—)
<ai>	/ey/	aid	chain	(—)
	/e/	(—)	said	(—)
	/ə/	(—)	fountain	(—)
	/ay/	aisle	(—)	(—)
	/æ/	(—)	plaid	(—)
<ei>	/ey/	eight	veil	lei
	/e/	(—)	heifer	(—)
	/iy/	(—)	receive	(—)
	/i/	(—)	forfeit	(—)
	/ay/	(—)	height	(—)
<oi>	/oy/	oil	boil	(—)
	/ə/	(—)	purpoise	(—)
	/way/	(—)	choir	(—)

<ui>	/i/	(—)	build	(—)
	/uw/	(—)	fruit	(—)
	/ay/	(—)	guide	(—)
	/wi/	(—)	cuirass	(—)
<eo>	/iy/	(—)	people	(—)
	/e/	(—)	leopard	(—)
	/ə/	(—)	dungeon	(—)
	/ow/	(—)	yeoman	(—)
<io>	/ə/	(—)	tension	(—ˊ)
<au>	/ɔ/	author	fault	(—)
	/æ/	aunt	laugh	(—)
	/ey/	(—)	gauge	(—)
	/ow/	(—)	hautboy	(—)
<eu>	/uw/	(—)	maneuver	(—)
	/yuw/	eulogy	feud	(—)
	/yu/	Europe	(—)	(—)
<ou>	/aw/	out	house	thou
	/ɔ/	ought	brought	(—)
	/ow/	(—)	soul	(—)
	/uw/	ouzel	group	you
	/ə/	(—)	couple	(—)
	/u/	(—)	could	(—)
<eau>	/yuw/	(—)	beauty	(—)
	/ow/	(—)	bureaucratic	bureau
	/ə/	(—)	bureaucrat	(—)
<eou>	/ə/	(—)	righteous	(—)
<ieu>	/(y)uw/	(—)	(adieux)	adieu
<iou>	/ə/	(—)	vicious	(—)

The following statements will be made about the compound vocalics of English:

(1) Out of twenty possible combinations of two-vocalic compounds sixteen do appear, and mostly represent English vowel phonemes, half simple and the other half complex nuclei.

(2) It would be rather arbitrary to assign the basic correspondences of these compound vocalics since the number of phonemes represented is rather high, and the distribution is limited. (cf. 4. 3. 2.) Here only some regular correspondences will be given.

\<ae\>	/iy/		\<-ie-\>	/iy/
\<ai\>	/ey/		\<oa\>	/ow/
\<au\>	/ɔ/		\<oi\>	/oy/
\<ea\>	/iy/		\<ou\>	/aw/
\<ei\>	/ey/		\<-oe\>	/uw/ or /ow/
\<eu\>	/yuw/		\<-ue\>	/uw/ or /ow/
\<io(-n)\>	/ə(-n)/			

(3) The occurrence of compound vocalics of three members is strictly limited, and the phonemes represented by them are only six. \<eou\> and \<iou\> both represent /ə/ occurring before \<-s\> with a weak stress. \<eau\> represents /yuw/, /ow/, and /ə/, and \<ieu\> represents /(y)uw/, but the number of words with them seems to be very low.

4.3.4. Compound vocalics with \<y\> or \<w\>.

\<aw\>	/ɔ/	awe	lawn	law
\<ew\>	/yuw/	ewe	news	few
	/ow/	(—)	sewing	sew
	/uw/	(—)	news	blew
\<ow\>	/aw/	owl	cowl	now
	/ow/	own	bowl	blow
\<iew\>	/yuw/	(—)	reviewer	review
\<ay\>	/ay/	ay(e)	(—)	(—)
	/ey/	ay(e)	wayward	pay
	/e/	(—)	(says)	(—)
	/iy/	(—)	(Sundays)	Sunday
\<ey\>	/ey/	(—)	conveyance	they
	/ay/	(eye)	geyser	(—)
	/iy/	(—)	(keys)	key
	/e/	eyre	(—)	(—)
\<oy\>	/oy/	oyster	boycott	toy
\<uy\>	/ay/	(—)	(buyer)	buy
\<uay\>	/iy/	(—)	(quays)	quay
\<uoy\>	/oy/	(—)	buoys	buoy

(1) The compound vocalics containing \<y\> generally represents vowel phonemes with a glide /y/, and those with \<w\> generally represents vowel phonemes with the other glide /w/.

(2) The basic grapheme-phoneme correspondences are as follows :

\<aw\>	/ɔ/		\<uy\>	/ay/
\<iew\>	/yuw/		\<uay\>	/iy/
\<oy\>	/oy/		\<uoy\>	/oy/

4.3.5. Silent vocalics.

<e>	/Ø/	(—)	(loves)	love
<ue>	/Ø/	(—)	(rogues)	vague

(1) A final <e> after a consonantal is usually silent, but it has an important function to indicate phonemic differences of the preceding vocalics.

(2) <ue>, occurring after <g> and <q>, is often silent.

4.3.6.

As we have seen so far, it is hard to assign the basic representations of vocalics. Here a table will be given to show only (a) regular representations and (b) non-regular representations of the English vocalics.

Phonemes	Regular Representations	Non-regular Representations
/i/	<i> in <(C)__C(C)>	<-a-> <(-)e-> <-o-> <-u-> <(-)y-> <(-)ea-> <-ae-> <-ee-> <-ei-> <-ie-> <-ui->
/e/	<e> in <(C)__C(C)>	<(-)a-> <-u-> <-ai-> <ae-> <-ay-> <-ea-> <-ei-> <-eo-> <ey-> <-ie-> <-oe->
/æ/	<a> in <(C)__C(C)>	<(-)au-> <-ai->
/ə/	<u> in <(C)__C(C)> <a, e, i ,o, u> in<..__r> <-iou-, -eou-> in <..__s> <-io-> in <n..__>	<a> <e> <-i-> <-o-> <-y-> <-ai-> <(-)ea-> <-ei-> <-eo-> <-ia-> <-ie-> <-oi-> <-oo-> <-ou-> <-wo-> <-eau->
/a/	<o> in <(C)__C(C)> <a> <aa>	<-e-> <-ea-> <-ow->
/u/	<u>	<-o-> <-oo-> <-ou->
/ɔ/	<o> <au> <aw>	<(-)a-> <(-)oa-> <(-)ou-> <-oo->
/iy/	<e> in <(C)__Ce*> <ae> <ea> <ee> <-ie-> <uay>	<-i(-)> <-y> <-ei-> <-eo-> <-ey> <(-)oe->
/ey/	<a> <ai> <ay> <ei> <ey>	<-e> <-au-> <-ea(-)>
/ay/	<i>	<-y(-)> <ai-> <ay-> <(-)ey> <-ei-> <-uy(-)> <-ie(-)> <-ui->
/oy/	<oi> <oy> <uoy>	
/aw/	<ou> <ow>	

/uw/	⟨u⟩ ⟨oo⟩ ⟨-oe⟩ ⟨-ue⟩	⟨-o(-)⟩⟨-eu-⟩ ⟨-ew(-)⟩ ⟨ou⟩ ⟨-wo⟩ ⟨-ieu(-)⟩ ⟨-ui-⟩
/ow/	⟨o⟩ ⟨oa⟩ ⟨-oe⟩	⟨-au-⟩⟨-eo-⟩⟨-ew(-)⟩⟨-oo-⟩ ⟨-ou-⟩ ⟨ow⟩
/yuw/	⟨eu⟩ ⟨eau⟩ ⟨iew⟩ ⟨-ue⟩	
/way/		⟨-oi-⟩
/wi/		⟨-ui-⟩
/Ø/	⟨-e⟩ ⟨-ue⟩	

5. So far we have shown how the English segmental phonemes are represented by the English graphemes, and have pointed out some of the characteristics found in the system. But we need further research for the vocalic representations especially in relation to stress placement. Also, in order to study the complex representations of vowel phonemes of English, it will be necessary for us to direct our attention to the history of English and do research from a diachronic point of view.

References

Bloomfield, Leonard. *Language*, New York ; Henry Holt & Co., Inc., 1933

Chang, Suk-Jin. "Grapheme-Phoneme Correspondences and Hierarchy of Difficulty in Reading English", *ATHENAEUM* Vol. IV. 1966, Seoul National University, Seoul, Korea.

Francis, W. Nelson. *The Structure of American English*, New York, The Ronald Press Company, 1958

Gelb, Ignace J. *A Study of Writing*, Chicago, The University of Chicago Press, 1963

Gleason, H. A. *An Introduction to Descriptive Linguistics*, New York, Henry Holt & Co., Inc,, 1955

Gunshi, Toshio. *A Pocket Inverted English Dictionary*, Tokyo, Kaibunsha, 1967

Hall, Robert A. Jr. *Sound and Spelling in English*, New York, Chilton Company, 1961
————————, *Introductory Linguistics*, Philadelphia, Chilton Company, 1964

Hockett, Charles F. *A Course in Modern Linguistics*, NewYork, The Macmillan Co., 1958

Jespersen, Otto. *A Modern English Grammar*, Part One, London, George Allen & Unwin Ltd. 1949

Yasui, Minoru, *Onsei to Tsuzuriji* (Sound and Spelling), English Grammar Series 2, Tokyo, Kenkyusha, 1955