Asymmetries in Latin glide formation[*]

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In memoriam Edward J. Hausfeld.

1 Introduction

- In this talk I consider whether Classical Latin glides [j, w] are allophones of the high vowels /i, u/, respectively. I assume this premise and then attempt to dismiss apparent counterexamples and contradictions.

    > Counterexamples to a grammatical rule are of interest only if they lead to the construction of a new grammar of even greater generality or if they show some underlying principle is fallacious or misformulated. (Chomsky and Halle 1968:ix)

(1)

a.	*uoluit*	[wo.lu.it]	's/he rolls'
	uoluit	[wol.wit]	's/he wished'
b.	*belua*	[be.lu.a][a]	'wild beast'
	silua	[sil.wa]	'forest'
c.	*aquam*	[a.kwã:]	'water' (acc.sg.)
	acuam	[a.ku.ã:]	'I would sharpen'

[a]To be revised; see §4.

- I pursue this question because

    - the study of glide formation within a single language complements crosslinguistic surveys (e.g., Padgett 2008) and diachronic descriptions (e.g., Meiser 1998), and

    - the analysis of one language can influence our analyses of other languages.

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> ...evidence from Japanese can [...] have indirect—but very powerful—bearing on the choice of the grammar that attempts to characterize the I-language attained by a speaker of English. (Chomsky 1986:38).

- In this process, I find that

  - glide formation is involved in both allophony as well as alternations,

  - there are systematic asymmetries between front and back glide formation.

2 A programmatic note on pure allophony

- While Halle (1959) dispenses with the structuralist distinction between phonemics and morphophonemics, some later generativists reject *pure allophony* outright.

  (2) PURE ALLOPHONY: Let the phonemic inventory of some grammar G be P and the set of surface phones generated by G from P be S. If some phoneme $p \in P$ always corresponds—in some sense to be made precise—to some phone $s \in S$, and if $s \notin P$, then s is a *pure allophone* of p.

- For example, if s $\in P$ and ʃ $\notin P$, but all [ʃ]s ⟵ /s/, then [ʃ] is a pure allophone of /s/.

  (3) KOREAN SECONDARY PALATALIZATION: s ⟶ ʃ / __ i

- One might argue that alternations are **more entrenched** facts than pure allophony, simply because it is always possible to construct a grammar free of pure allophony.

  (4) a.   /si/
        b.   /ʃi/   ⟶   [ʃi]   'poem'

- One early attempt to rule out pure allophony—and thus motivate the choice of /ʃi/ over /si/—is the *alternation condition* (Kiparsky 1968)

  (5) ALTERNATION CONDITION: The UR of a morpheme may not contain a phoneme /x/ that is always realized phonetically as identical to the realization of some other phoneme /y/. (Kenstowicz and Kisseberth 1979:215)

- Another recent version of this idea—often attributed to Dell (1973) or Stampe (1973)—is the notion of *lexicon optimization* (Prince and Smolensky 1993:192):

> A correspondent to this list wonders why, in a grammar G such that $G(a) = G(b)$ for potential input elements /a, b/, a nonalternating observed element [a] is not (sometimes, always, freely) lexically /b/. The correct answer is surely "why bother?"—i.e. to set up /b/ for [a] when /a/ will do [...] The basic idea reappears as "lexicon optimization" in recent discussions. (Alan Prince, electronic discussion; cited in Hale and Reiss 2008:246)

- Should grammars with pure allophony be permitted? The question is not, as is sometimes supposed, a purely philosophical one (see Hale and Reiss 2008:16–22): **both linguists and infants acquiring language require a satisfactory answer**.

- The burden of proof lies with those who would deny pure allophony. They must explain how the language acquisition device (LAD) either

  - induces grammars that satisfy the alternation condition,
  - or optimizes all pure allophony out of them after the fact.

- "Why bother" could go either way: why posit either complication to the LAD when pure allophony will do?

- The linguist faces a similar problem to the infant. To wit, I began this project assuming Latin glide formation was purely allophonic, and only later uncovered—subtle and rare—evidence for vowel-glide alternations.

- Thus in this paper, I make no apology for—and draw no further attention to—the fact that some data are purely allophonic.

- **This important question will have to be settled by other means.**

3 Pronunciation reconstruction

- Very little Latin text from antiquity comes to us unadulterated; most texts are known to us via medieval parchment copies.

- Classical Latin orthography is *defective* in that it does not distinguish between the high vowels [i, iː, u, uː] and the glides [j, w], respectively. High front vocoids are written ⟨ɪ⟩ (now transcribed as *i*), and high back vocoids are written ⟨v⟩ (transcribed *u*).

- Thus to study glide formation, we must employ other sources of evidence, including

  - the testimony of the classical grammarians,
  - non-standard orthographic conventions in inscriptions (e.g., Rolfe 1922),
  - loanword adaptation both to and from Latin,
  - subsequent developments in Romance, and

- poetic meter and wordplay.

- For the study of glide formation, I draw heavily on evidence from scansion; for details of pronunciation not relevant to this question, I largely defer to Allen (1978).

- Latin poetic meters are characterized by systematic alternations between "light" (L) and "heavy" (H) syllables, schematized below.[1]

(6)
L:	$C^?V$
H:	$C^?V{:}C^?$
	$C^?V{:}^?C$

- I focus on evidence from the most common meter: *dactylic hexameter*. Verses in this meter consist of six feet, each of two to three syllables.

  - Each of the first four feet may be either a *dactyl* (a heavy syllable followed by two light syllables) or a *spondee* (two heavy syllables).
  - The fifth foot is almost always a dactyl (but rarely a spondee).
  - The sixth foot may either be a spondee or a *trochee* (a heavy syllable followed by a light syllable).

- Optional sandhi processes—including resyllabification and elision (or perhaps coalescence) of adjacent vowels—can be applied to fit the text to the meter (e.g., Allen 1978:78).

(7) *arma uirumque canō Troiae quī prīmus ab ōris*   (Verg., *Aen.* 1.1)
[ar.ma.wi|rũː.kwe.ka|noː.troj|jaj.kwiː|priː.mu.sa|bōː.ris]

- While there is some flexibility in the meter, scansion can also be used to infer phonetic properties not indicated by orthography alone.

- For example, if one wishes to determine whether the medial *u* in *uoluit* is read as a vowel or a glide, then one need only determine whether the meter requires LLH or HH.

(8)
LLH:	[wo.lu.it]	's/he rolls'
HH:	[wol.wit]	's/he wished'

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[1]As is well-known, Latin word stress is a quantity-sensitive system in which heavy syllables (defined as above) attract stress (e.g., Mester 1994), providing convergent evidence for this description of syllable weight.

4 Latin glides

- There are several contexts where orthographic *i, u* are virtually guaranteed to be glides—word-initial pre-vocalic, or intervocalic—and others where they are always syllabic—such as between two consonants (e.g., *pirus* [pi.rus] 'pear tree).

	a.	*iecur*	[je.kur]	'liver'
		iocus	[jo.kus]	'joke'
	b.	*uacca*	[wak.ka]	'cow'
		uocō	[wo.ko:]	'I call upon'
(9)	c.	*aiō*	[aj.jo:]	'I say, assert'
		maior	[maj.jor]	'greater'
	d.	*aueō*	[a.we.o:]	'I wish for'
		prāuē	[pra:.we:]	'wrongfully'
	e.	*iuuenis*	[ju.we.nis]	'young'

- The word *iecur* 'liver', for example, scans as LH, i.e., [je.kur], not LLH, i.e., *[i.e.kur], and *uīuācisque*, the gen.sg. of *uīuāx* 'vivacious' cliticized with the conjunction *-que* 'and', scans as HHHL, i.e., [wi:.wa:|kis.kwe].

(10) *immortāle **iecur** tondens fēcundaque poenīs* (Verg., *Aen.* 6.576)
[im.mor|ta:.le.**je**|**kur**.ton|dẽ:s.fe:|kun.da.kwe|poj.ni:s]

(11) ***uīuācis**que **iecur** ceruī quibus insuper addit* (Ov., *Met.* 7.273)
[**wi:.wa:**|**kis**.kwe.**je**|**kur**.ker|wi:.kwi.bu|sin.su.pe|rad.dit]

- In (9c), intervocalic *i* is transcribed as a geminate [j.j]. The convergent evidence for this pronunciation is substantial (Allen 1978:39):

  - Intervocalic *i* is written as ⟨II⟩ in several inscriptions.
  - It is explicitly described as such by the late classical grammarian Quintilian.
  - It anticipates geminates in Italian cognates (e.g., *peior* 'worse' > It. *peggio* [pedʒ.ʒo]).
  - The preceding syllable scans as heavy; e.g., *maior* [maj.jor] 'greater' scans as HL.

(12) *nec pietāte fuit nec bellō **major** et armīs* (Verg., *Aen.* 1.545)
[nek.pi.e|ta:.te.fu|it.nek|bel.lo:|**maj.jo.r**e|tar.mi:s]

(13) **Asymmetry I**: Intervocalically, *i* forms a geminate glide and *u* a singleton glide.

- Hall (1946), possibly influenced by orthographic conventions, assumes the glides are allophones of high vowels, and Steriade (1984) provides a partial account of glide formation.

- However, there are several difficult near-minimal pairs, as in (1) above.

- Cser (2012) and Hoenigswald (1949) draw attention to the ambiguous *uoluit*.

(14) a. /uolu-i-t/ $\longrightarrow$ [wol.wit] 's/he rolls' (cf. *uoluō* [wol.wo:] 'I roll')
      b. /uol-U-i-t/ $\longrightarrow$ [wo.lu.it] 's/he wished' (cf. *uolō* [wo.lo:] 'I wish')

- Anticipating a later conclusion (§C), the failure of glide formation in [wo.lu.it] is due to a peculiar property of the /-U-/ perfect suffix.

- Cser draws attention to *belua* 'wild beast', which would seem to form a near-minimal pair with *silua*. While metrical evidence indicates that the *u* in *belua* is in fact vocalic, it also reveals that the first syllable is unexpectedly heavy.

(15) *et centumgeminus Briareus, ac **belua** Lernae*   (Verg., *Aen.* 6.287)
      [et.ken|tũ:.ge.mi|nus.bri.a|re.u.sak|**bel.lu.a**|ler.naj]

- Since some manuscripts have *bellua*, I assume this is properly [bel.lu.a]. Anticipating a later conclusion (§6), I assume the onset of the preceding geminate blocks glide formation.

- The noun *aquam* [a.kwã:], the acc.sg. form of *aqua* 'water', has been compared to *acuam*, the 1sg. subjunctive form of the verb *acuō* 'I sharpen'). However, this comparison is only valid if one assumes *qu* is /ku/, which seems unworkable (e.g., Cser 2013).
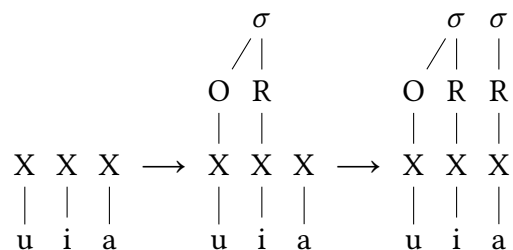
5 "Leftmost wins"...except when it loses

- Steriade (1984) provides a simple analysis of glide formation, focusing on two environments illustrated above.

(16) **#__V**: word-initial pre-vocalic cf. (9abe)
      V__V: intervocalic cf. (9cde)

- These contexts may overlap. For instance, in *uia* [wi.a] 'road', by hypothesis /uia/, the initial /u/ is word-initial and pre-vocalic whereas the following /i/ is intervocalic.

- To handle such cases, Steriade proposes a principle "leftmost wins", implemented by left-to-right application of the CV rule.

(17) Syllable parsing for /uia/ (after Steriade 1984:6a):

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            σ              σ  σ
           ╱ |            ╱ |  |
          O  R           O  R  R
          |  |           |  |  |
  X X X → X  X  X  →  X  X  X
  | | |     | |  |      |  |  |
  u i a     u  i  a     u  i  a
```

- However, the following shows that is not the whole story.

(18)   *ūua*   [uː.wa]   'grapes'
    ūuidus   [uː.wi.dus]   'damp'

(19)   *ūritur et prēlīs nōn inuidet **ūua** Falernis*   (Stat., *Silv.* 2.2.5)
    [uː.ri.tu|ret.pre:|li:s.no:|nin.wi.de|tuː.wa.fa|ler.nis]

(20)   ***ūuidus** hībernā uēnit dē glande Menalcas*   (Verg., *Ecl.* 2.20)
    [**uː.wi.du**|si:.ber|naː.we:|nit.de:|glan.de.me|nal.kas]

- These examples suggest that it is not the leftmost high vocoid which undergoes glide formation (i.e., "wins"), but rather the leftmost **short** vocoid.[2] See §B for further discussion.

6   Post-coda glide formation

- With the exception of the so-called labiovelars—*qu* [kw], *gu* [gw], and *sw* [sw]—glides do not form branching onsets.

- Front glide formation never occurs when preceded by a coda consonant.

- However, back glide formation occurs when /u/ is preceded by a coda liquid /l, r/ and followed by a vowel (Devine and Stephens 1977:62, 134f.).

(21)   a.   *puluis*   [pul.wis]   'dust'
      silua   [sil.wa]   'forest'
   b.   *ceruus*   [ker.wus]   'deer'
      seruiō   [ser.wi.oː]   'I serve'

- Further complexities arise with intervocalic sequences of adjacent high vocoids.

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[2]I reject the possibility that glide formation is blocked by a parochial constraint against tautosyllabic [wu], as this constraint is not surface-true.

(22)
   a.   *dēuius*   [deː.wi.us]   'devious'
         pauiō   [pa.wi.oː]   'I beat'
   b.   *naeuus*   [naj.wus]   'birthmark'
         saeuiō   [saj.wi.oː]   'I am furious'

- Arguably, this is a violation of the spirit of "leftmost wins" (§5).

- Back glide formation also occurs when the adjective-forming suffix *-u-* (and the appropriate vowel-initial agreement suffixes, e.g., masc. nom.sg. *-us*) derive this environment.[3]

- When this derivational suffix is followed by a liquid, it is realized as [w] as in (23b).

(23)
   a.   *assiduus*   [as.si.du.us]   'constant'
         mūtuus   [muː.tu.us]   'borrowed'
   b.   *caluus*   [kal.wus]   'bald'
         curuus   [kur.wus]   'bent'

(24)   *Ītaliae **curuīs**que immūgiit Aetna cauernīs*   (Verg. *Aen.* 3.674)
      [iː.ta.li|aj.**kur**|**wi**ː**s**.kwim|muː.gi.i|tajt.na.ka|wer.niːs]

(25) **Asymmetry II**: Not counting the onset phase of an intervocalic geminate, *i* is never a glide in post-coda position; after coda /l, r, j/, *u* is ordinarily a glide.

- A morphologically conditioned exception to this generalization is discussed in §C.

7   Conclusions

- Under these assumptions, Latin "glide formation" is a "taxonomic artifact", a cover term for the interaction of several different processes.

  > There are no rules for forming relative clauses in Hindi, verb phrases in Swahili, passives in Japanese, and so on. The familiar grammatical constructions are taken to be taxonomic artifacts, useful for informal description perhaps but with no theoretical standing. (Chomsky 2000:8)

- This taxonomic artifact is not only asymmetric with respect to front vs. back glides, it has anti-functional properties:

  - Post-consonantal back glide formation can bleed front glide formation, as in [pa.wi.oː], but it can also co-exist with gratuitous front glide formation, as in [naj.wus].
  - Post-consonantal back glide formation fails to obtain in perfects.

- These generalizations are easily expressed with ordered rules, but may pose difficulties for teleological and/or non-derivational theories of phonology.

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[3]These derivatives have a similar semantics to past participles ("having been Xed") but some can also be read as "able to be Xed"; e.g., *dīuiduus* [diːwi.du.us] (cf. *dīuidō* [diːwi.doː] 'I divide') can mean either 'divided' or 'divisible'.

A Variation in post-coda glide formation

- Lehmann (2005) notes that post-consonantal, pre-vocalic context permits some degree of variability, at least in poetry.

- *Diaeresis*—underapplication of glide formation—occurs in a Asclepiadean verse (Hor., *Carm.* 1-23.4) in which *siluae*, the gen.sg. form of *silua* 'forest', scans as LLL, suggesting [si.lu.aj] rather than the expected [sil.waj] (Hor., *Carm.* 1.23.4).

- *Synizesis*, or overapplication of glide formation, is characteristic of 's hexameters.

- Virgil occasionally uses *synizesis*—overapplication of glide formation—to post-coda front glides, *contra* (25). For instance, *abiēte*, the ab.sg. form of *abiēs* 'silver fir', scans as [ab.je:.te] rather than the expected [ab.i.e:.te].

  (26) *inclūsēre cauī et nigrā nemus **abiēte** cingunt*   (Verg., *Aen.* 8.599)
        [iŋ.klu:|se:.re.ka|wi:t.nig|ra:.ne.mu|s**ab.je:.te**|kiŋ.gunt]

- Similarly, Virgil also engages in synizesis with post-coda /u/. For example, *tenuis* scans as [ten.wis] rather than the expected [te.nu.is] (cf. Steriade 1984:48).

  (27) ***tenuis** ubī argilla et dūmōsīs calculus arvīs*   (Verg., *G.* 2.180)
        [**ten.wi.s**u|bi:r.gil|let.du:|mōsīs|kal.ku.lu|sar.wi:s]

- Variable synizesis might provide further evidence for the productivity of glide formation.

B Desinences

- Traditional grammars present the Latin diphthongs *ae* [aj] and *au* [aw] as unary segments,[4] but Cser (1999) uses distributional evidence to argue they are biphonemic sequences of a short monophthong followed by a coda glide:

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[4]For sake of completeness, I note the existence of five other diphthongs, all of low type frequency.

- *ei* [ej] occurs in contractions such as *deinde* 'afterwards, next' (< *dē* + *inde*).

- *eu* [ew] occurs in a few words including the interjection *ēheu* [e:.hew] 'alas!' and the conjunction *seu* [sew] 'either, or' (< *sī* + *ve*).

- *ou* [ow] occurs only in the conjunction *prout* [prowt] 'according to, insofar as' (< *prō* + *ut*).

- *ui* [uj] occurs in the interjection *hui* [huj] 'my word!' and in pronouns such as the dat.sg. demonstrative and interrogative pronouns *huic* [hujk] and *cui* [kuj].

- *oe* [oj] is found in Greek borrowings and in a few native stems (e.g., *foetus* [foj.tus] 'fetus'), but merged with *ē* during the Classical period.

- Syllables containing diphthongs are always heavy.
- Whereas monophthongs can be followed by tautosyllabic sonorants, as in *umbra* [um.bra] 'shade' or *ōrnō* [o:r.no:] 'I furnish', diphthongs never are.

- These together suggest that the offglide portion of the "diphthongs" are simply coda glides, and diphthongal syllables are heavy because they are closed as in (6).

- Under Cser's analysis, and assuming that glides are allophones of high vocoids, the 1st declension gen.sg. and dat.sg. desinence *-ae* [aj] is formed by word-final glide formation.

- Further evidence for the principle (discussed in §5) that only short monophthongs are eligible for glide formation comes from the absence of glide formation in certain desinences of the marginal declensions, namely

  - the masc. and fem. dat.sg. *-uī* [u.i:] of the 4th declension,
  - the gen.pl. *-uum* [u.ũ:] of the 4th declension, and
  - the gen.sg. and dat.sg. *-eī* [e.i:] of the 5th declension.

- Note that length in the 4th declension gen.pl. [u.ũ:] is the result of a lengthening triggered by word-final nasalization.[5]

- Evidence that word-final nasals are realized as nasalization of the preceding vowel comes from *testimonia* and inscriptions like ⟨COSOL⟩ for *consul* (Allen 1978:28).

- And lengthening is needed to explain why affected syllables still scan as heavy, as in the final syllable of *manuum*, the gen.pl. form of *manus* 'hand'.

(28)   *accipe et haec,* **manuum** *tibi quae monumenta meārum*   (Verg., *Aen.* 3.486)
        [ak.ki.pe|tajk.**ma.nu**|**ũ**:.ti.bi|kwaj.mo.nu|men.ta.me|a:rũ:]

C   Athematic perfects

- A more involved case concerns the so-called "third" (or "perfect") stems.

- Schoolchildren learning Latin memorize four forms (or principal parts) of each verb.

  - The first two principal parts can be used to derive present-tense forms of the verb.
  - The third principal part, the 1sg. perfect active (e.g., *amāvī* 'I loved'), can be used to derive the perfectives of the verb.

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[5]I take no position on whether compensatory lengthening was synchronically active during the Classical period.

- The relationship between present and perfect stems may be phonologically unpredictable, up to and including full suppletion.

- This has lead some (e.g., Lieber 1980:141f.) to suggest that the perfect stem is "stored"—not derived. But Aronoff (1994: chap. 4) and Steriade (2012) argue the relationship between the stems is partially phonological.

- Most verbs form perfects by concatenating:

  √: the verb root,

  Th: the appropriate theme vowel,

  Perf: the perfect suffix, usually a back vocoid here written as /-U-/, and

  Agr: the appropriate person-number agreement suffixes, e.g., 1sg. /-iː/.

- For such canonical verbs, the perfect /-U-/ is always intervocalic—preceded by a theme vowel and followed by a vowel-initial agreement suffix—and realized as [w].

  (29) *cupīuī* /kup-iː-U-iː/ ⟶ [ku.pi:.wi:] 'I desired'
       dēlēuī /deːl-e-U-iː/ ⟶ [de:.le.wi:] 'I destroyed'

- However, some verbs lack a theme vowel in the perfect. In these *athematic perfects*, /-U-/ occurs immediately after the stem.[6]

  (30) *domuī* /dom-U-iː/ ⟶ [do.mu.i:] 'I tamed'
       rapuī /rap-U-iː/ ⟶ [rap.u.i:] 'I snatched'

- Glide formation does not obtain here, even when the verb stem ends in a coda liquid.

  (31) *aperuī* /aper-U-iː/ ⟶ [a.pe.ru.i:] 'I opened'
       uolui   /uol-U-i/   ⟶ [wo.lu.i:]   'I wished'   cf. (14b)

  (32) *iactātam hāc dēmum **uoluit** cōnsistere terrā*   (Verg., *Aen.* 1.629)
       [jak.ta:|ta:k.de:|mũ:.**wo.lu**|**it**.kõ:|sis.te.re|ter.ra:]

- There are several ways one might derive the peculiar properties of perfect /-U-/:

  – If the relevant rule of glide formation is *R*, it may be an ordinary /-u-/ with a negative rule feature [−*R*] (à la Chomsky and Halle 1968:§4.2.2).
  – Alternatively, it could be an effect of cyclic spellout; i.e., perhaps the vowel-initial Agr suffix is not yet present when *R* applies.
  – Or, the Th exponent in "athematic" perfects could be a phonetically null segment that blocks glide formation (à la Trommer 2012:§9.2.3).[7]
  – Or one could even appeal to underspecification (à la Inkelas and Orgun 1995).

- I take no position on the matter for now.

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[6]Athematic perfects are found in all four major conjugations, but are most common in the 2nd (-*ē*-) conjugation.
[7]Thanks to Anthi Revithiadou (p.c.) for suggesting this possibility.

Note on data sources

A digital copy of the Lewis and Short (1879) dictionary was used for lexical searches. Crucial forms have been confirmed with the *Oxford Latin Dictionary* (Lee 1968) or the Silver Age poetic corpus, particularly the Pharr (1964) *Aeneid.*

Abbreviations used

1sg. first person singular
abl.sg. ablative singular
acc.sg. accusative singular
dat.sg. dative singular
fem. feminine
gen.pl. genitive plural
gen.sg. genitive singular
Hor. Q. Horatius Flaccus: *Carm.* (*Carmina*)
It. Italian
LAD language acquisition device
masc. masculine
nom.sg. nominative singular
Ov. P. Ouidius Naso: *Met.* (*Metamorphoses*)
Stat. P. Papinius Statius: *Silv.* (*Siluae*)
Verg. P. Vergilius Maro: *Aen.* (*Aeneis*), *Ecl.* (*Eclogae*), *G.* (*Georgica*)

References

Allen, W. Sidney. 1978. *Vox Latina: A Guide to the Pronunciation of Classical Latin.* Cambridge University Press, 2nd edition.

Aronoff, Mark. 1994. *Morphology by Itself: Stems and Inflectional Classes.* MIT Press.

Chomsky, Noam. 1986. *Knowledge of Language: Its Nature, Origins, and Use.* Praeger.

Chomsky, Noam. 2000. *New Horizons in the Study of Language and Mind.* Cambridge University Press.

Chomsky, Noam, and Morris Halle. 1968. *The Sound Pattern of English.* MIT Press.

Cser, András. 1999. Diphthongs in the syllable structure of Latin. *Glotta* 75:172–193.

Cser, András. 2012. The role of sonority in the phonology of Latin. In *The Sonority Controversy*, ed. Steve Parker, 39–64. Mouton de Gruyter.

Cser, András. 2013. Segmental identity and the issue of complex segments. *Acta Linguistica Hungarica* 60:247–263.

Dell, François. 1973. *Les règles et les sons.* Hermann.

Devine, Andrew M., and Laurence D. Stephens. 1977. *Two Studies in Latin Phonology.* Anma Libri.

Hale, Mark, and Charles Reiss. 2008. *The Phonological Enterprise.* Oxford University Press.

Hall, Robert A. 1946. Classical Latin noun inflection. *Classical Philology* 41:84–90.

Halle, Morris. 1959. *The Sound Pattern of Russian.* Mouton.

Hoenigswald, Henry M. 1949. Antevocalic *u*-diphthongs in Latin. *Language* 25:392–394.

Inkelas, Sharon, and Cemil Orhan Orgun. 1995. Level ordering and economy in the lexical phonology of Turkish. *Language* 71:763–793.

Kenstowicz, Michael, and Charles Kisseberth. 1979. *Generative Phonology: Description and Theory.* Academic Press.

Kiparsky, Paul. 1968. *How Abstract is Phonology?* Indiana University Linguistics Club.

Lee, G. M., ed. 1968. *Oxford Latin Dictionary.* Clarendon Press.

Lehmann, Christian. 2005. La structure de la syllabe latine. In *Essais de phonologie latine*, ed. Christian Touratier, 157–206. Publications de l'Université de Provence.

Lewis, Charlton T., and Charles Short. 1879. *A Latin Dictionary.* Harper & Brothers.

Lieber, Rochelle. 1980. On the organization of the lexicon. Doctoral dissertation, MIT.

Meiser, Gerhard. 1998. *Historische Laut- und Formenlehre der lateinischen Sprache.* Wissenschaftliche Buchegesellschaft.

Mester, Armin. 1994. The quantitative trochee in Latin. *Natural Language and Linguistic Theory* 12:1–61.

Padgett, Jaye. 2008. Glides, vowels, and features. *Lingua* 118:1937–1955.

Pharr, Clyde. 1964. *Vergil's Aeneid: Books I-IV*. D.C. Heath & Co., revised edition.

Prince, Alan, and Paul Smolensky. 1993. Optimality Theory: Constraint interaction in generative grammar. Technical Report TR-2, Rutgers University Center For Cognitive Science and Technical Report CU-CS-533-91, University of Colorado, Boulder Department of Computer Science.

Rolfe, John C. 1922. The use of devices for indicating vowel length in Latin. *Proceedings of the American Philosophical Society* 61:80–98.

Stampe, David. 1973. *A Dissertation on Natural Phonology.* Garland.

Steriade, Donca. 1984. Glides and vowels in Romanian. In *Proceedings of the 10th Annual Meeting of the Berkeley Linguistics Society*, 47–64.

Steriade, Donca. 2012. The cycle without containment: Latin perfect stems. Ms., MIT.

Trommer, Jochen. 2012. Ø-exponence. In *The Morphology and Phonology of Exponence*, ed. Jochen Trommer, 326–354. Oxford University Press.