

NEW LIGHT ON THE *ADDITAMENTVM ALDINVM* (SILIUS ITALICUS, *PVNICA* 8.144–223)*

ABSTRACT

The authenticity of the Additamentum Aldinum (Sil. Pun. 8.144–223) has long been a matter of debate. While many scholars have expressed doubts that it is by Silius and suggest rather that it is from the hands of a skilful humanist, it has not, up to this time, been possible to provide solid evidence to support their intuition. This paper not only re-examines the standard arguments for and against authenticity but brings the latest computational stylistic techniques to bear on the question. These analyses reveal that the style of the Additamentum differs in statistically significant terms from the rest of Silius' Punica.¹

Keywords: Silius Italicus; authorship attribution; computational stylistics; Latin verse

In 1417 an ancient and imperfect manuscript of Silius Italicus' *Punica* was discovered at St Gall by the famous hunter of classical texts, Poggio Bracciolini.² At least one copy was taken,³ which Poggio himself corrected up to Book 13, before sending it on to

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illam fors dulci quondam notum cor amore
expectat, curas cupiens aequare priores.

¹ The crucial sources are as follows. The most efficient summary of the transmission is M.D. Reeve, 'Silius Italicus', in L.D. Reynolds (ed.), *Texts and Transmission* (Oxford, 1983), 389–91, although H. Blass, 'Die Textesquellen des Silius Italicus', *Jahrbücher für classische Philologie. Supplementband* 8 (1876), 161–250 remains indispensable. The standard modern edition of the *Punica* is J. Delz (ed.), *Sili Italici Punica* (Stuttgart, 1987). The two key articles in defence of authenticity of the *Additamentum* are W.E. Heitland, 'The great lacuna in the eighth book of Silius Italicus', *The Journal of Philology* 24 (1896), 188–211 and G. Brugnoli and C. Santini, *L'Additamentum Aldinum di Silio Italico (BollClass, Supplement 14)* (Rome, 1995). A number of important papers are collected in A. Augoustakis (ed.), *Brill's Companion to Silius Italicus* (Leiden and Boston, 2010) (several other works by Augoustakis are important, but will be cited elsewhere to avoid confusion).

² No part of this statement is iron-clad. It may have been Poggio, but it may also have been his constant companion and friend Bartolomeo de Montepulciano. Poggio writes of several of the discoveries in the plural: Blass (n. 1), 166 n. 8. Neither is the exact date of the discovery certain; Blass (n. 1), 164 wonders whether it may have been discovered in 1416, although it was certainly sent by 1417. As for the location, that too is unclear; St Gall is essentially a best guess: Blass (n. 1), 166–8, noting also (166) that Poggio was somewhat secretive about the precise details of his discoveries.

³ It is possible that Bartolomeo ordered a second copy made. Clark champions this view, holding that it resolves a number of problems with the stemma. Without going into excessive detail, the

Italy.⁴ During the next seventy years or so, many manuscript copies were made of the *Punica*,⁵ but the codex Sangallensis (= S) that Poggio found and the copy that he sent to Italy no longer exist.⁶ Every extant manuscript of the *Punica* depends on S. In all of them, and in all printed editions before 1523, there is a substantial lacuna in Book 8 between what are now line 143 and line 225. It is this lacuna that will concern us. By the last quarter of the fifteenth century not only was the lacuna well known to Italian scholars of Silius⁷ but there was also some consensus about the content needed to bridge the gap—in the words of Calderini:⁸

post aeneae coniunx desunt librorum negligentia quinquaginta circiter versus ut arbitrator. nam ex instituta historia reliquum erat ut consecratio annae in numico narraret<ur> quam ovi(dius) in fastis commemoravit et ut anna iret ad annibalem et iunonis mandata exponeret.

after *aeneae coniunx* there are, I estimate, around fifty verses missing owing to the carelessness of the copyists. For the purposes of the story, what is left is that the consecration of Anna in the Numicus be told, as Ovid recounts in the *Fasti*, and that Anna go to Hannibal and explain the orders of Juno.

In 1523, and without any fanfare or attribution, the Aldine edition made by Francisco Asulano repaired the lacuna by the insertion of the eighty-one lines that are now known as the *Additamentum Aldinum*. There can, however, be little doubt that the Aldine editor obtained these lines from Chapter 92 of a collection of articles on Greek and Latin texts, the *Collectaneorum Hecastostys*, which had been published by Giacomo Costanzi in 1508. Costanzi claimed that the lines had been discovered by his teacher, Battista Guarino, who had sent them ‘e Gallia’ along with ‘other items of great interest’ and that he (Costanzi) had now resolved to publish them. Guarino had died in 1503,⁹ and so it is possible that Costanzi intended to honour his teacher’s memory—but it is remarkable that this publishing coup was buried in the last few pages of a volume of dry textual criticism, and it is puzzling that Guarino never published the missing text himself.

This textual mystery has been well known for centuries. Heinsius (d.1655), in so far as his notes are preserved in the 1717 edition of Drakenborch, doubts the authenticity of

manuscripts split into two families, one based on MSS F and L and another, much bigger (but worse), based on MSS O (= Q Clark), V and G. See A.C. Clark, ‘The literary discoveries of Poggio’, *CR* 13 (1899), 119–30, at 127–9 and also the stemma at Delz (n. 1), lii.

⁴ This story is set out in a letter printed in Clark (n. 3), 125. Poggio says that ‘libros transcripsit ignorantissimus omnium viventium fuit’ and that ‘ego legi usque ad xiii librum Silii, multa emendavi ...’.

⁵ See Delz (n. 1). The conspectus may be found in the *Praefatio*, ix–liv.

⁶ This is only the bare bones of the story, such as is required to understand the transmission. For a much more detailed account of the eventful century or so following the discovery of this influential work, see F. Muecke, ‘Silius Italicus in the Italian Renaissance’, in A. Augoustakis (ed.), *Brill’s Companion to Silius Italicus* (Leiden and Boston, 2010), 401–24.

⁷ Heitland (n. 1), 189 cited Marsus as the first to note it in the 1483 Venice edition, but we know now that Marsus depended on his one-time teacher Calderini. On this, see F. Muecke and A.J. Dunston (edd.), *Domizio Calderini. Commentary on Silius Italicus* (Geneva, 2011), 463. Delz (n. 1), lxiv–lxv found similar marginalia in several of the manuscripts; the earliest of them dates probably to the 1440s, more on which below.

⁸ As quoted by Delz (n. 1), lxv.

⁹ This is sometimes given as 1513, but Delz (n. 1), lxvii n. 2 shows via ample evidence that it cannot have been later than 1503.

the lines: 'a vetustis absunt exemplaribus ... an Sili sint multum ambigo'.¹⁰ The modern debate was rekindled in 1896, when Heitland published a lengthy article in defence of their authenticity.¹¹ In 1905 Sabbadini listed them among examples of fifteenth-century forgery.¹² In 1967 Duckworth performed some quantitative analysis and accepted them since their metrical patterns showed 'many similarities' to the rest of the *Punica*.¹³ Spaltenstein's 1986 commentary remains neutral, simply recording that their authenticity has been much discussed, though with no dominant view emerging.¹⁴ Delz, the editor of the standard modern edition of 1987, is adamant that the lines are an interpolation.¹⁵ His arguments, along with the testimony of Heinsius, eventually persuaded Reeve.¹⁶ The most recent entry is a booklet of 112 pages published by Brugnoli and Santini in 1995 which attempted a spirited but disorderly defence using multiple lines of argument.¹⁷ Reeve returned fire in 1998 with a trenchant review,¹⁸ and there the matter has stood.

To plan a new venture into these stormy (but well-charted) waters is therefore cause for considerable trepidation. Nevertheless, we believe that there are good reasons to do so. First, there have been only two sustained treatments—both from proponents of authenticity—while many more, but shorter, opinions favour interpolation. This has led to an imbalanced view of the scholarly consensus. Second, Reeve's entry on the transmission¹⁹ predated later analysis from Delz, and (as he later acknowledged) does not give full weight to the important considerations raised by MS C (Coloniensis), which was discovered in the sixteenth century.²⁰ A third concern is that the notes on the literary/philological aspects of the debate are now spread among half a dozen sources. It seems worthwhile to synthesize and evaluate all of this in one location. Finally, and most importantly, we bring substantial new evidence. We present a detailed stylometric analysis, using state-of-the-art computational techniques. Quantitative analyses have been attempted before,²¹ but they were limited in scope and lacked formal statistical foundation; we fill this gap. We examine the style of the *Additamentum* in terms of three different measures (metrical, lexico-grammatical and intertextual) and, in each of the three cases, find that there is a significant difference in style between the *Additamentum* and the rest of the *Punica*.

¹⁰ Heinsius in Drakenborch, commenting on *Pun.* 8.145. The rest of the note is a short summary of the lines' original publication; it identifies Costanzi as the source of the Aldine lines.

¹¹ The scholars listed here are by no means the only participants. A broader survey appears later.

¹² R. Sabbadini, *Le scoperte dei codici latini e greci ne' secoli XIV e XV* (Florence, 1905), 182.

¹³ G.E. Duckworth, 'Five centuries of Latin hexameter poetry: Silver Age and Late Empire', *TAPhA* 98 (1967), 77–150, at 91 n. 43 and 142.

¹⁴ F. Spaltenstein, *Commentaire des Punica de Silius Italicus (livres 1 à 8)* (Geneva, 1986), on 8.144.

¹⁵ Delz (n. 1), lxvii: 'ego puto toti illi fabulae diffusus Jacobum Constantium ... et ad fidem rei augendam nomine praeceptoris illustris abusum esse'.

¹⁶ In his transmission entry mentioned above (n. 1), Reeve simply states that 'W. E. Heitland upheld their genuineness against earlier doubts.' Later, in his review of Delz's edition he unequivocally accepts Delz's view: M.D. Reeve, 'A new edition of Silius Italicus', *CR* 39 (1989), 215–18.

¹⁷ Brugnoli and Santini (n. 1).

¹⁸ M.D. Reeve, 'G. Brugnoli, C. Santini: L'*Additamentum Aldinum* di Silio Italico', *CR* 48 (1998), 195–6.

¹⁹ Reeve (n. 1).

²⁰ Discussed in Reeve (n. 16).

²¹ Notably, of course, those of Duckworth (n. 13) and Brugnoli and Santini (n. 1). L. Ceccarelli, *Contributi per la storia dell'esametro latino* (Rome, 2008) is also worth consulting here, although he does not enter an opinion on the precise question at hand.

THE SCHOLARLY CONSENSUS

In the recent *Brill's Companion to Silius Italicus*, Ganiban, while considering Sil. *Pun.* 8.149, a line contained in the *Additamentum*, asserts that '[m]ost scholars consider these lines to be authentic; see, e.g., Santini (1991) 54–6, as well as Brugnoli and Santini (1995)'.²² This, as we see it, gravely misrepresents the scholarly consensus, underscoring the fact that a reprise of this issue is overdue. In fact, Brugnoli and Santini, whom Ganiban cites twice, are the only modern scholars who make a full-throated argument for authenticity. They and Heitland form a vocal minority, having written more words in favour than all the combined opinions against.

The lines of the *Additamentum Aldinum* present a vexing problem. Since Calderini, it has been clear that Anna's story is incomplete without them and so the secondary scholarship has been forced to step carefully around this accretion of uncertainty.²³ To examine the evolution of the *status quaestionis*, we briefly recapitulate the views of editors and translators. Lefebvre (1781) is the only editor who unreservedly accepts the lines: 'Nec dubito quin Silii sit'. Ruperti is characterized by Heitland as 'haltingly favourable',²⁴ although some might think him equivocal at best; he certainly notes that 'the imitation of [Virgil] and Ovid seems too servile'.²⁵ Corpet and Dubois note Lefebvre's acceptance but dissent on the basis of the clumsiness of the textual adaptation.²⁶ Bauer says: 'Along with Heinsius and others, I believe these lines were invented in order to fill up the lacuna.'²⁷ In the English tradition, Summers's edition appeared not long after Heitland's article, in Postgate's great *Corpus Poetarum Latinorum* (London, 1905). His notes in such a cramped tome are necessarily brief and refer the reader to his earlier remarks in *The Classical Review*.²⁸ That position is quite clear: 'Its genuineness is well-proved by Heitland',²⁹ but one wonders whether the note in Postgate's *Corpus* is deliberately ambiguous—'Silio non indignos esse luculenter demonstravit Heitland' ('not unworthy of Silius' does not rule out interpolation, only incompetence).

Moving to the modern era, Miniconi and Devallet are guarded, but appear to favour authenticity.³⁰ In the 1983 Loeb volume, Duff seems sympathetic: 'the verses fit in perfectly with the context, and ... are such as Silius might have written'.³¹ Spaltenstein's 1986 commentary is diplomatic,³² but like several others he too finds that borrowings from Virgil and Ovid become both more frequent and more overt.

²² R.T. Ganiban, 'Virgil's Dido and the heroism of Hannibal in Silius' *Punica*', in A. Augoustakis (ed.), *Brill's Companion to Silius Italicus* (Leiden and Boston, 2010), 73–99, at 94 n. 68.

²³ As two of many examples, A. Augoustakis, *Motherhood and the Other: Fashioning Female Power in Flavian Epic* (Oxford, 2010), 139–42 deals with the lines only after summarizing the textual crux, and is careful to draw a distinction between Silius and 'the narrator' of the *Additamentum*. A similar approach is taken in M. Fernandelli, 'Anna Perenna in Ovidio e in Silio Italico', *GIF* 61 (2009), 139–71, at 167–71: 'il poeta dei versi "aldini" vel sim.

²⁴ Heitland (n. 1), 199.

²⁵ G. Ruperti (ed.), *Caii Silii Italici, Punicorum libri septemdecim* (Göttingen, 1795), on 8.144.

²⁶ M. Corpet and M. Dubois (transl.), *Silius Italicus, Les Puniques* (Paris, 1838), 2.374.

²⁷ L. Bauer (ed.), *Silius Italicus, Punica* (Leipzig, 1890), 177.

²⁸ W.C. Summers, 'N. Heinsius and the Cologne MS. of Silius', *CR* 16 (1902), 169–72.

²⁹ Summers (n. 28), 171.

³⁰ G. Devallet and P.-J. Miniconi (transl.), *Silius Italicus, La Guerre Punique* (Paris, 1979), 127.

³¹ J.D. Duff (transl.), *Silius Italicus, Punica*, 2 vols. (Cambridge, MA, 1934), 1.xvii.

³² Spaltenstein (n. 14), on 8.144. His remarks here are fairly extensive, and worth consulting in full.

At the turn of the century, Ariemma expressed a similar view: ‘the flavour of pure adaptation ... deviates slightly from the Silian norm’.³³ Our statistical analysis provides empirical evidence in support of this scholarly intuition. In his 2005 translation, Villalba Álvarez simply acknowledges uncertainty,³⁴ but in the most recent translation (2021) Augoustakis and Bernstein, in tune with current thinking, are unequivocal: ‘Lines 144–223 ... are considered an interpolation to complete Anna Perenna’s narrative’.³⁵

In summary, then, we have just Heitland as well as Brugnoli and Santini who argue for authenticity at length. Brugnoli and Santini’s arguments are varied and deserve a fuller treatment, which will follow. The only editor or translator who commits unreservedly to authenticity is Lefebvre,³⁶ and he offers no support for his position. Delz, Bauer, Sabbadini, and Augoustakis/Bernstein are firmly of the opinion that the piece is an interpolation. Reeve, an expert on the transmission, concurs—convinced on external grounds provided by Summers and internal ones by Delz.³⁷ The rest of the opinions fall somewhere in the middle, but even among the neutral commentators most note that the adaptation of Virgil and Ovid increases noticeably in frequency and decreases in subtlety. So, in so far as we have consensus, the prevailing mood is sceptical, with proponents of interpolation outweighing the few defenders.

THE TRANSMISSION OF THE *ADDITAMENTVM* AND THE IMPORTANCE OF MS C

All theories of transmission that allow for the genuineness of the *Additamentum* share the following general assumption—that the lines were present in MS S but were lost, somehow, during the creation of Poggio’s copy. Then, following the identification of the lacuna, the missing lines were rediscovered, found their way to Guarino and thence to Costanzi. And so, the urgent question is this: *assuming that the lines we have received were present in MS S, how, precisely, is it that they are absent from the copies, and how were they then rediscovered?* Both Goold and Heitland offer conjectures based on a ‘loose sheet’. Without going into detail, if the codices were bound in such-and-such a way, with so-and-so lines per page, then if the *Additamentum* had formed the middle leaf of a quire it might have been dislodged and then later rediscovered.³⁸ Neither scholar, however, offers an explanation as to how the rediscovery might have happened after so many intervening years. No search can have occurred until the lacuna was

³³ E.M. Ariemma, *Alla vigilia di Canne: Commentario al libro VIII dei Punica di Silio Italico* (Naples, 2000), 67–8.

³⁴ J. Villalba Álvarez (transl.), *Cayo Silio Itálico, La guerra púnica* (Madrid, 2005), 99.

³⁵ A. Augoustakis and N. Bernstein (transl.), *Silius Italicus’ Punica. Rome’s War with Hannibal* (London and New York, 2021), 132 n. 9.

³⁶ Summers (n. 28) should not be assigned to this group. Although he notionally supports Heitland, he dissents in so far as he does not believe the lines to have been in MS C. As will be argued, if the lines were not in MS C, they cannot have been in MS S.

³⁷ Reeve (n. 16).

³⁸ Heitland (n. 1), 194–5 postulates that a single bifolium was dislodged from MS S which, given its likely Carolingian date, may have had, like several other manuscripts, 20 to 21 lines per page. Goold’s theory is more inventive, and involves just one side of a bifolium (at 40 lines per page) being lost from Poggio’s copy—see G.P. Goold, ‘Observationes in codicem Matritensem M. 31: De Sili et Statii Silvarum scripta memoria’, *RhM* 99 (1956), 9–17, at 11.

noticed, and the earliest such note is after 1440.³⁹ Guarino himself (if it were he that recovered them) was not born until 1435.

The most significant challenge to these theories is posed by MS C. In the late sixteenth century an independent manuscript⁴⁰ was discovered in Cologne, which was collated by both Carrio and Modius, the first publishing some readings in 1583, the latter in 1582. We know that those collations were consulted by Heinsius in the 1660s, with the aid of the notes he found in a 1547 Gryphian edition (possibly Carrio's own), and that Heinsius made his own notes in two different editions, a Colinaei and a Dausque.⁴¹ These notes of Heinsius were copied 'quanta fide potui' by Drakenborch in the preparation of his 1717 edition. Not only is MS C lost, but so too are the collations of Carrio and Modius, the annotated Gryphian relied upon by Heinsius, as well as the Colinaei and the Dausque in which he made his own notes. Now, if MS C contained the lines, then either Carrio or Modius, when performing their collations, should have discovered, and hence recorded, one of two things. Modius, collating against the 1543 Basel edition⁴² (without the *Additamentum*) should have been amazed to see the lines in MS C (Blass uses this point as a key to his claim that the lines were not there).⁴³

As for Carrio, collating against a Gryphian (containing the Aldine lines): if MS C had the lines, then it must have had line 157a, which is present in the lines from Costanzi and hence purportedly from MS S, but is *not* present in the Aldine. The presence of a new line would surely have been noteworthy. This view is also taken by Summers, leading him to dissent from Heitland ('I think the balance favours the absence of the lines from C.').⁴⁴ However, given this, it is baffling that Summers can accept that the lines' 'genuineness is well proved by Heitland'. If MS C did not contain those missing lines, especially given the very close correspondence of MSS S and C in all other respects, then certainly neither did MS S.⁴⁵ It is simply impossible that precisely the eighty-odd lines omitted while copying MS S should, coincidentally, happen to be missing in MS C. However, the only way to reconcile their *presence* in MS C with the silence of the commentators is to assume, via tortuous logic, that they noticed the lines but made no comment (thus Heitland),⁴⁶ or to assume that Modius or Carrio *did* make such a comment but that it was lost owing to the unreliability of Heinsius,⁴⁷ Drakenborch, or both of them (considered but eventually rejected by Summers).⁴⁸

One final issue to be considered is the cleanliness of the transmitted text of the *Additamentum*. As Reeve notes, it 'differs by a single letter (s in 204) from what

³⁹ This from Delz (n. 1), lxi–lxv. The earliest note we can date seems to be that of Panormita in MS R, a sibling of MS G, both assigned by Delz to the 1440s.

⁴⁰ This independence is generally accepted. Goold (n. 38), 12–13 dissents, but his theory that MS S moved to Cologne and was mutilated in the process is dismissed by Delz (n. 1), lxxvii n. 5 and easily countered by Reeve (n. 1), 390 on the basis of at least five variant readings.

⁴¹ For the full story, see Delz (n. 1), liv–lxiv.

⁴² On this, see Blass (n. 1), 205 n. 33.

⁴³ Blass (n. 1), 188 n. 20.

⁴⁴ Summers (n. 28), 171. This is not his only argument. He also notes some textual variations between the lines from Costanzi and the Aldine (as printed in the Gryphian).

⁴⁵ Blass (n. 1), 188 draws the only reasonable conclusion: that the lines were in neither manuscript.

⁴⁶ Heitland (n. 1), 197.

⁴⁷ The reliability of Heinsius is discussed by Summers (n. 28), 170–2, Delz (n. 1), lviii n. 2 and Blass (n. 1), 187–216.

⁴⁸ Summers (n. 28), 172.

someone could have written'.⁴⁹ Blass uses this as part of his argument to deny that the lines were in MS C,⁵⁰ implying that there were no variants because the lines were not there. Heitland presents an alternative—that the lines were clean because 'as the result of a later search they [were] copied at leisure and under far more favourable conditions than the rest of the poem'.⁵¹ This might be plausible as far as it goes, but even if the *copy* were perfect, the source manuscript was still, it is argued, of the ninth century and in poor condition. Textual problems occur frequently in the transmitted text, despite Poggio's corrections.⁵² We have no idea what proportion of these issues stem from problems in MS S and what proportion are due to copying errors, but certainly not all of them can be of the latter sort. It remains an intriguing peculiarity that the only portion of *Punica* Book 8 that is essentially free from textual problems should be the eighty-one lines of the *Additamentum*.

For those inclined to accept the view of Blass, Summers, Reeve, et al., who believe the lines to have been missing in MS C, then the matter is already settled—if the lines were not in MS C then they were not in MS S, and if they were not in MS S then we have no existing theory to account for their transmission. However, the evidence from MS C is weak. The manuscript is lost, the collations are lost, even Heinsius's notes based on those collations are lost—we have nothing but Drakenborch, which seems entirely too little. We therefore proceed on the basis that the case from MS C is not proved, intending to show that, even if this is left aside, there is still ample evidence to suggest that the *Additamentum* was not written by Silius.

EVIDENCE FROM LITERARY ANALYSIS

We now move to a consideration of the *Additamentum* on philological grounds. It is important to bear in mind that the modern authorship debate is set against the backdrop of a sweeping re-appraisal of the poetic value of Silius.⁵³ From his very first sentence, Heitland is deprecating: 'Silius Italicus is not a poet of the first order. But he has a place of some kind in Latin literature ...'. Delz, on the other hand, implies the opposite opinion when, after listing 'some grammatical, stylistic and metrical observations' regarding the *Additamentum*, he concludes that 'these, and others, I consider to be utterly unworthy of Silius'.⁵⁴ Although it is entirely natural for us, as readers, to bring our aesthetic judgement to bear, we must then be aware that we are arguing at one remove from the real question. Whether the *Additamentum* is good or bad poetry is not relevant—we are asking whether it is Silian. Having said that, it is possible that scholars with a dismissive attitude towards Silius are more liable to accept stylistic anomalies. Heitland, it seems, erred sometimes in this direction with such statements as '[w]e may for the present remark that imitation of Vergil can hardly be too servile for Silius'.⁵⁵

⁴⁹ Reeve (n. 1), 216 is perhaps being somewhat kind to line 209 *vigili ... voce*, discussed below.

⁵⁰ Blass (n. 1), 188 n. 20.

⁵¹ Heitland (n. 1), 196.

⁵² As discussed above, and see Clark (n. 3), 125 for the text of the correspondence.

⁵³ To give this the attention it deserves would take us too far afield; a useful starting point for further exploration is W.J. Dominik, 'The reception of Silius Italicus in modern scholarship', in A. Augoustakis (ed.), *Brill's Companion to Silius Italicus* (Leiden and Boston, 2010), 425–47.

⁵⁴ Delz (n. 1), lxxviii.

⁵⁵ Heitland (n. 1), 199.

A greater problem with this manner of analysis is that not only can each small point be rebutted in isolation, but most are presented in terms that are not objectively verifiable or, if they are, are not probative. Heitland, for example, says of line 194 that ‘the rhythm is very Silian’ (whatever that might mean), and at line 187 comments that ‘*velamen* is common in Silius’ (true, but hardly relevant. There are thirteen occurrences, but fifteen in the *Metamorphoses*, which is shorter). In any case, if this is to be a comprehensive treatment, then the most important arguments need to be considered. The simplest approach is to work line by line:

145. *umbra ... magni corporis*. For Delz, with characteristic bluntness, ‘ridiculum est’. The model appears to be Verg. *Aen.* 4.654 *magna ... mei imago*. Heitland offers Luc. 6.720 *proiecti corporis umbram*, which gives a little support to everything except *magni*. Spaltenstein is silent, except for a note that *magni* has been transposed arbitrarily for the ‘more natural’ *magna*.

146. *fors* here adverbially (for *forsitan*) is rare and, as pointed out by Delz, is not used by Silius. Spaltenstein diplomatically reminds us that it is far from the only hapax legomenon in Silius. ‘In any case,’ he continues, ‘the inventiveness of this line and the reference to Vergil are very typical of Silian manner’.⁵⁶ In that judgement we bow to his opinion, but of course being ‘typical of Silian manner’ and being of Silian composition are two different things. Heitland has no comment on this line, which is odd (cf. his lengthy note on line 199). These kinds of arguments from rarity are superficially interesting but not terribly useful as evidence. There is no sound statistical test which would tell us whether the use of a hapax legomenon is stylistically ‘Silian’ or not. Philologically, we have yet to see a convincing argument as to why rare words would be more likely from an interpolator (if anything, intuition suggests the opposite). What would be needed here is positive evidence that adverbial *fors* was more common in humanist poetry.

155–6. These lines transparently rework Verg. *Aen.* 4.690–1. Delz’s verdict is that ‘*revoluta*, taken from *Aen.* 4.691, is absurd in this location’. Presumably Delz dislikes the image of Anna flopping back into the lifeless arms of her sister—if so, we agree; it seems bathetic. Neither Spaltenstein nor Heitland offers anything here. Brugnoli and Santini remind us that this is not the only projection of the Aeneadic story of Dido onto Anna, citing *Pun.* 8.171–3 (also in the *Additamentum*) and 8.71 (undisputed).⁵⁷ The issue, however, is not the projection but the clumsy manner of its execution.

159. *devenio*. The first word of the line is enjambed, so the clause ends after *devenio*, punctuated by Delz with a semicolon. What seems initially to be a problem is that the line is scanned with an elision in *devenio; hinc* which ignores the strong sense-pause. However, Brugnoli and Santini offer at least three more instances of an enjambed initial quadrisyllable being elided across a strong sense-pause: 4.502 *Sicania? en;* 8.460 *Fulgina, his;* 13.667 *militia. heu*.⁵⁸ The nascent objection evaporates.

165. Identical to 7.282, and the only time a verbatim repeat occurs in Silius. Noted by all commentators, with the only real defence being mounted by Spaltenstein, who remarks that Virgil reuses part of Verg. *G.* 2.291 as *Aen.* 4.445 (not his only repeat—*Aen.* 4.124 and 4.165 are identical and just forty-one lines apart). Courtney

⁵⁶ Spaltenstein (n. 14), ad loc.

⁵⁷ Brugnoli and Santini (n. 1), 53.

⁵⁸ Brugnoli and Santini (n. 1), 54.

finds this persuasive and suggests, based on several examples, that ‘the composer of the interpolation, having just read Book 7, had that book prominently in mind’.⁵⁹

166. *Dido aegerrima*. Delz, correctly: ‘There is no exemplar for this brutal elision in the name of Dido.’ The name appears thirty-four times in the *Aeneid* and ten in the *Punica*, none of which is elided. It is surprising that none of the other commentators addresses this.

179. *Numicus*. Within the space of twelve lines we have two variant spellings for the name of the river, which are not (*per* scansion) problems with the text. Heitland concedes that *Numicius* is the usual nominative form and that its genitive *Numici* is much more common in literature in general. He defends *Numicus* with Livy 1.2.6.3 *super Numicum flumen*, but in fact that is the only other classical instance.⁶⁰ However, *Numicus*, with accusative *Numicum*, is the form habitually used by Servius in his late antique commentary on Virgil, a text that was well known to humanist scholars. Note in particular that Calderini uses *numico* in his prescription for the content of the lacuna (see n. 8 above) as well as in his comments on lines 1.666 and 8.358.⁶¹

181. *rapies*. Used here in two senses—Dido instructs Anna to *rapies viam* (‘set out immediately’) and *rapies ... tutos receptus* (‘take advantage of safe refuge’). Delz is unimpressed: ‘the zeugma seems too daring’, while Spaltenstein is unfazed: ‘*Rapies* does not have the same sense in the two phrases, but the zeugma explains this.’ Heitland notes a textual problem, but has nothing to say about the zeugma. Delz here is perhaps pushing his case too zealously.

191. *abscondidit*. Delz correctly observes that the word ‘is foreign to epic diction’. None of the other commentators remarks on this variant perfect (*-didit* vs *-dit*) found elsewhere only in comedy.⁶² Compare Luc. 4.458 *corpora saepe tulit caecisque abscondit in antris*.

192. *dies ... radiis*. The first of three lines that Reeve laconically adds to Delz’s list of ‘objections on internal grounds’.⁶³ To be sure, *radiis ... solis* is much the more common figure of speech. However, contrast: Prop. 4.6.86 *iniciat radios in mea vina dies*; Ov. *Met.* 7.411 *contraque diem radiosque*; Sen. *QNat.* 5.10.5 *aestate incipiunt flare, cum et longius extenditur dies et recti in nos radii diriguntur*; and so forth.

195. *manifesta*. Only here in Silius, but rare in any case. See nn. on lines 146, 199.

196. *ab alto* is criticized by Delz as ‘obscurum’. This is certainly true, and we can take as evidence the fact that both Heitland and Spaltenstein devote lengthy notes to its construction. The confusion essentially revolves around whether the waters are being drawn back from the sea as in Verg. *Aen.* 9.125 where the Tiber reverses its course (*revocatque pedem ... ab alto*) or from the deep. In the *Fasti*, Ovid instead has the river stop still (3.649–52 *sustinuit ... amnis aquas*), which is how Duff, undaunted by the text, has translated this line. Once again, if we argue that the text is not genuine

⁵⁹ E. Courtney, ‘Some problems in the text of Silius Italicus’, *RFIC* 117 (1989), 325–8, at 326.

⁶⁰ R.M. Ogilvie, *A Commentary on Livy Books 1–5* (Oxford, 1970), 41, citing W. Schulze, suggests that ‘Numicus and Numicius are found indiscriminately’, but this is a misinterpretation. W. Schulze, *Zur Geschichte lateinischer Eigennamen* (Berlin, 1933), 481 simply says he is confident that there is a connection between the relatively rare *gens Numicius* and the name of the Spring god. It is true that Schulze notes two spellings for the latter but, of the examples he gives, only this one line of Silius uses *Numicus*.

⁶¹ See Muecke and Dunston’s edition (n. 7).

⁶² Plaut. *Merc.* 360; fr. 49; Caecilius, *com.* 40; Pompon. *Atellanae* 67.

⁶³ Reeve (n. 16), 216.

because the meaning is obscure, we would need to show that genuine Silius prizes clarity; that is not a case which anyone should take up with enthusiasm.

199. *affarier*. An archaic infinitive and a Silian hapax legomenon (in fact, this precise form does not occur elsewhere in classical Latin). This is the second of Reeve's objections. Heitland mounts a lengthy defence and certainly seems successful in showing that Silius 'is fond of old forms'. In the immediate context of Anna's apotheosis, the solemnity of an archaic form does not seem inappropriate.

209. *vigili ... voce*. Delz, with characteristic terseness: '*mirum*', presumably in the sense of 'incomprehensible'. Nobody has a satisfactory interpretation for a 'wakeful voice'. Heitland offers one semantic conjecture—namely, that Hannibal is 'awake and talking out loud to himself'—but spends the bulk of his note evaluating proposed emendations before favouring *mente*. Spaltenstein prefers Bentley's emendation *corde* for *voce*, which to him 'seems quite impossible'.

217. *Tirynthius heros*. The last of Reeve's additional objections. The reference is to Fabius by lineage, but *heros* should really refer to Hercules himself. Fabius in *Pun.* 2.3 is *Tirynthia proles*. As metonymy, it does not seem impossible. For a full analysis of how Silius connects Fabius to Hercules throughout the poem, see Lee ad loc. with bibliography.⁶⁴

Taken on balance, we find the philological arguments persuasive but not conclusive. In our view, the strongest arguments for interpolation are at lines 165 (repeated), 166 (*Dido aegerrima*), 179 (*Numicus*) and 191 (*abscondidit*). We are not persuaded that the quality of the *Additamentum* is so much better or worse than genuine Silius as to constitute evidence in either direction,⁶⁵ but each reader finds something different in each text. This, as much as anything else, motivates our use of computational analysis as an adjunct to scholarly intuition. Before then, however, there is one more consideration.

THE ARGUMENTS OF BRUGNOLI AND SANTINI

Several criticisms of Brugnoli and Santini's *L'Additamentum Aldinum di Silio Italico* were laid out, in excoriating fashion, by Reeve in his review;⁶⁶ while we concur, we will not waste space by repeating them. Leaving most of those flaws aside, the authors bring two lines of argument that merit examination. The first is that there are detectable allusions (*riecheggiamenti*) to the *Punica* in Petrarch's *Africa* (c.1340) and in Walter of Châtillon's *Alexandreis* (c.1170), including allusions to lines that are contained in the *Additamentum*.⁶⁷ If established as fact, this immediately destroys the theory that the lines are a Renaissance interpolation—there is no need, as the authors attempt, to show that the frequency of allusion to the *Punica* is somehow consistent between the undisputed text and the *Additamentum*. So, leaving aside the broader question of

⁶⁴ J.M. Lee, 'Silius Italicus' *Punica* 8.1–241: a commentary' (Diss., University of Adelaide, 2017), 132–3.

⁶⁵ Cf. the closing statement of Fernandelli (n. 23), 171 ('L'autore dei versi ... è poeta dottissimo e davvero abile; tanto quanto Silio, si non di più'), although he is concerned mostly with allusive technique.

⁶⁶ Reeve (n. 18).

⁶⁷ Brugnoli and Santini (n. 1), 55–98.

those authors' knowledge of the *Punica*,⁶⁸ all that is required is to evaluate each proposed allusion (to the *Additamentum*) on its merits. There are only five, so it is swiftly done. We abbreviate some of the passages, but retain the underlining by which Brugnoli and Santini indicate their 'matches':

Pun. 8.144 vidi constructas nostrae Carthaginis arces
Afr. 3.419 menia construxit magnam Carthaginis urbem

This is the first and best example. *Carthaginis arces/urbem* is nothing out of the ordinary, but the proximity of *construere* (*struere* would be more common) is rare. If there were another four or five matches of this quality, the argument might begin to convince.

Pun. 8.175 pax nulla Aeneadas inter Tyriosque manebit
Afr. 1.107 pacatique nichil ...

Unconvincing. There are dozens of instances of *pax* near *nulla* in the classical canon (leaving aside the fact that *nihil* and *nulla* are, technically, entirely different words).

Pun. 8.201 per totam Ausoniam venerando numine culta est
Pun. 8.231 aequatam gemino simulacri numine Dido
Afr. 3.433–4 nunc colit extinctos numerumque auxisse deorum
 extimat ac gemini veneratur numinis aram

These two lines of the *Punica* are too distant to be considered as a unit. The second line of Silius does not fall within the *Additamentum* and thus (as discussed) is not relevant to the argument. Considering line 8.201 by itself is no help. Forms of *venero* near *numen* are, unsurprisingly, common;⁶⁹ no case can be built without the unusual collocation with *geminus*. Connecting *culta* to *colit* seems ambitious.

Pun. 8.208–9 incertos rerum eventus belique volutans
 anxia ducebat vigili suspiria voce
Alex. 5.83 pectore confusam reprimunt suspiria vocem

Alexandreis 5.83 matches only the second line, but in any case the intertext is weak—for example Verg. *Aen.* 1.371 *suspirans imoque trahens a pectore uocem* seems at least as good a model. These next lines from the *Africa* are still cited against *Pun.* 8.208–9 above:

Afr. 8.3 Scipio curarum laqueis, suprema volutans
 ...
Afr. 8.7 cuncta simul tacitus vigili sub mente movebat

Again, hardly a convincing intertext—*volutans* vaguely near *vigili*. There is just one more:

Pun. 8.221 concelebror, vestri generata e sanguine Beli
Alex. 2.324 cui genus a prisca descendit origine Beli

⁶⁸ Reeve's view (n. 18) that they did not know it seems persuasive, but our argument here does not compel us to take a position.

⁶⁹ There are many. See, for example, Columella, *Rust.* 10.1.1.32 *arboris antiquae numen venerare Priapi*; Ov. *Met.* 6.203 *quodque licet, tacito venerantur murmure numen*, 15.680 *quisquis adest, iussum veneratur numen*; Stat. *Achil.* 1.697–8 *egressi numen venerantur amicae | Aetolusque Ithacusque deae*.

which seems futile. Not only do the underlined ‘matches’ smack of desperation, the authors themselves provide a more plausible model for the line from the *Alexandreis*—namely, Ov. *Met.* 4.213 *septimus a prisco numeratur origine Belo*.⁷⁰

In summary, it simply cannot be accepted that Brugnoli and Santini have proved any kind of connection between either of these two texts and the contents of the *Additamentum*. Once again, we express no opinion on their claims regarding the *Punica* in general as an influence on the *Africa* and the *Alexandreis* since it is not pertinent to the question at hand.

The other claim, laid out in Chapter II, relates to the way in which Ovidian allusion is handled throughout the Anna Perenna episode (8.44–235). Essentially, the authors argue that allusion is used to tone down the story in the *Punica* compared to Ovid’s racier account in the *Fasti*, and that this practice (‘l’intento di denaturare il modello ovidiano’) is consistent between the undisputed text and the *Additamentum*. They then categorize and count allusions in 108 lines of undisputed Silius vs 80 lines of the *Additamentum*. Statistically, there are many objections. Leaving aside the breakdown into categories, which are completely subjective (the authors themselves identify this as a limitation),⁷¹ the total number of allusions cited in each section is not ‘pressoché equivalente’ as is claimed. Sixteen total instances⁷² in 108 lines of undisputed Silius is around 14.8 per cent, whereas eight instances in 81 lines of the *Additamentum* is 9.9 per cent, although there is no way of knowing whether this variation is significant. Essentially, the sample is just too small to be worthwhile. In total, about two hundred lines are analysed, of twelve thousand in the *Punica*. The authors’ argument is interesting from a literary perspective,⁷³ but it cannot be made statistically. At this point in the story, anyone, whether Silius or an interpolator, ‘was bound to make ample use of *Aeneid* 4 and *Fasti* 3.523–656’,⁷⁴ not least *because that is precisely what Calderini had said should be done*. To build a quantitative picture of authentic Silian style, the authors would have done better to consider Virgilian allusions which occur throughout the *Punica* and not the allusions to *Fasti* 3 which are naturally concentrated in this section. The beginning of such an analysis occurs in the very last line of the chapter, where they record the relative proportions of two types of Virgilian allusion. Their data indicates that the *Additamentum* has a slightly higher proportion of both. This finding—that the Virgilian allusions increase—is consistent with the intuition of many of the commentators (as discussed above) and is, in fact, one of the arguments *against* authenticity.

⁷⁰ Brugnoli and Santini (n. 1), 72.

⁷¹ Brugnoli and Santini (n. 1), 47.

⁷² The sums of the table in Brugnoli and Santini (n. 1), 47 for their categories a¹, a² and a³.

⁷³ Until the previous century, Silius was taken to owe the bulk of his intertextual debt to Virgil. This was challenged by R.T. Bruère in two seminal papers: ‘*Color Ovidianus* in Silius’ *Punica* 1–7’, in N. Herescu (ed.), *Ovidiana. Recherches sur Ovide* (Paris, 1958), 475–99; and ‘*Color Ovidianus* in Silius’ *Punica* 8–17’, *CPh* 54 (1959), 228–45. The relationship with Ovid has been taken further by M. Wilson, ‘Ovidian Silius’, *Arethusa* 37 (2004), 225–49 and recently by R. Marks, ‘Searching for Ovid at Cannae: a contribution to the reception of Ovid in Silius Italicus’ *Punica*, in N. Coffee, C. Forstall, L. Galli Milliç, D. Nelis (edd.), *Intertextuality in Flavian Epic Poetry: Contemporary Approaches* (Berlin and Boston, 2020), 87–106. Also important here is Fernandelli (n. 23), in particular because he situates himself as a follower of Brugnoli and Santini’s ideas (at 147), but argues instead from a purely literary standpoint.

⁷⁴ Reeve (n. 1), 195.

A STYLOMETRIC INVESTIGATION

In this section we set out the most novel contribution of this paper.⁷⁵ These techniques are drawn from the latest methods in computational stylometry and represent a true cross-disciplinary approach.⁷⁶ We employed three different types of analysis to compare the *Additamentum* to the rest of the *Punica*. The rationale behind providing three different studies is to explore the nature of the *Additamentum* from three orthogonal perspectives, examining metre, language and literary allusion. We show that the style of the *Additamentum* is a statistical outlier in all three terms. As we have discussed, even a very close philological examination is subject to endless debate. Many scholars have expressed reservations regarding the authenticity of the *Additamentum*, but it has not yet been possible to provide *evidence* through a unified analysis that considers several factors at once. It is hoped that this section will finally fill that gap.

The first study concerns metrical style. Although the quantitative study of the Latin hexameter is well established in ‘traditional’ Classics and Philology⁷⁷ and stylometry has been applied to the *textual* features of Latin prose writers,⁷⁸ computational stylometrists have rarely studied the *metrical* patterns of Latin poets.⁷⁹ On the ‘traditional’ side, Duckworth considered the genuineness of the *Additamentum* in 1967 and concluded that ‘[t]he fact that there are so many similarities between the passage in question and the *Punica* as a whole argues strongly for the authenticity of the passage’.⁸⁰ Duckworth’s analysis (and indeed his prolific work on the quantitative analysis of Latin poetry in general) was groundbreaking, but considerable advances have been made in the intervening half-century. His brief investigation compares the percentages of certain hexameter foot patterns, along with some metrics of his own invention (repeats, pattern variety, reverses, etc.), but it has no formal statistical basis.⁸¹ We aimed, therefore, to investigate the metrical qualities of the *Additamentum* using updated techniques. Because this application to Latin metre was

⁷⁵ Owing to the nature of the present venue, the finer technical details would obstruct effective communication of the results. We have therefore published supplementary information containing a complete description of the experiments, the supporting analysis (to validate the selected methods and parameters) and the pre-processed corpus. Using this data, it should be possible for technical readers to fully replicate every figure and statistic we provide: <http://doi.org/10.5281/zenodo.5010746>

⁷⁶ For technical background, approachable surveys are available in P. Juola, ‘Authorship attribution’, *Foundations and Trends in Information Retrieval* 1 (2007), 233–334 and in E. Stammatos, ‘A survey of modern authorship attribution methods’, *Journal of the American Society for Information Science and Technology* 60 (2009), 538–56.

⁷⁷ Some we have already discussed: Duckworth (n. 13) (who has several other publications, all worthwhile) and Ceccarelli (n. 21). M. Platnauer, *Latin Elegiac Verse: A Study of the Metrical Usages of Tibullus, Propertius and Ovid* (Cambridge, 1951) is well known, and mention might also be made of W. Knight, ‘Homodyne in the fourth foot of the Vergilian hexameter’, *CQ* 25 (1931), 184–94. The list is by no means exhaustive.

⁷⁸ The best known is perhaps I. Marriott, ‘The authorship of the *Historia Augusta*: two computer studies’, *JRS* 69 (1979), 65–77.

⁷⁹ Virtually the only work here is C.W. Forstall, S.L. Jacobson and W.J. Scheirer, ‘Evidence of intertextuality: investigating Paul the Deacon’s *Angustae Vitae*’, *Literary and Linguistic Computing* 26 (2011), 285–96. Forstall and Scheirer also have an un-reviewed note entitled ‘A statistical study of Latin elegiac couplets’, available at <http://tesseract.caset.buffalo.edu/blog/wp-content/uploads/2012/10/forstall-scheirer.dhcs2010.pdf>. Our metrical study uses an entirely different approach.

⁸⁰ Duckworth (n. 13), 92 n. 43.

⁸¹ It is certainly not our intention to dismiss this style of analysis out of hand—it is an important part of qualitative literary analysis: consider, for example, the approach taken in R.J. Littlewood, *A Commentary on Silius Italicus’ Punica* 10 (Oxford, 2017), lxix–lxxii.

Table 1: A description of feature abbreviations used

Feature	Description
1SP ... 4SP	Foot <i>n</i> is a spondee 1 if Spondee, 0 if Dactyl
1CF ... 4CF	Ictus/Accent conflict in foot <i>n</i> 1 if there is conflict, 0 for harmony
1DI ... 4DI	Diaeresis in foot <i>n</i> 1 for diaeresis: — ¯ or — —
1SC ... 4SC	Strong Caesura in foot <i>n</i> 1 if there is a word break after the initial longum: —
1WC ... 4WC	Weak Caesura in foot <i>n</i> 1 if there is a word break after the first breve: — ¯ May only exist in dactylic feet.
ELC	Elision count A count of elisions—lines may have more than one. Does not include prodelision.

novel, it seemed sensible to expose it to formal peer review in a technical journal. A complete description of these techniques and results is now available,⁸² and we refer the reader to the full paper for additional detail.

In addition to foot patterns (dactyls and spondees), we analysed pauses (caesurae and diaereses), conflict between ictus and accent, and elisions (the features are described in more detail in Table 1). Because the number of metrical features is reasonably low, our approach provides highly interpretable results (Table 2). To validate this metrical analysis, we first demonstrated that hexameter authors can be distinguished with high accuracy based on their metrical style. In cases where authorial styles are very different, such as those of Ovid and Juvenal, passages as short as ten lines are sufficient. When using passages of at least 75 lines, every classification experiment produced more than 90 per cent accuracy, which supports the application of our methods in the case of the *Additamentum* (81 lines).

To compare the *Additamentum* with the rest of the poem, we took successive 81-line chunks using a ‘rolling window’. The results show that the metre of the *Additamentum* differs substantially from typical Silian style (Fig. 1). The specific metrical differences, as compared to the Silian mean, can be seen in Table 2(a). A stretch of eighty-one lines without a single second-foot weak caesura (2WC) is unmatched in classical hexameter,⁸³ and presumably this is connected to the marked differences in the first foot (1WC, 1CF, 1DI). The other significant anomaly is the much more circumspect use of fourth-foot ‘bucolic’ diaeresis (4DI). Furthermore, there is only one passage in the *Punica* whose metrical style is more unusual, that being lines 8.564–644 (during the catalogue of Italian troops).

When the passage from the catalogue (8.564–644) is compared to the *Additamentum*, it is clear that the metrical qualities in which it diverges are quite different. In the

⁸² B. Nagy, ‘Metre as a stylometric feature in Latin hexameter poetry’, *Digital Scholarship in the Humanities* (2021): doi: 10.1093/lle/fqaa043.

⁸³ Authors’ analysis, using the same software that was developed for the metrical study (see n. 82 above).

Table 2: The two most significant metrical outliers from Silius' general style. For each feature, we show the squared Mahalanobis distance (Score), the percentage of lines in the sample containing that feature (Samp. %) and the percentage of lines with that feature taken across the entire *Punica* (Mean %). Higher M^2 distances are further from typical Silian style. Features are described in detail in Table 1.

(a) The Aldine Additamentum				(b) Book 8, Catalogue of Troops			
Book Ref. 8:144-223		M^2 57.85	p -value < 0.0001	Book Ref. 8:564-644		M^2 61.60	p -value < 0.0001
Feat.	Score	Samp. %	Mean %	Feat.	Score	Samp. %	Mean %
2WC	19.37	0.00	11.48	4SC	40.07	34.57	60.16
1WC	14.55	23.46	9.52	3SP	7.81	76.54	61.33
4DI	7.37	35.80	50.81	3DI	4.40	18.52	10.52
1CF	6.14	28.40	42.48	4DI	4.28	41.98	50.81
1DI	4.73	22.22	29.44	4WC	4.07	11.11	4.89
4SC	2.87	66.67	60.16	1DI	2.94	23.46	29.44
3SC	2.49	79.01	81.80	4SP	2.91	79.01	72.64
2DI	1.75	4.94	7.53	1SP	2.00	58.02	50.61
3CF	1.74	87.65	84.30	1SC	1.87	23.46	30.68
3WC	1.69	9.88	12.22	2WC	1.67	9.88	11.48
4SP	0.75	76.54	72.64	2CF	1.15	76.54	78.42
1SC	0.73	34.57	30.68	2DI	0.89	3.70	7.53
3DI	0.30	12.35	10.52	1WC	0.81	12.35	9.52
4WC	0.30	6.17	4.89	1CF	0.60	49.38	42.48
3SP	0.30	59.26	61.33	3CF	0.31	88.89	84.30
2SP	-0.17	62.96	56.36	3SC	0.24	87.65	81.80
ELC	-0.41	51.85	44.17	2SP	0.12	54.32	56.36
1SP	-0.55	43.21	50.61	2SC	-0.40	64.20	62.86
2SC	-1.41	72.84	62.86	ELC	-0.62	46.91	44.17
4CF	-1.43	64.20	60.74	3WC	-1.34	9.88	12.22
2CF	-3.27	82.72	78.42	4CF	-12.17	45.68	60.74

passage from the catalogue (Table 2[b]), most of the distance is created by a single feature—the use of the strong fourth-foot caesura (4SC) is much less frequent than usual. When analysed by hand, thirty-five of the eighty-one lines in this section are built on an identical metrical template: they have a third-foot spondee with a strong third-foot caesura, and the fourth foot is unbroken inside a single word. One possible interpretation of this pattern is that it creates a strongly divided line with a sort of regular rhythm, as if the poet is marching to a martial theme. In any case, it seems that there is a clear poetic device, concentrated in a single feature. However, in the case of the *Additamentum* (Table 2[a]) there does not seem to be any deliberate poetic effect connecting the five features whose deviances from Silius' general style make up the bulk of the distance score.

In summary, the metrical technique of the *Additamentum* differs from the rest of the poem in a statistically significant way ($p < 0.001$). This result is *contra* Duckworth, but note that Duckworth analysed only foot patterns, not pauses. Examining Table 2(a), the general proportions of spondees and dactyls in each key position (1SP, 2SP, 3SP, 4SP) have low distances, confirming that, as Duckworth found, they match Silian proportions

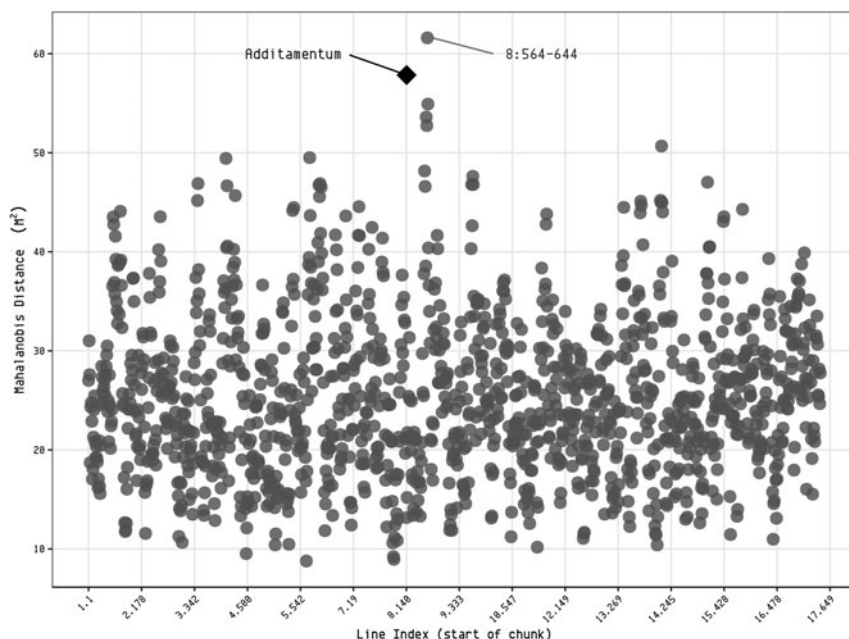


FIGURE 1: An analysis of metrical style, sampled as a rolling window throughout the text. Each point represents an 81-line chunk. Chunks with higher scores are more unusual when compared to typical Silian practice.

fairly closely.⁸⁴ However, it requires no particular stretch of the imagination to accept that foot patterns are easily counted and imitated. Winbolt offers a well-known and comprehensive guide to the composition of Latin hexameter in which he recommends precise ratios to imitate Virgilian style, and there is no reason to suppose that simple arithmetic methods were beyond a sixteenth-century humanist.⁸⁵

For the next experiment, we performed ‘Latent Semantic Analysis’ (henceforth, LSA) on the language of the *Additamentum* as compared to the language in the rest of the *Punica*. In this kind of analysis, the text is broken down into either words or ‘*n*-grams’, but it is the latter method that performs best on this problem.⁸⁶ The *n*-gram approach involves considering fragments of words: for example, ‘*punica*’ contains the 3-grams *pun*, *uni*, *nic* and *ica*.⁸⁷ By analysing the relative frequencies of

⁸⁴ Feet that are not spondees are, of course, dactyls, so it suffices to measure only spondees.

⁸⁵ S.E. Winbolt, *Latin Hexameter Verse* (London, 1903). Even the ancients were able to do this. As noted by Duckworth (n. 13), 98, ‘Silius must have studied Vergil’s metrics with extreme care to have been able to imitate him so closely.’

⁸⁶ The foundational paper here is B. Kjell, W.A. Woods and O. Frieder, ‘Discrimination of authorship using visualization’, *Information Processing and Management* 30 (1994), 141–50, but character *n*-gram methods are common, and also well covered in Juola (n. 76) and Stamatatos (n. 76).

⁸⁷ The texts were pre-processed in two important ways. First, proper nouns were removed and replaced with a single unique token. This aims to avoid ‘overfitting’. Without such normalization, the algorithm would easily classify the *Aeneid*, for example, by looking for a small handful of ‘giveaway’ *n*-grams, such as *aen*. Overfitting artificially inflates the classification accuracy, but makes the model less useful for distinguishing style in general. The second step was to transform regular Latin orthography to a phonetic representation which correctly differentiates consonantal *u*, respects

every *n*-gram in the texts it is possible to build extremely effective classifiers. *n*-grams are sensitive to minute subtleties of authorial style in terms of both lexicon and grammar (because of inflections). An immediate matter for consideration is that this type of stylometric analysis is typically applied to prose and has mostly been validated for much larger pieces of text. Because the *Additamentum* needs to be analysed as a single passage, this study works with 81-line chunks, which are around 500 words. We hypothesized that the semantic density of Latin poetry would allow strong results to be obtained, even though the samples are small. To this end, it was critical to establish first that we could effectively distinguish different authorial styles at our target sample size. We chose ten works (not restricted to hexameter): *Aeneid*, *Eclogues*, *Georgics*, *Pharsalia*, *Punica*, *Thebaid*, Juvenal's *Satires*, Ovid *Amores* Book 3, *Fasti* and *Metamorphoses*. To perform the validation, we used 'supervised' classification algorithms. In a classification experiment, the computer model is 'trained' on a subset of the data (commonly 80 per cent) and then attempts to predict the classes of the remaining 20 per cent, which it has never seen (in this case, it tries to predict the work).⁸⁸ The overall accuracy for the supervised classification tests was over 95 per cent, indicating that it is reasonable to apply LSA to the data we are examining—in particular, reliable results may be achieved even working with these seemingly small chunks.

The result presented here uses 'unsupervised' clustering, in which the chunks are arranged into clusters by the computer algorithm, and the individual points are then labelled by work.⁸⁹ The results of this clustering are shown in Fig. 2. The clustering performance is extremely strong, and it is encouraging to note that different works by the same author cluster together but retain individual identity. The *Punica*, as can be seen, has a slightly messy stylistic border with the *Aeneid* (as we would expect), but the *Additamentum* itself is markedly more similar to the lexico-grammatical style of the *Aeneid* than to any other passage in the *Punica*.⁹⁰

It is noteworthy that a lengthy section (*Pun.* 14.300–584) is detected as being stylistically close to Luc. 3.514–673.⁹¹ The passage from Lucan relates the naval attack

elision, and offers a variety of other features designed to make the *n*-grams more conducive to analysis. The full details are available in our supplementary information cited in n. 75 above.

⁸⁸ Three well-established classifiers (with quite different algorithmic approaches) were used to produce a data agnostic result—Support Vector Machines (SVC), Random Forest (ExtraTrees) and Naïve Bayes. As is standard, we used '*k*-fold cross-validation', which means that several different 80/20 splits were made, to ensure that the stated accuracy was robust, and not simply the result of a lucky train/test split. As before, we provide full replication details externally (see n. 75 above).

⁸⁹ Technically, this approach used the combined 2-, 3- and 4-grams, with frequencies transformed by TF-IDF, and a subsequent reduction from ~36k dimensions using UMAP (L. McInnes, J. Healy and J. Melville, 'UMAP: Uniform Manifold Approximation and Projection for dimension reduction', *ArXiv*, 1802.03426 [2018]). The visualizations are somewhat qualitative—in particular, it is not appropriate to make statistical claims based on distances in the UMAP figures; the intent is simply to demonstrate that the data clusters extremely well, even with 'small' samples.

⁹⁰ An earlier version of the paper presented a *p*-value here, but based on further experiments we are concerned that distances in such high dimensional space (even after reduction by LSA) may not be statistically reliable with so few samples. An abundance of caution seems warranted. Thus, while our initial experiment still feels correct, and the resulting *p*-value was significant at the 95 per cent confidence level, at this point in time we rely only on the qualitative result of the unsupervised clustering, and leave a 'hard' statistical determination to future work (if such a thing is possible—the surviving amount of comparable verses may simply be too small). For re-analysis of our own experiment, see the technical supplement (cited in n. 75 above).

⁹¹ We note one other anomaly. The chunk beginning at *Pun.* 13.628 (during Scipio's *nekyia*) is shown as being close to Statius' *Thebaid* but not to any extended section (the nearest passages begin at *Theb.* 5.205, 1.568 and 3.76).

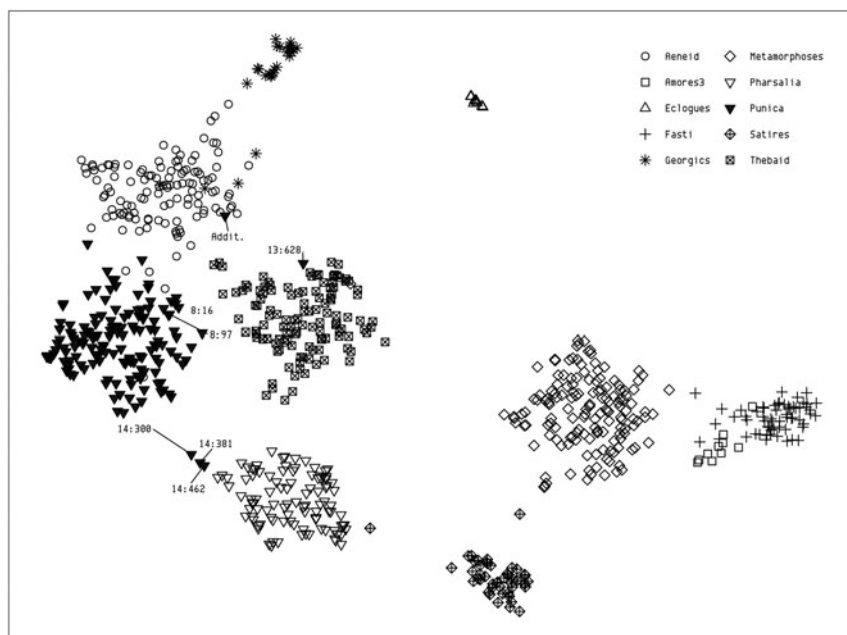


FIGURE 2: 'Latent Semantic Analysis' on the language of the *Additamentum* as compared to the language in the rest of the *Punica*.

on Massilia, while the section in *Punica* Book 14 deals with a sea battle near Syracuse. Both passages make rich use of technical language concerning warships and there are multiple synonyms for 'ships', 'sailors', 'water' and 'fire'. It seems that the specific language of naval combat is distinctive enough to dominate the general differences in authorial style between Silius and Lucan. This raises an important point. The battle at Syracuse is deliberately modelled on Lucan,⁹² so it is reasonable to wonder (given that intentional allusivity can pull a passage so far towards the cluster representing a different author) whether the *Additamentum* is simply being shown as highly allusive. Without intending to dismiss the concern (this is, after all, why we chose to perform three different studies rather than to rely on a single approach) we make two points. The first is that after the application of TF-IDF stylistic similarity scores, by design, are more affected by uncommon words than by common ones, and so this rare naval vocabulary has a disproportionately large effect; there is no such specialized lexis in the *Additamentum*. The second point is made in two parts. First, the *Additamentum* is shown as strongly Virgilian, but the surrounding text is not. This seems odd given that the extended engagement with *Aeneid* Book 4 begins at around line 8.40. Second, as so well demonstrated above (n. 73), allusion in the *Additamentum* is as much (or more) to *Fasti* Book 3 as to *Aeneid* Book 4, and yet the lexico-grammatical style as detected by the clustering appears slavishly Virgilian. None the less, it should

⁹² On which, see R. Marks, 'Silius and Lucan', in A. Augoustakis (ed.), *Brill's Companion to Silius Italicus* (Leiden and Boston, 2010), 127–53, at 144 and n. 48.

be made quite clear that the problem of differentiating ‘true’ allusivity is certainly a limitation of this technique.

The third and final experiment was designed specifically to investigate the question of Virgilian reuse.⁹³ As mentioned elsewhere in this paper, many commentators have noted that, although imitation of Virgilian lines is common in Silius, the level of borrowing within the *Additamentum* is unusually high. To perform this experiment we began with data from the well-established tool Tesseract which ‘aims to provide a flexible and robust web interface for exploring intertextual parallels’.⁹⁴ We configured the tool to search for parallels between the *Punica* and the *Aeneid*, restricting the output to high-quality matches, and then post-processed the results. To cover the technical minutiae would be tiresome; however, certain important limitations must be identified and explained. Tesseract finds parallel lines that share two or more words. The software has the ability to match words which are different forms from the same lemma, so *struxit* will match *strueram*, but in some cases this can produce false matches where morphological forms overlap. Each Tesseract match is assigned a score based on its custom algorithm, which generally lies in the range of 6 to 10 (higher being better). Qualitatively, the Tesseract authors have found that matches with a score of 7 or higher tend to be genuinely relevant when reviewed by a human,⁹⁵ although some matches might be missed at this threshold. For our purposes, since the matches could not be individually reviewed (there are around thirty-five thousand in total), we preferred an even higher threshold to avoid false positives. From there, we summed the scores for each chunk of eighty-one lines and considered this as a general score of ‘Virgilian Intertextuality’ for that chunk. We then graphed this score for a rolling window of sequential chunks taken throughout the poem (Fig. 3). A full philological exploration of the results is beyond the scope of this article, but it is comforting that we can observe some expected dips in reuse, for example at the end of Book 8 (a catalogue of Italian geography with no parallel in Virgil) and of Book 14 (the naval battle which we have already discussed as being stylistically closer to Lucan’s *Pharsalia* Book 3). In other words, the method appears to produce sensible results. This analysis confirms that the whole Anna Perenna episode is unusually Virgilian—entirely expected given the densely woven echoes of *Aeneid* Book 4. However, the *Additamentum* itself has a markedly higher score than the rest of the *Punica* and is a clear outlier both locally and in terms of the poem as a whole ($p < 0.01$).⁹⁶ This analysis suggests that, although

⁹³ The study of intertextuality is also part of the ‘digital turn’ in literary analysis, and readers might be interested to compare the methods in several chapters of N. Coffee, C. Forstall, L. Galli Millić, D. Nelis (edd.), *Intertextuality in Flavian Epic Poetry: Contemporary Approaches* (Berlin and Boston, 2020); in particular those by N. Bernstein (‘Quantitative and qualitative perspectives on the use of poetic tradition in Silius Italicus’ *Punica*, 373–88), P. Heslin (‘Lemmatizing Latin and quantifying the *Achilleid*’, 389–408) and N. Coffee and J. Gawley (‘How rare are the words that make up intertexts? A study in Latin and Greek epic poetry’, 409–20).

⁹⁴ Tesseract can be found at <https://tesseract.caset.buffalo.edu/>. This research used results from the version 3 system (the site has been recently updated), which at the time of writing is available at <https://tesseractv3.caset.buffalo.edu/>.

⁹⁵ C. Forstall, N. Coffee, T. Buck, K. Roache and S. Jacobson, ‘Modeling the scholars: detecting intertextuality through enhanced word-level n -gram matching’, *Digital Scholarship in the Humanities* 30(4) (2015), 503–15, at 511. Based on inspection of the *Punica/Aeneid* matches, we chose to increase the cut-off score to 8.

⁹⁶ The summed Tesseract scores for each chunk were confirmed to be normally distributed. The bands on the figure represent, respectively, two and three standard deviations from the mean. This suggests that at least 99.7 per cent of random chunks are less textually Virgilian than the *Additamentum*.

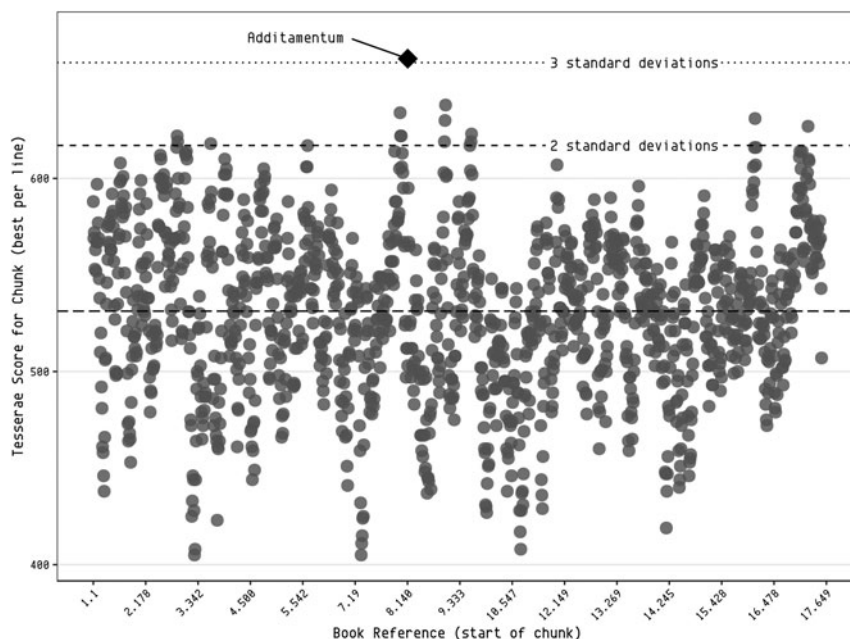


FIGURE 3: Virgilian borrowing, sampled using a rolling window through the text. The score for each chunk is the sum of the best Tesseract score for each line. Higher scores are more Virgilian. The *Additamentum* is more than three standard deviations from the Silian mean.

Silius is undeniably attracted to Virgilian style, it *is* (*pace* Heitland) ‘possible for the imitation of Virgil to be considered too servile’, even for Silius.

In summary, these three experiments measure style in three quite different ways:

1. Lexical/Grammatical Style

The most orthodox analysis is the ‘Latent Semantic Analysis’ (LSA) approach using TF-IDF normalized *n*-grams. This type of analysis has been applied to many texts in a variety of languages and is widely considered the most robust of the general stylometric techniques. We demonstrated that LSA can be applied to Latin poetry with small sample sizes while still yielding extremely accurate classification results. Our visualization (Fig. 2) displays meaningful and well-separated clustering behaviour, both at the level of authors and at the level of works. The LSA experiment shows that, in lexico-grammatical terms, the *Additamentum* is an outlier from the rest of the *Punica*, and the clustering results suggest that the style of the *Additamentum* is more similar to Virgil’s *Aeneid* than to Silius—just as many scholars have already observed.

2. Metrical Style

The metrical analysis (Fig. 1, Table 2) shows the highest-confidence margin of the three results, but is also the most novel technique. As with the LSA approach, it was shown to provide highly accurate classification on small samples and offers the most interpretable results. In the metrical analysis the *Additamentum* is one of two extremely strong outliers ($p < 0.001$). The patterns of dactyls and spondees

employed in the *Additamentum* are a reasonable match to Silian style (something that is quite feasible to imitate), but the handling of pauses in the hexameter is clearly different. We believe that this metrical fingerprint is the most difficult for an interpolator to conceal.

3. Virgilian Borrowing

The final experiment measures direct reworking of Virgilian lines and is based on data from an external tool, Tesseract. The results confirm the intuition of Spaltenstein, Delz, Ariemma and others by showing that the *Additamentum* displays significantly more direct borrowing from Virgil than Silius does in general ($p < 0.01$), even allowing for the deep connections between the Anna Perenna episode and *Aeneid* Book 4.

CONCLUSION

The authenticity of *Pun.* 8.144–223 has been questioned for almost four centuries. We have attempted to synthesize and evaluate a complex web of existing information while incorporating important recent scholarship. The essential question remains unanswered: if the lines existed in MS S, our sole source for the *Punica*, how were they lost, and how did they come to be rediscovered almost a century later? Heitland and Goold offered conjectures which, as discussed, are possible but implausible. Nobody has proposed any concrete theory as to how the lines came into Guarino's alleged possession after so many years, nor offered any corroboration for Costanzi's claim to have received them from him. Accordingly, we do not accept, as Heitland does, Costanzi's statement as 'positive evidence of the genuineness of the lines'. Furthermore, several scholars—including Reeve, Summers and Blass—believe that the unconnected MS C did not have the lines. If that case were to be proved, it is essentially impossible that the lines were in MS S. It cannot be imagined that the very same lines which were somehow lost and rediscovered in MS S were coincidentally missing from MS C. Sadly, the arguments from MS C rest on weak evidence—essentially third-hand reasoning based on notes in the unreliable 1717 edition of Drakenborch. Yet, even if we disregard the arguments from MS C, the external evidence for authenticity is weak and the defending hypotheses improbable.

Many scholars skirt the issue of authorship, avoiding a seemingly quixotic discursion. In such an atmosphere, the opinions of the vocal minority sound louder than perhaps they should. There are only two sustained arguments in favour of the genuineness of the *Additamentum*—Heitland, and Brugnoli and Santini. The arguments of Heitland have been considered at length throughout. The work of Brugnoli and Santini is both lengthy and passionate but, unfortunately, entirely unconvincing. Taken more broadly, we have showed that the current scholarly 'consensus' is split between active (but laconic) proponents of interpolation and the studiously non-committal.

Returning to the text itself, the philological debate has been stymied by the fragility and subjectivity of the evidence. Each argument that is made—a suspicious hapax legomenon here, an unusual spelling variation there—can be individually countered or ignored. Many of these 'arguments' are little more than unsupported assertion—this 'rhythm is very Silian', or that 'zeugma is too daring'. To the general instability of this debate, add the fact that the critical opinion of Silius' work has swung markedly to that poet's favour in the century or so since Heitland began the modern discussion.

Heitland, dismissive of Silius' value, sees nothing unusual in the heavy-handed reworking of Virgil in the *Additamentum*. Delz, keen to defend the rest of the *Punica*, doggedly pursues infelicities of style which he brands as 'unworthy of Silius'. After a detailed evaluation of the arguments, we suggest that little further can be achieved on the philological side. It is too easy for each scholar to accept the points that suit them, rebut the ones that do not, and then move on to try to settle the matter in a different way. Certainly, we are not persuaded that the *quality* of the *Additamentum* is so much better or worse than genuine Silius as to constitute conclusive proof in either direction.

Finally, this paper introduced a detailed stylometric analysis, using the latest techniques. We examined the style of the *Additamentum* via three different metrics and, in each of the three cases, found that there was a significant difference in style. Each method was carefully validated to ensure that it reliably differentiates authorial style and, crucially, that it does so at the smaller sample size required to examine the 81-line *Additamentum*. As befits a modern scientific investigation, every part of the computer code and data has been made fully available for review, re-analysis, enhancement, or criticism (see n. 75 above). As the results stand, they show emphatically that the style of the *Additamentum* is significantly different from the rest of the *Punica*. When the three analyses are considered in combination, the probability that this is a statistical accident is negligible. No statistical analysis can prove with certainty that the lines were *not* written by Silius. However, when this result is combined with the philological concerns, the weakness of the transmission hypotheses, and the stylistic intuition of most Silian scholars, it seems that the weight of evidence has shifted. Unless and until new evidence emerges, the default position should be that the *Additamentum* was not written by Silius, but is a sixteenth-century interpolation, written to fill the lacuna identified by Panormita, Calderini and others.⁹⁷

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⁹⁷ Many will wonder to whom, in particular, the authorship should be assigned. We cannot say. It seems certain that the interpolator was writing in deliberate imitation of Silius, and so stylometry is unlikely to identify them, even if we were to find enough of their own poetry to make a comparison. As the science is no help in this regard, this small mystery may have to live on.