Histos 13 (2019) 34–52

NEW LIGHT ON ARRIAN'S *PRAENOMEN* FROM DIGITAL EPIGRAPHY*

Abstract: This article reconsiders the evidence for Arrian's long-disputed *praenomen* using digital imaging techniques that have only recently become available. Through the application of Reflectance Transformation Imaging and 3-D scanning combined with traditional epigraphic methods, the authors clarify the text of the only inscription preserving Arrian's *praenomen*, thus contributing to the body of knowledge about an important historical personage and his relationship to elite communities in the eastern Mediterranean. The uses and limitations of these technologies are discussed to illuminate their value for original epigraphic research, which, the authors argue, is greater than has generally been recognised.

Keywords: Arrian, epigraphy, digital imaging, RTI, 3D scanning

1. Introduction

The literary and political careers of Flavius Arrianus, better known as Arrian, mark him as an exceptionally successful member of the Roman Empire's elite, but, although many aspects of his life are well understood, his full name remains controversial. The main problem lies with Arrian's *praenomen*, which appears in abbreviated form in an inscription from Athens, but the stone is damaged such that it is virtually impossible to tell with the naked eye whether the abbreviated name is Λ(ούκιος) or Α(ὔ̓λος).[1] A second inscription from Nicomedia, destroyed long ago, was reported in a state so garbled as to be unusable, but there too the possible interpretations of Arrian's abbreviated praenomen include Λύ(κιος) and Αὔ̓(λος).[2] Numerous attempts have been made to supplement the evidence of the Athenian inscription

* The authors would like to thank the staff of the Epigraphic and Numismatic Museum of Athens, particularly Athanassios Themos and Elena Zavvou, whose assistance in setting up a workspace to accommodate our technology, navigating the museum's archives, and identifying the source of the marble was indispensable. We would also like to thank the American School of Classical Studies at Athens, the anonymous reviewers for *Histos*, Steve Marshak, Scott Pike, Denver Graninger, and especially Molly Richardson. The Ministry of Culture and Sport of Greece retains the copyright to all photos and digital images in this article.

[1] *Editio princeps* by Peppas-Delmousou (1970); further discussion in Oliver (1970), Borza (1972), Kapetanopoulos (1973), Follet (1976) 34–6, Oikonomides (1980), and Grassl (1987). A minor controversy attaches also to Arrian's use of the name Xenophon, possibly as a part of his official name (Stadter (1967)), but more likely a simple nickname (Sisti (2001) XXVIII n. 1).

[2] Papadopoulos (1874); cf. Borza (1972) 101–2; see below for further discussion.

ISSN: 2046-5963 23 May 2019

(summarised below), but the controversy remains. While the *praenomen* has virtually no impact on the study of Arrian's literary production or political career, it is nevertheless important for two reasons. First, we know so little about the personal lives of most figures from Classical antiquity that when we can uncover any detail it is worth the effort. Second, what we do know about Arrian's life suggests that he was a member of a prominent family in his native province of Bithynia. He was also a Roman citizen who rose to the consulship, commanded legions, and governed the border province of Cappadocia, and it seems likely that his family, like others in the eastern provinces, had received a grant of Roman citizenship which they commemorated by giving their sons the *praenomen* and *nomen gentilicium* of their benefactor.[3] The *praenomen,* then, can potentially add to our body of knowledge concerning the relationship between Arrian's family and other notable families in the region, including their entanglement with the growing presence of Roman authority.

We have approached this old problem using new technologies in an attempt to resolve the ambiguity once and for all. Two digital imaging techniques (Reflectance Transformation Imaging and 3D laser scanning), in combination with traditional epigraphic autopsy, have allowed us to clarify the text and unequivocally state that Arrian's *praenomen* was Lucius. In what follows we explain how each method contributed something unique to our conclusions, but it is important to emphasise from the outset that we found ourselves consistently bouncing back and forth between our methods, developing partial hypotheses in a building-block fashion. None of these methods by itself could have led us to our ultimate conclusion.

2. *SEG* 30.159 and its Abbreviated *Praenomen*

The Attic inscription *SEG* 30.159 (Fig. 1) is the only surviving record of Arrian's *praenomen*. Although other inscriptions mention Arrian, none

[3] This is, of course, a general tendency and not a rule. For a thorough overview of naming patterns in the Greek-speaking communities of the Roman empire, see Rizakis (1996a), esp. 27–8 on this particular pattern; cf. Sandys (1969) 217–8. The large number of T. Flavii in Bithynia reflects an active interest in the region on the part of the Flavian emperors; cf. Fernoux (2004) 203–5; Arrian's use of the *praenomen* Lucius (or Aulus, for that matter) therefore implies that his family's citizen status predates the Flavian period. Syme (1982) 184 suggested a Republican origin of Arrian's family's citizenship on the basis of the presence in the eastern Mediterranean of L. Flavius, a suffect consul in 33 BCE, but there is no direct evidence for the connection.

preserves his *praenomen* in any useful state.[4] Not much is known about this inscription's provenance, but it most likely originated in Athens during Arri-

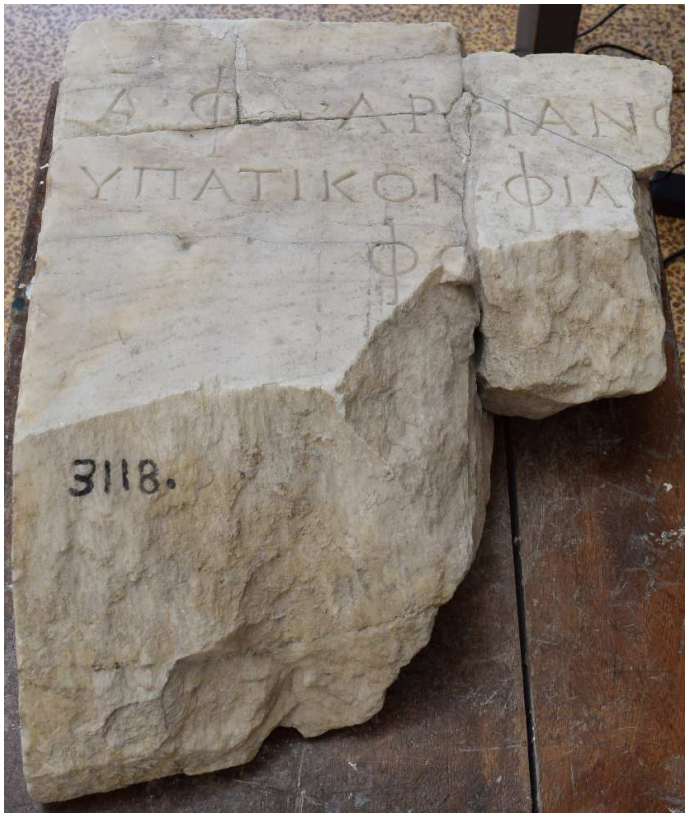

Figure 1. Inscribed face of *SEG* 30.159 (EM 2868+3025+3118+2990+3036), a monument base honouring Arrian housed in the Epigraphic and Numismatic Museum in Athens. Mid-second century CE. With permission from the Epigraphic and Numismatic Museum in Athens (Photo: authors)

an's lifetime and it must have accompanied an honorary statue or dedication of some sort. Sometime after its use for Arrian's monument, the stone bearing the inscription was broken into multiple pieces, five of which have been joined together by the staff of the Epigraphic and Numismatic Museum in Athens, where it now resides.[5]

[4] Owing to the length and success of his public life, Arrian is named or clearly referred to many times on stone. His entry at *PIR*² F 219 covers the majority of these appearances cautiously and thoroughly. In addition, the present inscription, Corinth VIII.iii.124, and *AE* 1974 370 (= *SEG* 26.1215) have subsequently appeared. For the attribution of the Corinth inscription to Arrian of Nicomedia, see Bowersock (1967). The attribution of *AE* 1974 370 is disputed (see *SEG* 57.990). For earlier discussions of the present inscription, see above, n. 1.

[5] EM 2868+3025+3118+2990+3036; Peppas-Delmousou (1970) 337 states that there are no records concerning the Epigraphic and Numismatic Museum's acquisition of the individual pieces but that they came into the possession of the museum many years ago,

The inscription appears on a block of white marble with preserved dimensions of approximately 0.50 x 0.51 x 0.20m. The size of the original inscription (and therefore the extent of lost text) is unknown since only the left side and top of the block are preserved. The right side, the bottom, and the back of the stone are all severely damaged. Some locations of breakage and shearing are still visible but the bonding material joining the fragments obscures others.

Text of *SEG* 30.159

Λ̄ ˙ Φλ̣ ˙ Ἀρριανὸ[ν]
ὑπατικὸν φιλό̣[σο]-
vac. φον̣

Line 1 (*praenomen* letter). Λ̄ with overline and no mid-line symbol: *ed. pr.* Peppas-Delmousou (1970) p. 378; Λ with no overline and no mid-line symbol: *ed. pr.* Peppas-Delmousou (1970) 380; Λ̄ ˙ wrongly recording ˙ as a mid-line dot: Oliver (1970); Λ̣ or Λ̣ without abbreviatory marks: Borza (1972); Λ without abbreviatory marks: Kapetanopoulos (1973); Λ̣ without abbreviatory marks: Oikonomides (1980).

3. Date and General Character of the Inscription

At first glance, the inscription is quite clear. The letters are neatly cut and evenly spaced on a relatively smooth piece of white marble bearing mica striations and faint claw chisel marks (Fig. 2). The content, too, is for the most part clear. Arrian's name appears in the accusative case and he is identified as a 'consular' (ὑπατικόν, line 2) and 'philosopher' (φιλόσοφον, lines 2–3). The *praenomen* and *nomen gentilicium* are recorded in abbreviated form in line 1. A horizontal line above the *praenomen* letter and antisigmas after the first and third letter of the line clearly mark the abbreviation, and in the context of a Roman name Λ and ΦΛ can only abbreviate the various Greek spellings of Lucius and Flavius respectively. The antisigmas exhibit slightly different shapes, with the first one more similar to a semicircle than the second.[6] The designation 'philosopher' is found in other inscriptions mentioning Arrian and he seems to have been most famous in his lifetime for his work in that field, so it is no surprise to see him so honoured here.[7] 'Consular' is more surprising, only because no other political office is mentioned in the inscription. One might have expected a reference to his

possibly from the collection of the Greek Archaeological Society. The exact circumstances and date(s) of the join(s) are unknown.

[6] For the abbreviatory symbols, see Threatte (1980) 86–7, 103.

[7] Corinth VIII.iii.124; Suda, s.v. Ἀρριανός (A 3868 Adler); Phot. *Bibl.* cod. 58; cf. Oliver (1982); Grassl (1987).

eponymous archonship in Athens, and its absence has prompted some to date the inscription to after his consulship (129 or 130) but before the archon-

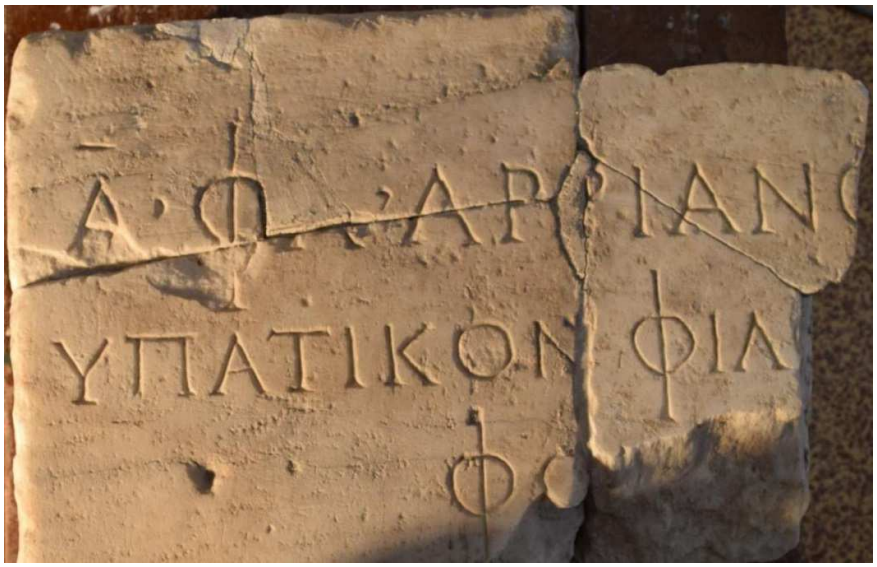

Figure 2. Inscribed text of *SEG* 30.159. With permission from the Epigraphic and Numismatic Museum in Athens (Photo: authors)

ship (145/6).[8] This view is not unlikely, but since the identity and priorities of the dedicator are unknown, it remains a guess. As for the identity of the dedicator, Oikonomides has suggested that much more of the right half of the inscription is missing than most critics have supposed, and that the indented phi in line 3 belongs to the name of the dedicator.[9] While possible, the large amount of vacant space at the beginning of line 3 and below the extant inscription militates against any interpretation involving a complete line of text. Furthermore, the engraver has left a margin of reserved space approximately the width of one letter on the left. If we posit a comparable margin on the right following Ἀρριανόν (line 1), the third line would be almost perfectly centred.

4. The *Praenomen* Letter

The first letter of the first line is clearly an abbreviated *praenomen*, but the stone is broken between two diagonal strokes joined at the top so that it is

[8] Kapetanopoulos (1973) 302; cf. Follet (1976) 35.

[9] Oikonomides (1980) 94 tentatively offers Φούλβιος or Φούλβια but acknowledges that there is not much to go on in the third line. We note also that the trace of the final letter in that line, identified as nu in all other texts, is vertical, and therefore upsilon is impossible.

difficult to tell whether we are looking at an alpha or a lambda and thus whether the *praenomen* was Αὖλος or Λούκιος. The break occurs within the preserved edges of the diagonals, and at the right height and angle to suggest that the surface of the stone has chipped away beginning at the crossbar of an alpha. However, careful examination even with the naked eye raises objections to this conclusion.

Figure 3. The *praenomen* letter. With permission from the Epigraphic and Numismatic Museum in Athens (Photo: authors)

The surviving edge of the 'crossbar' exhibits a shredded appearance similar to the cracks running below the letter on the right and left (Fig. 3). Furthermore, if there was a crossbar here, no evidence of the engraver's chisel survives. The letter may thus be a lambda instead of an alpha. Comparisons with the other alphas and lambdas of this inscription cannot confirm either reading: the diagonals are of varying lengths and the alpha crossbars are cut at varying angles and depths.[10] Owing to these inconsist-

[10] Borza (1972) 100 asserted that the alphas have a longer left leg, but the opposite is true of the first alpha in Ἀρριανόν and the lambda in line 2 also has a slightly longer left

encies, no satisfactory solution has yet arisen from visual inspection of the stone, whether through autopsy or photographs.[11]

The next step is to examine the onomastic record to determine whether Aulus Flavius or Lucius Flavius was more common in this period. Whereas many men were called Lucius Flavius, there is no record of any other Aulus Flavius in the region. Lack of a parallel is not damning, of course. There is, for example, only one Cn. Flavius (*PIR*² 371: Cn. Flavius Strabo) so Arrian could have been the only Aulus Flavius whose name survived on stone. Nevertheless, the balance of probability lies with Arrian's relationship to another prominent family, rather than to one otherwise unknown.[12]

The only other inscription that could have shed light on the *praenomen* question no longer survives, and no photographs or drawings are available. An inscription bearing Arrian's full name was uncovered in a rescue excavation near the Palace of Diocletian in Nicomedia in the 1870s along with other inscriptions and sculptural fragments but was subsequently destroyed, as reported by Papadopoulos.[13] The transcription in the original report is lamentably inaccurate, although Papadopoulos' observations are otherwise astute. Some obvious errors (e.g. ΑΓΑΘΗΙ ΣΥΧΗΙ for ΑΓΑΘΗΙ ΤΥΧΗΙ) render the transcription untrustworthy, wherever one may choose to assign the blame.[14] In the Nicomedia inscription, Arrian's *praenomen* is abbreviated ΛΥ, which would be unusual but not unparalleled for Λύκιος, an alternate spelling of Λούκιος. However, in a faulty transcription, ΛΥ could easily be a mistake for ΑΥ, which would also be an unusual abbreviation for Αὖλος but also possible, and so the Nicomedia inscription presents the same problem as the Athens inscription.

Visual inspection and traditional epigraphic and prosopographical methods were inconclusive, but led to a slight preference for lambda and that is where the question has stood since the early 1970s when, after its initial publication, the inscription became a 'hot topic' for a few years.[15] We now

leg. Moreover, the bases of the second alpha's legs appear on two different fragments which have been joined imperfectly, as the misalignment of the iota in Ἀρριανόν shows clearly, so the relative length of the diagonals is unknown.

[11] See below, n. 15.

[12] Borza (1972) 100–1.

[13] Papadopoulos (1874).

[14] Compare the remarks of Borza (1972) 101–2 and Kapetanopoulos (1973) 303.

[15] Kapetanopoulos (1973) undertook the most complete study of the inscription to date, drawing together the various approaches of those who came before him and adding a new and rigorous inspection of the stone. His conclusion was firmly lambda and that has been the dominant opinion ever since. Nevertheless, not all subsequent readers have been as certain. Shortly after Kapetanopoulos' article appeared, Follet (1976) 34–5 with n. 8 and Wheeler (1977) 13–14 remained incompletely convinced. In his influential Loeb, Brunt

have at our disposal advanced imaging techniques that may allow us to resolve the matter. The rest of this paper will present the results of our application of these techniques.

5. Digital Imaging and the Arrian Inscription: RTI and Laser Scanning

Digital imaging techniques are in something of a revolution, increasingly employed in archaeological and epigraphic studies.[16] Laser scanning, photogrammetry, and other methods have been used for documentary and archival purposes, but less commonly in original epigraphic research. As with non-visible light spectrum methods used in palaeography and papyrology, however, these methods are equally significant as research tools because they illuminate details that are invisible to the naked eye. A handful of epigraphers have found that digital imaging techniques allow revised reconstructions of older texts, especially involving worn or damaged inscriptions.[17] In an effort to resolve the *praenomen* question, we examined the Arrian inscription, giving particular attention to its first letter, using two relatively inexpensive imaging technologies, Reflectance Transformation

(1976) IX retained Aulus as a possibility. Among more recent authors, Sisti (2001) XI–XII n. 5 left no room for doubt, but Bosworth (1980) 1 n. 2 lent his weighty authority to lambda using hedging language: 'Lucius (not Aulus) now *seems* assured' (emphasis ours). Similarly, Stadter (1980) 189 n. 5 preferred lambda but acknowledged that 'A(ulus) appears possible'. Tonnet (1988) II.18–19 n. 89 suggested that there is no way to know for certain, and as recently as 1995 a major prosopography by Traill (1995) gave equal likelihood to Aulus and Lucius (*PAA* III.204160).

[16] The term 'digital epigraphy' refers to the digital publication, sharing, and storage of texts for use on various computer interfaces. Bodel (2012) 287–91 provides a background to the development of digital epigraphy as a facet of the epigraphical discipline and describes some early examples of digital imaging technologies employed in Latin epigraphy. For a general overview of the available digital epigraphy resources, see Elliot (2014). See Bozia et al. (2014) 421–5 for a discussion of trends in digital epigraphy and the uses to which new technologies have been put, such as the facilitation of epigraphic studies, dissemination of content, the illustration of texts, and original research via computerised techniques. An example of the latter includes, for example, Tracy and Papaodysseus (2009), who applied computerised methods to identify the hands of Attic letter-cutters.

[17] For example, Frasson (2014) demonstrates the ability of simple editing software for digital photographs to clarify painted texts. Pires et al. (2014) and Correia Santos et al. (2014) show that 3D scanned point clouds (created through photogrammetry and structured light scanning) can dramatically improve our ability to read worn and abraded inscriptions when the data is manipulated using a specific algorithm (Morphological Residual Model). Papadaki et al. (2015) applied structured light-scanning technology to the Parthenon inventory lists.

Imaging and 3D laser scanning. We had two main goals: to identify, if possible, any traces of a carved crossbar and to clarify the relationship between the inscribed letters and the break patterns in the stone.

Reflectance Transformation Imaging, also known as RTI, combines the manipulation of digital photographs with raking light; the technology allows users to interactively change the direction of raking light across a series of images.[18] The resulting computerised composite reveals information about an object's surface that even direct observation cannot uncover. Although the final image composite is two-dimensional, the ability to easily change lighting scenarios accentuates three-dimensional features. Over the last ten years, RTI has become one of the most widespread digital-imaging methods employed in the cultural heritage fields. For our investigation, we collected 52 digital images of the inscription using raking light from various directions and angles. We combined and analysed the images using open-source software provided by Cultural Heritage Imaging.

Our final RTI composite illuminated the surface of the block well and showed the features of the marble, the pattern of chisel marks, and fracture details. Computerised enhancements dramatically showcased the features of the break at the *praenomen* letter (Fig. 4). The difference between the naturally formed breaks and the tool-made marks became apparent, which in turn highlighted the attributes of the supposed crossbar. When a break follows the line of a letter stroke, it is still possible to see traces of the carving. The phi of Φλ(άβιον) shows the tendencies clearly: at the lowest part of the letter the broken surface of the stone is contained by the serif and the vertical stroke of phi, which are still readily apparent, but just below the circle of the phi the break completely obliterates the vertical, and there it is not possible to see evidence of carving. This pattern is the same across the entire face of the stone. When a break follows the line of a letter, it is always possible to see some evidence of the original carving. Most importantly, there is no sign detectable through RTI of a carved crossbar in the *praenomen* letter. These observations confirm the conclusions of our visual inspection and support the circumstantial case outlined already.

The interactive raking light and photo enhancement options provided by RTI improved our analysis, but the technology still confines users to a two-dimensional examination of the surface. In order to achieve three-dimensional manipulation of the artefact, we turned to 3D laser scanning.[19]

[18] Also known as Polynomial Texture Mapping (PTM), the method was first introduced in 2001. For a discussion of the technology and its archaeological and epigraphic uses, see Earl et al. (2010).

[19] Wachowiak and Karas (2009) provide an introduction to the various 3D technologies used in the archaeological and heritage management fields.

Figure 4. The text viewed using Specular Enhancement Mode in the RTI Viewer software. With permission from the Epigraphic and Numismatic Museum in Athens (Photo: K.A. Rask)

This method has become more common in ancient Mediterranean archaeology, but as yet there is no consensus on best practices for its use in epigraphy. Most digital epigraphy projects have focused on 3D renderings of squeezes, or employ laser scanning to document and disseminate models as illustrations or outreach, and thus have not produced models with sufficiently high resolution for research purposes. Because we aimed to produce extremely accurate visualisations suitable for scientific analysis, we employed a scanner designed for medical and scientific imaging, the recently designed STEM3D scanner. This triangulation-based laser scanner works by bouncing lasers off of the surface of an object and measuring the intervening distance. Millions of data points are produced which are then analysed by computers to map the object's surface topography. As a desktop model, the STEM3D scanner offers greater precision and accuracy than handheld models. It measures data points approximately every 80 microns, a high enough resolution and scale to create images that are sufficiently detailed for use in cultural heritage studies.[20]

[20] Slizewski and Semal (2009) investigate 3D scanner accuracy during the digitalisation of archaeological and anthropological artefacts, specifically considering the correct replication of artefacts' surface morphologies; they emphasise the importance of scanner

One problematic aspect of laser scanning is surface reflectivity, which can negatively affect the quality of 3D scanned data, either by deflecting the laser or absorbing it. The practical effect is that the machine cannot accurately record the laser's measurement. Although not as problematic as gold or glass objects, marble items produce a strong variation in data quality depending on their makeup. Translucent or crystalline stone such as Parian marble not only deflects the laser at the surface, but also causes sub-surface scattering of the laser beam with the result that the data quality decreases.[21] In our case, the Arrian inscription most likely appears on a block of Pentelic marble, which does have calcite crystal grains in its matrix, but they are smaller than those in Parian or Thasian marble, and therefore do not deflect the laser as much.[22]

Although the smaller calcite crystals did affect our laser data, the resultant model nevertheless featured high resolution and provided valuable information. The 3D image revealed the uneven planes of the broken surface area making up the lower half of the *praenomen* letter; moving from right to left, it is possible to trace the break's upper edge as it cuts across (and partially obliterates) the letter's right diagonal stroke, turns sharply at the 'crossbar', and stops at the outside edge of the opposite diagonal (Fig. 5). Perhaps even more importantly, the scan highlights several features that indicate that no portions of the alleged alpha crossbar were carved, and so for clarity we will henceforth refer to this feature as the letter's 'crosswall' or 'horizontal break'. First, the bed of the broken section is relatively uneven with an undulating surface. In the 3D image, two slight ridges can be seen moving vertically from the lower half of the letter up towards the crosswall (Fig. 5). Manipulating the image shows that these two ridges continue up the

choice in ensuring the highest quality visualisation. Additionally, although we scanned the entirety of the inscription, we confined our analysis to individual scans (or meshes) rather than a reconstructed 3D model. Combining (or 'gluing') multiple meshes together and processing the scans using common surface smoothing models (such as 'poisson') decreases detail and accuracy. For the purposes of this investigation, we applied minimal digital processing to each mesh, removing noise and errors from the raw scans using MeshLab.

[21] Godin et al. (2001); Guidi et al. (2009). The traditional 3D scanning method for dealing with reflectivity is to spray items with an anti-glare coating, such as developer spray, inappropriate for use on most heritage artefacts. Archaeological materials can be treated with a conservation-grade, removable matte-agent, such as a cyclododecane spray, which sublimates naturally. The use of such conservation materials on ancient artefacts usually requires special permission, which we did not seek.

[22] The opinion of two staff members at the museum was that the marble is Pentelic, although we did not carry out a full geological analysis of the stone to verify their opinion.

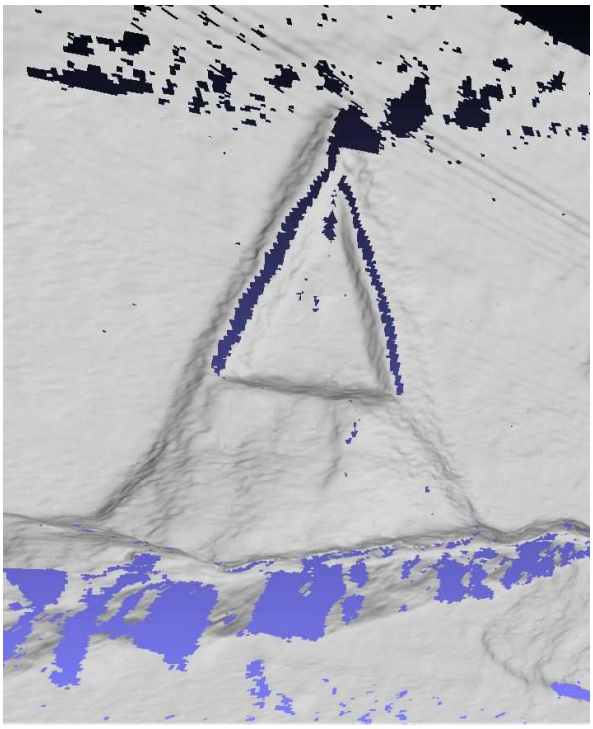

Figure 5. 3D scan of the *praenomen* letter after limited cleaning using MeshLab software. With permission from the Epigraphic and Numismatic Museum in Athens (Photo: K.A. Rask)

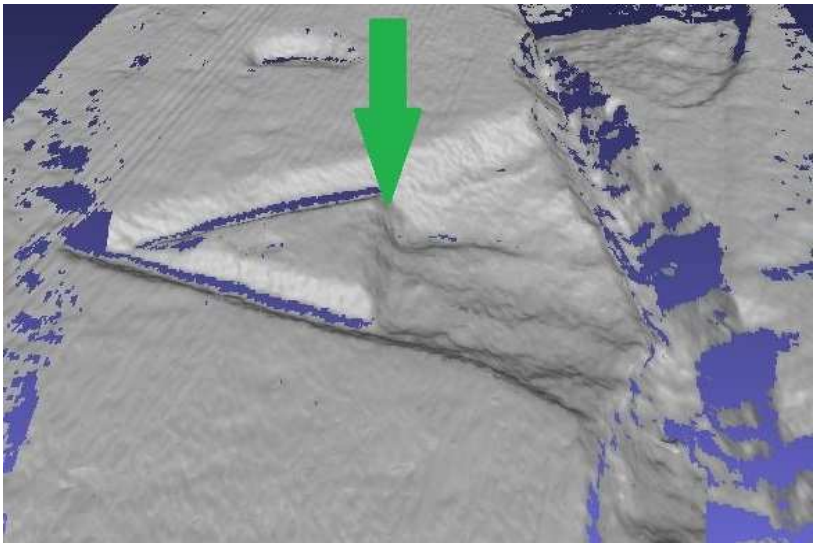

Figure 6. 3D scan of the *praenomen* letter, showing the broken surface area with deeper ridges running vertically up the crosswall. With permission from the Epigraphic and Numismatic Museum in Athens (Photo: K.A. Rask)

wall of the horizontal break (Fig. 6). If this had been a purposefully cut portion of a letter, those ridges would not match the topography of the bed so precisely. These deeper ridges provide clear visual evidence that no tool-carved 'crossbar' exists.

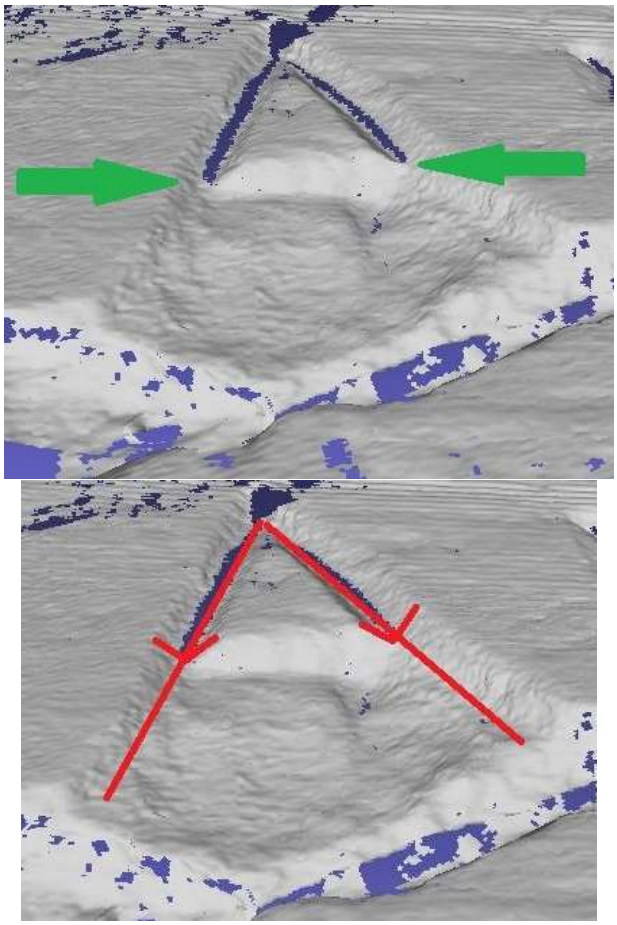

Figure 7. 3D scan of the *praenomen* letter, showing the relationship between carved and broken portions. *Top*: the preserved shallower channels of the tool-carved diagonal strokes, where they are disrupted by the deeper break. *Bottom*: the reconstructed continuation of the diagonal strokes' depth in relation to the uneven, broken surface area of the lower half of the letter. Note that most of the left diagonal stroke channel is preserved. With permission from the Epigraphic and Numismatic Museum in Athens. (Photo: K.A. Rask)

Second, anomalous features related to the depth of the crosswall become readily apparent when viewed in 3D (Fig. 7). The bottom edge of the crosswall sharply tilts downward toward the right and the horizontal break is much deeper than the inscribed portions of the letter. The three alphas on the block share an average depth with the slanting strokes of the *praenomen* letter but the crosswall is up to three times as deep. This confirms that a *praenomen* crossbar, if it ever existed, is completely gone, leaving no trace behind. Instead, we are looking at a natural break surface consistent with the patterns of damage elsewhere on the stone. The fractured surface area has much in common with other fractures, such as the one at the phi of **Φλ**(*άβιον*), in that the inscribed letter form did not dictate the shape of the fractured area. This too strongly suggests that with the *praenomen* letter we are looking at a naturally formed break between the two diagonals of a lambda.

Through the use of digital imaging techniques, then, we can conclude that no observable carved crossbar channels exist at the *praenomen* letter. Thus far our conclusions have largely been negative in that we have focused on eliminating the possibility of an alpha. While we have shown that there is no evidence, whether physical or circumstantial, for an alpha, that absence by itself cannot lead to a positive conclusion. It therefore remains for us to explain our preference for another interpretation. In that respect, it has been important to discuss how RTI and laser scanning also allowed us to refine our understanding of the character of the marble, particularly as regards the relationship between naturally occurring breaks and deliberately carved lines. In fact, the stone's marble and break patterns suggest an alternative explanation for the coincidental location of the crosswall.

6. Pentelic Marble and the Formation of an Accidental Crossbar

Several details about the block itself are vital to understanding the damage that distorts this inscription, especially relating to the character of Pentelic marble, which frequently contains mica-rich veins and foliation planes where cracks can open up.[23] Numerous veins are visible on the block as blackish grey smudges or fine lines, running both north-south and quite prominently east-west (Fig. 8). In fact, one such mica band (labelled #1, Fig. 8) visibly runs all the way through the stone from the front face to the back of the block; its direction parallels the major crack that originally split the stone and interrupted the first line of text; the vein indicates a tensile crack with potential to further sunder the block. Closer examination also reveals a very faint mica vein on the surface extending to the left of our *praenomen* letter and running directly on from the horizontal break (Fig. 9), along precisely the same angle and showing a similar uneven appearance. The mica vein accounts for the horizontal break better than a hypothetical crossbar. The broken surface here was shaped by a natural plane of weakness along the horizontal mica band and by the cutting of the two diagonal strokes, which controlled the break and prevented it from extending further. In other words, the cracks in the stone can be explained by the features of the marble: in some places, mica bands resulted in deep stress fractures all the way through the block; in others—as at the *praenomen* letter—smaller mica veins resulted in less significant breaks that were partially controlled by previously carved channels. That the crack at the *praenomen* letter appeared to be a carved alpha crossbar is not surprising, as it is not uncommon for mica veins to split stones in a manner that appears deliberate. For example, in 1921

[23] Herz and Pritchett (1953).

Figure 8. Arrows identify faint mica veins running through the block, some of which have begun to crack open. With permission from the Epigraphic and Numismatic Museum in Athens. (Photo: authors)

Figure 9. Faint mica vein extending from *praenomen* letter break. With permission from the Epigraphic and Numismatic Museum in Athens. (Photo: D. Leon)

William Dinsmoor described a mica vein that cracked one of the Acropolis building account inscriptions into four fragments (*IG* I 284–8): 'The split surface is so clean that at first glance it was taken for a worked joint, and the pieces were thought to be separate blocks.'[24]

7. Conclusion

In conclusion, we have several observations to offer. First of all, Arrian was definitely Lucius (not Aulus) Flavius Arrianus, and so this inscription appears to connect him with a segment of the aristocracies of both Bithynia and the western Asian provinces more generally that owe their citizen status to a pre-Flavian benefactor. Second, the break that so resembles an alpha crossbar is almost certainly a natural crack resulting from a mica vein running through the block. Third, none of our three primary methods (autopsy, RTI, 3D scanning) could have produced this certainty alone, but in combination they confirmed pieces of the conclusions arrived at through each. The advanced digital imaging technologies employed in this project—which involves a mostly clear inscription—have the potential to resolve more difficult problems on inscriptions that are not as well preserved. As epigraphers are becoming increasingly aware, the technology cannot fully replace traditional methods, but it can enhance them. By using multiple modes of analysis and documentation, we have both derived a significant piece of information from an old inscription and created a more complete record for use in future research.

University of Illinois at Urbana-Champaign DANIEL W. LEON
dleon@illinois.edu

Duquesne University K. A. RASK
raskk@duq.edu

[24] Dinsmoor (1921) 118.

BIBLIOGRAPHY

Bodel, J. (2012) 'Latin Epigraphy and the IT Revolution', in J. Wilkes and J. K. Davies, edd., *Epigraphy and the Historical Sciences* (Oxford) 275–96.

Borza, E. (1972) 'Some Notes on Arrian's Name', *AAA* 5: 99–102.

Bosworth, A. B. (1980) *A Historical Commentary on Arrian's* History of Alexander, *vol. 1* (Oxford).

Bowersock, G. (1967) 'A New Inscription of Arrian', *GRBS* 8: 279–80.

Bozia, E., A. Barmpoutis and R. S. Wagman (2014) 'Open-access Epigraphy: Electronic Dissemination of 3D-digitized Archaeological Material', in Orlandi et al. (2014) 421–35.

Brunt, P. A. (1976) *Arrian: Anabasis of Alexander and Indica*, vol. 1 (Cambridge, Mass. and London).

Correia Santos, M. J., O. Sousa, H. Pires, J. Fonte, and L. Gonçalves-Seco (2014) 'Travelling Back in Time to Recapture Old Texts. The Use of Morphological Residual Model (MRM) for Epigraphic Reading: Four Case Studies (CIL 02, 02395a, CIL 02, 02395c, CIL 02, 02476, CIL 02, 05067)', in Orlandi et al. (2014) 437–54.

Dinsmoor, W. B. (1921) 'Attic Building Accounts. IV: The Statue of Athena Promachos', *AJA* 25: 118–29.

Earl, G., K. Martinez, and T. Malzbender (2010) 'Archaeological Applications of Polynomial Texture Mapping: Analysis, Conservation and Representation', *Journal of Archaeological Science*, 37: 2040–50.

Elliott, T. (2014) 'Epigraphy and Digital Resources', in C. Bruun and J. Edmondson, edd., *The Oxford Handbook of Roman Epigraphy* (New York and Oxford) 78–85.

Fernoux, H.-L. (2004) *Notables et élites des cités de Bithynie aux époques hellénistique et romaine* (Lyons).

Follet, S. (1976) *Athènes au II^e^ et III^e^ siècle* (Paris).

Frasson, F. (2014) 'Image Editing Programs as Tools for the Study of Ancient Inscriptions: a Practical Example from the Epigraphic Dossier of Luna (Italia—Regio VII Etruria)', in Orlandi et al. (2014) 145–50.

Godin, G., M. Rioux, J.-A. Beraldin, M. Levoy, L. Cournoyer, and F. Blais (2001) 'An Assessment of Laser Range Measurement on Marble Surfaces', Paper presented at the 5th Conference on Optical 3D Measurement Techniques, Vienna, Austria, October 1–4, 2001 (https://graphics.stanford.edu/papers/marble-assessment/marbre_gg_final2e_coul.pdf).

Grassl, H. (1987) 'Die Laufbahn des L. Flavius Arrianus im Lichte neuerer epigraphischer Denkmäler', Πρακτικά του Η' Διεθνούς Συνεδρίου Ελληνικής και Λατινικής Επιγραφικής, Αθήνα 3–9 Οκτωβρίου 1982, vol. 2 (Athens) 246–8.

Guidi, G., F. Remondino, M. Russo, and A. Spinetti (2009) 'Range Sensors on Marble Surfaces: Quantitative Evaluation of Artefacts', in S. El-Hakim, F. Remondino, and M. Shortis, edd., *Videometrics, Range Imaging, and Applications X, San Diego, USA* (Proceedings of SPIE: vol. 7447), 744703, 1–12.

Herz, N. and W. K. Pritchett (1953) 'Marble in Attic epigraphy', *AJA* 57: 71–83.

Kapetanopoulos, E. (1973) 'Arrian's Praenomen Again', *AAA* 6: 301–4.

Kent, J. H. (1966) *Corinth VIII, iii: The Inscriptions, 1926–1950* (Princeton).

Oikonomides, Al. N. (1980) 'Arrian and the Inscriptions', *AncWorld* 3: 94–6.

Oliver, J. (1970) 'Arrian and the Gellii of Corinth', *GRBS* 11: 335–8.

—— (1982) 'Arrian in Two Roles', *Hesperia* Suppl. 19: 122–9.

Orlandi, S., R. Santucci, V. Casarosa, and P. M. Liuzzo, edd. (2014) *Information Technologies for Epigraphy and Cultural Heritage: Proceedings of the First EAGLE International Conference* (Rome).

Papadaki, A. I., P. Agrafiotis, A. Georgopoulos, and S. Prignitz (2015) 'Accurate 3d Scanning of Damaged Ancient Greek Inscriptions for Revealing Weathered Letters', *The International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences* XL-5/W4: 237–43.

Papadopoulos, C. (1874) '*Ἐκδρομή εἰς Νικομηδείαν*', *Ἐφημερίς τῶν Φιλομαθῶν*: 2778–80.

Peppas-Delmousou, D. (1970) '*Βάσις ἀνδριάντος τοῦ Ἀρριανοῦ*', *AAA* 3: 377–80.

Pires, H., L. Gonçalves-Seco, J. Fonte, M. J. Correia Santos, and O. Sousa (2014) 'Morphological Residual Model: A Tool for Enhancing Epigraphic Readings of Highly Erosioned Surfaces', in Orlandi et al. (2014) 133–44.

Rizakis, A.D. (1996a) 'Anthroponymie et société: Les noms romains dans les provinces hellénophones de l'empire', in Rizakis (1996b) 11–30.

——, ed. (1996b) *Roman Onomastics in the Greek East: Social and Political Aspects*. (Athens).

Sandys, J. (1969) *Latin Epigraphy*[2]; revised by S. G. Campbell (Groningen).

Sisti, F., ed. (2001) *Arriano: Anabasi di Alessandro, vol. I* (Rome).

Slizewski, A. and P. Semal (2009) 'Experiences with Low and High Cost 3D Surface Scanner', *Quartär* 56: 131–8.

Stadter, P. (1967) 'Flavius Arrianus: The New Xenophon', *GRBS* 8:155–61.

—— (1980) *Arrian of Nicomedia* (Chapel Hill).

Syme, R. (1982) 'The Career of Arrian', *HSCPh* 86: 181–211.

Threatte, L. (1980) *The Grammar of Attic Inscriptions, Volume I* (Berlin and New York).

Tonnet, H. (1988) *Recherches sur Arrien: sa personnalité et ses écrits atticistes*, 2 vols (Amsterdam).

Tracy, S., and C. Papaodysseus (2009) 'The Study of Hands on Greek Inscriptions: The Need for a Digital Approach', *AJA* 113: 99–102.

Traill, J. (1995) *Persons of Ancient Athens, vol. 3: Ar- to Aulōn* (Toronto).
Wachowiak, M. J. and B. V. Karas (2009) '3D Scanning and Replication for Museum and Cultural Heritage Applications', *Journal of the American Institute for Conservation* 48: 141–58.
Wheeler, E. L. (1977) *Flavius Arrianus: A Political and Military Biography* (diss., Duke University).
Williams, W. S., B. Trautman, S. Findley, and H. Sobel (1992) 'Materials Analysis of Marble from the Parthenon', *Materials Characterization* 29: 185–94.