The Ancient History Bulletin

VOLUME THIRTY-ONE: 2017
NUMBERS 1-2

ISSN 0835-3638

ANCIENT HISTORY BULLETIN

Volume 31 (2017) Numbers 1-2

Contents of volume thirty-one

Numbers 1-2

NOTES TO CONTRIBUTORS AND SUBSCRIBERS

AHB promotes scholarly discussion in Ancient History and ancillary fields (such as epigraphy, papyrology, and numismatics) by publishing articles and notes on any aspect of the ancient world from the Near East to Late Antiquity. Submitted articles should normally be in English, but the journal will consider contributions in French, German, Italian or Spanish.

SUBMISSION GUIDELINES

AHB adheres to the usual North American editorial policies in the submission and acceptance of articles but imposes no House Style. Authors are, however, asked to use the abbreviations of *L'Année philologique* (*APh*) for journals, and of the *Thesaurus linguae latinae* (*TLL*) for Latin authors. Please send submissions to the editor most closely identified with your field of enquiry or, in case of doubt, to Timothy Howe (howe@stolaf.edu). Articles must be submitted in electronic format, preferably generated by MS Word. Greek font or other special characters must convert such to Unicode and should be accompanied by a PDF version. Authors will receive PDF offprints of their contributions. Copyright is retained by the author. Books for reviews and enquiries concerning book reviews should be directed to Joseph Roisman (jsroisma@colby.edu).

SUBSCRIPTION INFORMATION

The subscription rate for individual and institutional subscribers is USD 25.00. Detailed instructions about subscriptions and access to digital content can be found on the AHB website: http://ancienthistorybulletin.org

PAYMENT

Payment may be made via the subscription portal on the AHB website:
http://www.ancienthistorybulletin.org/subscribed-users-area/membership-levels/

Cover image courtesy of The Nickle Arts Museum, University of Calgary

Setting a Royal Pace: Achaemenid Kingship and the Origin of Alexander the Great's *Bematistai*

Christopher Kegerreis

Shortly after Alexander's death, a Cretan named Philonides put up a statue of himself at Olympia. Scholars have debated if this was the result of an Olympic victory or the completion of a 2400 *stadia* run from Elis to Sicyon and back, a feat recorded by Pliny the Elder.[1] Regardless, the inscription on the statue base suggests that Philonides was interested in advertising another accomplishment. It reads as follows: "Philonides, son of Zoitas the Cretan, from Chersonesus, day-runner (courier) of King Alexander and *bematist* of Asia, dedicated this to Olympian Zeus."[2] Philonides' double employment in the army of Alexander was certainly a source of pride and social prestige for the runner.[3] More importantly, the inscription provides valuable evidence concerning the origin of the *bematist* specialty.[4] Scholars have traditionally assumed a pre-campaign origination date for these technical experts, often associating them with the professionalization of the Macedonian army under Philip II.[5] I will argue instead that the *bematist* specialty originated during Alexander's Asian campaign. Alexander, like Philonides, played several roles on campaign. Some of his most famous actions involved the assumption of Achaemenid royal practices.[6] Most scholarly work on this topic has been devoted to his political borrowings. However, by examining Achaemenid geographical practices alongside Greek sources, I argue that the *bematistai* were a practical, mid-campaign creation built upon Achaemenid precedent and the impending lack of geographical knowledge

[1] Plin., *HN*, 2.181; 7.84. Matthews 1974, 165-6, suggests that it was for the Elis to Sicyon run. Pearson 1955, 440-1, argues it was for an Olympic victory. Tzifopoulos 1998, 141, thinks that his connection to Alexander earned him the statue. Plin., *HN*, 2.181; 7.84. While there is some debate concerning lengths of the stade, the distance would have corresponded to roughly ten marathons. On the length of the Greek stade, see Engels 1985.

[2] Dittenberger, *SIG* 1960, 303. βασιλέως Ἀλεξάνδρου ἡμεροδρόμας καί βηματιστὴς τῆς Ἀσίας Φιλωνίδης Ζωΐτου Κρὴς Χερσονάσιος ἀνέθηκε Διὶ Ὀλυμπίοι. Also see *IvO* 276-277, which has the same inscription on two different surfaces. Pausanias includes an abbreviated version at 6.16.5, but does not note his title of *bematist*. Tzifopoulos 1998, 143, suggests that Pausanias may not have known the meaning of the word. On Chersonnesus, see Hansen and Nielsen 2004, 953.

[3] Fraser 1996, 78. Fraser views these positions as mutually exclusive. The prestige associated with serving as a courier to a king was also highly valued by the Persians. The title of royal courier was held by both Artaxerxes II and Darius III. Plut., *De Alex. Fort.*, 2.8=340c; 2=326e ; Plut., *Alex.*, 18.7.

[4] The dual career of Philonides is also used as a cornerstone of Tzifopoulos 1998, in which he argues that the *hemerodromos* specialty, and by extension the *bematistai*, emerged out of Cretan military training. He spoke briefly with me during an American School of Classical Studies summer trip to Dion concerning the origin of the *bematistai* and supported my thesis that the *bematistai* emerged mid-campaign out of the ranks of Alexander's couriers and scouts. Kalleris also sees a likely connection between the *hemerodromoi* and *bematistai*. Kalleris 1976, Vol.1, 182 n.4.

[5] Wilcken 1967, 80; Pédech 1976, 402; Fraser 1996, 78.

[6] Lane Fox 2007; Fredricksmeyer 2000.

beyond the Caspian Gates.[7] My proposed mid-campaign starting date for the *bematist* specialty also demands a reconsideration of how these men performed their duties. Prevailing studies on the *bematistai*—notably that of Donald Engels—have argued that the *bematistai* used an early *hodometer*.[8] Instead, I conclude that they used advanced pace-measuring.

The *Bematistai* and Scholarly Interpretations

Little is known about the individual *bematistai*. The only ones named are associated with Alexander's campaign.[9] Along with the Cretan Philonides, our sources name Baeton, Diognetus, and Amyntas. Most of our evidence comes from Pliny, Strabo, and Athenaeus.[10] Aside from three sections in Pliny and Strabo, all these examples refer to brief chorographical or ethnographical snippets from the written works of the *bematistai*, entitled *Stations,* or *Stathmoi* in Greek.[11] Lionel Pearson suggested that these narrative productions were provided by ghost writers or copied from more notable authors, though there is little reason to suspect that the *bematistai* could not have written these accounts themselves.[12]

Although the fragmentary record concerning the *bematistai* leaves many questions, there is no doubt concerning their primary function.[13] *Liddell Scott Jones* defines *bematist* as "one who measures by paces," constructed upon the Greek for step or pace, *bêma*.[14] However, scholarly discussion concerning their practices does not always adhere to this narrow definition. For some, the more appropriate definition is the more generic "distance-measurer."[15] While at least one scholar has proposed that the *bematistai* drew simple maps of the areas they traversed, their distances were by far their most important contribution.[16] These measurements held great significance for the advancement of geographical knowledge in the

[7] The only scholar to suggest such a borrowing is P.M. Fraser, though he does so only noting the general distance-measuring tradition of the Persians. Fraser 1996, 79.

[8] My argument that the *bematistai* used pacing to obtain their measurements is an attempt to overturn the popular argument of Engels 1978, 68-69, who argues that they used a primitive odometer. For other scholarship on the *bematistai*, see Robert Hannah and Cam McPhail 2011-2012, 163-177, especially 163 n.3. To this list, I add Berve 1926, 51-52; Wilcken 1967, 153; Kalléris 1954, 130-1; Tzifopoulos 1998; Pritchett 1980, 165-167; Stoneman 2015, 64.

[9] Ath., *Deipnosophists*, 10.59. They probably served under the Ptolemies and Seleucids as well. For the Ptolemies, see Martianus Capella, 6.598 IIB, 41B. On the Seleucids, see Plin., *HN*, 6.63.

[10] Ael., *NA*, 5.14; 17.17. Ath., *Deipnosophists*, 2.74; 11.59; 11.102; 12.9; 12.39. Euseb, *Hist. Eccl.*, 9.36. Hyginus, *Poetic Astronomy,* 2.30. Plin., *HN*, 2.181; 2.73; 6.44-45; 6.61-63; 6.69; 7.11; 7.20; 7.84. Strabo, 2.1.5-8; 2.1.23; 11.8.9; 11.9.1; 15.1.28.

[11] Ath., *Deipnosophists*, 11.59; 11.102; 12.9; 12.39. Pliny, *HN*, 6.45. Strabo, 15.2.8.

[12] Schwartz 1897, 226-267; Pearson 1955, 441-443; Pearson 1960, 261.

[13] Cf. Baynham 2003, 4.

[14] *LSJ*, 314.

[15] According to Pliny's Latin, they are the "surveyors of Alexander's marches" *itinerum eius mensores*, Plin., *HN*, 6.61. This probably reflects his very general knowledge concerning their practices and should not preclude the likelihood that they measured by pacing.

[16] Hannah and McPhail 2011-2012, 174.

Hellenistic era. Their measurements helped to fill in the picture of the eastern *oikoumene*, large sections of which were *terra incognita* prior to the campaign.[17] The measurements also provided a center line for use in measuring latitude, first conceived by the Peripatetic philosopher Dicaearchus around 300 BCE and perfected by Eratosthenes at the end of the third century.[18] Eratosthenes may further have used the records of *bematistai* to determine the first semi-accurate measurement of the earth's circumference.[19] Scholars have even argued that their measurements lived on to serve as the basis of medieval depictions of Asia, most famously on the Peutinger Map.[20]

Despite their importance for ancient geography, very little is known of the origin of the *bematist* specialty. Etymological analysis provides some assistance. The noun (βημᾰτιστής) and its associated verb (βημᾰτίζω) appear only in sources that cover Alexander's campaign or the Hellenistic era.[21] In fact, Philonides' inscription at Olympia is the earliest known mention of the term. The fifth century CE grammarian Hesychius, who frequently demonstrates an awareness of the Macedonian dialect in his collection of unusual words, argued that it was Macedonian in origin.[22] Nevertheless, it should be emphasized that the term seems to have originated from a common Greek noun.[23] The Macedonians, though distinct from other Greek-speaking peoples, spoke Doric Greek. There is a clear connection to the word for "step" or "pace" (βῆμα), seen in both the Aeolic and Doric dialects and found as early as the sixth century in Pindar.[24] The Macedonians probably used the word for step in Doric Greek and added the active component of measuring, and hence, Hesychius' claim.[25] The timing and context of the term's usage strongly suggest an origin in the Macedonian army shortly before or during the campaign.

While the difficulty of the scant source evidence has precluded most efforts to search out the origins of the *bematistai*, Yannis Tzifopoulos has produced an excellent study on the likely background of these specialists. He suggested that the *bematistai* emerged out of the profession of the *hemerodromos*, illustrated best by the example of Philonides.[26] After all, if they did

[17] Wilcken 1967, 153.

[18] For Dicaearchus, see Agathemerus, *Sketch of Geography*, 1.5. For Eratosthenes, see Strabo, 2.1.21-31. For scholarship, see Hannah and McPhail 2011-2012.

[19] Strabo, 2.1.5. Scholars have argued that Eratosthenes borrowed from Ptolemaic *bematistai* concerning the distance from Syene to Alexandria. Lewis 2001, 22; Fraser 1996, 80-81; Rawlins 1982, 211-219, especially 215 n.15. Rawlins himself argues that Eratosthenes thought he was using land measurements but in fact was using measurements drawn from astronomical data.

[20] Goukowsky 1978, 160.

[21] For the verb, Polyb., 3.39.8; Strabo, 7.7.4. These examples deal with later Roman measuring of roads, though it should be noted that these Greek authors may have used the only term known to them for Greek distance-measuring, specifically pace-measuring, for an action that used the *hodometer*. For the noun, see Ath., *Deipnosophists,* 10.442. According to the *Oxford Classical Dictionary*, 238, they are exclusively the distance-measurers of Alexander.

[22] Hesychius, "βηματίζει - τὸ τοῖς ποσὶ μετρεῖν. ἔστι δέ πως ἡ λέξις Μακεδονική."

[23] Kalléris 1954, Vol.1, 130-1.

[24] Pind., *Pyth.*, 3.43. Pindar was a favorite of Alexander and other Macedonian elites. It can also be found in the fifth century in Eur., *Andr.*, 880.

[25] Kalléris 1954, Vol.1, 130-1n.44-45; Tzifopoulos 1998, 143, 147.

[26] Tzifopoulos 1998.

accomplish their measurements by pace-counting, those with extensive running experience would have been most adept at the practice.[27] The *hemerodromos*, or "day runner," had a long history in Classical Greece and included the famous Athenian Philippides.[28] Although given a different title, *hodopoioi*, Hellenistic road-makers also served in the function of couriers.[29] These couriers and scouts probably had training in pace-counting for the purposes of calculating distances between armies, towns and roads, rendering them likely candidates as distance-measurers.

If Tzifopoulos is correct, it goes some way toward answering a significant gap in our knowledge concerning the *bematistai*. Their organization within the Macedonian army and the way they compilated measurements is unknown. Tzifopoulos and others have assumed that a special reconnaissance unit existed.[30] P.M. Fraser argued that such a unit was composed "of *bematistai*, land-surveyors, distance-measurers, and day runners."[31] While probable, it is impossible to confirm. More convincing is Tarn's old argument that the measurements of the *bematistai* were collected for Alexander himself by a high-ranking officer.[32] Philonides' inscription specifically states that he was a designated *bematist* of Alexander. Pliny also said that Diognetus and Baeton served as Alexander's measurers.[33] Alexander's letters even cited their distance measurements.[34] This may support the frequent argument that their measurements were transferred into Alexander's royal journal.[35] Andrew Chugg has bolstered this thesis by demonstrating that the *bematist* Diognetus of Erythrae was probably an author of the royal journal.[36] Thus, there is little doubt that the *bematistai* held an official capacity, and that their measurements were deemed an essential component of campaign data collection.

This is the extent of Greek evidence concerning the background of the *bematistai* and the collection of their measurements. One can safely conclude that they had some official role in

[27] Tzifopoulos 1998, 184. Tzifopoulos has suggested that the lack of a regional concentration for the *bematistai* is a good indication that the expectations of the specialty were rigorous.

[28] Matthews 1974, 161-9. Usage of this term can be found in Hdt., 6.105; 9.12; Pl., *Prt.,* 335e4; Pseudo-Arist., *De Mundo*, 338a30; Diod. 15.82; 25.19; Plin., *HN,* 2.181; 7.84.

[29] Graf 1994, 174. *Papyri Oxyrhynchus*, 1656.1. It is likely these individuals used measuring lines on newly built roads, whereas Alexander's *bematistai* only did preliminary distance approximations.

[30] Tzifopoulos 1998, 149.

[31] Fraser 1996, 78. Clearly Fraser sees a much different version of the *bematist* than the version presented here. Fraser's argument is aided by the note of Diogenes Laertius concerning a *chorographer* on Alexander's campaign. Diog. Laert., 2.17. These specialists wrote basic descriptions of regions, including topographical and ethnographical material. As Tzifopoulos 1998, 143, has demonstrated, chorographers almost always provided distance measurements as well. See Strabo, 2.4.1; 5.2.7-8; 6.1.11; 6.2.11; 6.3.10.

[32] Tarn 1948, 13.

[33] Plin., *HN*, 6.61. *Diognetus et Baeton itinerum eius mensores.*

[34] Plin., *HN*, 6.62-63. *epistulae quoque regis ipsius consentiunt his.*

[35] Hammond 1988, 139. Hammond 1993, 211. Chugg 2005, 156-159. The mere existence of the royal journal has been cause for much debate. For an overview, see the following: Wilcken 1894; Robinson 1932; Pearson 1955; Samuel 1965; Bosworth 1971; Bosworth 1988, 157-184; Anson 1996.

[36] Chugg 2005, 156-159. Chugg accomplishes this by demonstrating that a Diodotus of Erythrae credited as an author of Alexander's journal in Ath., *Deipnosophistae*, 10.434b, is likely Diognetus based upon similarities in name meaning and origin city. Diognetus' attribution to Erythrae is found in Hyginus, *Poetica Astronomica*, 2.30; *FGrH* 120 F2.

Alexander's administration. A rough dating for their origins clearly points to Alexander's campaign, though an exact date is uncertain. With this chronological window in mind, it is instructive to consider potential Achaemenid influence. As scholars have argued that Alexander's royal journal was inspired by Persian precedent, it is possible that the measurements recorded in it also belonged to Near Eastern traditions.[37]

Achaemenid Tradition and the Mid-Campaign Development of the *Bematist*

The practical and ideological center of Persian geographical collection practices were the treasuries. These were not simply storehouses for imperial wealth—they were demonstrations of imperial power, and thus centers for the display of geographical knowledge concerning their empire. The Persians held salt from Siwah as well as water vials from the Nile and Danube in the treasury as symbols of their territorial power.[38] From a more practical standpoint, the treasuries held valuable information relevant to the travel networks that funneled tribute into the Persian capitals.[39] As a corollary of this imperial control, the Achaemenid administration developed official itineraries replete with stage and *parasang* listings.[40] The Persians may have even provided maps of their territories, which would explain Herodotus' tale concerning Aristagoras of Miletus using a bronze *pinax* in his attempt to gain Spartan assistance for the Ionian Revolt.[41] Stories like this suggest that Herodotus and Ctesias borrowed their information concerning the Achaemenid road system from Persian administrative copies, perhaps best represented in the extant corpus by an Aramaic passport from Susa to Egypt.[42]

Alexander appears to have had a thorough knowledge of the Persian treasury system, as he adopted it early in the campaign.[43] This should serve as no surprise, as Greeks had demonstrated an awareness of the system for a century prior. Herodotus and Ctesias, author of a treatise entitled *Concerning the Revenues of Asia*, both provided detail concerning the system.[44] At Sardis, where he captured an Achaemenid treasury, Alexander put a certain Nicias in charge

[37] On the Persian influence of the royal journal, see especially Anson 1996.

[38] Plutarch, *Al*., 36.4. (*FGrH* 690 F23b). Ath., *Deipnosophists*, 2.74. (*FGrH* 690 F23a). Their interest in holding water extended to a preference for water from different rivers for different purposes. See Strabo, 15.3.22, where the Persian kings liked Euphrates River water because it is supposedly lighter than any other. More than any other, they preferred that of the Choaspes. Ctesias F37. Ath., *Deipnosophists*, 2.23; 2.74. For a discussion of Achaemenid geographical symbolism, see Briant 2002, 191-193.

[39] On the Achaemenid road network, see especially Graf 1994. Colburn 2013. The Persepolis Fortification Tablets provide the core of information from Persian sources concerning road administration Designation: PF, PFa. For an overview concerning this corpus, see Henkelman 2008, Chapter 2, 65-179. Hallock 1969. Hallock 1978. For other valuable sources, see especially Kuhrt 2007, Part IV: Achaemenid Imperial Organization, 667-878.

[40] The evidence for this is best found in Greek sources. Hdt., 5.52-54; Phot., *Bibl.*, 72.45a1-2.

[41] Hdt., 5.48-50.

[42] Grelot 1972, 67 AD 6. For discussion, see Briant 2002, 359.

[43] Drachmann 1963, 97, oddly says that Alexander did not access the Persian treasuries. On his decision to adopt the Achaemenid system, see Briant 2010, 32. Higgins 1980. Both base their argument on Arr., *Anab.*, 1.17.1-2. See also 1.17.7.

[44] Hdt., 3.89-97. *FGrH* 688 F53. Pfister 1961, 46.

of assessing and collecting tribute.[45] According to Plutarch, Alexander even found evidence for Demosthenes' acceptance of bribes from the Persian king in this treasury.[46] Alexander's appointment of Cleomenes as collector of tribute in Egypt and Libya demonstrates his continuing appropriation of Achaemenid tribute practices *en route* to Babylon.[47] Shortly before crossing the Euphrates, he assigned yet another tribute collector.[48] Upon his capture of Babylon, Alexander appointed a Royal Treasurer:[49] Alexander's friend Harpalus, who eventually took advantage of his position while Alexander was in the east, was the first appointment to this office.[50]

Alexander's adoption of the Persian treasury system was practical, but he clearly understood the complexities and symbolic importance of the treasuries. The aforementioned water vials and salt were reported by Deinon of Colophon, a contemporary of Alexander's, whose *Persika* owed much of its knowledge to the campaign.[51] A Thessalian officer named Polycleitus, a campaign author, detailed the history of the Susa treasuries, replete with an explanation of how the Persian kings since Darius I had built separate treasuries to celebrate their tribute collection.[52] A very enticing passage from Athenaeus cites an Amyntas who wrote a brief work on the revenues of the Persian king.[53] As Athenaeus cites the *bematist* Amyntas on five occasions, he is probably referring to the same man. [54] This reveals an insider's knowledge of the Persian tribute system, and more importantly, suggests that Alexander's *bematistai* were closely linked to the treasury system.

This pivotal connection between Alexander, his *bematistai*, and the Persian treasuries are confirmed by a passage from Strabo concerning a Hellenistic Babylonian treasury:[55]

> But neither is this [assertion] of Patrocles unlikely, when he says those who made the expedition with Alexander acquired only cursory information about everything, but

[45] Arr., *Anab.*, 1.17.7.

[46] Plut., *Demosthenes*, 20. Later accusations of Demosthenes accepting bribes can be found in the story of Harpalus' flight to the Athenians. Diod. 17.108.6-8.

[47] Quintus Curtius, 4.8.5; Arr., *Anab.*, 3.5; Lane Fox 2007, 273. Lane Fox maintains that the absence of an assigned satrap initially suggests his avoidance of Achaemenid practice, but does take note of tribute.

[48] Arr., *Anab.*, 3.6.4.

[49] I use the term loosely, preferring to look at their actual financial measures as indicative of Achaemenid borrowings. For the debate on the actual titles, see Briant 2009, 166 n.10.

[50] Concerning Harpalus and his eventual betrayal, see Ath., *Deipnosophists*, 13.67; Diod. 17.108.4-8. For scholarship, see Badian 1961; Worthington 1986.

[51] Ath., *Deipnosophists*, 2.74. (*FGrH* 690 F23a). Deinon was also the father of Cleitarchus, who started the Vulgate tradition. Plin., *HN*, 10.136.

[52] Strabo, 15.3.21.

[53] Ath., *Deipnosophists*, 2.74

[54] Ath., *Deipnosophists*, 2.74; 11.59; 11.102; 12.9; 12.39. In fact, the only other reference to an Amyntas in this work is to King Amyntas III at 13.59.

[55] There has been some hesitation in stating that Babylon housed the treasury mentioned in this passage. Nevertheless, four things point to this city as the site: 1. Alexander's lengthy presence there after his return from India. 2. The importance of the city as Alexander's Asian capital. 3. The continuation of Achaemenid titles for the treasurer. 4. Patrocles' position as an officer of the Seleucids, which at this early point would point to Babylon. For further, see Pearson 1955, 440; Hammond 1988, 138-140.

> Alexander himself made accurate investigations, since the men best acquainted with the entire country had described all of it for him, and Patrocles said this record was later presented to him by Xenocles the treasurer.
>
> οὐδὲ τοῦτο δὲ ἀπίθανον τοῦ Πατροκλέους, ὅτι φησὶ τοὺς Ἀλεξάνδρῳ συστρατεύσαντας ἐπιδρομάδην ἱστορῆσαι ἕκαστα, αὐτὸν δὲ Ἀλέξανδρον ἀκριβῶσαι, ἀναγραψάντων τὴν ὅλην χώραν τῶν ἐμπειροτάτων αὐτῷ: τὴν δ'ἀναγραφὴν αὐτῷ δοθῆναί φησιν ὕστερον ὑπὸ Ξενοκλέους τοῦ γαζοφύλακος.[56]

It is difficult to know whether the *bematistai*, with their distance measurements and prose descriptions of the conquered lands, are here those who "inquired cursorily" or the "most knowledgeable experts." Lionel Pearson argued that those "cursorily" recording the regions traversed were the historians of Alexander and that Patrocles consulted a later production that utilized the materials of the *bematistai* after Alexander's death.[57] Conversely, N.G.L. Hammond argued that the term ἐπιδρομάδην, an adverb with a common etymological background to *hemerodromos,* indicated Alexander's couriers were responsible for the less accurate information and were supplanted by more precise reports from Achaemenid officials.[58] An alternative reading could render the first group only regular soldiers, the second *bematistai* and other campaign writers. Fortunately, a definitive conclusion is not necessary for our purposes. The obvious takeaway is that Alexander maintained geographical records from his *bematistai* in a treasury. Further, these records were managed by an officer referred to in the Greek version (*gazophylax*) of the Old Persian word (*ganzabara*) for treasurer.[59] This interpretation suggests that Alexander was consciously borrowing, and building upon, these traditions.

Alexander's decision to maintain records in a Babylonian treasury coincides with another significant borrowing from Achaemenid tradition that may help to explain Amyntas' knowledge of the Persian tribute system. Persian "road surveyors" were present in the Persepolis Fortification Tablets of the late sixth and early fifth century BCE. Referred to in Elamite as *dattimara*, these individuals were responsible for measuring distances along the road network.[60] They are sometimes called "spear bearers" as well, and appear to have served as elite guides and/or military escorts.[61] Since the texts generally refer to groups, they may have used some kind of measuring lines as the Greeks did in short-distance surveying.[62] A tablet from Cyrus' reign (530 BCE) attests to the use of date palm beams in the measuring of a short

[56] Strabo, 2.1.6.

[57] Pearson 1955, 440.

[58] Hammond 1988, 138-139, instead argues in favor of Alexander's couriers, who can probably be linked to the *bematistai* as suggested by myself and Tzifopoulos. I also disagree with Hammond's conclusion that Patrocles saw this compilation in Alexandria. After all, the Seleucids must have controlled the Babylonian treasury at this point. Hammond's argument rests upon Eratosthenes' later access to archive documents.

[59] Hammond 1988, 138; Lane Fox 2007, 292.

[60] All of the following include some reference to road surveying: PF 1284; PF 1307; PFA15; PFA19; PFA21; PFA22; PFA23; PFA30; PFA31. For discussion, see Graf 1994, 172; Hallock 1978, 109-136; Tuplin 1997, 405-407.

[61] Hallock discusses a few variants of "spear-bearer," the one presumably Elamite *sikak-kutira*, the other utilizing the Akkadian *sukurrum* for spear. Hallock 1978, 112.

[62] PFA15 refers to only one *dattimara*, though he is accompanied by several "gentlemen." Referred to also as a "spear-bearer," he may be serving here in the capacity of a guard or guide, or both.

section (less than three kilometers) of a royal road in the vicinity of Sippar (near Babylon) on the Euphrates.[63] Whatever their methods, these measurements found their way into Persian geographical record-keeping.

Thanks to the Persepolis Fortification Tablets, one can follow the progress of one or maybe two groups of *dattimara* near Persepolis. Richard Hallock's translation of PFA19 is as follows, "Irdaba the spear bearer together with his five companions received rations. They computed (surveyed) the road."[64] In PFA21-23, two leaders (Irdaba or Ambaduš) at the head of five or six men, receive supplies along their route, and each time are referred to as "road counters." But at PFA30, their importance is magnified:

> Ambaduš (and) his 4 companions, spear bearers (and) road "counters" (surveyors), (who) previously went across (and) "computed" the Ramitepe road, then at his (the king's?) order (?) came (and) waited (at) Hadaran until the king came—they received (it as) rations. (For) 6 days (in) the eighth month, 21st year, they received each 1 QA (daily).

From this passage it seems likely that the king himself may have determined the location of their measurements. Such examples show that administrative controls over distance measurements existed. Their findings probably informed the itineraries kept at the royal treasuries. It is likely that they also placed distance markers as they worked, as some scholars have postulated.[65]

Alexander and his followers clearly borrowed from some aspects of Achaemenid geographical collection practices, especially as related to the treasury system. Alexander utilized the treasury administration from the very start for tribute collection. A treasurer whose title borrows from Achaemenid practice oversaw his geographical archive. But perhaps the most salient fact is that one of his *bematistai* even wrote a treatise on the Persian treasury system. The evidence is suggestive even before considering their measurements.

These excerpts demonstrate the nearly identical records available to these authors. Both start at the Caspian Gates and have measurements only to the north and east of this position. Both follow the path of the main army. Both split up distances to Bactria and India. The only variation in measurement locations, aside from a few cities in the path of the main army, are readily explained as later measurements conducted under the Seleucids beyond Alexander's stopping point in India.[66] The most intriguing parts of these examples revolve around the usage of the Caspian Gates as a starting point and the measurements to the northwest of them, where Alexander's main army never marched (Figure 1, below).

---

[63] The translation is available in Kuhrt 2007, 710. Inscription 22i: Babylonian Tablet. BM 79746. Sippar X/7/8, Cyrus 2 January 530, translated by Michael Jursa (Vienna, 1995).

[64] Hallock 1978, 123. While this tablet suggests that an Ambadus gave food to these men, PFA21 groups Ambadus with these other five men when receiving wine. PFA22-23 reverts back to Irdaba as the leader, only to switch again back to Ambadus at PFA30.

[65] Tuplin 1997, 415. Bivar 1985, 629. There is evidence for Hellenistic borrowings of this tradition near Pasargadae. Bivar 1978, 161-2; Lewis 1978, 159-161. Another Hellenistic marker has been found near Ephesus. French 1998, 195.

[66] The Seleucids clearly built upon Alexander's work. See Plin., *HN*, 6.17.44, who cites distances of Seleucid cities from the Caspian Gates.

The following records from Pliny and Strabo are the primary evidence for the measurements of the *bematistai*:[67]

Pliny, *Natural History*, 6.17.44-45. The Parthian capital Hecatompylus is 133 miles from the [Caspian] Gates… immediately upon marching out from the [Caspian] Gates, the Caspian people, who give their name to the gates and to the sea, extend as far as the coastline. Turning away from this people towards the Cyrus River is reported 225 miles, if proceeding on to the Gates from the same place in the river, 700 miles. Indeed, these [gates] are made the starting/turning/ central(?) point of Alexander the Great's Itineraries; from these gates to the border of India is reported 15,690 *stadia*, to the city Bactra, which they call Zariasta, 3700 *stadia*, from that place to the Jaxartes River 5,000 *stadia*. (my translation) Pliny, *Natural History*, 6.21.61-62. Diognetus and Baeton, the surveyors of his expeditions, write that the distance from the Caspian Gates to the Parthian City of Hecatompylos is the number of miles that we stated above; and rom thence to the city of Alexandria of the Arii, which Alexander founded, 575 miles, to the city of the Drangae, Prophthasia, 199 miles, to the town of the Arachosii 565 miles, to Kabul 175 miles, and thence to Alexander's Town 50 miles (in some copies of this record we find different numbers): this city is stated to be situated immediately below the Caucasus; from it to the river Kabul and the Indian town of Peucolatis 237 miles, and thence to the river Indus and the town of Taxilla 60 miles, to the famous river Jhelum 120 miles, to the not less notable Beas 390 miles—this was the terminus of Alexander's journeys, although he crossed the river and dedicated altars upon the opposite bank. The king's actual dispatches also agree with these figures. The remaining distances after the Beas were ascertained by the exploration of Seleucus Nicator; to the Sutlej 169 miles, to the river Jumna the same (some copies add 5 miles), thence to the Ganges 112½, to Rhodapha 569 (others give 325 miles in this space), to the town of Callinipaza 167½ (others 165), thence to the confluence of the river Jumna and the Ganges 625 (a great many add 13½), to the town of Patna 425, to the mouth of the Ganges 637½. (translation by H. Rackham, Loeb, 1954)	Strabo, 11.8.9. Eratosthenes gives the distances as follows: From Mt. Caspius to the Cyrus River, about one thousand eight hundred stadia; hence to the Caspian Gates, five thousand six hundred; then to Alexandreia in the country of the Arians, six thousand four hundred; then to the city Bactra, also called Zariaspa, three thousand eight hundred and seventy; then to the Iaxartes River, to which Alexander came, about five thousand; a distance all told of twenty-two thousand six hundred and seventy stadia. He gives also the distance from the Caspian Gates to India as follows: To Hecatompylus, they say one thousand nine hundred and sixty stadia; to Alexandreia in the country of the Arians, four thousand five hundred and thirty; then to Prophthasia in Drangê, one thousand six hundred others say one thousand five hundred); then to the city Arachoti, four thousand one hundred and twenty; then to Ortospana, to the junction of the three roads leading from Bactra, two thousand; then to the borders of India, one thousand; a distance all told of fifteen thousand three hundred stadia. (translation by H.L. Jones, Loeb 1932) Strabo, 15.2.8. Its [India's] length from the Caspian Gates, as recorded in the work entitled Asiatic Stathmi, is stated in two ways: that is, as far as Alexandreia in the country of the Arii, from the Caspian Gates through the country of the Parthians, there is one and the same road; and then, from there, one road leads in a straight line through Bactriana and over the mountain pass into Ortospana to the meeting of the three roads from Bactra, which city is in the country of the Paropamisadae; whereas the other turns off slightly from Aria towards the south to prophthasia in Drangiana, and the remainder of it leads back to the boundaries of India and to the Indus; so that this road which leads through the country of the Drangae and Arachoti is longer, its entire length being fifteen thousand three hundred stadia. (translation by H.L. Jones, Loeb, 1932)

Pliny's discussion of the Caspian Gates could suggest that they were a starting point, a meeting point for the measurements eastward and those to the north, or both. The Latin is as follows (translation above):

> egressos Portis excipit protinus gens Caspia ad litora usque, quae nomen portis et mari dedit. laeva montuosa. ab ea gente retrorsus ad Cyrum amnem produntur [ccxxv], ab eodem amne si subeatur ad portas, [dcc]. hunc enim cardinem alexandri magni itinerum fecere ab iis portis ad indiae principium stadia [xv] dclxxxx prodendo, ad bactra oppidum, quod appellant zariasta, mmm dcc, inde ad iaxartem amnem [v].[68]

By using the term *cardinem* for the Caspian Gates (*portas*), Pliny could refer to a few things. The term is sometimes defined as a "starting point" or "limit" point. The Oxford Latin Dictionary also provides the enticing usage of *cardinem* as a starting point specifically for measuring, and even uses this passage from Pliny as an example. However, the word is more commonly translated elsewhere as a "transition point" or "hinge." Both authors' reference to

[67] For tables and mileage using these excerpts, see Engels 1978, 157 and Fraser 1996, 84-85.

[68] Plin., *HN*, 6.17.45.

measurements to the north of the Caspian Gates suggest this latter usage, as could the split routes to India and Bactria. But here appears a significant problem—Alexander never reached the Cyrus River, which flows through modern day Azerbaijan and Georgia.

Figure 1 Measurement Routes of the *Bematistai*

A plausible explanation for these northern measurements is that Alexander sent an expedition in this direction during his final year. In this case, one of the most confusing features of the evidence is the most helpful. Both authors refer to a Caspian location apart from the Caspian Gates. Pliny references a Caspian people (*gens Caspia*) in the nominative, while Strabo refers to the noun Caspian in the genitive singular (τοῦ Κασπίου) that Jones translated as Mt. Caspius. Neither is very helpful in locating this position. However, Pliny notes in a previous section that different "Caspian Gates" could be attributed to similarly named passes near these peoples along the western Caspian. More importantly, he claimed that one could only clarify this confusing picture with the information from Alexander's logbooks, clearly attributing the measurements to Alexander's efforts.[69]

Alexander undoubtedly sent an expedition into Armenia that provided the measurements found in Strabo and Pliny. In fact, there are two evidential bases for this argument. The first is a source tradition that says he sent an officer named Menon to claim an Armenian gold mine just south of Trapezus.[70] The second is a much more substantial tradition involving an expedition of Thessalians, which generated several myths concerning an ancient connection between Thessaly and the Armenian people emerged during the early Hellenistic period.[71] The founding myth involved an eponymous ancestor named Armenus who supposedly joined Jason

[69] Plin., *HN*, 6.15.40.

[70] Strabo, 11.14.9.

[71] The most thorough study of these claims and the Thessalian expedition is Bernard 1997.

on the *Argo*.[72] Similar parallels drawn between the Albanians along the northern bank of the Cyrus River and the descendants of Jason mentioned in Pliny may also reflect this campaign tradition.[73] While these mythical traditions suggest a Thessalian venture in Armenia, there is even some scientific evidence of their role there. Strabo cites information from Medius of Larissa, a favorite of Alexander, on the course of the lower Araxes (modern Aras) River, close to the Caspian.[74] The timing of both Menon's expedition and that of the Thessalians is uncertain, but the general consensus is that Menon travelled to the gold mines in 331 or 330 BCE, as part of Alexander's expanding control in the region.[75] Scholarship is less certain about the chronology of the Thessalian expedition, but generally treats it as separate from Menon's. Paul Bernard, who has written extensively on both expeditions, argues that the Thessalians were most likely sent out by Perdiccas in 322 or perhaps even as late as 304-303 on the orders of Antigonus.[76] However, Bernard did not consider the distance measurements of the *bematistai*, running through Armenia along the coast of the Caspian Sea.

It is difficult to ascribe the measurements to Menon if using the traditional date of 331-330, when he presumably would have used a more direct route to the gold mines. Fortunately, there is another possibility at hand. Arrian notes Black Sea ambassadors visiting Alexander in Persis during his return from India, as well as the king's surprise at the short time it took them to reach him.[77] Not only does this detail provide a possible incentive for an expedition, it also suggests that Alexander did not have reliable information on the geographical situation of northern Armenia and the eastern Black Sea, which he presumably would have obtained if Menon's expedition had taken place in 331-330. Instead, Alexander's Armenian expedition may have followed the nameless ambassadors up the coastal route along the western Caspian shoreline, up the Cyrus River, and on to the Trapezus gold mine via the Black Sea coastline. This later dating would make it more probable that Menon was accompanied by the Thessalian officers who generated the connection between their own peoples and the Armenians. Regardless, one can assume that Menon or these Thessalians, or both, played a role in the expedition that collected the measurements noted in the *Asiatic Stathmoi*.

The measurements recorded in Strabo and Pliny are thus a combination of the campaign route and a separate expedition, likely dated to 324. At the center of these measuring efforts lay the Caspian Gates east of modern day Tehran.[78] Pliny described it as a narrow, eight-mile-long pass through red cliffs, featuring a salty stream and an abundance of snakes.[79] The Macedonians interpreted the gates as a significant border between west and east. In the speech that Arrian attributes to Alexander at the Hyphasis River mutiny, the king himself notes the gates as an imperial geographic marker that designated those to the east as falling outside of the Achaemenid power structure, an erroneous claim that still demonstrates the importance of

[72] Strabo, 11.14.12-13.

[73] Plin., *HN*, 6.38-39.

[74] *FGrH* 129 F1=Strabo, 11.14.12-14.

[75] Hammond 1996, 130-137; Bernard 1999, 48-51; Lane Fox 2004, 23-30.

[76] Bernard 1997, 184-187.

[77] Arr., *Ind.*, 40.5.

[78] On the specific location, see note 125.

[79] Plin., *HN*, 6.17.43.

the gates in the geographical thought of Arrian's time.[80] After Alexander's measurements, the pass remained a significant dividing line between western and central Asia, not only for geographical purposes but also between the civilized world and barbarian outsiders.[81] The second century (CE) Alexandrian geographer Dionysius Periegetes even called them the Keys to Farther Asia.[82] While they likely played a significant role in Near Eastern geographical perception already, Alexander and his *bematistai* ensured their place in Greco-Roman conceptions of Asia.

Alexander's assertion in his Hyphasis speech that Achaemenid control was less extensive to the east of the Caspian Gates is odd considering the importance of Bactria in the Achaemenid power structure. However, a consideration of Achaemenid administrative controls concerning roads and communications may explain why the *bematistai* measurements begin only at the Caspian Gates. The Achaemenid east had fewer precise distance measurements.[83]

This is not surprising. After all, the western half of the empire had a long history of road administration beginning with the Assyrians. Therefore, the major routes of Mesopotamia and the Levant were well represented in the administrative documentation of the royal road network.[84] However, the only eastern route with significant coverage in the Persepolis Fortification Tablets was the road from Susa to India via Persepolis, Carmania, and Arachosia.[85] While Achaemenid documents from Bactria demonstrate the issuance of food stores along imperial routes, there is no evidence supporting detailed road measurements in the Fortification Tablets or elsewhere.[86] The only exception to this line of thinking comes from Ctesias, who provided a survey of the Achaemenid road system from Ephesus to Bactria and India. He did include the number of stages, as well as *parasangs*, but estimated them.[87] It is possible that only the primary routes to Bactria (Khorasan Road) and India (via Carmania and Arachosia) offered even these approximations. There is no evidence that the roads interlinking Bactria and India had any such measurements. After all, campaign authors noted the lack of roads in some of the areas that Alexander traversed. In Sogdia, Alexander himself supposedly lamented the lack of roads near the Rock of Ariamazes.[88] According to Arrian, Alexander had to

[80] Arr., *Anab.*, 5.25.5. καὶ ὅσων δὲ οὐκ ἦρχον, τὰ ὑπὲρ τὰς Κασπίας πύλας.

[81] Graf 1994, 186; Thomson 1948, 126; Goukowsky 1978, 160; Anderson 1928, 141; Stoneman 1994, 99-100. See also Strabo, 11.12.1.

[82] Dionysius Periegetes, 1034.

[83] A point already made by Stoneman 2015, 64, but without a consideration of earlier measurements.

[84] Allen 2005, 118; Graf 1994, 171.

[85] List provided in Graf 1994, 186-187. These tablets cover the last decade of the sixth century BCE until approximately 494 BCE. For another chart demonstrating usage and maintenance of this road utilizing the Persepolis Fortification Tablets, see Colburn 2013, 34.

[86] Concerning the issue of food supplies, see Naveh and Shaked 2012, *IA17*, *IA 21*. On the absence of knowledge concerning roads in the eastern half of the empire, see Allen 2005, 117; Badian 1985, 440; Graf 1994, 171. Alexander certainly took this route. Arr., *Anab.*, 3.23.1. For a useful contrast concerning the usage and maintenance of this roads using the Persepolis Fortification Tablets, see Colburn 2013, 34.

[87] *FGrH* 688 F33 = Phot., *Bibl.*, 72.

[88] Polyaenus, *Strat.*, 4.3.29.

cut a road through the jungle *en route* to the Indus River.[89] Such stories do not suggest that precise distance measurements existed for roadways in these regions. Thus, Alexander's *bematistai* were perhaps instituted to replace the time-based approximations of the Persians.[90]

This theory has potential detractors, as Donald Engels and others have argued that the *bematistai* measured in Mesopotamia.[91] These claims are grounded primarily in Eratosthenes' measurements of the region.[92] However, there is no mention of Alexander's *bematistai* in the fragments of Eratosthenes, nor any similarity with the excerpts from the known records in Strabo and Pliny. The only evidence supporting this claim comes from Eratosthenes' attempt to measure the distance between the Euphrates River and the Caspian Gates. Strabo describes Eratosthenes' process in coming up with the 10,000 stadia distance between the Euphrates and Caspian Gates thusly:

> He divides the whole into portions, as he found registered measurements recorded as follows: he started back at the Euphrates crossing near Thapsacus and from there to the Tigris, where Alexander crossed, he records 2400 stadia; from here to several locations in order, through Gaugamela and the Lycus and Arbela and Ecbatana, where Darius fled from Gaugamela to the Caspian Gates, he fulfills the 10,000 stadia.[93]

The locations mentioned here represent vital points of the Achaemenid road system. Arrian claims that Alexander chose the Thapsacus-Armenia-Tigris route because it offered ample supplies *en route*.[94] In fact, Alexander's skirting of southern Armenia is perhaps suggestive that he was on the royal road described by Herodotus, which featured several stages described as Armenian.[95] Second, the place where Alexander crossed the Tigris was almost certainly connected to the military road, as a fording location was readily found with

[89] Arr., *Anab.*, 4.30.7.

[90] Lane Fox 2007, 293.

[91] Engels 1978, 68-69; Fraser 1996, 81n10 ; Herzfeld 1968, 9, 35, 135; Hannah and McPhail 2011-2012, 171.

[92] The relevant section is from Strabo, 2.1.23-30. Some use is also made of Arr., *Anab.*, 3.15.5; 6.11.5. Here he refers to the distance from Gaugamela to Arbela, which clearly falls under the measurement of the royal road system as discussed below. Arrian adds that his sources are merely "the writers" οἱ ξυγγράψαντες who have provided measurements for this route. In addition, the 500-600 *stadia* range mentioned at 6.11.5. is much broader than we would expect to see from Alexander's *bematistai*, who were typically very close on their measurements. For more on the passage from Arrian, see Graf 1994, 179.

[93] Strabo, 2.1.24. κατὰ μέρος δὲ διαιρῶν, ὡς ἀναγεγραμμένην εὗρε τὴνμέτρησιν οὕτω τίθησιν, ἔμπαλιν τὴν ἀρχὴν ἀπὸ τοῦ Εὐφράτου ποιησάμενος καὶ τῆς κατὰ Θάψακον διαβάσεως αὐτοῦ. μέχρι μὲν δὴ τοῦ Τίγριδος, ὅπου Ἀλέξανδρος διέβη, σταδίους δισχιλίους καὶ τετρακοσίους γράφει: ἐντεῦθεν δ' ἐπὶ τοὺς ἑξῆς τύπους διὰ Γαυγαμήλων καὶ τοῦ Λύκου καὶ Ἀρβήλων καὶ Ἐκβατάνων, ᾗ Δαρεῖος ἐκ τῶν Γαυγαμήλων ἔφυγε μέχρι Κασπίων πυλῶν, τοὺς μυρίους ἐκπληροῖ. Eratosthenes' point concerning the Tigris crossing is repeated at 2.1.38. and 16.1.21.

[94] Arr., *Anab.*, 3.7.3.

[95] Hdt., 5.52-53. For Alexander in Armenia, see Quintus Curtius, 4.9.14. Arr., *Anab.,* 3.7.3. On Alexander's using the famous royal road, see Lane Fox 1974, 103; Lane Fox 1980, 128.

local assistance and Darius seems to have anticipated that Alexander would cross at this location.[96]

If Eratosthenes' measurements do coincide with a Persian royal road, it would have been measured long before Alexander traversed it. Of course, this does not mean that Alexander did not take measurements. After all, Strabo cites measurements in Greek *stadia*. But there are several reasons to question such a hypothesis. First, it appears that Eratosthenes, as might be expected of an advanced Greek geographer, converted Persian *parasangs* into *stadia* elsewhere in his work.[97] The measurements might also reflect later Hellenistic efforts, especially since Pliny references measurements in Mesopotamia using cities built by the Seleucid rulers.[98]

The line quoted in Strabo is even more suggestive. Alexander did not pursue Darius directly from Arbela to Ecbatana, but headed south for Babylon instead.[99] While it is possible that he sent for measurements of the route, all the known *bematist* measurements follow the line of march except for the northern measurements. The reference to Alexander and Darius is probably intended to demonstrate Eratosthenes' historical acumen or assist his readers, who would have better understood these locations in the context of Alexander's expedition. The reference may even belong to Strabo, who wrote a biographical work entitled *Deeds of Alexander*.[100]

The nature of the established *bematist* records provide no hints that they were measuring prior to reaching the Caspian Gates. Both Strabo and Pliny provide comprehensive linear listings when referencing known *bematist* measurements, unlike the piecemeal measurements that Eratosthenes utilizes.[101] Eratosthenes' comments on Mesopotamia reveal no such tendency, and there is no further evidence that he drew from measurements of Alexander's *bematistai* prior to the Caspian Gates.

The Greek sources may offer further assistance in explaining the lack of measurements to the west of the Caspian Gates. There are indications that changes were made to the army's structure after Babylon and before its arrival at the Caspian Gates. Arrian suggests that these changes were made after Susa, while Curtius and Diodorus both say they were made between

[96] Arr., *Anab.*, 3.7.4-5; Diod. 17.55; Quintus Curtius, 4.9.11-24. On the exact location, several theories are available, mostly circulating around Saphe and Abu Wijnam. The exact location of the royal road crossing is uncertain. See Herzfeld 1968, 40; Stein 1942; Engels 1978, 67-70.

[97] For instance, he appears to have converted the parasangs reported by Patrocles for the distance between the (erroneous) mouths of the Oxus and Iaxartes Rivers in the Caspian Sea. Strabo, 11.6.1; 11.11.5. In the latter, Strabo even notes the varying measurements of the Persian parasang, listing 30, 40 or 60 stadia as equivalent. Eratosthenes listed 2400 stadia, which would match the eighty parasangs of Patrocles if using the thirty stadia formula.

[98] Plin., *HN*, 6.17.43, for Hamadan and Great Seleucia.

[99] Arr., *Anab.*, 3.16.1-3. Arrian specifically says that Darius took this route because it was too rough for Alexander's baggage train. See also Diod. 17.64.1-3; Quintus Curtius, 5.1.3-9. Hannah and McPhail 2011-2012, 171, say that Alexander chased Darius all the way to the Caspian Gates on this road. There is no ancient evidence that suggests this is the case.

[100] Strabo, 2.1.9.

[101] Strabo, 11.8.9, does not specifically cite the *bematistai* or the title of their works, but the measurements include several Alexandrias, note that Alexander reached the Iaxartes River, and include the same measuring points as the other noted *bematistai* records. He also refers to the *Asiatic Stathmoi* at 15.2.8.

Babylon and Susa.[102] Arrian's version primarily deals with the incorporation of new Macedonian soldiers into existing regiments, while Curtius says that Alexander made several changes advantageous for the operations of his army, including an ethnic diversification of his regiments and signal changes for the break-up of camp. Diodorus primarily notes the advancement of commanders, but he does note that Alexander made improvements "most useful" (πολλὰ πρὸς τὴν εὐχρηστίαν) for future campaigns among the common soldiery. Other changes in the army took place at Ecbatana, where Arrian notes that Alexander released Greek soldiers from duty.[103] None of this provides definitive proof, but the general picture is one of change and reorganization. When paired with the known measurement locations, it is a reasonable hypothesis to suggest that the *bematistai* were established during this period.

Even if the Mesopotamian measurements attributed to Eratosthenes in Strabo belonged to Alexander's *bematistai*, they still only reflect measurements starting at the Euphrates River. This does not change the likelihood that Persian geographical collection practices influenced them, as Alexander had already accessed multiple treasuries by this point.[104] It is also possible that a crude Macedonian military measurement system evolved into a collection process inspired by Persian imperial precedent. Either way, a Persian influence is almost certain.

The *bematistai* were probably established midway through Alexander's campaign out of his desire to collect information in the Persian center and east, lands less known to the Greeks. This explains not only the Persian-inspired titles of their works, *Stathmoi* (*Stations*), but also the relatively late appearance of their measurements on campaign. Alexander's own geographic interests meshed with an ancient Near Eastern practice of road documentation, a scientific collection of distances connected to imperial tribute and travel networks.

How did the *Bematistai* Measure?

Alexander's *ad hoc* initiation of the *bematist* specialty in Asia further elucidates previously contested aspects of their practices. Persian road-surveying tradition may have inspired Alexander's decision to record distance measurements, but the method of measurement was certainly different. As stated above, road measurements in the Achaemenid administration were taken by small parties during peacetime that appear to have conducted measurements with measuring lines or date palm beams. Our lone textual example cites a road measuring just over two kilometers.[105] However, the necessity of compiling distance measurements on the march rendered a different type of calculation: pace-measuring.[106]

[102] Arr., *Anab.*, 3.16.10-11; Diod. 17.65.1-4; Quintus Curtius, 5.1.39-5.2.3.

[103] Arr., *Anab.*, 3.19.4-6.

[104] See notes 52-55 above.

[105] See note 73 above.

[106] Lewis 2001, 21-22. Lewis suggests that for long distances it was necessary to use pace counting rather than measuring lines. On the difficulties of the *bematistai* on Alexander's march in comparison to their Persian counterparts, see Fraser 1996, 79-80.

Distance Measurements of the *Bemastistai*				
Route	**Strabo, 11.8.9.**		**Pliny, *HN*, 6.17.44-45, 6.21.61-62.**	
	Stadia	Modern miles	Roman miles	Modern miles
Mt. Caspius-Cyrus River	1800	206	225	206
Cyrus River-Caspian Gates	5600	643	700	643
Caspian Gates-Hecatompylos	1960 (1260)	225 (144)	133	122
Hecatompylos-Alexandria Areion	4530	520	575	528
Caspian Gates-Alexandria Areion	6400	735	***708***	***650***
Alexandria Areion-Prophthasia	1600 (1500)	184 (172)	199	184
Prophthasia-Arachoti Polis	4120	473	565	519
Arachoti Polis-Kabul			175	161
Kabul-Alexandria ad Caucasum			50	46
Arachoti Polis-Hortospana	2000	230		
Alexandria ad Caucasum-Peucolatis			237	218
Hortospana-Border of India	1000	115		
Peucolatis-Taxila			60	55
Taxila-River Hydaspes (Jhelum)			120	110
River Hydaspes (Jhelum)-River Hyphasis (Beas)			390	358
Caspian Gates-Border of India	15300	1757	15690 *stadia*	1801
Border of India-Bactra (Zariaspa)			3700 *stadia*	425
Bactra (Zariaspa)-River Iaxartes	5000	574	5000 *stadia*	574
Alexandria Areion-Bactra (Zariaspa)	3870	444		
Caspian Gates - Iaxartes River	22670	2603		

Numbers in parentheses reflect alternative values in author's report.
Numbers in bold and italics represent computed sums of smaller segments for comparison.

A pace-oriented measure disagrees with the argument of Donald Engels, a major contributor to the study of Alexander's logistics and intelligence gathering while on campaign. He argued that the accuracy of the *bematistai* indicates the use of a *hodometer* like that developed by Heron of Alexandria in the 1st century CE. Because of his recognized expertise in the field, Engels' theory is now entrenched in the popular imagination.[107] Engels' argument rests solely on his interpretation of the impressive accuracy of their measurements. According to Engels, the *bematistai* averaged less than a five percent error when comparing their measurements to modern estimates of the same routes.[108] However, there are several problems with his argument. Not only is Engels overly optimistic about our ability to track the exact points of their measurements, his insistence upon the *hodometer* runs counter to the available evidence.

A consideration of the measuring points demonstrates the extreme difficulty in trying to reach a precise computation of modern mileage equivalents. To his credit, Engels recognized the impossibility of doing so for the measurements to the north of the Caspian Gates. Mt. Caspius will forever elude us, as will the exact position on the Cyrus (Kyr) River where measurements concluded. Nonetheless, it is noteworthy that the assigned measurements are generally accurate for much of the river's path in western Azerbaijan. Engels' insistence upon accurately pinpointing the Caspian Gates and Hecatompylos are more troublesome. Even in the ancient world, locating the Caspian Gates geographically was extremely difficult. Pliny famously noted the many versions of the Caspian Gates and the need of referring to the Alexander campaign depictions to accurately find it.[109] Even so, there were many different interpretations. Arrian said that it was about one day's march from Rhagae, now a suburb of southern Tehran, at Alexander's fast pace while chasing Darius.[110] Apollodorus alternatively offered a much longer distance: 500 *stadia* from this city, a distance of approximately fifty-seven miles.[111] This is already too far for even Alexander's fast pace, but Arrian says that Alexander slowed down after giving up hope of catching Darius and came upon the Caspian Gates at the end of a day's march from Rhagae.[112] This indicates a distance of less than thirty miles, much less than Apollodorus' estimation. Such ancient confusion has led to a variety of modern guesses at the location, unaided by the fact that the roads east of Tehran run through several passes. Even if one limits the possibilities to the two most favored sites, the Sar-i-Darreh and Hableh Rud gorges, these sites are approximately twenty miles apart.[113]

[107] Engels 1978, 158. Engels borrowed this idea from Neuberger 1930, 215. A quick Google search will demonstrate the prevalence of Engels' argument among a popular audience. See for instance "odometer" and "bematist" on Wikipedia. Sleeswyk makes a similar argument concerning the accuracy of Xenophon's distances in the *Anabasis*. Sleeswyk 1979, 11.

[108] Engels 1978, 157.

[109] Plin., *HN*, 6.15.40.

[110] Arr., *Anab*., 3.20.2.

[111] Strabo, 11.9.1.

[112] Arr., *Anab*., 3.20.3-4.

[113] The bibliography on this topic is vast. The most important recent studies are the following: Hansman 1968, 116-119; Standish 1970; Bosworth 1980, 333-341; Stoneman 1994, 99-100. Jackson 1911 and Anderson 1928 are also pivotal studies. For bibliography, see Hansman 1968, 118n45, Standish 1970; Bernard 1994, 483 n.11.

One might rectify the problem associated with the Caspian Gate measurements by examining the next measured city, if only it was easily placed. However, Hecatompylos is no easier identified on a modern map. John Hansman's excavations in the 1960s and 1970s have unearthed a likely candidate at Shahr-i-Qūmis, supported by pot sherds and period appropriate architecture.[114] However, his methodology in utilizing the *bematistai* measurements to prove the site is Hecatompylos is questionable. Hansman oddly proclaimed a scholarly consensus for the Sar-i-Darreh as the Caspian Gates, then used the exact distance from the end of that defile to Rhagae (51 miles) to compute an alternative length of the *stadia* noted by Strabo for the distances both from Rhagae to the Caspian Gates and the Caspian Gates to Hecatompylos.[115] This rendered an uncommon *stade* measure of 538 feet, or 163 meters. Hansman uses this strange measure to calculate Strabo's distance between the Caspian Gates and Hecatompylos at 128.5 miles, which is reasonably close to the 122 miles of Pliny. His preferred site falls between these distances from the Sar-i-Darreh.[116] However, the more likely Attic *stade* renders Strabo's distance at 144 miles. In addition, Hansman ignores the much longer measurement for the Caspian Gates to Hecatompylos in Strabo's account of the *bematistai* measurements, which computes to 225 miles.[117] This 1960 *stadia* report is likely an error for the 1260 *stadia* noted in the following chapter, but such variance in the reports does not support the certitude of either Hansman or Engels in identifying Hecatompylos, much less the distance between this site and the elusive Caspian Gates.[118]

There are many such problems in placing the cities of the campaign. Engels admitted that Prophthasia was not easily identified as Juwain, and similarly saw problems with the identification of Arachoti Polis with Kandahar, the majority view despite that fact that the measurements anticipate a site notably further east.[119] Instead, he proposed Kelat-i-Ghilzai, a much more likely candidate on the basis of the measurements.[120] But this is merely educated guesswork. In fact, the only easily identified location on the list prior to Kabul is Alexandria Areion, modern day Herat.

After Kabul, our ability to make modern comparisons is notably improved. Pliny reports forty-six miles between Kabul and Alexandria ad Caucasum, almost certainly modern Begram. Engels' forty-seven mile measurement demonstrates the impressive accuracy of the *bematistai*. Another useful example is Taxila to the River Hydaspes (modern Jhelum). The *bematistai* reports from Pliny account for 110 miles. Engels, using Sir Aurel Stein's route, arrived at 105 miles.[121] The longer measurements are equally sound. While the exact position of Strabo's "Border of India" is unknown, it certainly lay somewhere between Alexandria ad

[114] Hansman 1968, 1970, 1981.

[115] Strabo, 11.9.1.

[116] Hansman 1968, 118.

[117] The longer measurement is from 11.8.9, while the shorter, more reasonable estimate of 1260 *stadia* is at 11.9.1.

[118] In fact, Engels creates separate Northern and Southern Caspian Gates to accommodate for these extreme differences. While the ancients certainly were confused by them, the likelihood is that Strabo or some earlier writer simply wrote nine for two in the hundreds column. Engels 1978, 158.

[119] On the identification of Arachoti Polis with Old Kandahar, see Boyce and Grenet 1991, 128.

[120] Engels 1978, 157-158.

[121] Engels 1978, 157-158.

Caucasum and Peucolatis, perhaps around modern day Jalalabad, Afghanistan. The distance from the two preferred Caspian Gates locations to this city approximates to between 1750-1800 miles using Alexander's route. The *bematistai* measurements in Strabo equate to 1757 miles, Pliny 1801. While Engels was perhaps overconfident in his ability to pinpoint the exact sites, he was undoubtedly correct in the general accuracy of the measurers. According to Engels' estimations, the *bematistai* measurements average less than a five percent deviation from the actual distance. This is not provable for some of the distances, but less than a ten percent error is very likely, even when accommodating for the difficulty in establishing measuring points.

On the basis of this accuracy, Engels assumes the use of a *hodometer*. However, a late Classical origination date for the *hodometer* has little supporting evidence. The earliest extant descriptions of such a device belong to the Roman engineer Vitruvius (1st c. BCE) and the aforementioned Heron in the 1st c. CE. More importantly, the gearing mechanisms used in the devices described by these engineers were probably not available to Alexander's engineers. Historians of engineering have proposed that the scholars of Alexandria and the Syracusan scientist Archimedes perfected such advanced mechanisms as the hypoid gear and screw gear in the 3rd c. BCE.[122] Further, an instrument relying on such geared mechanisms would have been limited to relatively flat and gentle terrain.[123] While Alexander certainly used the available royal roads on large sections of the campaign, the eastern regions cited in the records of the *bematistai* offered poorer, less accessible roads.[124] It is difficult to imagine Alexander's *bematistai* traversing the frequently mentioned deserts and mountains of the campaign, not forgetting the jungles of the Indus River Valley, with a device that relied on smooth terrain.[125] In addition, why would they have brought such a device from Greece only to start using it at the Euphrates River, or more likely, the Caspian Gates? Rather, the chronological trajectory and design of the *hodometer* requires a more organized road system, that of the Romans.[126]

Instead of a *hodometer*, there is ample evidence suggesting the *bematistai* utilized a pace-oriented measure. The title itself suggests so. As noted earlier, the *Liddell Scott Jones* defines *bematist* as "one who measures by paces," constructed upon the Greek for step or pace, *bêma*. Further, the *bêma* also served as a measurement of the average pace, the Attic version of which corresponded to two and a half *podoi*, or Greek feet.[127] Hesychius' fifth century CE definition for the term *bematist* further aids this connection, as he says that the bematist "measured with/by feet."[128] Whether he intends the plural dative τοῖς ποσὶ to mean the method of measure or the actual measurement unit is uncertain. Nonetheless, the measurements themselves suggest the

[122] Field and Wright 1985, 200; Lewis 1993, 112-113; Lewis 2001, 135-137; Sleeswyk 1979, 14; 1981, 198-200; 1990, 28.

[123] Lewis 2001, 135-137.

[124] Arr., *Anab.*, 3.18.1. Scholarship has long recognized that Alexander utilized the royal road system. Engels 1978, 69.

[125] Fraser 1996, 80.

[126] Lewis 2001, 137. The importance of the device in terms of later mapmaking and mathematical geography is apparent. Lewis points especially to Agrippa's great world-map, the Antonine Itinerary and Peutinger Table, and the geographers Marinus of Tyre and Ptolemy.

[127] *LSJ*, 314.

[128] Hesychius, "βηματίζει - τὸ τοῖς ποσὶ μετρεῖν."

bematistai utilized a *stade* measurement conducive to pace measuring. The Attic *stade* corresponded to 600 feet, or approximately 185 meters. Although other distances (notably 157 meters, or 515 feet) have been proposed, Strabo's *stadia* measurements for the *bematistai* equate to Pliny's Roman miles using the standard Attic formula of eight *stadia* to one Roman mile.[129] An Attic *stade* also happens to agree more closely with modern measurements of the same routes. Assuming this usage of the Attic *stade*, forty paces (*bemata*) would equal a single plethron, or one hundred feet, while two hundred and forty paces would equal a single Attic *stade*. The roundness of the numbers, along with the fact that the average pace served as the foundation of their titles, aids the argument for pace measuring.

The extant measurements provide further aid for the pacing argument. Much can be gleaned from the fact that the distances varied among the reports of different *bematistai*.[130] A few of the measurements of Strabo and Pliny are identical, but these come from the regions furthest on the periphery, such as the Cyrus River connections and those from Bactra to the Iaxartes River. For these, it is possible that only an individual or one team was responsible for them. However, most of the measurements along the army's main line of march are slightly different in Strabo and Pliny. Further, both authors suggest that there were variations in the records of the *bematistai*.[131] While it has been suggested that this is an indication of their use of different routes or even variations in *stade* lengths, it strongly suggests that these measurements were produced by different individuals or pairings.[132] This counters the use of a *hodometer*, as such a precise machine would not necessitate multiple measurements. The same argument could negate the likelihood of their use of measuring lines as well. In fact, Strabo said that Hellenistic measurements of an Indian royal road from the Indus to Palibothra were precise because measuring lines were used, perhaps suggesting that they were not used for Alexander era measurements.[133] The existence of multiple measurements and slight differences between them suggests that the campaign administration expected variation and employed several measurers to establish a working average.

The *bematist* title and the existent measurements all point toward pacing as the method of measurement. This leaves only the question of whether precise, long-distance measurements could be accomplished by foot. It is clear from later sources that precise measurements of

[129] The debate over the length of Eratosthenes' *stade* is an old one. Several studies have pointed to the appropriateness of the 157-meter itinerary *stade* for his measurement of the earth's circumference, i.e. Letronne 1851, 104-119, 212-246; Hoyle 1962, 84; Firsov 1972. However, the measurements of Alexander's *bematistai* strongly suggest an Attic standard of approximately 185 meters. Engels put forward the persuasive argument concerning the equality of Strabo's *stade* and Pliny's Roman mile according to Attic standards. Engels 1985, 308-309.

[130] The fragments in Pliny and Strabo differ in terms of distances provided, though this could be an issue of transmission. Strabo, 2.1.7-8; 2.1.23; 11.8.9. Plin., *HN,* 6.21.61-65. Pliny explicitly says that there were varying figures provided at 6.21.62.

[131] Strabo, 11.8.9, notably on the routes Alexandria Areion-Prophthasia. His numbers for Caspian Gates-Hecatompylos are also different, but it is not clear that the alternative number at 11.9.1 is from the *bematistai*. Plin., *HN*, 6.21.61-62, notably for the route Kabul-Alexander's Polis.

[132] Fraser 1996, 84n14. My thesis helps to explain Fraser's confusion over the variations in measurement. Fraser provides a chart of the distances on this page. For an argument concerning different measurements of *stadia*, see Fraser 1996, 76n2.

[133] Strabo, 15.1.11. μῆκος δὲ τὸ ἀπὸ τῆς ἑσπέρας ἐπὶ τὴν ἕω: τούτου δὲ τὸ μὲν μέχρι Παλιβόθρων ἔχοι τις ἂν βεβαιοτέρως εἰπεῖν: καταμεμέτρηται γὰρ σχοινίοις καὶ ἔστιν ὁδὸς βασιλικὴ σταδίων μυρίων.

distance were accomplished on foot during the Roman period. Vegetius, a Roman military commander of the fourth century CE, claimed that accurate measurements of distance were calculated using the step taken by the average soldier:

> Now in the first part of training, the novices are to be taught the military step … with the military grade of pace they should traverse twenty miles in exactly five summer hours. However, with the full step, which is faster, twenty-four miles can be completed in the same number of hours. If you go any faster, it is now running, the distance for which cannot be determined.[134]

While these are obviously estimations, they demonstrate that pace-measuring had become a regular part of military training by Vegetius' time. They further corroborate the likelihood that the *bematistai* used the common marching step for their measuring.[135]

Pace-measuring is still taught in military land navigation as a viable alternative to more advanced forms of distance measurements. The *U.S. Army Map Reading and Land Navigation Handbook* provides detailed explanations concerning pace-measuring, giving specific ratios for conducting measurements on sloped ground. It even suggests the dropping of stones into one's pocket to mark off a predetermined distance, an image that recalls the *hodometer* of the ancient world.[136] A study conducted by the U.S. Army Research Institute for the Behavioral and Social Sciences found that soldiers averaged between three and five percent error on flat terrain in both day and night conditions while using unassisted pace-measuring. When put on a course with elevation change, accuracy dropped slightly during the day (between four and six percent) and more precipitously at night (between eight and thirteen percent).[137] Since Alexander's *bematistai* would have been measuring for the most part during the day, these numbers demonstrate that the slight inaccuracies of the *bematistai* are in line with reasonable expectations of pace-measuring. Studies performed with the *bematistai* in mind have arrived at similar conclusions. Dr. Tzifopoulos informed me that his colleague, Dr. Pikoulas of the University of Thessaly, found that extensive practice led to high levels of precision in pace-counting in his own field trials.[138] There is nothing in the evidence that suggests the *bematistai* used either measuring lines or a primitive odometer. They used their own pacing and measuring expertise to produce some of the most valuable distance measurements in world history.

[134] Veg., *Mil.*, 1.9. Primis ergo meditationum auspiciis tirones militarem edocendi sunt gradum … Militari ergo gradu XX milia passuum horis quinque dumtaxat aestiuis conficienda sunt. Pleno autem gradu, qui citatior est, totidem horis XXIIII milia peragenda sunt. Quicquid addideris, iam cursus est, cuius spatium non potest definiri.

[135] Pédech 1976, 96. Pédech instead suggests that the steps were approximated due to the length of the march, correcting for type of terrain.

[136] Department of the Army, *Army Field Manual 3-25.26: Map Reading and Land Navigation Handbook,* 5-8.

[137] Guadognoli, Fober, and Terry 1990.

[138] Tzifopoulos 1998, 147n.27. He also mentioned this in his comments during our meeting noted above.

Conclusion

In conclusion, I would like to return to the runner Philonides. If we accept Alexander's assumption of Achaemenid practices concerning geographical collection, a much clearer understanding of Philonides' career is possible. If Alexander wanted someone with pace-counting experience to fill the rolls of his new *bematist* unit, it makes sense that he chose runners. As noted above, they would already occupy positions as couriers and scouts. Philonides started this new job somewhere in the Achaemenid center, which explains his ability to connect himself to Alexander through two separate, but interrelated titles. Last, and most importantly, it explains his title as "*bematist* of Asia." While the word itself has a clear Greco-Macedonian etymology, the title originated with Alexander's assumption of Achaemenid geographic controls and thus reflects its hybrid origins midway through the campaign. While Philonides recognized that this title was incredibly significant because of its proximity to Alexander, he could not have anticipated the importance of his paces for the future of ancient geography.

CHRISTOPHER KEGERREIS
UNIVERSITY OF CALIFORNIA AT SANTA BARBARA

Bibliography

Allen, L. (2005). *The Persian Empire*. Chicago: University of Chicago Press.

Anderson, A. (1928). "Alexander at the Caspian Gates." *TAPhA* 59, 130-163.

Anson, E. M. (1996). "The *Ephemerides* of Alexander the Great." *Historia* 45, No.1, 501-504.

Badian, E. (1961). "Harpalus." *JHS* 81, 16-43.

Badian, E. (1985). "Alexander in Iran." In I.L. Gershevitch, ed., *The Cambridge History of Iran* II, Cambridge: Cambridge University Press, 420-501.

Baynham, E.J. (2003). "The Ancient Evidence for Alexander the Great." In J. Roisman, ed., *Brill's Companion to Alexander the Great.* Edited, Leiden: Brill Publishing, 3-29.

Bernard, P. (1994). "L'Asie centrale et l'empire séleucide." *Topoi* 4, No.2, 473-511.

Bernard, P. (1997). "Les origines thessaliennes de l'Arménie vues par deux historiens thessaliens de la génération d'Alexandre." *Topoi, Supplément 1: Recherches récentes sur l'Empire achéménide*, 131-216.

Bernard, P. (1999). "Alexandre, Ménon et les mines d'or d'Arménie." In *Travaux de numismatique grecque offerts à Georges le Rider*, London: Spink, 37-64.

Berve, H. (1926). *Das Alexanderreich auf Prosopographischer Grundlage*, Vol.1, München: Beck.

Bivar, A.D. (1978). "The Aramaic Summary." In D. Stronach, ed., *Pasargadae: A Report on the Excavations Conducted by the British Institute of Persian Studies from 1961-1963,* Oxford: Clarendon Press, 161-162.

Bivar, A.D. (1985). "Achaemenid Coins, Weights, and Measures." In I.L. Gershevitz, ed., *The Cambridge History of Iran* II, Cambridge: Cambridge University Press, 610-639.

Bosworth, A.B. (1971). "The Death of Alexander the Great." *CQ* 65, 119-122.

Bosworth, A.B. (1980). *A Historical Commentary on Arrian's History of Alexander* I, Oxford: Clarendon Press.

Bosworth, A.B. (1988). *From Arrian to Alexander: Studies in Historical Interpretation*, Oxford: Oxford University Press.

Boyce, M. and Grenet, F. (1991). *A History of Zoroastrianism* Vol. 3: *Zoroastrianism under Macedonian and Roman rule*. Leiden: Brill.

Briant, P. (2002). *From Cyrus to Alexander*, translated by Peter Daniels, Winona Lake, Indiana: Eisenbrauns.

Briant, Pierre (2009). "The Empire of Darius III in Perspective." In Waldemar Heckel and Lawrence Tritle, eds., *Alexander the Great: A New History*, West Sussex: Wiley Blackwell, 141-170.

Briant, Pierre (2010). *Alexander the Great and His Empire: A Short Introduction*, translated by Amélie Kuhrt, Princeton, NJ: Princeton University Press.

Chugg, A. (2005). "The Journal of Alexander the Great." *AHB* 3-4, 155-175.

Colburn, H. (2013). "Connectivity and Communication in the Achaemenid Empire." *JESHO* 56, 29-52.

Department of the Army. *Army Field Manual 3-25.26: Map Reading and Land Navigation Handbook.*

Dittenberger, W. (1960). *Sylloge Inscriptionum Graecarum*, NB Hildesheim: George Olms.

Drachmann, A.G. (1963). *The Mechanical Technology of Greek and Roman Antiquity,* Copenhagen: Munksgaard/ Madison.

Engels, D. (1978). *Alexander the Great and the Logistics of the Macedonian Army*, Berkeley: University of California Press.

Engels, D. (1985). "The Length of Eratosthenes' Stade." *AJPH* 106, No. 3, 298-311.

Field, J. and Wright, M. (1985). "The Early History of Mathematical Gearing." *Endeavour*, *New Series* 9, 198-203.

Firsov, L.V. (1972). "Eratosthenes' Calculation of the Earth's Circumference and the Length of the Hellenistic Stade." *VDI* 121, 154-175.

Fraser, P.M. (1996). *Cities of Alexander the Great*, Oxford: Oxford University Press.

Fredricksmeyer, E. (2000). "Alexander the Great and the Kingship of Asia." In A.B. Bosworth and E.J. Baynham, eds., *Alexander the Great in Fact and Fiction*, Oxford: Oxford University Press, 136-166.

French, D. (1998). "Pre- and Early-Roman Roads of Asia Minor. The Persian Royal Road." *Iran* 36, 15-43.

Graf, David (1994). "The Persian Royal Road System." In Heleen Sancisi-Weerdenburg, Amelie Kuhrt, and Margaret Cool Root, eds., *Achaemenid History 8: Continuity and Change*, Leiden: Nederlands Institut Voor Het Nabije Oosten.

Grelot, P. (1972). *Documents araméens d'Égypte*, Paris: Éditions du Cerf.

Goukowsky, P. (1978). *Essai sur les origins du mythe d'Alexandre (336–270 av. J.-C.)*, Vol.1, Nancy: France.

Guadognoli, M.; Fober, G.; and Terry, P. (1990). "Accuracy of Pace Count as a Distance Estimation Procedure." *Military Psychology* 2(3), 183-191.

Hallock, R. (1969). *The Persepolis Fortification Tablets*, Chicago: Chicago University Press.

Hallock, R. (1978). "Selected Fortification Tablets." *Cahiers de la Délégation Archéologique Française en Iran* 8, 109-136.

Hammond, N.G.L. (1988). "The Royal Journal of Alexander." *Historia Bd.37, H. 227*, 129-50.

Hammond, N.G.L. (1993). *Sources for Alexander the Great: An Analysis of Plutarch's Life and Arrian's Anabasis of Alexander*, Cambridge: Cambridge University Press.

Hammond, N.G.L. (1996). "Alexander and Armenia." *Phoenix* 50, 130-137.

Hannah, R. and McPhail, C. (2011-2012). "The Cartographers of the Taurus line: the Bematistai, Dicaearchus and Eratosthenes." *Geographia Antiqua* 20-21, 163–77.

Hansen, M.H. and Nielsen, T.H. (2004). *An Inventory of Archaic and Classical Poleis*, Oxford: Oxford University Press.

Hansman, J. (1968). "The Problems of Qūmis." *The Journal of the Royal Asiatic Society of Great Britain and Ireland* 100, No. 3/4, 111-139.

Hansman, J. and Stronach, D. (1970). "Excavations at Shahr-i-Qūmis, 1967." *Journal of the Royal Asiatic Society of Great Britain and Ireland* 102, No. 1, 29-62.

Hansman, J. (1981). "The Measure of Hecatompylos." *The Journal of the Royal Asiatic Society of Great Britain and Ireland* 113, No. 1, 3-9.

Henkelman, W. (2008). *The Other Gods Who Are: Studies in Elamite-Iranian Acculturation based on the Persepolis Fortification Texts*, *Achaemenid History* 14. Leiden: Nederlands Instituut Voor Het Nabije Oosten.

Herzfeld, E. (1968). *The Persian Empire: Studies in Geography and Ethnography of the Ancient Near East*, Gerold Walser, ed., Wiesbaden: Franz Steiner Verlag.

Higgins, W. (1980). "Aspects of Alexander's Imperial Administration: Some Modern Methods and Views Reviewed." *Athenaeum* 58, 129–52.

Hoyle, F. (1962). *Astronomy*, London: Rathbone.

Jackson, A.V.W. (1911). *From Constantinople to the Home of Omar Khayyam*, New York.

Kalleris, J.N. (1954). *Les anciens Macédoniens: Etude linguistique et historique*, Vol.1, Athenes, Institut Francais d'Athénes.

Kalleris, J.N. (1976). *Les anciens Macédoniens: Etude linguistique et historique*, Vol. 2, Athenes, Institut Francais d'Athénes.

Kuhrt, A. (2007). *The Persian Empire: A Corpus of Sources from the Achaemenid Period,* Vol.1-2, London: Routledge.

Lane Fox, R. (1974). *Alexander the Great*, London: Allen Lane.

Lane Fox, R. (1980). *In Search of Alexander*, Boston: Little, Brown, and Company.

Lane Fox, R. (2004) "Introduction." In Robin L. Fox, ed., *The Long March: Xenophon and the Ten Thousand*, New Haven: Yale University Press, 1-46.

Lane Fox, R. (2007). "Alexander the Great: 'Last of the Achaemenids'?" In Christopher Tuplin, ed., *Persian Responses: Political and Cultural Interaction within the Achaemenid Empire*, Swansea: Classical Press of Wales, 267-311.

Letronne, A. (1851). *Recherches sur les fragments d'Héron d'Alexandrie ou du système métrique égyptien*, Paris.

Lewis, D.M. (1978). "The Seleucid Inscription." In D. Stronach, ed., *Pasargadae: A Report on the Excavations Conducted by the British Institute of Persian Studies from 1961-1963,* Oxford: Clarendon Press, 159-161.

Lewis, M. (1993). "Gearing in the Ancient World." *Endeavour, New Series* 17 (3), 100-115.

Lewis, M. (2001). *Surveying Instruments of Greece and Rome*, Cambridge: Cambridge University Press.

Matthews, V.J. (1974). "The Hemerodromai: Ultra Long-Distance Running in Antiquity." *CW* 68, 161-169.

Naveh, J. and Shaked, S., eds., (2012). *Aramaic Documents from Ancient Bactria*, London: Khalili Family Trust.

Neuberger, A. (1930). *The Technical Arts and Sciences of the Ancients*, New York: Macmilllan.

Pearson, L. (1955). "The Diary and Letters of Alexander the Great." *Historia* 3, 429-55.

Pearson, L. (1960). *The Lost Histories of Alexander the Great*, Oxford: Blackwell Publishing.

Pédech, P. (1976). *La Géographie des Grecs*, Paris: Les Belles Lettres.

Pfister, Friedrich (1961). "Das Alexander-Archiv und die hellenistisch-romische Wissenschaft." *Historia: Zeitschrift für Alte Geschichte*, Bd. 10, H. 1, 30-67.

Pritchett, W. (1980). *Studies in Ancient Greek Topography Part 3: Roads* (*Classical Studies* Vol. 22), Berkeley: UC Press.

Rawlins, D. (1982). "The Eratosthenes-Strabo Nile Map. Is it the Earliest Surviving Instance of Spherical Cartography? Did it Supply the 5000 Stades Arc for Eratosthenes' Experiment?" *Archive for History of Exact Sciences* 26, No.3, 211-219.

Robinson, Jr., C.A., (1932). *The Ephemerides of Alexander's Expedition*, Providence, RI: Brown University Studies.

Samuel, A. (1965). "Alexander's 'Royal Journals'." *Historia* 14, No.1, 1-12.

Schwartz, E. (1897). "Bematistai." *RE* 3, 226-267.

Sleeswyk, A.W. (1979). "Vitruvius' waywiser." *Archives internationales d'histoire de science* 29, 11-22.

Sleeswyk, A.W. (1981). "Vitruvius' odometer." *Scientific American* 245, 158-71.

Sleeswyk, A.W. (1990). "Archimedes' odometer and water clock." *Ancient Technology*, *Tekniikan museon julkaisuja* 5, Helsinki: Finnish Institute at Athens, 23-37.

Standish, J.F. (1970). "The Caspian Gates." *Greece and Rome* 17, 17-24.

Stein, A. (1942). "Alexander's Crossing of the Tigris and the Battle of Arbela." *The Geographical Journal* 100, No.4, 155-164.

Stoneman, R. (1994). "Romantic Ethnography: Central Asia and India in the Alexander Romance." *Ancient World* 25, No.1, 93-107.

Stoneman, R. (2015). "How Many Miles to Babylon? Maps, Guides, Roads and Rivers in the Expeditions of Xenophon and Alexander." *Greece and Rome* 62, Issue 1, 60-74.

Tarn, W.W. (1948). *Alexander the Great* Vol.1-2, Cambridge: Cambridge University Press.

Thomson, J. (1948, reprinted 1965). *History of Ancient Geography*, New York: Biblo and Tannen.

Tuplin, C. (1997). "Achaemenid arithmetic: numerical problems in Persian history." *Topoi (Lyon)* Supplement 1, 365–421.

Tzifopoulos, Y. (1998). "'Hemerodromoi' and Cretan 'Dromeis': Athletes or Military Personnel? The Case of the Cretan Philonides." *Nikephoros* 11, 137-170.

Wilcken, U. (1894). "Hypomnematismoi." *Philol.* 53, 84-126.

Wilcken, U. (1967). *Alexander the Great*, translated by G.C. Richards, New York: W.W. Norton.

Worthington, I. (1986). "The Chronology of the Harpalus Affair." *Symbolae Osloenses* 61, No.1, 63-76.