Philological Notes on the Crossbow and Related Missile Weapons

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TO CLARIFY SOME PROBLEMS related to the early history of the crossbow, this paper assembles some philological material on missile weapons from Late Antiquity (in particular Ammianus and Vegetius) to *ca* 1100. These problems arise from the tendency of modern interpretations of ancient technical documents to ascribe a fixed value to technical vocabulary by defining it either in the abstract or on the basis of documents from different periods or cultures; the context is then adjusted to fit a preconceived notion of a term instead of inferring its precise value at a particular point in time from a given context. To show how misleading this procedure is, in modern English a 'gun' is a portable firearm, but a 'gunner' is an artilleryman. The latter reflects the earliest uses of the English *gonne*: "A siege engine that casts missiles; ballista, mangonel, trebuchet; also, a ram." The meaning of *gonne* evolved along with technology and came to mean various kinds of artillery pieces in Elizabethan times.[1] If only fragmentary documentation survived from the past thousand years, it might be easy to confuse 'gunners' and 'gunmen' (that is, military men and gangsters); and if the researcher were misled by lexical uniformity, he might seek identity between heavy artillery on ramparts and pearl-handled guns in night tables, and he would then feel called upon to account for inexplicably large night tables.

For examples from Late Antiquity, Souter's definition of *tragularius,* "a soldier who shoots a TRAGULA (javelin)," is incorrect, since it rests on Veg. 2.15: *tragularii, qui ad manuballistas vel arcuballistas dirigebant sagittas."*[2] However illogical it might seem, a *tragularius* shoots not *tragulae* but arrows. We find the same slackness in translations of ancient authors: Rolfe translates Amm. Marc. 16.2.5, *Et nequa interveniat mora, adhibi-*

[1] S. Kuhn and J. Reidy, edd., *Middle English Dictionary* IV (Ann Arbor 1963) 250a *s.v.*

[2] A. Souter, *A Glossary of Later Latin to 600 A.D.* (Oxford 1949).

tis cataphractariis solis et ballistariis, parum ad tuendum rectorem idoneis, as "And to avoid any delay, he took only the cuirassiers and the crossbowmen, who were far from suitable to defend a general."[3] In Medieval Latin *ballistarius* meant crossbowman, but this definition need not hold for the fourth-century *ballistarius*. Rolfe's note, "The *ballistarii* had charge of the *ballistae*, which took the place of artillery," makes "crossbowmen" even less suitable as a translation, given that crossbows are not artillery. Further, Ammianus uses *ballista* to describe a siege engine; but it does not follow that a *ballistarius* is a siege engineer, for in his description of the *ballista* Ammianus uses *artifex* for the operator of the engine (23.3.1f). We must first examine the context to see if artillery is involved: Julian sets out on a raid with a small force, pared to essentials, both powerful and extremely mobile, roaming in a wild area and hoping to strike like lightning. Siege engines would be inexplicable; Ammianus points out elsewhere that they are a little unwieldy (19.7.6): *sedit consilium quod tutius celeritas fecit, quattuor eisdem ballistis scorpiones opponi, qui dum translati e regione, caute (quod artis est difficillimae) collocantur.*[4] Vegetius mentions the *ballistarii* with the *levem armaturam, hoc est ferentarios sagittarios funditores ballistarios* (2.2). Here again, we can expect them to be, not siege engineers, but soldiers equipped with a portable weapon. Vegetius' inclusion of the *ballistarii* with the *levis armatura* fits with Julian's decision to bring them on a raid, and with Ammianus' strictures on this decision.

In his description of Roman Imperial artillery, Marsden uses sources ranging from the first century B.C. to the fifth century and organizes his material thematically without strict attention to chronology, under the assumption that late evidence may be applied to much earlier times.[5] It is unlikely that military form and function remained static over this period of 600 years, from the days of the Republic, when the main activity of the army was the conquest of city-states or pre-state tribes and involved many sieges, to the Golden Age of the Antonines, when

[3] J. C. Rolfe, tr. *Ammianus Marcellinus* (Loeb edition: London 1950) I 207.

[4] Emphasis added. For more information on the logistics of field artillery, their transport, and deployment, see E. W. MARSDEN, *Greek and Roman Artillery: Historical Development* (Oxford 1969: hereafter 'Marsden') 164ff.

[5] Marsden 174–85, and 183 n.1: "Although Vegetius' remarks [at 2.2] refer to the second and third centuries, broadly speaking, it is clear that they must have applied equally to the legions from the times of Augustus onwards."

its activities were mainly either political (usurpations, civil wars) or protective (frontier security), to the fourth century, which witnessed both the reforms of Constantine at the beginning and the disaster of Adrianople in 378; and it is certainly known that language changed. This seems to have been overlooked by Marsden: "The Roman legionary *ballistarius* probably performed the same functions as the καταπαλταφέτης in the Hellenistic period" (192). Without pursing the comparison, this comment cannot apply to Vegetius' *ballistarius,* who belongs to the *levis armatura* along with slingers and bowmen. Elsewhere (196) Marden also defines *ballistarius* in a manner inconsistent with Vegetius' usage:

> Special legions of *ballistarii* had to be raised from men who did understand machinery and were capable of operating and maintaining pieces of artillery. If these legions comprised 1,000 men, like the infantry legions of the same epoch, and if Vegetius is approximately right, as he may well be, in saying that eleven men formed the detachment working each arrow-shooting *ballista,* then a unit of *ballistarii* constituted an artillery regiment with about fifty pieces of ordnance.

But Vegetius makes no mention of entire legions of *ballistarii.*[6] His legions are made up of heavy armed infantry, light-armed infantry, and cavalry; and the *ballistarii* belong to the second group with other types of missile troops (2.2). For the rôle of artillery in the legion Vegetius says (2.25):

> *Nam per singulas centurias singulas carroballistas habere consuevit, quibus muli ad trahendum et singula contubernia ad armandum vel dirigendum, hoc est undecim homines, deputantur.... In una autem legione quinquagenta quinque carroballistae esse solent. Item decem onagri, hoc est singuli per singulas cohortes.*

Surely Vegetius is clear: each legion has fifty-five *carroballistae* and ten *onagri*; this makes artillery an element of the legion. It does not mean that the whole legion is composed of artillerymen. We might note that Vegetius does not call artillery operators *ballistarii* but *homines.* The same point can be made for Ammianus, whose stone-throwing *onager* was operated by

[6] The legions of *ballistarii* in the *Not. Dig.* can only be evaluated against the history of artillery. I propose to discuss this topic elsewhere.

four young men and a *magister* (23.4.4). Hence a curious paradox in these authors: their *ballistarii* are infantry or cavalry and their artillery is operated by 'men'. This should advise caution with fragmentary epigraphical evidence. For instance, Marsden discusses Vedennius, "whose tombstone has a bas-relief of an arrow-shooting catapult" (185); the inscription gives his occupation as *arcitect. armament. imp.* Marsden also notes (191f) the epitaphs of Optatus and Priscinus, the first a *magister ballistarius* and the second a *ballistarius*; he does not, however, discuss the terminological difficulties and assumes that all three are involved with artillery.[7] This is clearly true for Vedennius; if Optatus should turn out upon a better reading to be a *magister ballistarum* instead of *magister ballistarius,* then he too would qualify for artillery. Priscinus, however, could be an infantryman equipped with a hand weapon; without pictorial evidence or a more complete record, it is not certain that he was one or the other. (As the crossbow is the prime focus of this paper, a full investigation of the term *ballistarius* cannot be undertaken here, but it should be noted that a *ballistarius* is not a crossbowman and that in at least some sources he seems to be an infantryman).

Scorpio also changes its meaning according to context, as seen in Vegetius and Ammianus.

> *Scorpiones dicebant, quas nunc manuballistas vocant, ideo sic nuncupati, quod parvis subtilibusque spiculis inferunt mortem. Fustibalos arcuballistas et fundas describere superfluum puto, quae praesens usus agnoscit. Saxis tamen gravioribus per onagrum destinatis non solum equi eliduntur et homines sed etiam hostium machinamenta* (Veg. 4.22).

Ammianus also describes a *scorpio quem appellant nunc onagrum*: operated by four young men and a *magister,* it casts stones with such force that it crushes the walls upon which it stands by its violent concussion, rather than by its weight; and it was called earlier a "scorpion because it has an upraised sting" (23.4.4). Obviously, Vegetius and Ammianus do not use the word *scorpio* for the same piece of equipment. Vegetius uses *onager* in the same manner as Ammianus, but he distinguishes *scorpio* and *onager* as separate pieces of equipment. The ques-

[7] No more than does M. A. Tomei, "La tecnica nel tardo imperio romano: le macchine da guerra," *DialArch* 1 (1982) 63–88, esp. 65–69.

tion of who is right is irrelevant; they might both be right. A proper lexical entry based on an analysis of the contexts would include for *scorpio*:

> **scorpio** (1) in Ammianus: an outdated synonym for the *onager,* a stationary stone-thrower operated by four men and a master (23.4.4). (2) in Vegetius: an outdated synonym for *manuballista,* a weapon that casts small darts and is operated by a *tragularius* (4.22 and 2.15).

At times Marsden overlooked this basic precaution: "After all, [Ammianus'] regular word for the standard contemporary stone-thrower, the one-armed *onager,* is *scorpio,* and everyone knows that *scorpio* denotes a small catapult" (189). On the contrary, Vegetius cannot identify a stone-thrower as a *scorpio,* for they were used not with stones but *parvis subtilibusque spiculis.*[8]

More work needs to be done to define words of the *ballista* family. According to Marsden, "In the fourth century A.D. the word *ballista* and its compounds *arcuballista, carroballista* and *manuballista,* signify arrow-shooting engines" (188f). First, let us note that these words are most clearly attested by Vegetius and that Ammianus uses only *ballista.* In both authors the *ballista* is a siege engine: all references in Ammianus are connected with sieges, and his descriptions of the *ballista* and the *onager* are included with the other *murales machinae* (23.4); likewise, Vegetius mentions the *ballista* in the context of sieges in all cases but one, which refers to naval warfare.[9] The *carroballista* seems indeed to have been a type of artillery, but moveable and fit for an army on the march, as made clear at Veg. 2.25: *Non solum autem castra defendunt, verum etiam in campo post aciem*

[8] Like Marsden, P. Fleury, "Vitruve et la nomenclature des machines de jet romaines," *REL* 59 (1981) 216–34, esp. 230ff, discusses the history of the word *scorpio* in Ammianus and Vegetius without noticing that the same word refers to very different pieces of equipment in each author.

[9] Amm. Marc. 19.1.7, 5.6, 7.2, 5–7; 20.7.2, 10, 11.20, 22; 23.4.1; 24.2.13, 4.16; Veg. 2.10, 3.3, 4.9f, 18, 22, 28, 44 (naval warfare). One observation might be made here: in his discussion of the First Dacian War, Marsden (190) does not explain on what grounds he assigns the moveable artillery to the wings only and static engines behind the infantry. One would first have to demonstrate that static engines were indeed used in the field and not exclusively in sieges.

gravis armaturae ponentur.[10] Certainly, however, *arcuballista* and *manuballista* were not artillery; their context in Vegetius leaves other possibilities open. It is pointless to look for something esoteric and complex when assessing the *arcuballista*: *Fustibalos, arcuballistas et fundas describere superfluum puto, quae praesens usus agnoscit* (Veg. 4.22). A commonplace article, it is clearly something on the same level as the sling. In the following I shall investigate the possible connection of *arcuballista* and *manuballista* with archery and the crossbow.

I. The Arrow-Guide in the Byzantine Army

In the *Strategikon* attributed to the Emperor Maurice, we find a description of the equipment carried by a light-armed infantryman, including σωληνάρια ξύλινα μετὰ μικρῶν σαγιττῶν καὶ κουκούρων μικρῶν, ἅπερ καὶ ἐπὶ πολὺ διάστημα ῥίπτονται διὰ τῶν τοξαρίων καὶ τοῖς ἐχθροῖς ἀχρεῖα εἰσιν (12B.5).[11] The passage is paraphrased in Leo *Tactica* 6.26 (Migne, *PG* 107). These σωληνάρια are also mentioned in tactical texts from the Macedonian dynasty, where the ψιλοί are enjoined to have

> καὶ νευρὰς ἀνὰ δύο καὶ σωληνάρια ξύλινα μετὰ μικρῶν ἕκαστον ὀϊστῶν καὶ κουκούρων τοιούτων· τοὺς δὲ μικροὺς τοιούτους ὀϊστοὺς καὶ μένας καλοῦσί τινες. Χρήσιμα δὲ τὰ βέλη ταῦτα κατὰ τὸν πόλεμον ὅτι τε πορρωτάτω διὰ τῶν τόξων πέμπονται καὶ ὅτι ἀθέατα τοῖς πολεμίοις εἰσὶ διὰ τὴν βραχύτητα καὶ διὰ τοῦτο

[10] According to Marsden (180), "the illustrations on Trajan's Column provide the earliest evidence for the *carroballista.*" This is no doubt true for the existence of the piece of equipment; the word *carroballista,* however, does not occur on the Column and is first recorded in Vegetius. It is not certain that the piece of equipment depicted on the Column was called a *carroballista* under Trajan. Changes in technology and terminology are noticeable between the second and the fourth centuries, no doubt due to demilitarization under the Antonines and the troubles of the third century.

[11] "wooden σωληνάρια with short arrows in small quivers which can be shot over a great distance with the bows and are useless to the enemy"; G. Dennis, ed., *Das Strategikon des Maurikios,* tr. E. Gamillscheg (=*CFHB* 17 [Vienna 1981]). Unless otherwise indicated, translations are mine.

τάχιστα ἀναιροῦσιν· ἄλλως τε καὶ ὅτι τοῖς πολεμίοις
οὐ χρησιμεύουσι ταῦτα τὰ βέλη δι' ἀπειρίαν.[12]

In the past twenty years, three articles have dealt with the σωληνάρια;[13] the first two sought to identify the σωληνάριον with the crossbow; the third established its identity with the arrow-guide known from Islamic sources[14] but left some problems connected with the missiles used with these σωληνάρια. In his attempt to identify the σωληνάριον with the crossbow, Dennis sought to integrate as one item three different types of missiles: μυωτά mentioned in the seventh-century medical writer Paul of Aegina (6.88), μύ(ϊ)αι of Byzantine ship-borne catapults, and the μέναι used with the σωληνάριον. This identification is unfounded and we shall examine each item separately.

The form of μυωτά in Paul of Aegina is uncertain and otherwise not attested. DuCange read the word as μικτά[15] and LSJ as μυωτόν.[16] Briau and Heiberg, the most important editors of this medical text, selected the reading μυωτά, citing the variants μυϊατά and μυϊτά.[17] Sophocles, who used Briau, perceived it as

[12] *Sylloge Tacticorum* 38.8f, ed. A. Dain (Paris 1938): "also two bowstrings each, and wooden σωληνάρια with small arrows each and with quivers of the same type; some call such small arrows μέναι. These missiles are useful against the enemy, because they are shot with the bows at the greatest distance, and because they are invisible to the enemy on account of their shortness and because they strike most quickly and also generally because these missiles are of no use to the enemy on account of their inexperience."

[13] J. F. Haldon, "ΣΩΛΗΝΑΡΙΟΝ—The Byzantine Crossbow?" *University of Birmingham Historical Journal* 12 (1969–70) 155ff; G. T. DENNIS, "Flies, Mice and the Byzantine Crossbow," *ByzModGkSt* 7 (1981: hereafter 'Dennis') 1–5; D. NISHIMURA, "Crossbows, Arrow-Guides and the *Solenarion*," *Byzantion* 58 (1988: hereafter 'Nishimura') 422–35.

[14] J. D. LATHAM and W. F. PATERSON, edd., *Saracen Archery: An English Version and Exposition of a Mameluke Work on Archery (ca. A.D. 1368)* (London 1970: hereafter '*Saracen Archery*'); N. A. FARIS and R. P. ELMER, edd., *Arab Archery: An Arabic Manuscript of about A.D. 1500 "A Book on the Excellence of the Bow and Arrow" and the Description thereof* (Princeton 1945: hereafter '*Arab Archery*'). I am greatly indebted to Professor B. S. Hall of the University of Toronto for these references and for discussion of the technical aspect of military equipment and its use.

[15] So did a Greek edition from the Renaissance: see H. Gemusaeus, ed., *Pauli Aeginetae Medici optimi, libri septem* (Basel 1807).

[16] Defined as "small *arrowhead* (in Egypt)." Emphasis added.

[17] R. Briau, *La chirurgie de Paul d'Egine* (Paris 1855); I. L. Heiberg, *Paul of Aegina* (=*CMG* IX.1–2 [Leipzig 1924]). I am grateful to the Harvard Medical Library for a long term loan of Briau's rare volume.

an adjective μυωτός -η -ον, derived from 'mouse' and meaning 'short', and he did not connect it with the word μύια in tactical works. Though the form of μυωτά/μικτά is uncertain, its meaning is clear: it is an arrowhead. Paul of Aegina first establishes a distinction between the shafts and the arrowheads, and the rest of the passage concerns only the arrowheads, as their size indicates: the items under discussion vary from "three fingers' breadth in size" to "as small as one finger." Missiles ranging in size from dart to arrow would be "as small as one finger" to "as long as one arm":

> λεκτέον οὖν πρῶτον τὰς διαφορὰς τῶν βελῶν.
>
> διαφέρουσι τοίνυν τὰ βέλη ὕλῃ, σχήματι, μεγέθει, ἀριθμῷ, σχέσει, δυνάμει, ὕλῃ μέν, καθ' ὃ τῶν καλουμένων ἀτράκτων αὐτῶν ἢ ξυλίνων ἢ καλαμίνων ὑπαρχόντων αὐτὰ τὰ βέλη ἢ σιδηρᾶ ἐστιν ἢ χαλκᾶ ἢ κασσιτέρινα ἢ μολίβινα ἢ ὑέλινα ἢ κεράτινα ἢ ὀστέινα ἢ λίθινα ἢ καλάμινα καὶ αὐτὰ ἢ ξύλινα· τοσαύτη γάρ τις διαφορὰ μάλιστα παρ' Αἰγυπτίοις εὑρίσκεται....
>
> μεγέθει δέ, καθ' ὃ τὰ μέν εἰσιν μεγάλα ἄχρι τριῶν τὸ μῆκος δακτύλων, τὰ δὲ μικρὰ ὅσον δακτύλου, ἃ δὴ καὶ μυωτὰ καλοῦσιν κατ' Αἴγυπτον, τὰ δὲ τούτων μεταξύ.
>
> ἀριθμῷ δέ, καθ' ὃ τὰ μέν εἰσιν ἁπλᾶ, τὰ δὲ σύνθετα· λεπτὰ γάρ τινα αὐτοῖς ἐπεντίθεται σιδήρια, ἄτινα ἐν τῇ τοῦ βέλους ἐξολκῇ διαλανθάνοντα μένει κατὰ τὸ βάθος.
>
> σχέσει δέ, καθ' ὃ τὰ μὲν οὐραχὸν ἔχει τοῖς ἀτράκτοις ἐγκείμενον, τὰ δὲ αὐλὸν τούτοις περικείμενον, καὶ τὰ μὲν ἀσφαλῶς ἐνήρμοσται πρὸς τὸν ἄτρακτον, τὰ δὲ ἀμελέστερον, ἵνα κατὰ τὴν ἐξολκὴν χωριζόμενα εἴσω καταμένῃ.
>
> δυνάμει δέ, καθ' ὃ τὰ μέν εἰσιν ἀφάρμακτα, τὰ δὲ πεφαρμαγμένα.[18]

[18] 6.88 Heiberg: "We must first describe the different kinds of weapons [βελῶν]. Warlike instruments, then, differ from one another in material, figure, size, number, mode and power. In material, then, as the shafts are made of wood or of reeds; and the heads themselves are either made of iron, copper, tin, lead, glass, horn, bones, stone, and of reeds, too, or of wood: and such differences are found especially among the Egyptians.... They differ in size, inasmuch as some are three fingers' breadth in size, and some are as small as one finger, which are called μυωτά in Egypt, and some are intermediate between them. In number, inasmuch as some are simple and some com-

Dennis' argument (4) is as follows: a tenth-century manuscript, the Cod. Ambros. gr. B119 suppl., calls (at 139) "mice" (μυαί) the missiles used with the σωληνάριον; the same word is found in Paul of Aegina, who mentions small missiles that the Egyptians call "mice" (μυαί). The *Sylloge Tacticorum* states that the missiles used with the σωληνάριον are called μένας; this word, however, makes no sense and is an obvious error for μυάς or μυίας.

This will not do. Paul of Aegina uses neither μυαί nor μέναι but μυωτά, a word of uncertain etymology that may not be connected with mice; what Paul is describing is not an arrow but an arrow*head*; and he makes no mention of a tube or an auxiliary device required with arrows equipped with such heads. Paul does not support the argument presented by Dennis and accepted by Nishimura (428) that μυωτά are identical with the μύ(ι)αι and the μέναι of Byzantine treatises.

Dennis also sought to establish that σωληνάριον, τζάγγρα, and τοξοβαλλίστρα were three names for the same instrument—the crossbow. No doubt Anna Comnena's τζάγγρα was a crossbow[19] and the σωληνάριον an arrow-guide, but the τοξοβαλλίστρα seems to have been a stationary arrow-shooter, mounted on city walls or on shipboard, and not a personal

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pounded. For certain small pieces of iron are inserted in them, which, in the extraction of the weapon, remain concealed in deep-seated parts. In mode, as some have the sharp extremity fixed to a tail and some to a shaft; and some have it carefully inserted in the shaft, and some carelessly, so that in the extraction they may separate and leave the head behind. In power, as some are not poisoned and some are poisoned." Tr. F. Adams, *The Seven Books of Paulus Aegineta* (London 1844) II 418 (slightly modified). Adams' version reflects the earlier use of μίκκα for μυωτά.

[19] B. Leib, ed., *Alexiade* 10.8.6f (Budé): Ἡ δὲ τζάγγρα τόξον μέν ἐστι βαρβαρικὸν καὶ Ἕλλησι παντελῶς ἀγνοούμενον. Τείνεται δὲ οὐχὶ τῆς μὲν δεξιᾶς ἑλκούσης τὴν νευράν, τῆς δὲ λαιᾶς ἀνθελκούσης τὸ τόξον, ἀλλὰ δεῖ τὸν διατείνοντα τὸ ὄργανον τουτὶ τὸ πολεμικὸν καὶ ἐκηβολώτατον, ὡς ἄν τις εἴποι, ὕπτιον κείμενον ἑκάτερον μὲν τῶν ποδῶν ἐνερεῖσαι τοῖς ἡμικυκλίοις τοῦ τόξου, ἀμφοτέραις δὲ ταῖς χερσὶ τὴν νευρὰν μάλα γενναίως ἀνθελκύσαι. Ἧς κατὰ τὸ μέσον σωλὴν ἐστι κυλινδρικὸν ἡμίτομον ἐξημμένον αὐτῆς τῆς νευρᾶς καὶ ὥσπερ τι βέλος ἀξιόλογον μέγεθος ἀπολαμβάνον διήκει ἀπ' αὐτῆς τῆς νευρᾶς ἐς τὸ τοῦ τόξου μεσαίτατον· ἀφ' οὗ βέλη παντοδαπὰ διεκπίπτουσιν. Ἐν τούτῳ τοίνυν τὰ βέλη τιθέμενα βραχύτατα μὲν τῷ μήκει, παχύτατα δὲ καὶ πρόσθεν ἀξιόμαχον βάρος σιδήρου λαμβάνοντα. Καὶ τῇ ἀφέσει τῆς νευρᾶς μετὰ σφοδρότητος καὶ ῥύμης ἁπάσης ἀφιείσης τὰ βέλεμνα οὗ ἂν τύχῃ ἐπεισπεσόντα οὐκ εἰς τοὔμπαλιν ἀποπίπτει, ἀλλὰ καὶ ἀσπίδα διέτρησε καὶ θώρακα βαρυσίδηρον διατεμόντα ἐκεῖθεν διὰ θατέρου μέρους ἐξεπετάσθη.

weapon;[20] there is therefore a considerable range in size, function, and complexity between these three pieces of equipment. Dennis (4) sought to prove also that the *my(i)ae* used with the τοξοβαλλίστρα and the μέναι used with the σωληνάριον were identical, and that the word μέναι was "an obvious error for *myas* or *myias.*" Nishimura (430ff) used Dennis' argument to prove that the missiles used with the σωληνάριον were identical with the catapult bolts of the Late Roman world. Bolts could be used instead of darts with an arrow-guide, but it took some work to fit them for the purpose. The author of the treatise edited in *Saracen Archery* prides himself on an elaborate arrow-guide of his own design: "My aim in designing it was to enable the user to shoot *jarkh* bolts back at the enemy and do twice as much damage as the *jarkh*" (147). The *jarkh* in this treatise refers to the crossbow, specifically the Frankish crossbow.[21] The darts used with the σωληνάριον are claimed to be so small as to be invisible in flight ([Maurice] *Strat.* 12B.5; *Syll. Tact.* 38.8f); this is not the case with crossbow bolts, which are short but very thick and armored, nor with the catapult bolts described and illustrated in Nishimura (430ff). Further, it is by no means certain that μέναι at *Syll. Tact.* 38.8f is a misreading for μύ(ι)αι. (Dain, who edited this text, accepted the MS. reading.) The sentence, "these small arrows are also called μέναι by some," is a gloss on [Maurice] *Strat.* 12B.5, highlighting that this word is unusual; μύ(ι)αι, however, is common. Anna Comnena's description of the τζάγγρα (10.8.6) does not use such words as μυωτά, μύ(ι)αι, μύαι, μέναι for bolts, but simply βέλος and its derivatives; and she uses ὀϊστός for regular arrows.

While μέναι are used with a σωληνάριον, μύ(ι)αι are mentioned in connection with τοξοβαλλίστραι.[22] We shall first consider τοξοβαλλίστραι, regularly translated as *arcuballistae* in bilingual editions such as the Bonn corpus. This practice should

[20] *De Cerimoniis* 2.45 (ed. Reiske, Bonn VII 670.10–13) lists military equipment used during the ill-fated Cretan expedition of 949; τοξοβαλλίστραι are given as siege equipment: διὰ τῆς ἐξοπλίσεως καστρομαχίας ξυλόπυργος, χελῶναι, τοξοβολίστραι μεγάλαι μετὰ τροχιλίων καὶ κόρδων μεταξοτῶν, τετραρέαι, λαβδαρέαι, μαγγανικὰ, καὶ ἡ τούτων ἐξόπλισις. In this paper references to this edition of the text are to page and line number in vols. VII (text and translation) and VIII (notes).

[21] *Saracen Archery* 8: "Crossbows are of different types. The Franks, for instance, have the *jarkh*.... "

[22] Dennis n.8 quotes Cod. Ambros. gr. B119 sup. (139) for the only occurrence of μύαι possibly used with σωληνάρια.

be avoided as we are dealing here with faux-amis. There is no evidence that Vegetius' *arcuballista* is a siege engine, since he lists it with *fustibali* and *fundae*; the medieval *arcuballista is* a cross-bow, which is not a siege engine. We need not doubt, however, that τοξοβαλλίστραι *were* siege engines, probably arrow-shooters: Καὶ περὶ τὰ τείχη δὲ κατασκευὰς ποιῆσαι καὶ παρασκευάσαι ὅπλισιν· οἷον τὰ λεγόμενα μαγγανικὰ, καὶ τοξοβολίστρας, καὶ τὰ ἄλλα ὅλα ὅπλα ὅσα πρὸς τειχομαχίαν ἀντίκειται, καὶ ἑτέρας δὲ πρὸς τειχομαχίας ἐπιτήδεια.[23] The key difference between the Frankish *arcuballista* and the Byzantine τοξοβαλλίστρα is that the first is an individual assault weapon that can be used on horseback, and the second is an anti-siege engine mounted on walls.

In the collection of texts edited by Dain under the title *Naumachica* are included two almost identical passages, the first from extracts attributed to Leo VI and the second to Nicephorus Uranus; they confirm the connection between τοξοβαλλίστραι and μύαι: Καὶ τοξοβαλίστραι δὲ ἔν τε ταῖς πρύμναις καὶ ταῖς πρῴραις καὶ κατὰ τῶν δύο πλευρῶν τοῦ δρόμωνος ἐκπέμπουσαι σαγίτας μικρὰς τὰς λεγόμενας μυίας.[24] The same connection is found in the inventory of supplies for the Cretan expedition of 949 (*De Cerimoniis* 2.45), where χειροτοξοβολίστρα and τοξοβολίστρα also occur with μύαι, but σωληνάριον and μέναι do not appear: ναύκλας μετὰ χειροτοξοβολίστρων καὶ κόρδων μεταξοτῶν κ΄. σαγίτας χιλιάδας ι΄. μῦας σ΄. τριβόλια χιλιάδας ι΄ (669.21–670.2); ἐδόθη τὸν δρουγγάριον τοῦ πλοΐμου ἀπὸ τοῦ κατεπάνω τοῦ ἄρματος σπαθία γ, σκουτάρια γ, κοντάρια γ, σαγίτας χιλιάδες σμ΄, ἑτέρας σαγίτας λόγῳ τῶν τοξοβολίστρων μύας χιλιάδες δ΄ (676.14–17).

Reiske would read μύιαι and he translates this word with *muschettae,* but does admit that the reading is μύαι. Let us note that the χειροτοξοβολίστραι seem to relate to those small boats

[23] Leo *Tact.* Epilog. 60: "Making preparations around the walls, organize the armament such as the so-called engines or τοξοβολίστραι and generally all weapons and supplies used against a siege."

[24] *Naumachica* 1.60, ed. A. Dain (Paris 1943). Nicephorus' version (6.57) presents only slight variations in word order and a different verb for 'cast', but the technical terms are identical: "And the τοξοβαλίστραι, located fore and aft, aport and starboard are the dromon-cast arrows called μυίαι."

as the larger τοξοβολίστραι to the δρόμωνες.[25] In conclusion, μέναι are to σωληνάρια, and σωληνάρια are to infantrymen what μύ(ι)αι are to τοξοβαλλίστραι, and τοξοβαλλίστραι are to δρόμωνες.[26]

Both the *Strategikon* and the *Sylloge Tacticorum* demonstrate the presence of the arrow-guide in Byzantine armies, and they do so in an off-hand manner that implies that it was well-known. We shall now consider two historical questions relating to the arrow-guide: (a) when did it become known in the Graeco-Roman world? (b) what is its relationship to the medieval crossbow?

II. The Arrow-Guide in Late Antiquity

First let us note that the arrow-guide comes in two models: mobile and fixed. The mobile arrow-guide is equipped with a tassel or loop of silk or leather that enables the archer to retain the guide after shooting. The fixed arrow-guide is attached to the bow stave, though not necessarily permanently. Because in *Strat.* 12B.5 soldiers are instructed to carry it in their quiver, the σωληνάριον belongs to the mobile category, but this does not rule out the possibility that the Byzantine also had fixed arrow-guides, perhaps under another name. We are dealing then with five different pieces of equipment: (1) the simple bow, (2) the bow with a mobile arrow-guide, (3) the bow with a fixed arrow-guide, (4) the crossbow, (5) the arrow or bolt-shooting engine. An arrow-shooting engine is not a crossbow; the differences between the two pieces of equipment may not have been great in size and technical complexity, but the crossbow is an individual weapon and the arrow-shooter is mounted on walls or on shipboard, so that their functions in battle are different. A bow with a fixed arrow-guide is not a crossbow; the distinguishing

[25] Reiske does not comment on these small boats and what they are doing on *dromones*, but he expresses his puzzlement at the presence of caltrops on shipboard since these are usually used against cavalry (VIII 794 *ad* 671.10). Caltrops were used in naval warfare as a means of disabling and hindering the enemy's sailors (*Naumachica* 6.59f). Were these small boats supplied with an unexpectedly large number of caltrops and used to slip around enemy ships and cause harm to the sailors?

[26] Arrow-guides were also known in mediaeval India, and tiny arrows that may have been used with them are displayed in the Arms Gallery, National Museum, New Delhi. For literary and historical references, see G. M. Pant, *Indian Archery* (Delhi 1978) 195–200.

feature of the crossbow is not its crosspiece but its mechanical release. The bow with or without an arrow-guide requires a manual release (the 'loose').[27] We must also bear in mind that these handy little weapons may have been used, as in the Islamic treatises, to shoot not only arrows, but also stone or metal pellets, iron darts and/or needles (*Arab Archery* 126). Starting with the pictorial evidence, we shall consider a comment made by Campbell on the "crossbows" found on bas-reliefs from Solignac-sur-Loire and Saint-Marcel:[28]

> These are obviously not belly-bows since they lack the distinctive crescent-shaped stomach-rests which characterize such weapons. Nor is there any sign of a winching mechanism for spanning the bows, which appear to be composite, or at any rate non-torsion. Perhaps such weapons (are these the elusive *arcuballistae*?) could be used by mounted archers.

These could be bows with fixed arrow-guides, as represented on two relifs now at Le-Puy-en-Velay.[29] The *cippus* depicting a hound and hunting weapons was found not *in situ* but in the crypt of a church; the inscription has nearly disappeared and sheds no light on the date. A bas-relief found on the site of a Gallo-Roman villa shows two hunters and a servant; one of the hunters carries a quiver and what may be a crossbow; and all three figures wear Roman dress. Espérandieu comments (*supra* n.27: II 444): "Sculpture assez soignée paraissant du 1er siècle." Since these bas-reliefs appear to be earlier than Vegetius, Campbell's suggestion that they represent a weapon known to him deserves a close look; two items may be considered: the *arcuballista* and the *manuballista*. Since both are in the hands of *tragularii* who use them to shoot *sagittae* (Veg. 2.15), we can expect some basic similarities between the two pieces of equipment. Vegetius does not supply sufficient information for us to determine if either the *arcuballista* or the *manuballista*

[27] This approach is radically different from that used by T. G. Kolias, *Byzantinische Waffen* (Vienna 1988) 239–53, and will lead to quite different conclusions.

[28] D. B. Campbell, "Auxiliary Artillery Revised," *BonnJbb* 186 (1986) 117–32 at 131.

[29] For further details see E. Espérandieu, *Recueil général des bas-reliefs de la Gaule romaine* (Paris 1908) II nos. 1679, 1683. Both are displayed in the Musée Crozatier.

might be a bow with an arrow-guide. It is possible that the first is the bow with the fixed guide, and the second the bow with the mobile guide; the fixed arrow-guide can be conceptualized as part of the bow (*arcuballista*), while the mobile version, retained by the hand with the help of a tassel, may be thought of as an extension of the hand (*manuballista*).

Vegetius includes both *manuballista* and *arcuballista* with the *levis armatura,* just as the σωληνάριον is part of the equipment of the Byzantine ψιλός—another point of reference between these weapons and the arrow-guide. A certain similarity also exists between the missiles used with the *manuballista* and those used with the arrow-guide: *Scorpiones dicebant, quas nunc manuballistas vocant, ideo sic nuncupati, quod parvis subtilibusque spiculis inferunt mortem* (Veg. 4.22). σωληνάρια with small arrows "are useful against the enemy ... because they are invisible to the enemy on account of their shortness" (*Syll. Tact.* 38.8f). Since darts used with the arrow-guide are smaller than arrows, the archer may carry twice as many; if the enemy is attacked with darts, he will not see them and dodge in the same way as he might if long arrows are used (*Saracen Archery* 145). This similarity of missiles indicates a possible similarity in the delivery systems.

The puzzle remains that a small auxiliary device should bear a name derived from that of a siege engine, but again modern English offers an analogy for this anomaly: the word 'catapult', a siege engine for military historians, is applied in everyday language to a toy.

In late Latin, apart from Vegetius, the word *arcuballista* occurs only in Hegesippus' translation of Josephus, where it is used for the Greek ὀξυβελής; here it refers to a piece of artillery, not to a hand weapon.[30] Why this is so is not clear; the translator's choice of *arcuballista* for ὀξυβελής might simply have been an error, although this error need not have been made at random. The Hellenistic word ὀξυβελής for an arrow-shooting machine was replaced by βαλλίστρα in later Greek. Its evolution is probably beyond discovery at this point; but there is one witness to

[30] Jos. *BJ* 2.553; Hegesippus 2.15.8 (=*CSEL* LXVI.1 177). Hegesippus is unknown and it has been surmised that this name is actually a pseudonym of Ambrose, bishop of Milan in the second half of the fourth century. On the basis of vocabulary studies, he could well have been a contemporary of Ambrose: W. F. Dwyer, *The Vocabulary of Hegesippus* (Washington, D.C., 1931) esp. 178f regarding the date.

the development from βαλλίστρα[31] to τοξοβαλλίστρα: *De fluminibus trajiciendis*—"une paraphrase, impossible à dater, d'un passage du *Strategicon de Maurice.*"[32] The phrase τοὺς βαλλιστοφόρους δρόμωνας of *Strat.* 12B.21, 43 becomes τοὺς δρόμωνας τοὺς τὰς τοξοβαλλίστρας ἔχοντας in *Naumachica* 3.10. If the word τοξοβαλλίστρα already existed when Hegesippus prepared his translation, he may have thought it a synonym of ὀξυβελής and made the same error in the use of *arcuballista* as Reiske in translating *De Cerimoniis.* The written evidence for the evolution from βαλλίστρα to τοξοβαλλίστρα is dated to the sixth century and later, but Greek conservatism leaves open the possibility of this interpretation, for the change may have taken place in the spoken language long before it was recorded in writing.

Another possible source of error may have been Hegesippus' use of *arcuballista* instead of *ballista.* Another ancient translation of Josephus, much closer to the Greek text, is attributed, among others, to Rufinus of Aquileia.[33] Erasmus' edition of this passage reads:[34] *adeo ut metu perculsi milites, machinas sive tormenta muralia, itemqz ballistas, multaqz alia instrumenta relinquerent.*[35]

[31] The date at which the epenthetic /r/ was added to *ballista* is unknown and does not affect the argument.

[32] A. Dain and J.-A. Foucault, "Les stratégistes byzantins," *TravMém* 2 (1967) 317–92 at 347.

[33] A great many manuscripts survive and a critical edition is in progress, although it does not yet include *BJ*: F. Blatt, *The Latin Josephus* (Copenhagen 1958). If the attribution to Rufinus is correct, this makes his translation roughly contemporary with that of Hegesippus.

[34] *Flavii Iosephi Hebraei, Historiographi clariss. opera ... Interprete Ruffino presbytero* (Cologne 1524) 267 (2.24); emphasis added. At the time of these very early editions the Greek text was thought to be lost, and the Latin editions could not be compared with the Greek for 'improvements': H. Schreckenberg, *Bibiographie zu Flavius-Josephus* (Leiden 1968) 6f, and *Die Flavius-Josephus Tradition im Antike und Mittelalter* (Leiden 1972) 58f.

[35] *Cf.* Hegesippus: *plena erat via inpedimentorum, quae fugientes Romani derelinquebant, ne iniusto quisquam sub fasce moraretur. passim iacebant uasa, utensilia, uel etiam bello necessaria, arcoballistae arietes ceteraque instrumenta in excisionem urbis aduecta.* Hegesippus did not adhere closely to Josephus' text and he consulted other authors as well; it has been even proposed that he should be rehabilitated as an historian in his own right: see A. A. Bell, Jr, *An Historiographical Analysis of the De Excidio Hierosolymitano of Pseudo-Hegesippus* (diss.University of North Carolina, Chapel Hill 1977).

To summarize the evidence from Hegesippus: his use of *arcuballista* for ὀξυβελής may be an error in translation, or it may reflect a usage of *arcuballista* not recorded elsewhere. Nevertheless, whether he is using the correct word or not, the meaning is clear: the object in question is a piece of artillery. Not only the Greek original and the translation ascribed to Rufinus testify to that, but even the context and the general sense: the Romans decamped leaving behind their heavy artillery. Presumably they could and probably would have taken their portable weapons.

III. The Arrow-Guide and the Medieval Crossbow

We shall now proceed to the period when the bow with arrow-guide is replaced by the crossbow, a change that may be obscured by terminology if both were called *arcuballista* in Latin sources from Late Antiquity to the Renaissance. A few preliminary remarks may be advisable. First, this replacement was gradual, and the crossbow did not displace archery, with or without auxiliary devices. The bow with arrow-guide may still have been used in the West as late as the eleventh century: Loewe supplies information on the possible existence of a bow with a removeable crosspiece:

> It is to be noted that Rashi [a Rabbinic exegete born *ca* 1040 in Troyes, France, where he spend most of his life] states that the tablet is "slotted" into the bow, by pressure: *taqa'* means to *push* or *fix in*, with a view to subsequent removal, and it is the verb used in connection with *knocking in* tent-pegs, etc., or of *clasping* hands. In cases where a permanent fixture is intended, the proper Hebrew term is not *taqa'* but *qaba'*. Rashi's language consequently implies a removeable cross-piece. This seems natural enough. We may suppose that before the cross-piece as here illustrated was perfected, an early version was made to be fitted and removed at will—particularly since a variety of bolts was in use with crossbows, and not all of them might be suitable for use with such a cross-piece. If the early ones were detachable, it should occasion no surprise that no specimens have been preserved *in situ*, and that if any survive separately, they have not been recognized by specialists in weaponry. Indeed, a feature very like what I here postulate can be observed on

> the Le Puy *cippus* ... albeit at the rear end of the crossbow groove.[36]

Rashi, a near contemporary of Anna Comnena, may well be referring to the crossbow; but here again a fixed but detachable crosspiece might not have been sturdy enough for the vigorous spanning needed for the crossbow, and what Rashi refers to may be a bow with an arrow-guide. Whether or not the bow-engine replaced the bow with arrow-guide in the West, it certainly did not do so in Islamic lands, where the two weapons co-existed for centuries, as the following two items indicate (*Saracen Archery* 9):

> In the West (i.e. North Africa and Muslim Spain) crossbows are a great favorite and are the weapon of preference. Those who use hand bows, however, deprecate them. My own view is that in the manoeuvres of [mounted] combat, in the desert, and on expeditions the hand bow is a better and more serviceable weapon, whereas in fortresses, sieges and ships greater power and advantage will be derived from the crossbow.

According to Latham and Paterson, surviving examples of a Middle Eastern arrow-guide are unknown (*Saracen Archery* 149). They may exist, however, and have been wrongly classified. Harmuth's study of an Arab 'crossbow' in the Archaeological Museum in Granada (Spain), dated to the fourteenth century on the basis of its ornamentation, concludes that this weapon had little in common with the crossbow known from contemporary Europe, but had a great deal of resemblance to the weapons depicted on the bas-reliefs at the Musée Crozatier. The Granada specimen had no stirrup; the size of the groove shows that it must have been used with arrows instead of bolts; the stock is very delicate; it is attached to the stave with leather strips, and ends with a knob similar to that of the Le Puy example.[37]

[36] R. Loewe, "Jewish Evidence for the History of the Crossbow," in G. Dahan, ed., *Les Juifs au regard de l'histoire. Mélanges en l'honneur de B. Blumenkrantz* (Paris 1985) 87–107 at 102f.

[37] E. Harmuth, "Eine arabische Armbrust," *Waffen und Kostümkunde* 25 (1983) 141–44, who does not discuss the possibility that this specimen might be a bow with an arrow-guide, similar to those described in the Arabic treatises on archery. "Arabic crossbow" is a misnomer, for in the absence of a stirrup,

Because the continuity of the word *arcuballista* veils the date of the invention of the Medieval bow-engine, we must rely on evidence from non-Latin sources and from representations in art. One certain landmark, Anna Comnena's description of the τζάγγρα, dates towards the end of the eleventh century, perhaps earlier. Quite apart from her statement that it was a novelty at the time of the Crusades, we have some evidence that it was not known earlier. Byzantine treatises offer information on enemy tactics; the presence of such a thing as a bow-engine would, I think, have been mentioned in connection with the fortunate user. A detailed analysis of all relevant passages is not possible here, but [Maurice] *Strat.* 11 illustrates the point: the author is concerned with adapting tactics to those of the enemy, who at the time of the *Strategikon* included Persians, Scythians (Avars, Turks, and various Hunnic peoples), northern barbarians (Franks and Lombards), and Slavs, Antes, and others. This book contains occasional references to bows and to the various enemies' practices in archery, but none that would indicate a difference between regular bows and crossbows for either the Byzantines or their enemies, whether they were highly civilized like the Persians or rather primitive like the Avars or the Antes. No differential information of this sort seems to be available from the later treatises either, whether they deal with naval warfare or skirmishing, with field or siege warfare. For the record, there is no mention made of a crossbow, or of a bow that is in some way different from the regular bow in the following tactical works: the *Tactica* of Nicephorus Uranus (second half of the tenth century);[38] *Naumachica* (Dain's collection of variously dated extracts on naval warfare); *De re strategica,* to which a short treatise on archery is appended (sixth century); *De velitatione* (second half of the tenth century); *Anonymus*

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lock, and trigger, the Arabs might not have considered it a crossbow: "The Turks and most of the Persians make this bow heavy, and set it on a grooved stock (majra [=arrow-guide]), which they fit with lock and trigger and to the end affix a stirrup, thus making it a foot bow" (*Arab Archery* 12).

[38] J. A. Foucault, "Douze chapitres inédits de la *Tactique* de Nicéphore Ouranos," *TravMém* 5 (1973) 281–312.

Tacticon (end of the tenth century);[39] *Anonymus De Obsidione Toleranda* (tenth century).[40]

Negative evidence is a two-edged sword, but these tactical works regularly mention "archers," "slingers," and "pike-men"; they make distinctions between cavalry and infantry, cuirassiers and light-armed troops, but nowhere refer to crossbowmen or crossbows.

Thus, Byzantine treatises compiled as late as the second half of the tenth century make no mention of a bow-engine. Let us compare this information with data available from the West in the same period. Richer of Saint-Rémi, a French chronicler of the second half of the tenth century, is generally quoted for the earliest evidence for the crossbow in the West on the occasion of the siege of Senlis in 949: *Belgae vero, quia ab urbanis nimium arcobalistis impetebantur, resistere quiescunt. Nihil enim contra nisi tantum scutorum testudine utebantur. Unde et regio iussu ab ea urbe discedunt, non solum ob arcobalistarum impetum verum etiam ob turrium plurimarum firmamentum.*[41]

Are these *arcobalistae* bow-engines? Or are they a bow with an arrow-guide? Richer had a predilection for scientific and technical subjects. He included a description of a siege tower (*machina bellica*) in his narrative of the capture of Laon in 938 (2.10) and the recapture of Verdun in 984 (3.105f). He also cited

[39] G. T. Dennis, ed., *Three Byzantine Military Treatises* (=*CFHB*, Washington Series 25 [Washington, D.C., 1985]); the *De re strategica* is now attributed to Syrianus Magister by C. Zuckermann, "The Military Compendium of Syrianus Magister," *JÖBG* 40 (1990) 209–24; for another edition of the *De velitatione* with French translation and commentary, see G. Dagron and H. Mihaescu, *La traité sur la guérilla (de velitatione) de l'Empereur Nicéphore Phocas (963–969)* (Paris 1986), although this commentary does not supply further information on bow-engines or arrow-guides.

[40] H. Van den Berg, ed. (Leiden 1947).

[41] 2.92, ed. G. Waitz, *Historiarum Libri IIII* (Hannover 1877). Note, however, that in this author *arcobalista* refers once to a delivery system, in the example above, and once to missiles, on the occasion of the capture of Verdun in 985: *Primo impetu sagittarii contra hostes ordinati sunt. Missaeque sagittae et arcobalistae cum aliis missilibus tam densae in aere discurrebant, ut a nubibus dilabi terraque exsurgere viderentur* (3.104). In a work of the same period, the *Posthumous Miracles of St Martin of Vertou,* we find another example of *arcuballista* in a passage concerning a miraculous yew tree, planted by the saint. The tree is described as "suitable for *spicula* and *arcubalistae*" and thus attracts the attention of Norman marauders, much to their subsequent regret: B. Krusch, ed., *Passiones Vitaeque Sanctorum aevi Merovingici et antiquiorum aliquot* (=*MGH*: *Scriptorum Rerum Merovingicarum* 3 [Hannover 1896]) 570f.

his patron Gerbert's scientific achievements, including the use of a sphere for the study of astronomy, and the construction of an abacus (3.43ff). His casual references to the *arcobalista* may be taken to mean that, whatever it was exactly, it was commonplace, as the author did not feel the need to comment or describe it.

Let us further consider the pictorial evidence: there is a great deal of similarity between the bas-reliefs at Le Puy and the frequently cited illustration from Cod. Par. Lat. 12302 fol. 1 of a siege illustration by Haimo of Auxerre.[42] There are slight differences: unlike the *cippus*, the weapons depicted in this codex have a handle to pull the string through the slot of the arrow-guide; likewise, the manuscript illustrations do not have the posterior knob seen on the *cippus*. Although these differences may not be so important as to affect function profoundly, one thing is certain: the weapons depicted by Haimo are *not* the crossbow described by Anna Comnena. That is easily observed from the comfortable fashion in which Haimo's archers draw their bows using their hands only. Anna's description of crossbowmen spanning their bows in reverse position, using their feet, illustrates the great divide between the ninth-century models and the later, more familiar crossbows. This was overlooked by Nishimura (433): "the general view has been that the crossbow was introduced to Byzantium from the West. The accounts of *arcoballistae* in use at Senlis in 949 and Verdun in 984 are well-known." This is only partly correct: granted that *arcoballistae* were used, the pictorial evidence shows that they were not bow-engines.

In conclusion, this comparison of evidence from Byzantine treatises up to the third quarter of the tenth century with the Western evidence of the same date, written and pictorial, provides some ground to narrow down the time within which the invention of the bow-engine took place: from the late tenth to the late eleventh century. It may be objected that five centuries separate Vegetius and Richer, during which the word *arcuballista* is hardly used in documents; that Richer is much closer in time to the twelfth century, when *arcuballista* is widely used and known to be applied to a bow-engine; and that Richer may have revived a dead word for a new technology. My contention is

[42] Reproduced in Loewe (*supra* n.34: 92); for these illustrations also see E. Harmuth, "Die Armbrustbilder des Haimo von Auxerre," *Waffen und Kostümkunde* 29 (N.F. 12: 1970) 127–30, which I have been unable to obtain.

that, though few written instances have survived during the period between Vegetius and Richer, the word *arcuballista* was not forgotten among the educated Gallo-Romans; and I am offering an argument to this effect based on the history of the French word *arbalète.*

Before evaluating this evidence, a short digression on the history of the French language will be helpful. French vocabulary is heavily derived from Latin but for historical purposes two classes are recognized: indigenous words that have been in continuous use in the spoken language from Imperial times, and learned words that have been lost in the spoken language, then borrowed from Classical or Church Latin at a later date.[43] Here 'indigenous' and 'learned' refer only to the manner of acquisition and not the level of speech. The phonology makes the attribution to one class or the other relatively easy; for instance, the Latin *potio* is the source for two words, *poison* that belongs to the first class and *potion* that belongs to the second. This evolution was not uniform for the whole of the Francophone territory but varied regionally: *e.g.* Latin *capra* becomes *cavre* in the south, *chièvre* in the north, and *chèvre* in the Ile-de-France.[44]

The medieval word *arbaleste* and its multitudinous variants and derivatives occupy some five columns in the Godefroy.[45] It is not, as Henri Grégoire and Josse Staquet have supposed (n.55 *infra*), a "mot savant" borrowed through Medieval Latin from the only two ancient authors who used it—Vegetius and Hege-

[43] The process of borrowing was a continual and is still active today; in fact, the dividing line between Medieval French and Medieval Latin is a very thin and words cross it from both sides.

[44] A considerable amount of research has gone into the historical phonology of French; the key events are summarized by P. Guiraud, *L'Ancien français* (Paris 1968) 40–60; for an in-depth study see E. Bourciez, *Précis de phonétique française* (Klincksieck 1927). I am grateful to Professor E. A. Heinemann of the University of Toronto for this reference.

[45] *E.g. aubelestre, abollatre, erbarestre, arblastre*; more details in F. Godefroy, *Dictionnaire de l'ancienne langue française et de tous ses dialectes du IX^e^ au XV^e^ siècle* (Paris 1880–1902) I 376c–77c, VIII 164b–65b (note that volume VIII is divided into two parts with different pagination; this reference is to the second part). The citations are drawn from literary masterpieces, such as the *Song of Roland,* inventories, and glossaries; the cities where these sources originate include Paris, Metz, Dijon, Montpellier, Rouen, and many others. The derivatives include such words as *arbalestée* (bowshot), *arbalestière* (dormer window), and *arbalestrerie* (crossbowmanship); this semantic range indicates the importance of this word in mediaeval French.

sippus; its many forms and the wide area over which it was used show that it has come down by word of mouth and that it must have been familiar to Gallo-Romans.[46] This ties in with Vegetius' well-known and commonly used *arcuballista.* Yet the continuous use of *arcuballista* > *arbalète* since the fourth century helps conceal rather than reveal the technological history behind it.[47] The evidence from French, however, covers the first and the last phases and leaves us in the lurch for the crucial period: it bridges the gap between Vegetius and Richer by demonstrating that a descendent of the *arcuballista* was widely used in speech, but the earliest literary monuments of the French language in which some late form of *arcuballista* is used are posterior to Anna Comnena.

Two Byzantine documents of the eleventh century may shed some light on the problem. Dennis (4) and Litavrin (n.48: 442f) argue that the existence of the word τζάγγρα during the eleventh century undermines Anna Comnena's credibility that the crossbow was a novelty. These texts, the *Parecbolae,* an anonymous compilation,[48] and Cecaumenus' *Strategikon*[49] indeed antedate Anna by a few decades, but several problems remain: in both cases the word refers to a wall-mounted engine and its form is uncertain.

Starting with the *Parecbolae,* we find in a section on how to defend the city walls the following injunction (44.16): Ὅτι δεῖ μελετᾶν ταῦτα· πῶς δεῖ ἀκοντίζειν μετὰ τῶν τοξοβολιστρῶν ἤτοι τῶν τζαρχῶν.[50] DuCange suggested that τζαρχῶν should be τζαγγρῶν, as Dennis points out (3 n.15), but Foucault retains

[46] *Cf.* A. Dauzat, J. Dubois, and H. Mitterand, *Nouveau dictionnaire étymologique et historique* (Paris 1971), which flags the word *arbalète* as indigenous. For the history of this word in French see W. von Wartburg, *Französisches etymologisches Wörterbuch* (Tübingen 1948) I 129 *s.v. arcuballista.*

[47] *Cf.* Latin *carrus* and its modern English descendant 'car': nothing in the word itself reveals the development from carts and chariots to automobiles.

[48] Ed., J.-A. de Foucault in *Strategemata* (Paris 1949); see also Dain and Foucault (*supra* n.30) 368f, where this text is dated to the middle of the eleventh century.

[49] G. G. Litavrin, ed., *Sovety i rasskazy Kekavmena* (Moscow 1972); this text is dated to 1075–78 by P. Lemerle, "Prolégomènes à une édition critique et commentée des 'Conseils et Récits' de Kekaumenos," *MemAcRoyBelg* 54 (1960) 19f.

[50] "It is necessary to attend to these things: how to cast with the help of *toxobolistrae,* that is *tzarchae.*"

τζαρχῶν. And we must keep in mind—with due respect to DuCange—that the reading τζαρχῶν might be correct, derived from the Persian *charkh* or the Arabic *jarkh*, to which we shall return.[51]

Thus the *Parecbolae*, dated to the middle of the eleventh century, like earlier treatises omits a bow-engine but mentions an anti-siege engine with a name possibly related to that of the crossbow. Similarly, Cecaumenus, the next source some two or three decades later, does not mention the bow-engine, but τζάγρα (not τζάγγρα) occurs for siege engines (33, p.178):

> Ἐὰν φυλάττῃς κάστρον καὶ ἀκούσῃς ἔρχεσθαι πρός σε τὸν ἐχθρόν, εὐτρέπισον σεαυτὸν πρὸς τὸ δέξασθαι πόλεμον· οἰκονόμησον τὰ τείχη τὰ διερρωγότα, τοὺς πύργους τοὺς προμαχῶνας κατοχύρωσον, σώρευσον λίθους ἐπάνωθεν τῶν τειχέων, πλέξον λέσας, ποίησον χάντακας διπλοῦς καὶ τριπλοῦς καὶ βαθυτάτους καὶ πλατεῖς, καὶ ἔξω τῶν χαντάκων λάκκους εἰς τὸ ὀλισθαίνειν τοὺς ἵππους, ἐπίστησον μαγγανικὰ τοῖς τείχεσι καὶ τζάγρας, ποίησον ἅρπαγας οὓς λύκους καλοῦσιν εἰς ἄμυναν τῶν κριῶν.[52]

Litavrin is quick to note that this occurrence of τζάγρα predates Anna Comnena (442f), but fails to comment on the difference in contexts and meanings. Anna's τζάγγρα is unmistakably the crossbow. Cecaumenus' τζάγρα is a wall-mounted anti-siege engine. Litavrin must have been aware of this, for he

[51] DuCange's emendation to τζάγγρα is not universally accepted: Joannes Meursius [Jan van Meurs] listed the word as τζάρχοι in his *Glossarium graecobarbarum* (Leiden 1614) 560f: "τζάρχοι. Arcuballistae. [Meursius quotes the above passage from the *Parecbolae*, which he attributes to Heron]. Nisi tamen quis censeat corrigendum τζαρχῶν. In quam sententiam est ut inclinem." Meursius makes the same error as Reiske, translating a synonym of τοξοβαλλίστρα with the Latin *arcuballista*, and failed to explain why he thought the word was masculine: it occurs only in the genitive plural and might as easily have been feminine or even neuter.

[52] "If you are guarding a fortress and hear that the enemy is marching against you, prepare yourself to wage war; concern yourself with the damaged walls, strengthen the rampart towers, gather stones upon the walls, plait ropes, dig out double and triple trenches, both wide and deep, and beyond the trenches, pits to cause the horses to slip; place upon the walls war engines [μαγγανικά] and τζάρχαι, make hooks of the type called 'wolves' for protection against rams."

translated τζάγρα with *metateljnye ustrojstva* (179), *i.e.*, missile-throwing engines, and not with *samostrel* or *arbalet*. Further, the reading in Cecaumenus is τζάγρα; but though this text is from the eleventh century, its only manuscript, the Mosq. Synod. 436, is posterior to the twelfth century; it was apparently written at Trebizond and dedicated to τοῦ ἁγίου ἡμῶν αὐθέντου καὶ βασιλέως μεγαλοκομνηνοῦ. This branch of the Comnenes, established at Trebizond after the fall of Constantinople to the Latins in 1204, fell in its turn to the Turks in 1461 (Litavrin 11–15). Possibly the scribe corrected the now unfamiliar τζάρχας to τξάγρας (supposing this to be an error for τζάγγρα), which was by the thirteenth century a widely-used term with a family of derivatives,[53] regardless of the meaning of τζάγγρα as a crossbow and not a siege engine; confusion in terminology between individual weapons and artillery is endemic.[54]

In conclusion, the form of the word is uncertain; in any case, it refers to a wall-mounted engine. That is not to say, however, that these documents are irrelevant for the history of the crossbow, since they may shed light on the etymology of the word τζάγγρα applied to the crossbow. A Romance etymology (τζάγγρα < *chancre, cancre*), propounded by Grégoire and Staquet,[55] is unsupported in Old French sources (*chancre* and *cancre* are not attested for the crossbow), but *arbalète* is widespread. *Arbalète* and not *chancre/cancre* is the vernacular for the learned *arcuballista*.[56] It is logical to suppose that if the

[53] Du Cange and Meursius record the presence of such derivatives as τζαγγράτωρ, τζαγγροτοξότης, *etc.*

[54] τζάγρα is not necessarily a mistake for τζάγγρα. It may have been pronounced τζάχρα and related to τζάρχα rather than τζάγγρα.

[55] H. Grégoire, "Notes sur Anne Comnène," *Byzantion* 3 (1926) 312ff; J. Staquet, "Anne Comnène, Alexiade X,8," *Byzantion* 13 (1938) 505–12.

[56] *Cf.* Godefroy (*supra* n.44) II 355c–56a, VIII 418a–b, IX 36b–c: the only meanings attested for *cancer/cancre/chancre* are: (1) the shellfish, (2) the disease, (3) the constellation. The articles offering this unsupported derivation are cited in Leib's edition of the *Alexiad* (*supra* n.18: *ad* 10.8.6f) and may mislead those unfamiliar with Medieval French. It is important to emphasize that a Crusader word *chancre* for the crossbow is unattested, and that the terminology of the crossbow is so well known that speculations are unjustified. In any case, the existence, before the crusades, of Byzantine *tzarch-* and *tzagra* and Arabic *jarkh* (all possibly derived from Persian *chark*) to mean a stationary arrow-shooter further undermines this French etymology.

weapon is of Western origin, its name is Western also, but logic has little to do with lexical evolution.

The Late Greek τζαρχ- has a specific relationship to Persian *charkh* and the Arabic *jarkh,* discussed by Latham and Paterson (apparently without cognizance of τζαρχ- in one Byzantine text). *Jarkh* as foot bow is used in the treatise edited by Latham and Paterson, but it occurs in only two manuscripts: British Museum Add. 23489 and Istanbul, Aya Sofya 2902 mük. All others use the regular Arabic *qaws ar-rijl.* This has apparently puzzled Orientalists, because the Persian *charkh* means a 'wheel'; Latham and Paterson suggest that this lexical evolution might be due to the use of a pulley to draw the crossbow and have influenced the adoption of the word for the pulley for the whole of the weapon (*Saracen Archery* 88, 184, 195).

Taybugha wrote in *ca* 1368. Some two centuries earlier, a treatise had been written for Saladin by Murdâ b. 'Ali b. Murdâ at-Tarsûsî,[57] in which *jarkh* and *qaws ar-rijl* are not synonymous. Latham and Paterson refer their readers to this text without further comment (88). In one chapter (129–43) Murdâ describes in varying detail five pieces of equipment used for shooting arrows and/or bolts. Pride of place is given to the *qaws al-zihar*, a complex piece of machinery which the description and the illustration enable us to identify as the redoubtable *ballista de torno* (129–32).[58] In declining order of importance are the *'aqaar*, the *jarkh*, the *qaws ar-rijl*, the regular bow, and the bow with arrow-guide. Murdâ describes in detail the *qaws ar-rijl*, which we can identify as the foot bow, but he does not describe the *jarkh* because it is too well known (132). Fortunately the illustrations and other references elsewhere in the text provide some information. In this treatise, the *jarkh* is a small stationary arrow-shooter used, for instance, in siege towers. A number of them can be mounted in one tower and operated at once by one man (134 and Pl. I,6). Some of these siege towers are elaborate (142 and Pl. III,14). However, a single *jarkh* can also be used on the battlefield along with regular bows (148). Assuming that τζάγγρα (crossbow) is indeed derived from τζαγρα/τζαγγρα (wall-mounted arrow-shooter), we find in the Muslim world a

[57] Excerpts edited and translated by C. Cahen in *BEO* 12 (1947–48) 103–63.

[58] Further details on this identification in K. Huuri, "Zur Geschichte des Mittelalterlichen Geschützwesens aus orientalischen Quellen," *StOr* 19.3 (1941) 125 (to be used with caution).

semantic shift similar to the Byzantine. This is hardly surprising: these small arrow-shooters were obviously no bigger than a crossbow, though their mode of operation may have been different and adapted to a different function in battle. What may be relevant, however, is the use of *jarkh* for the Latin crossbow in the manuscripts used as the basis of *Saracen Archery*.

The editors judge these two manuscripts containing *jarkh* the closest to the original text, especially Add. 23489, which is the basis of their text. Taybugha, the author of this treatise, was originally a "Turkish slave imported from Greece and manumitted on conversion to Islam" (*Saracen Archery* xxxvi); the other manuscripts are based on improved versions of Taybugha's original text (*Saracen Archery* xxxvii):

> In manuscripts of the B group [the later improved versions] we find a text characterized not only by a markedly higher standard of Arabic than found in A, but also by fewer errors of scansion in the poem. The language is more idiomatic, there are fewer colloquialisms, and a higher literary standard is attained ... Another interesting characteristic of the B group version is the disappearance or the emergence in modified form of material or phraseology to which the more sensitive elements of orthodox Islam society might rightly or wrongly take exception.

Although Latham and Paterson comment on the "poor and, at times, truly exercrable quality of the author's Arabic" (xxxvii), they do not elaborate on how much his deficiencies can be traced to specific elements of his mother tongue. Further research is needed in Greek, Persian, and Arabic, but it is possible that the Arab *jarkh* for crossbow is not derived directly from the Persian *charkh*, meaning wheel, but indirectly through the Byzantine τζαρχ- (whether it meant a crossbow, a siege engine, or both at different times or even at the same time), and through the Arabic *jarkh* for arrow-shooter. As the only author to use it in Arabic came from Greece and by his own admission wrote "barbarous Arabic" (*Saracen Archery* 4), he may have been influenced by Greek terminology.

We may now return to the three eleventh-century Byzantine documents: the *Parecbolae,* which uses for an anti-siege engine a term related to an earlier Arabic word for an arrow-shooter and to a later Mamluk word for the crossbow τζαρχ- > *jarkh*), and

Anna, who applies to the crossbow a word used by Cecaumenus for an anti-siege engine (τζάγρα > τζάγγρα). The dates and usages are so close that it is difficult to admit coincidence. I shall therefore offer the following suggestion: perhaps the invention of the crossbow is to be found in the second half of the eleventh century in Norman Sicily, where an aggressive and resourceful military caste had access to Byzantine and Saracen technology. Many of the Norman military engagements were sieges conducted against well-defended fortresses (*e.g.* Bari in 1068–1071, Palermo in 1071) and their ambitions were directed against two great military powers whose resources were greatly superior to those of the Norman invaders. The Byzantine words τζαρχ- and τζάγγρα are not attested before the eleventh century; they may be variants of the same word borrowed from Persian (*charkh*) as a new slang term for the τοξοβαλλίστρα or even for the smaller χειροτοξοβαλλίστρα. Their later application to the Latin crossbow may reflect something of its technical derivation; it may indicate an improvement of the old 'Roman' bow by the addition of mechanisms similar to those used in wall-mounted arrow-shooters. This bow-engine, more powerful against fortresses than the old *arcuballista,* was more useful to the Norman cavalry in their wars of aggression than the essentially defensive arrow-shooter.[59]

In conclusion, it is not possible in a short article to give more than a survey of the question, but it is hoped it will help bring together material from a wide area, both historically and geographically.[60]

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[59] For a survey of Norman war efforts both in Sicily and in the Near East, see D. C. Douglas, *The Norman Achievement: 1050–1100* (London 1969); for Norman Sicilian contributions to the development of medieval science and philosophy see C. H. Haskins, *Studies in the History of Mediaeval Sciences* (Cambridge 1924).

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